KINETIC DEVELOPMENT GROUP

KINETIC DEVELOPMENT GROUP
LDEDET REFERENCE: 12/1/9/2-V196

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT REPORT FOR THE PROPOSED FERROCHROME/FERROALLOYS SMELTER PLANT (125Ktpa – 1Mtpa) WITHIN THE MUSINA-MAKHADO SPECIAL ECONOMIC ZONE (MMSEZ), MUSINA-MAKHADO LOCAL MUNICIPALITIES, LIMPOPO

Prepared By:

gudaniconsulting
ENVIRONMENTAL & SOCIAL SCIENTISTS

P.O. Box 714, Faunapark, Polokwane, 0787
04 King Street, Bendor, Polokwane, 0699
Tel: 082 828 3412, Fax: 086 235 9820
mulanga@gudaniconsulting.co.za
setenane@gudaniconsulting.co.za
www.gudaniconsulting.co.za

JUNE 2025

LDEDET REFERENCE: 12/1/9/2-V196

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT REPORT FOR THE PROPOSED FERROCHROME/FERROALLOYS SMELTER PLANT (125Ktpa – 1Mtpa) WITHIN THE MUSINA-MAKHADO SPECIAL ECONOMIC ZONE (MMSEZ), MUSINA-MAKHADO LOCAL MUNICIPALITIES, LIMPOPO

DOCUMENT APPROVAL RECORD

ACTION	FUNCTION	NAME	SIGNATURE
Prepared	Lead EAP	M Sikhitha	
Checked	EAP	S. Nkopane	
Reviewed	Snr. EAP	L. Tigedi	

FINAL

GUDANI Project No: GC2024/088
GUDANI CONSULTING
O4 King Street, Bendor
POLOKWANE
0699

JUNE 2025

Compiled by:
Mulanga Sikhitha – *Cand. Sci. Nat/EAPASA*
Lorato Tigedi – *Pr. Sci. Nat/EAPASA*
Setenane Nkopane – *Pr. Sci. Nat*

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED

NAME OF APPLICANT:	KINETIC DEVELOPMENT GROUP LIMITED – t/a – KINETIC MINING DEVELOPMENT SOUTH AFRICA (PTY) LTD
Trading As	Kinetic Mining Development South Africa (Pty) Ltd – Registration No: 2024/137308/07
TEL NO:	+86 13520638501 / +27 071 479 1424 +86 186 0135 6906
EMAIL ADDRESS:	lijianyong@kineticme.cn
PHYSICAL ADDRESS:	29 BEKKER STREET FAUNAPARK, POLOKWANE, 0699 LIMPOPO
NEAS FILE REFERENCE NUMBER:	
LDEDET FILE REFERENCE NUMBER:	12/1/9/2-V196

IMPORTANT NOTICE

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application are submitted in the exact format of, and provide all the information required. Furthermore, please be advised that failure to submit the information required in the format provided will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the

information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the environmental impact assessment process is to, through a consultative process—

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
(b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
(d) Determine the—-
    (i) nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    (ii) degree to which these impacts—
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources, and
        (cc)can be avoided, managed or mitigated;
(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
(g) identify suitable measures to manage, avoid or mitigate identified impacts; and
(h) identify residual risks that need to be managed and monitored.

Copyright Warning
This document is privileged and confidential in nature and unauthorised dissemination or copying is prohibited. This document will be updated as required. Kinetic Development Group (t/a KMDSA) claims protection of this information in terms of the Promotion of Access to Information Act, 2002 (Act No. 2 of 2002) and without limiting this claim, especially the protection afforded by Chapter 4.

TABLE OF CONTENTS:

TABLE OF CONTENTS: 5
LIST OF FIGURES, TABLES, PLATES AND APPENDICES: 9
LIST OF ABBREVIATIONS: 15
GLOSSARY OF TERMS 17
EXECUTIVE SUMMARY 20
PART A - SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT 27
1.0 CONTACT PERSON AND ADDRESS 27
1.1 Details of the Applicant 27
1.2 Details of the Environmental Assessment Practitioner and Specialists 27
1.3 Expertise of the EAP 28
1.3.1 Qualifications of the EAP 28
1.3.2 Summary of the EAP's Past Experience 28
2.0 DESCRIPTION OF THE PROPERTY 30
2.1 Description of Study Area 30
2.2 Project Locality 30
2.3 Project Locality – Site Photos 36
3.0 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY 38
3.1 Listed and Specified Activities 38
3.2 Description of the Activities to be Undertaken 41
4.0 POLICY AND LEGISLATIVE CONTEXT 59
5.0 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES 64
6.0 MOTIVATION FOR THE PREFERRED DEVELOPMENT SITE AND THE PROCESS FOLLOWED 67
6.1 Proposed Development Footprint Alternatives Considered 67
7.0 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED 70
7.1 Notification and Identification of Interested and Affected Parties (I&Aps) 71
7.2 Advertisements and Background Information Document (BID) 71
7.3 Content of the Advertisements and Site Notices 72
7.4 Placement of Advertisements and Site Notices 73
7.5 Consultation Meetings 75
7.6 Authority Participation 76
7.7 Document Review 76
7.8 Summary of Issues Raised by I&APs 77
8.0 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE SITE – BASELINE ENVIRONMENT 78
8.1 Topography and Location 78
8.2 Geology and Soils 79
8.3 Climate 90
8.4 Ecology and Biodiversity 92
Expected and Observed Reptile Species Richness 110
Threatened Reptile species 110
8.5 Surface Water 112
8.6 Groundwater 119
8.7 Noise 142
8.8 Air Quality 154
8.9 Climate Change 167
8.10 Landuse 182
8.11 Heritage Resources, Cultural and Archaeological Aspects 183
8.12 Visual Aspects 187
8.13 Community Public Health 196
8.14 Socio-Economic Environment 210

9.0 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE 217
9.1 Environmental Features 217
9.2 Infrastructure on Site 219
10.0 IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCES AND EXTENT 220
10.1 Impacts Identified 220
11.0 METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS 229
11.1 Impact Measurement Criteria and Rating 229
12.0 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY AND THE ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED 235
13.0 POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK 235
14.0 OUTCOME OF SITE SELECTION MATRIX AND FINAL SITE LAYOUT PLAN 236
15.0 MOTIVATION WHERE NO ALTERNATIVES WERE CONSIDERED 236
16.0 STATEMENT MOTIVATING THE PREFERRED SITE 236
17.0 DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE 238
17.1 Topography 238
17.2 Soil, Landuse and Land Capability Assessment 241
17.3 Ecology and Biodiversity 246
17.4 Surface Water and Wetlands Assessment 251
17.5 Groundwater Assessment 256
17.6 Air Quality Assessment 261
17.7 Noise 270
17.8 Climate Change 280
17.9 Heritage and Archaeological Assessment 287
17.10 Visual Aspects 290
17.11 Community Public Health 303
17.12 Socio-Economic Assessment 310
18.0 ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK .. 315
18.1 Topography 315
18.2 Soils 315
18.3 Geology 316
18.4 Climate 316
18.5 Ecology and Bio-Diversity 317
18.6 Surface Water Resources 317
18.7 Groundwater 318
18.8 Landuse and Capability 318
18.9 Noise 319
18.10 Air Quality 319
18.11 Heritage, Cultural and Archaeological Aspects 320
18.12 Socio-Economic Aspects 320
18.13 Visual Aspects and Sense of Place 321
18.14 Public Health 321
19.0 SUMMARY OF SPECIALIST REPORTS 323
20.0 SUMMARY OF THE KEY FINDINGS 327
21.0 PROPOSED IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES FOR INCLUSION IN THE EMP 331
22.0 ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORIZATION 331
23.0 DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINITIES AND GAPS IN KNOWLEDGE. 331
23.1 Soil, Landuse and Land Capability Assessment 331

23.2 Climate Change 331
23.3 Ecology and Biodiversity 331
23.4 Surface Water and Wetlands 332
23.5 Groundwater 332
23.6 Noise 332
23.7 Heritage and Cultural Aspects 334
23.8 Socio-Economic Aspects 334
23.9 Visual Aspects and Sense of Place 334
23.10 Public Health 335
24.0 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED 336
24.1 Reasons Why the Activity Should be Authorized or Not 336
24.2 Conditions that must be included in the Authorization 336
24.3 Period for Which the Authorization is Required 337
25.0 UNDERTAKING 337
26.0 FINANCIAL PROVISION 337
26.1 Explain How the Aforesaid Amount was Determined 337
26.2 Confirm that the Amount can be Provided from Operating Expenditure .. 339
27.0 DEVIATIONS FROM THE APPROVED SCOPING REPORT 339
PART B - ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT 340
1.0 COMPOSITE MAP 340
2.0 IMPACT MANAGEMENT OBJECTIVES AND STATEMENTS 341
3.0 ENVIRONMENTAL MANAGEMENT OBJECTIVES, STATEMENTS AND CLOSUE OBJECTIVES 344
3.1 Measures Required to Contain/Remedy Causes of Pollution/Degradation or the Mitigation of Pollutants for Closure of Smelter and Post Closure 344
4.0 IMPACTS TO BE MITIGATED AND THEIR RESPECTIVE PHASES 367
5.0 ENVIRONMENTAL AWARENESS PLAN 407
5.1 Introduction 407
5.2 Implementing Environmental Awareness 407
5.3 Dealing with Environmental Risks and Emergencies 409
5.4 Environmental Non-Conformances 409
6.0 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR MANAGEMENT OF IMPACTS AND MONITORING ARRANGEMENTS 411
6.1 Introduction 411
6.2 List of Identified Impacts that Require Monitoring Programme 411
6.3 Functional Requirements for the Monitoring Programme 411
6.4 Roles and Responsibilities for the Execution of the Monitoring Programme . 412
6.5 Time Frames for Monitoring and Reporting 412
6.6 List of Source Activities that may cause Impacts that Require Management 413
6.7 Description of How the Implementation of Action Plans will be Monitored .. 415
6.8 Frequency of Proposed Reporting for EMP Performance Assessment/Audit . 415
6.9 Management Activities which, where applicable, will be Conducted Daily, Monthly, Quarterly, Annually or Periodically to Pollution or Environmental Degradation 416
6.10 The Roles and Responsibilities for the Execution of the Monitoring and Management Programme 422
7.0 ENVIRONMENTAL IMPACT STATEMENT 425
5.1 Key Environmental Findings 425
5.2 Recommendations 426
5.3 Conclusion 426
PART C - ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT 428
1.0 EAP UNDERTAKING 428
2.0 APPLICANT UNDERTAKING 428

LIST OF APPENDICES..... 429

LIST OF FIGURES, TABLES, PLATES AND APPENDICES:

LIST OF FIGURES:

Figure 1: Locality Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group
Figure 2: Site Layout Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group
Figure 3: Vertical View Ferrochrome Smelting Production
Figure 4: Ferrochrome Production Process Flow
Figure 5: Limpopo Mirror Newspaper Advert
Figure 6: Geology of the Site and MMSEZ Area
Figure 7: Soil Map – Proposed Site and MMSEZ Area
Figure 8: Land Capability Map - Proposed Site
Figure 9: Landuse Map – Proposed Site
Figure 10: Comparison of Agricultural Sensitivity Maps
Figure 11: Annual Rainfall Figures in Days
Figure 12: Tshipise Annual Precipitation (mm) and Temperatures (° C)
Figure 13: Wind Speeds in Days Per Annum
Figure 14: Wind Rose for Makhado and Mopane Area
Figure 15: Vegetation Type Associated with the Project Footprint
Figure 16: Limpopo Conservation Plan Biodiversity Areas - Project Footprint
Figure 17: The Project Site in Relation to Conservation and Protected Areas
Figure 18: Propose Project Footprint in Relation to NPAES Areas
Figure 19: Vegetation Types Delineated for the Project Footprint
Figure 20: Eco Region for the Project Area
Figure 21: Freshwater Ecosystem Priority Areas for the Project Area
Figure 22: Quaternary Catchment A71K
Figure 23: Surrounding Surface Water Resources – Project Area
Figure 24: Hydrocensus Map
Figure 25: Correlation Graph of Topography vs Available Groundwater Levels
Figure 26: Groundwater Flow Map
Figure 27: Groundwater and Surface Water Pie Diagram
Figure 28: Chloride Classed Concentration Map
Figure 29: Sodium Classed Concentration Map
Figure 30: Sulphate Classed Concentration Map
Figure 31: Model Boundary and Boundary Conditions
Figure 32: Groundwater Calibration Results
Figure 33: Modelled Groundwater Contours
Figure 34: Water Level Calibration Graph
Figure 35: Summary of ambient sound levels collected in vicinity of MMSEZ Project – Including the Proposed Ferrochrome Plant
Figure 36: Aerial Image Indicating Areas with a "very high" Sensitivity to Noise as per Screening Tool
Figure 37: Aerial Image Indicating Potentially Noise-Sensitive Receptors Close to the Proposed Project Focus Area
Figure 38: Aerial Image Indicating Potentially NSR close to the Proposed Project Infrastructure
Figure 39: Location of Potentially Sensitive Receptors in Relation to the Kinetic Project

Figure 40: Terrain Elevation for the Study Area
Figure 41: Period - Day and Night-Time Wind Roses (WRF data, 2022 to 2024)
Figure 42: Monthly Wind Roses (WRF data, 2022 to 2024)
Figure 43: Wind Speed Frequency Distribution - WRF Data for the Study Area (January 2022 to December 2024)
Figure 44: Diurnal Temperature Profile (WRF data, 2022 to 2024)
Figure 45: Monthly Precipitation at the Study Area (WRF data, 2022-2024)
Figure 46: The Diurnal Atmospheric Stability for the Site - WRF data (2022 to 2024)
Figure 47: Baseline (1961 to 1990) Annual Average Temperature for the Project Area (CSIR, 2019)
Figure 48: Baseline (1961 to 1990) Number of Very Hot Days (>35°C) Annually for the Project Area (CSIR, 2019)
Figure 49: Baseline (1961 to 1990) Annual Average Rainfall for the Project Area (CSIR, 2019)
Figure 50: Baseline (1961 to 1990) Annual Average Number of Extreme Rainfall Days (>20 mm in <24 hours) for the Project Area (CSIR, 2019)
Figure 51: Annual Average Temperature (top panel) and Temperature Anomaly (lower panel) Between 1979 and 2024 (Meteoblue, 2025)
Figure 52: Annual Average Rainfall (top panel) and Rainfall Anomaly (lower panel) Between 1979 and 2024 (Meteoblue, 2025)
Figure 53: Current Water Stress for the Project Area (Hofste, et al., 2019) (blue dot indicates project location)
Figure 54: Projected (2050) Water Stress for the Project Area (Hofste, et al., 2019) (blue dot indicates project location)
Figure 55: Current Water Availability for the Musina Local Municipality
Figure 56: Estimated Current and Future (2050) Water Supply Vulnerability Based on Medium Population Growth for the Musina Local Municipality
Figure 57: Current Annual and Monthly Surface Water Runoff, Precipitation and Evaporation for the Musina Municipality
Figure 58: Projected Monthly Change to Future (2050) Evaporation, Precipitation, and Estimated Runoff Values
Figure 59: Groundwater Potential and Depletion for 2050 for the Musina Local Municipality (dark blue marker indicates location of the project)
Figure 60: The Contribution that the Different Economic Sectors Make to the Total GVA of the Musina Local Municipality
Figure 61: Landuse Map Around the MMSEZ Area and Project Site
Figure 62: Other Known Heritage Sites Previously Recorded
Figure 63: Identified Visual Receptors within the Total Study Area
Figure 64: Identified Visual Receptors in Relation to Existing Visual Disturbances
Figure 65: Activity Impacts, Health Determinants and Health-Related Outcomes
Figure 66: Sustainable Development Goals
Figure 67: Social Sensitivity Plan
Figure 68: Economic Value Addition by Special Economic Zones
Figure 69: Modelled Borehole Drawdown
Figure 70: Existing Adjacent Opencast Mining Operations
Figure 71: Terrestrial Ecology Sensitivity Map
Figure 72: Modelled Borehole Drawdown
Figure 73: Simulated 99th Percentile Daily PM^{10} Concentration
Figure 74: Simulated Annual Average PM_{10} Concentration

Figure 75: Simulated 99th Percentile Daily $PM_{2.5}$ Concentration
Figure 76: Simulated Annual Average $PM_{2.5}$ Concentration
Figure 77: Simulated 99th Percentile Hourly NO_2 Concentration
Figure 78: Simulated Annual Average NO_2 Concentration
Figure 79: Simulated 99th Percentile Hourly SO_2 Concentration
Figure 80: Simulated 99th Percentile Daily SO_2 Concentration
Figure 81: Simulated Annual Average SO_2 Concentration
Figure 82: Simulated Highest Monthly Dust Fallout Rate
Figure 83: Conceptual Construction Noise Sources
Figure 84: Projected Conceptual Daytime Construction Noise Level Contours
Figure 85: Projected Conceptual Night-Time Construction Noise Level Contours
Figure 86: Conceptual Operational Noise Sources
Figure 87: Projected Conceptual Daytime Operational Noise Level Contours
Figure 88: Projected Conceptual Night-time Operational Noise Rating Level Contours
Figure 89: Overview of Scopes and Emissions
Figure 90: Percentage GHG emissions per Scope for Project Operation Activities
Figure 91: Terrain Slope of the Total Study Area
Figure 92: Slope Aspect of the Total Study Area
Figure 93: Terrain ruggedness
Figure 94: Relative Elevation
Figure 95: Landforms within the Study Area
Figure 96: Slope Positions
Figure 97: Potential Visual Absorption Capacity
Figure 98: Viewshed Visibility Count
Figure 99: Visibility Count Distance Rank
Figure 100: Visual Exposure Ranking
Figure 111: Visual Exposure and Visual Receptors
Figure 112: Potential Social Change Paths due to the Proposed Smelter
Figure 113: Estimated Financial Provision for Environmental Rehabilitation

LIST OF TABLES:

Table 1: Details of the Applicant
Table 2: Details and Expertise of the EAP and Specialists
Table 3: Project Locality and Property Description
Table 4: Listed and Specified Activities to be Authorized
Table 5: High (GB / T 5683-2008) Brand and Chemical Composition
Table 6: Typical South African Chromium Mineral Chemicals
Table 7: Chemical Composition of Silica
Table 8: Composition of Chemical Composition of Metallurgical Coke
Table 9: Electrode Paste and Chemistry Index
Table 10: Raw Material Consumption (In the Two Furnaces)
Table 11: Material Balance Table
Table 12: Main Parameters of the Electric Furnace
Table 13: Main Parameters of Electric Furnace Transformer
Table 14: Flue Gas Purification System Design Parameters
Table 15: Raw and Finished Materials and Water Quality Analysis
Table 16: Capital Investment and Labour Estimates
Table 17: Legislative Context
Table 18: Proposed Labour Estimates and Distribution

Table 19: Site Notice Placements
Table 20: Detailed Soil Legend of the Agricultural Impact Footprint
Table 21a: Comparison of Agricultural Sensitivity Ratings
Table 21b: Soil Chemical Analyses
Table 21c: Soil Fertility Compared to Broad Fertility Guidelines
Table 21d: Medium Term Crop Yields (5 years)
Table 21e: Medium Term Livestock Yields (5 years)
Table 22: List of Plant Communities with Ecological Sensitivity
Table 23: Summary of the Colophospermum Mopane Dense Bushveld
Table 24: Number of Species Recorded - Colophospermum Mopane Dense Bushveld
Table 25: Summary of the Colophospermum Mopane Open Bushveld
Table 26: Number of Species Recorded - Colophospermum Mopane Open Bushveld
Table 27: Summary of the Colophospermum Mopane Plains Bushveld
Table 28: Number of Species Recorded - Colophospermum Mopane Plains Bushveld
Table 29: Summary of the Drainage Lines
Table 30: Number of Species Recorded – Drainage Lines
Table 31: Summary of the Musina Ridge Bushveld
Table 32: Number of Species Recorded – Musina Ridge Bushveld
Table 33: Red Data, NEMBA and LEMA Listed Reptile Species
Table 34: Ecoregion Attributes (Department of Water Affairs, 2005)
Table 35: PES, EIS and Reserve data for Catchment
Table 36: Classification of River Health Assessment Classes
Table 37: Target Water Quality Range (TWQR) - Aquatic Ecosystems
Table 38: Recharge Calculation for the Shallow Unconfined Aquifer
Table 39: Hydrocensus Data Summary
Table 40: Groundwater Levels
Table 41: Water Qualities Compared to SANS 241-1:2015 Guidelines for Drinking Water.
Table 42: Water Qualities Compared to DWAF Domestic Use Guidelines
Table 43: Water Qualities Compared to DWAF Industrial Use
Table 44: Aquifer System Management and Second Variable Classifications
Table 45: Groundwater Quality Management (GQM) Classification System
Table 46: GQM Index for the Study Area
Table 47: Input Parameters to the Numerical Flow Model
Table 48: Optimal Calibrated Aquifer Parameters
Table 49: Calibration Statistics
Table 50: Potential Maximum Noise Levels Generated by Various Equipment
Table 51: Potential Equivalent Noise Levels Generated by Various Equipment
Table 52: Acceptable Zone Sound Levels for noise in districts (SANS 10103:2008)
Table 53: Monthly Temperature Summary (WRF data, 2022 to 2024)
Table 54: Summary of Air Pollutants Emitted from Various Sources in the Study Area
Table 55: Pollutant Concentrations Recorded at the Thohoyandou AQMS – 27 July 2024 to 28 May 2025
Table 56: Kinetic Project Point Source Parameters and Emissions
Table 57: Emission Factors and Parameters Used in the Fugitive Emission

Estimation
Table 58: Criteria Pollutant Emissions Inventory – Kinetic Project
Table 59: Forecasted Economic Gains or Losses for the RCP4.5 and RCP8.5 Scenarios
Table 60: Economic Contribution of Main Commodities for Musina Local Municipality
Table 61: Projected Economic Contribution of Main Commodities for Musina Local Municipality
Table 63: Environmental Health Areas
Table 64: Summary of Environmental Sensitivities - 2024 Screening for Proposed Ferrochrome Smelter Project
Table 65: Identified Impact and Associated Activities
Table 66: Impact Assessment Criteria
Table 67: Advantages and Disadvantages of the Ferrochrome Smelter Project vs the No-Go option
Table 68: Loss in Livestock Yields Due to the Development
Table 69: Predicted Drawdown at Affected Boreholes
Table 70: Greenhouse Gasses and 100-year Global Warming Potentials
Table 71: Greenhouse Gas Assessment Source Data and Assumptions for the Operational Phase
Table 72: Calculated Distances Travelled for Onsite Vehicles
Table 73: Emission Factors Used in the Assessment
Table 74: Estimated GHG Emissions for the Operational Phase of the Project
Table 75: Visibility Rating
Table 76: Visual Exposure Ranking
Table 77: Summary of the Positive and Negative Implications and Risks of the Proposed Activity and Identified Alternatives
Table 78: Measures to rehabilitate the environment affected by the undertaking of any listed activity
Table 79: Management Objectives and Outcomes

LIST OF PLATES

Plate 1: Kinetic Ferrochrome Smelter Site – MMSEZ
Plate 2: Access Roads – N1 Intersection and R525 Road
Plate 3: Site Notices Placed at Various Site Around the Project Area
Plate 4: Public Participation Meetings
Plate 5: Undulating Topography - Kinetic Ferrochrome Smelter Project Area
Plate 6: The Soil Profile within the Proposed Metallurgical Projects Area
Plate 7: A General View of the Colophospermum Mopane Bushveld
Plate 8: Colophospermum Mopane Dense Bushveld
Plate 9: The Colophospermum Mopane Open Bushveld
Plate 10: Colophospermum Mopane Plains Bushveld
Plate 11: The Taller and Denser Vegetation of a Drainage Line in the Background
Plate 12a: Dense Shrubby Vegetation on the foot-slope in Musina Ridge Bushveld
Plate 12b: The Rocky Nature of the Musina Ridge Bushveld
Plate 13: Site BG1 - GPS Coordinates: S22°37'38.00 E29°53'00.07
Plate 14: Site 24 - GPS Coordinates: S22°37' 51.00 E29° 52' 56.06
Plate 15: Topography of the Industrial (Ferrochrome Reserved) Area
Plate 16: Vegetation of Ferrochrome Smelter Site
Plate 17: Vegetation Disturbed by Human Activities in the Study Area

Plate 18: Syferfontein Mining Area Located 2 km North-West of KDG Site
Plate 19: Existing Railway Line and the Mopane settlement
Plate 20: Some of the Households, Accommodation Areas, School and Recreational Facilities
Plate 21: Partial Visual Screening by Vegetation
Plate 22: Some of Existing Visual Disturbances in the Area

LIST OF APPENDICES:

Appendix 1: Qualification of the EAP
Appendix 2: Summary of the EAP's Past Experience
Appendix 3: Locality Maps – Kinetic Ferrochrome Smelter
Appendix 4: Site Layout Map – MMSEZ – Including Kinetic Ferrochrome Smelter
Appendix 5: Public Participation Report – Issues and Response Table
Appendix 6: Closure and Environmental Rehabilitation Liability Costing
Appendix 7: Kinetic Development Group Limited Feasibility Report
Appendix 8: Specialist Reports

LIST OF ABBREVIATIONS:

ACRONYM	DESCRIPTION
AEL	Atmospheric Emissions License
APPA	Air Pollution Prevention Act
AQA	Air Quality Act
AU	Animal Unit
BID	Background Information Document
CARA	Conservation of Agriculture Resources Act, 1983
CE	Centres of Endemism
CR	Chrome Ore
COGHSTA	Department of Cooperative Governance, Human Settlements and Traditional Affairs
DARD	Department of Agriculture and Rural Development
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
DSoE	Desired State of Environment
ECZ	Environmental Constraint Zone
EIA	Environment Impact Assessment
EAP	Environmental Assessment Practitioner
EMF	Environmental Management Framework
EMP	Environmental Management Report
EMZ	Environmental Management Zone
ERF	Plot of land, usually urban, marked off for building purposes
FRAI	Fish Response Assessment Index
GC	Gudani Consulting
GIS	Geographical Information System
GN	Government Notice
ICOMOS	International Council on Monuments and Sites
IEM	Integrated Environmental Management
IDP	Integrated Development Plan
IMP	Integrated Management Plans
ISCW	Institute for Soil Climate and Water
I&APs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
IWULA	Integrated Water Use License Application
KDGL KMDSA	Kinetic Development Group Limited – t/a Kinetic Mining Development South Africa (Pty) LTD

KTPA	Kilo Tons Per Annum
LC	Land Capability Class
LDEDET	Limpopo Department of Economic Development, Environment and Tourism
LSU	Live Stock Unit
MaB	Man and the Biosphere
MAR	Mean Annual Run-off
MPRDA	Minerals and Petroleum Resources Development Act, 2002
MTPA	Million Tons Per Annum
MALM	Makhado Local Municipality
MULM	Musina Local Municipality
MMLM	Musina-Makhado Local Municipalities
MMSEZ	Musina-Makhado Special Economic Zone
NHRA	National Heritage Resources Act, 1999
NWA	National Water Act, 1998
NAAQS	National Ambient Air Quality Standards
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NRHP	National River Health Programme
NRWC	National Register of Water User Certificates
PMT	Project Management Team
PPP	Public Participation Process
POSA	Plants of South Africa
QDS	Quarter Degree Square
RHP	River Health Programme
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resource Agency
SANBI	South African National Biodiversity Institute
SANPARKS	South African National Parks
SAAQIS	South African Air Quality Information System
SAR	Special Administration Region (Chinese interpretation of SEZ)
SAWS	South African Weather Service
SDF	Spatial Development Framework
SEZ	Special Economic Zone
SEMP	Strategic Environmental Management Plan
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VDM	Vhembe District Municipality

GLOSSARY OF TERMS

Aeromagnetic Survey	Surveys flown by helicopter or fixed wing aircraft to measure the magnetic susceptibility of rocks at or near the earth's surface
Alien species	A plant or animal species introduced from elsewhere: neither endemic nor indigenous.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no go" alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.
Aluminium	Aluminium is a chemical element; it has symbol Al and atomic number 13. Aluminium has a density lower than that of other common metals, about one-third that of steel. It has a great affinity towards oxygen, forming a protective layer of oxide on the surface when exposed to air.
Ambient	The conditions surrounding an organism or area.
Archaean	The oldest rocks of the Precambrian era, older than about 2 500 Ma
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.
Basement	The igneous and metamorphic crust of the earth, underlying sedimentary deposits
Biodiversity	Measure of the number and relative abundance of biological species. The variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems.
Coal	A combustible black or brownish-black sedimentary rock usually occurring in rock strata in layers or veins called **coal beds** or **coal seams**. Coal is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen.
Chrome	Chromite is a crystalline mineral composed primarily of iron(II) oxide and chromium(III) oxide compounds. It can be represented by the chemical formula of $FeCr_2O_4$.
Climate	A measure of the long-term averages, i.e., normal, of key atmospheric variables such as temperature, precipitation and wind.
Dip and dip direction	The dip direction is the azimuth of the direction of the dip as projected to the horizontal, which is 90° off the strike angle
Dyke	A vertical or near vertical sheet of igneous rock, the widths of which may range from centimetres to hundreds of meters
Ecology	The study of the interrelationships between organisms and their environments.
Effluent	Effluent is an out flowing of water from a man-made structure such as a process plant or tailings facility.
Environment	The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects.
Environmental impact	A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation's activities or may be indirectly caused by them.
Environmental Impact Assessment	An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy which requires authorisation of permission by law and which may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.
Environmental Management Plan	A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.
Fault	A fracture or fracture zone, along which displacement of opposing sides has occurred

Ferroalloys	Various alloys of iron with a high proportion of one or more other elements such as chrome (Cr), manganese (Mn), aluminium (Al), or silicon (Si).
Ferrochrome	Ferrochromium (FeCr) is a type of ferroalloy, that is, an alloy of chromium and iron, generally containing 50 to 70% chromium by weight
Gabbro	Belongs to a group of dark, coarse-grained, intrusive mafic igneous rocks chemically equivalent to basalt.
Groundwater	Water which occurs below the surface of the Earth, where it occupies spaces in soils or geologic strata.
Industry	The use of land or a building for a factory, distributing depot, wholesale, storage, warehouse for the storage of wholesale merchandise, carting and transport services, laboratories, workshop and vehicle workshop and may also include offices which are normally associated with or which are reasonably essential for the main use as well as the sale of goods wholly or partially manufactured, processed or packed on the property.
Integrated environmental management	IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach.
Interested and affected parties	Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, work force, consumers, environmental interest groups and the general public.
Intrusion	Liquid rock (magma) which forms below the surface of earth and slowly cools into a solid rock mass
Key issue	An issue raised during the Scoping process which has not received an adequate response and which requires further investigation before it can be resolved.
Layered complex	A body of igneous rock which exhibits vertical layering or differences in composition and texture and shows evidence of fractional crystallisation. Ideally, the stratigraphic sequence of an ultramafic intrusive complex consists of ultramafic peridotites and pyroxenites toward the base with more mafic norites, gabbros and anorthosites in the upper layers
Listed activities	Development actions which are likely to result in significant environmental impacts as identified by the Minister of Environmental Affairs and Tourism in terms of Section 21 of the Environment Conservation Act.
Manganese	Manganese is a chemical element; it has symbol Mn and atomic number 25. It is a hard, brittle, silvery metal, often found in minerals in combination with iron
Mitigation	To cause to become less harsh or hostile.
Negative impact	A change which reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).
Positive impact	A change which improves the quality of life of affected people or the quality of the environment.
Property	Any piece of land indicated on a diagram or general plan approved by the Surveyor-General intended for registration as a separate unit in terms of the Deeds Registries Act and shall include an erf, a site and a farm portion as well as the buildings erected thereon
Public Participation Process	A process of involving the public in order to identify needs, address concerns, choose options, plan and monitor in terms of a proposed project, programme or development
Relevant authority	The environmental authority on national, provincial or local level entrusted in terms of the Constitution and in terms of the designation of powers in Notice No. R. 1184 of 5 September 1997 with the responsibility for granting approval to a proposal or allocating resources.
Scoping	This refers to the process of determining the spatial and temporal boundaries (the extent) for the EIA and key issues to be addressed in an environmental assessment.
Scoping Report	A report describing the issues identified.
Smelting Process	Smelting, process by which a metal is obtained, either as the element or as a simple compound, from its ore by heating beyond the melting point, ordinarily in the presence of oxidizing agents, such as air, or reducing agents, such as coke.
Study area	Refers to the entire study area encompassing all the alternative routes as indicated on the study area map.

Silicon	Silicon is a chemical element; it has symbol Si and atomic number 14. It is a hard, brittle crystalline solid with a blue-grey metallic luster, and is a tetravalent metalloid and semiconductor.
Special Economic Zone/s	Special Economic Zones (SEZs), are geographically designated areas of a country set aside for specifically targeted economic activities, supported through special arrangements (that may include laws) and systems that are often different from those that apply in the rest of the country.
Surrounding Owners	The registered owners of the properties directly bordering the property or across the road / street and also such owners that the Local Authority may specify.

EXECUTIVE SUMMARY

BRIEF INTRODUCTION

This document contains the the environmental impact assessment and management programme for the proposed Kinetic Development Group Limited (KDG – t/a Kinetic Mining Development South Africa (Pty) Ltd) - ferroalloys/ferrochrome smelter plant (125Ktpa – 1Mtpa) on the farms Van Der Bijl 528 MS and Dreyer 526 MS (Zone/Stand 12 and 31) within the Musina-Makhado Local Municipalities in Limpopo Province. The proposed ferroalloys/ferrochrome smelter plant will be within the existing and approved Musina-Makhado Special Economic Zone (MMSEZ). This study was undertaken by Gudani Consulting in conjunction with various environmental specialists in their role independent environmental assessment practitioners (EAPs) to Kinetic Development Group Limited for the proposed project.

GENERAL PROJECT DESCRIPTION

Kinetic Development Group Limited (KDG) intends to develop and establish a ferrochrome and ferroalloys smelter plant within the approved MMSEZ area. The scale of the project is initially planned to the annual output of 125 000 tons/year, and 2 x 33,000 kVA electric furnaces and their supporting facilities are to be constructed (Phase 1 - Unit). Ramp-up of seven additional units to full capacity production of 1 000 000 tons/year will be undertaken within five (05) years from inception. The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire protection, labour and training, project investment estimates, technical economy and evaluation.

Main facilities within the Project scope per smelting unit include:

High-carbon ferrochrome production workshop; Chromium furnace baking workshop (reserved); Raw materials, batching and feeding system; Charcoal dry; Furnace gas purification and dust removal system; Dust removal system in the production area; Compressed air preparation; 132KV (power supply) substation and the capacitor compensation device; Power supply and distribution, electrical control, automation instruments, telecommunications facilities; Whole-plant control system; Industrial TV monitoring system; Machine repair shop; Electrode shell production workshop; Water source connected to the production plant purification water supply system; Net ring water system; water system; Production and living water supply and drainage system; Whole-plant fire protection system; Ventilation and air-conditioning system; General map of transport and roads, walls, gates; Factory area office building; Laboratory room; Raw material storage yard, spare parts warehouse, finished product warehouse; Raw materials into the factory, finished products factory loadometer duty room; Fire protection, safety, environmental protection and other basic facilities and Slag disposal area.

The following associated infrastructure is also envisaged:

- Access roads;
- Diesel storage tanks;
- Slag/Pollution Control Dams/Areas (PCDs);
- Berms to separate dirty/clean water;
- Topsoil storage dumps;
- Offices.

Gudani Consulting has relied on the specialist opinion of the technical experts in their field to assist with the quantification of the baseline environmental conditions within the proposed area, potential impacts of the proposed ferrocalloys/ferrochrome activities and operations, and compilation of the requisite environmental impact assessment (EIA) and management programme (EMP) report. Gudani Consulting worked closely with interested and affected parties and the Musina-Makhado Local Municipalities to obtain inputs into the EIA/EMP process.

ENVIRONMENTAL IMPACT ASSESSMENT REQUIREMENTS

The proposed project will entail several listed activities, which may not commence prior to obtaining an Environmental Authorisation, in terms of Section 24 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). An application for Environmental Authorisation, in terms of NEMA, for activities listed in Government Notices (GNR 983, GNR 984 or GNR 985), 2014 has been submitted to Limpopo Department of Economic Development, Environment and Tourism (LEDET).

The proposed activities identified in GNR 983, GNR 984 or GNR 985 and which accordingly require Environmental Authorization in terms of NEMA, are summarized below:

Relevant Government Notice	Listing Notice and Activity No:	Description	Applicable Farms
GNR.983 December 2014	Listing Notice 1, Activity 9	Pipelines to the PCDs, Stormwater Management Structures	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.983 December 2014	Listing Notice 1, Activity 10	Pipelines to the PCDs	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.983 December 2014	Listing Notice 1, Activity 28	Establishment of ferroalloys/ferrochrome smelter plant and associated infrastructure – office and residential facilities	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.983 December 2014	Listing Notice 1, Activity 56	Construction of access and haul roads	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.984 December 2014	Listing Notice 2, Activity 4	Bulk Hydrocarbons Storage Facilities – 500m^3	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)

GNR.984 December 2014	Listing Notice 2, Activity 6	Ferroalloys/ferrochrome smelter plant	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.984 December 2014	Listing Notice 2, Activity 15	Vegetation Clearance for Establishment ferroalloys/ ferrochrome smelter plant, and associated infrastructure, office and residential facilities, ore stockpiles and discards stockpile/dumps	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.984 December 2014	Listing Notice 2, Activity 21	Ferroalloys/ferrochrome smelter plant	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.985 December 2014	Listing Notice 3, Activity 12	The clearance of an area of 300 m^2 or more of indigenous vegetation - for Establishment ferroalloys/ferrochrome smelter plant, and associated infrastructure, office and residential facilities, ore stockpiles and discards stockpile/dumps	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)

The following listed activities for waste management license and air quality license will be applied for under separate application submissions for the proposed ferroalloys/ferrochrome smelter and associated infrastructure project:

List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment published under Government Notice 718 in Government Gazette 32368 of 3 July 2009, in terms of section 19(2) of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008), proposed to be conducted at the proposed ferroalloys/ferrochrome smelter premises:

GNR.921 November 2013	Category B Activity - 7	Establishment of stockpiles and Discards stockpile/Dumps.	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)
GNR.921 November 2013	Category B Activity - 9	Establishment of stockpiles and Discards stockpile/Dumps.	Van Der Bijl 528 MS Dreyer 526 MS (Stand 12 and 31)

Listed Activities, as published in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No.39 of 2004) proposed to be conducted at the proposed ferroalloys/ferrochrome smelter premises:

Category of Listed Activity	Listed Activity 2:	Listed Activity Name	Listed Activity Description:
Category 2 Petroleum Industry	Sub-Category 2.2	Storage and Handling of	All permanent immobile liquid storage tanks larger than 500

		Petroleum Products	cubic meters cumulative tankage capacity at a site.
Category 4 Metallurgical Industry	Sub-Category 4.7	Electric Arc Furnace in Steel Making	Electric Arc Furnace in Steel Making
	Sub-Category 4.9	Ferro-Alloys Production	Production of alloys of iron with chromium, manganese, silicon or vanadium.
	Sub-Category 4.15	Process of Chromium, and Silicon	The metallurgical production and processing chromium and silicon and their compounds by the application of heat.

In addition, an Integrated Water Use Licence Application (IWULA) in terms of Section 21 of the National Water Act (NWA) (Act 36 of 1998) will be compiled and submitted to the Department of Water and Sanitation (DWS). In support of this IWULA, a comprehensive Integrated Water and Waste Management Plan (IWWMP) for the proposed ferroalloys/ferrochrome smelter operations will be compiled.

The following water uses, as defined in Section 21 of the National Water Act (Act 36 of 1998) (NWA), will be applicable for the proposed ferroalloys/ferrochrome smelter project, which require an integrated water use authorisation:

- Section 21 (a): Taking Water from a water resource;
- Section 21(b): Storing water;
- Section 21(c): Impeding or diverting the flow of water in a watercourse;
- Section 21 (e): Engaging in a controlled activity;
- Section 21(g): Disposing of waste in a manner which may detrimentally impact on a water resource;
- Section 21 (h): Disposing of water which contains waste from, or has been heated in, any industrial process;
- Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

The application for landuse change and township establishment has been submitted with Musina and Makhado Local Municipalities. The said landuse change required and environmental impact assessment to be undertaken and submitted with the application. The EIA/EMP report has been compiled for the MMSEZ and submitted to the local municipalities for the landuse change and township establishment application.

APPROACH TO THE PROJECT

The project is currently in the EIA/EMP phase to assess and document the impacts and specialist investigations have been integrated and considered as part of the impact assessment. Impacts have been evaluated on standard impact assessment criteria to determine the significance of the impacts.

PUBLIC PARTICIPATION

Public participation plays an important role in the compilation of an EIA/EMP, as well as the planning, design and implementation of a project. Public participation is a process leading to informed decision-making, through joint effort by the:

- Proponent;
- Technical experts;
- Governmental authorities; and
- Interested and Affected Parties (I&APs).

Public participation is a vehicle for public input, which achieves the following:

- Facilitates negotiated outcomes;
- Creates trust and partnership;
- Minimises negative effects;
- Maximises positive effects;
- Provides an indication of issues;
- Prevents the project continuing;
- Cause costly delays later; and
- Results in enhanced and shared benefits.

The public were informed about the project by means of the following:

- Stakeholders, including adjacent landowners and the relevant authorities, were notified of the proposed ferroalloys/ferrochrome activities and operations by means of consultation letters and Background Information Document (BID) pamphlets distributed during the month of August 2024.

- Advertisements were placed in the Limpopo Mirror News on the **13th September 2024 -** – See Appendix 5. Further advertisements will be placed in the Limpopo Mirror and Citizen Newspapers to notify I&Aps about the availability of the EIAR (this report) during **July 2025.**

- Various Site Notice boards advertising the proposed industrial development and informing I&APs were placed at visible locations on the site, Mopane, Makhado, Musina, as well as in close proximity to the site.

Consultation concerning the proposed ferrocalloys/ferrochrome smelting activities and operations with the respective community committees/property associations - CPA, ward councillors, municipality, farmers, members of the public/community and I&APs were undertaken through a series of meetings, distribution of BIDs and site notices during August and September 2024. The comments received from I&APs have been included in the Scoping Report and are captured in a Comments and Response Report - Appendix 5. Comments on the EIAR will also be captured following the comment period.

The Scoping Report was made available for public review from **20th September 2024** to **04th November 2024**. All comments received on the SR were addressed and incorporated within the Final Scoping Report submitted directly to the LDEDET.

The EIAR/EMP will be made available for public review from **30th June 2025 to 05th August 2025**. Any other comments received will be addressed in the final EIAR/EMP Report.

IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

A baseline description of the environment was gathered through visual inspections/field investigations of the site and its surroundings, desktop studies as well as specialist recommendations. This aforementioned information was used to assess the potential areas of study which could be affected by the proposed development.

Risks and key issues were identified and addressed through the following:

- Consultation with the Interested and Affected Parties (I&APs);
- Through an internal process based on similar developments;
- Identification of environmental impacts; and
- Various site visits.

The focus of the Scoping and EIAR/EMP process has been to assess the impacts on bio-physical and socio-economic site elements resultant from the project and to assign suitable management measures, where possible, to abate the identified impacts to within acceptable levels. The Scoping phase, as the name implies, had scoped/identified the more pertinent of the potential impacts on the environment and these were taken to the EIA/EMP phase for more comprehensive assessment:

- Impacts on surface and groundwater resources through the proposed ferroalloys/ferrochrome activities and operations to be used including the related infrastructure.
- Impacts on fauna and flora due to vegetation clearance and topsoil stripping, as well as the proximity to the water channels and any possible impacts on aquatic biodiversity.
- Impacts on the air quality which may result during windy periods, and providing problems related to emissions, dust and other particulate matter.
- Impacts on the visual and aesthetic character of the region due to the establishment of a new ferroalloys/ferrochrome smelting activities and operations within the area.
- Possibility of impacts on cultural or heritage resources, should any be within the vicinity of the proposed d ferroalloys/ferrochrome smelting activities and development.
- New ferroalloys/ferrochrome smelting activities will have a definite impact on the noise levels within the area and the impacts thereof were investigated.
- Impacts due to waste to be generated from the ferroalloys/ferrochrome smelting activities, and the management options thereof.
- Impacts on the health of people living in the vicinity of the proposed ferrochrome/ferroalloys smelting activities – and on climate change.

The above impacts, as well as many others, were comprehensively interrogated in the EIAR/EMP phase of the project and the impact significance assessment supplemented with specialist inputs where necessary. No environmental or socio-economic fatal flaws have been identified for the proposed project.

ALTERNATIVE ANALYSES

The inclusion of an alternative analysis is a specific requirement of the Integrated Environmental Management (IEM) procedure as underlined by the NEMA. The IEM

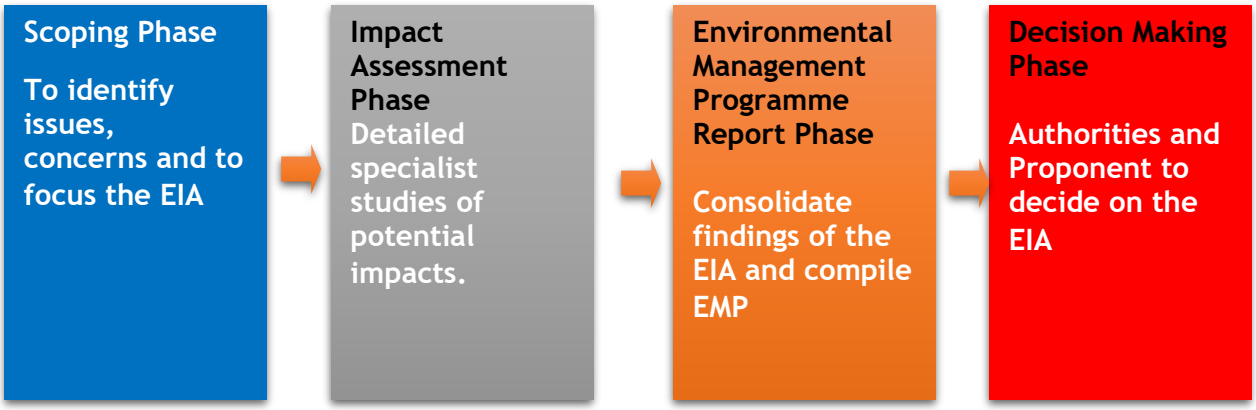
procedure stipulates that the environmental investigation needs to consider feasible alternatives for any proposed development.

The No-Go option is the only other alternative identified during the scoping phase, which has been discussed in detail as part of the EIAR/EMP phase – including the mitigation hierarchy. During both the Scoping and EIAR/EMP phases, public participation plays a key role and is a vital part of the IEM process.

CONCLUSION

The scoping process and report provided an overview of the findings of the initial assessment and consultation with Interested and Affected Parties (I&Aps).

The EIA process consists of the following phases:



The findings are of the scoping phase have been investigated in detailed under the following reports:

- Environmental Impact Assessment Report, ferroalloys/ferrochrome smelting project.
- Environmental Management Programme Report, ferroalloys/ferrochrome smelting project.

PART A - SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

1.0 CONTACT PERSON AND ADDRESS

1.1 Details of the Applicant

Table 1: Details of the Applicant

Name of Applicant	Kinetic Development Group Limited
Trading As	Kinetic Mining Development South Africa (Pty) Ltd – Registration No: 2024/137308/07
Address	29 Bekker Street Faunapark, Polokwane, 0699 Limpopo
Contact Person	Jianyong Li Muhui (Chris) HUANG
Cell	+86 13520638501 / +27 071 479 1424
Alternative Cell	+86 186 0135 6906
Email	lijianyong@kineticme.cn huangmuhui@kineticme.cn
Details of the Land	Van Der Bijl 528 MS and Dreyer 526 MS (Zone/Stand 12 and 31)
Surface Rights Holder	Mulambwane CPA

1.2 Details of the Environmental Assessment Practitioner and Specialists

Table 2A: Details and Expertise of the EAP and Specialists

Name of Environmental Assessment Practitioner (EAP)	Gudani Consulting
Project Coordinator	Setenane Nkopane - SACNASP
EAPs	Mulanga Sikhitha – SACNASP/EAPASA Lorato Tigedi – SACNASP/EAPASA
Postal and Physical Address	P. O. Box 714 Faunapark Polokwane 0787 04 King Street, Bendor Polokwane 0699
Contact details	Cell: 082 828 3412 Fax: 086 235 9820 Email: setenane@gudaniconsulting.co.za Website: www.gudaniconsulting.co.za
Professional Affiliation Professional Registration	IAIA-SA SACNASP - 400022/13 SACNASP – 119514 / EAPASA -2019/795 SACNASP - 400161/09 / EAPASA - 2020/2519
Qualifications of the EAPs to carry out the EIA/EMP/IWULA/AEL process	MSc. and BSc. Hons in Environmental Management and Assessments

Table 2B: Details and Expertise of the EAP and Specialists

Specialist Study	Specialist	Appendix
Air Quality	Airshed Planning Professionals	8A
Biodiversity, Ecology and Wetlands	Redkite Environmental Solutions	8B
Surface Water	Redkite Environmental Solutions	8C
Noise Impact Assessment	Enviro Acoustic Research	8D
Groundwater Assessment	Geo Pollution Technologies – Gauteng (Pty) Ltd	8E
Heritage Impact Assessment	A Pelser Archaeological Consulting	8F
Public Participation Process	Gudani Consulting	8G
Socio-Economic Impact Assessment	Gudani Consulting Demacon	8H
Soil, Land Capability, Land-Use	Rehab Green	8I
Visual Impact Assessment	Eco Elementum	8J
Climate Change	Airshed Planning Professionals	8K
Health Impact Assessment	Naira Environmental Consultants	8L
Geotechnical Investigations	Geo Equilibria	8M

1.3 Expertise of the EAP

1.3.1 Qualifications of the EAP

BSc. Hons – Environmental Science – Mulanga Sikhitha
BSc. Hons – Natural Science – Lorato Tigedi
MSc. - Environmental Management and Assessments – Setenane Nkopane

1.3.2 Summary of the EAP's Past Experience

Lorato Tigedi has approximately 22 years in environmental consulting and have completed basic assessment, environmental impact assessment, waste management license and water use license applications for Limpopo, Free State, Northern Cape, North West and Eastern Cape Provinces. She joined Geo Pollution Technologies (Free State) in 2003 and partnered with a Geohydrologist to set up Bokamoso Consultants as an environmental consultant, trading as NSVT Consultants. From 2004-2005 after completion of BSc Hons (Wildlife) she continued to study Master's in Environmental Management in 2006 but only completed the modules work and still have Mini-Dissertation. She has extensive knowledge regarding the competencies required to ensure implementation and alignment of environmental policy instruments such as EIA. For Continuous Professional Development, she has completed short courses in Planning for Effective Public Participation, Social Impact Assessment and Conflict Management, Introduction to Environmental Law, Introduction and Implementation of OHSAS 17001 and EMS 14001-2016 amongst other courses.

She has considerable public participation experience through her work in EIA and understand that an effective public participation process provides an opportunity for identifying problems during the EIA process and identifying opportunities that

could be used in the decision-making process. She is a registered EAP with SACNASP (400161/09) and EAPASA (2020/2519)

Mulanga Sikhitha is a Candidate Natural Scientist with 7 years working experience in the field of Environmental management. She holds an undergraduate degree in Life and Environmental Science from the University of Johannesburg and an Honours degree in Geography from the University of Limpopo. She also holds short learning certificate in Safety Management. Currently, she is enrolled for Masters degree in Environmental Management.

Mulanga has experience in obtaining Environmental Authorizations and environmental permits and is responsible for the following duties: conducting Environmental Impact Assessments (Both Full EIA and BAR), management of EIA Unit including Public Participation Processes, compilation of Environmental Management Plans/Programmes, and undertaking Environmental Awareness Programmes. Other duties have included liaison with governmental departments, non - governmental organisations, stakeholders and clients. She is a registered EAP with SACNASP (119514) and EAPASA (2019/795).

Setenane Nkopane has BSc. Honours and MSc. Degrees in Environmental Science and Management from the University of Cape Town. He worked with the Department of Minerals and Energy, Limpopo Province from 1997 – 2005 as Deputy Director: Mine Rehabilitation, and acted as Director: Mineral Development Limpopo Province from 1999 - 2002. His responsibility included: Regulation and assessment of impacts mining operations on the environment in the Province; implementation and maintenance of environment systems in mining industry; rehabilitation of land disturbed by mining operations including prevention, control and combating pollution; administration of the EMP approval process, and compliance thereof, and controlling of mine closure. He also worked as Environmental Manager at De Beers, Venetia Mine, South Africa from 2006 - 2008. Venetia Mine was an ISO 14001 certified mine. He is currently the Managing Director of Gudani Consulting (Environmental and Social Scientists), and has undertaken various environmental assessment, socio-economic, rural development and water resource management, public participation and capacity building projects in South Africa.

Setenane is a registered environmental assessment practitioner (EAP) - (SACNASP No: 400022/13) and a members of the International Association of Impact Assessment – South Africa Affiliate (IAIA-SA – Membership No: 601).

2.0 DESCRIPTION OF THE PROPERTY

2.1 Description of Study Area

The proposed ferrochrome/ferroalloys smelter site is located 30 km south-west of Musina Town and 35 km north of Makhado Town in Vhembe District, Limpopo Province. It is located close to the N1 national route from Makhado to Musina, along road 525 to Mopane settlement.

The Vhembe District Municipality (VDM) - (Venda: Masipala wa Tshiṱiriki tsha Vhembe; Tsonga: Masipala wa Xifundza xa Vhembe) - is one of the 5 districts of the Limpopo province of South Africa. VDM comprise of the following local municipalities: (Musina, Thulamela, Makhado, and Collins Chabane). It is the northernmost district of the country and shares its northern border with the Beitbridge District in Zimbabwe and on the east with the Gaza Province in Mozambique.

2.2 Project Locality

The proposed Kinetic Development Group Limited (KDG) ferroalloys/ferrochrome smelter plant (125Ktpa – 1Mtpa) is situated on the farms Van Der Bijl 528 MS and Dreyer 526 MS (Zone/Stand 12 and 31) within the Musina-Makhado Local Municipalities in Limpopo Province – South- 22° 37' 39.2" and East – 29° 52' 35.7".

Table 3: Project Locality and Property Description

Farm Name and No:														Dreyer 526 MS Van Der Bijl 528 MS						
Zone/Stand														12, 31						
Application Area (Ha):														300 Hectares						
Magisterial District:														Vhembe District						
Distance and Direction from Nearest Town:														30 km South-West of Musina 15 km North of Makhado						
21 Digit Surveyor General Code for Each Farm/ERF Portion:																				
T	**O**	**M**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**2**	**6**	**0**	**0**	**0**	**0**
T	**O**	**M**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**2**	**8**	**0**	**0**	**0**	**0**
1	**2**				**3**				**4**								**5**			

Local Municipality	Musina Local Municipality Makhado Local Municipality	
Communities	Mulambwane CPA Settlements, Mopane and Farm Homesteads	
Nearest Town	Musina, Louis Trichadt/Makhado	
Coordinates:	See Figure 1a	
	Latitude (Y)	Longitude (X)
	-22.634091 -22.639313	29.884374 29.875988

Figure 1a: Locality Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group

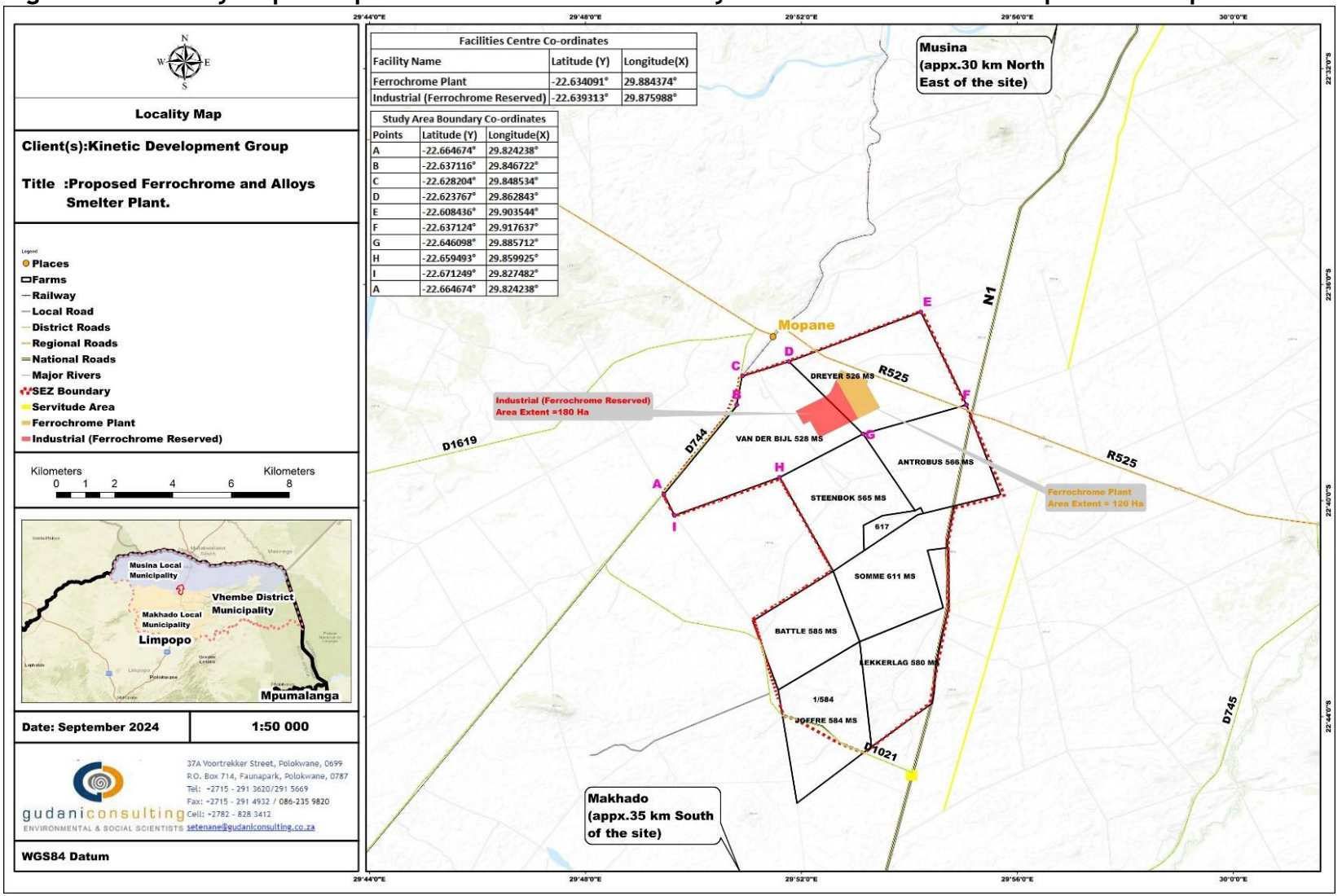


Figure 1b: Locality Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group

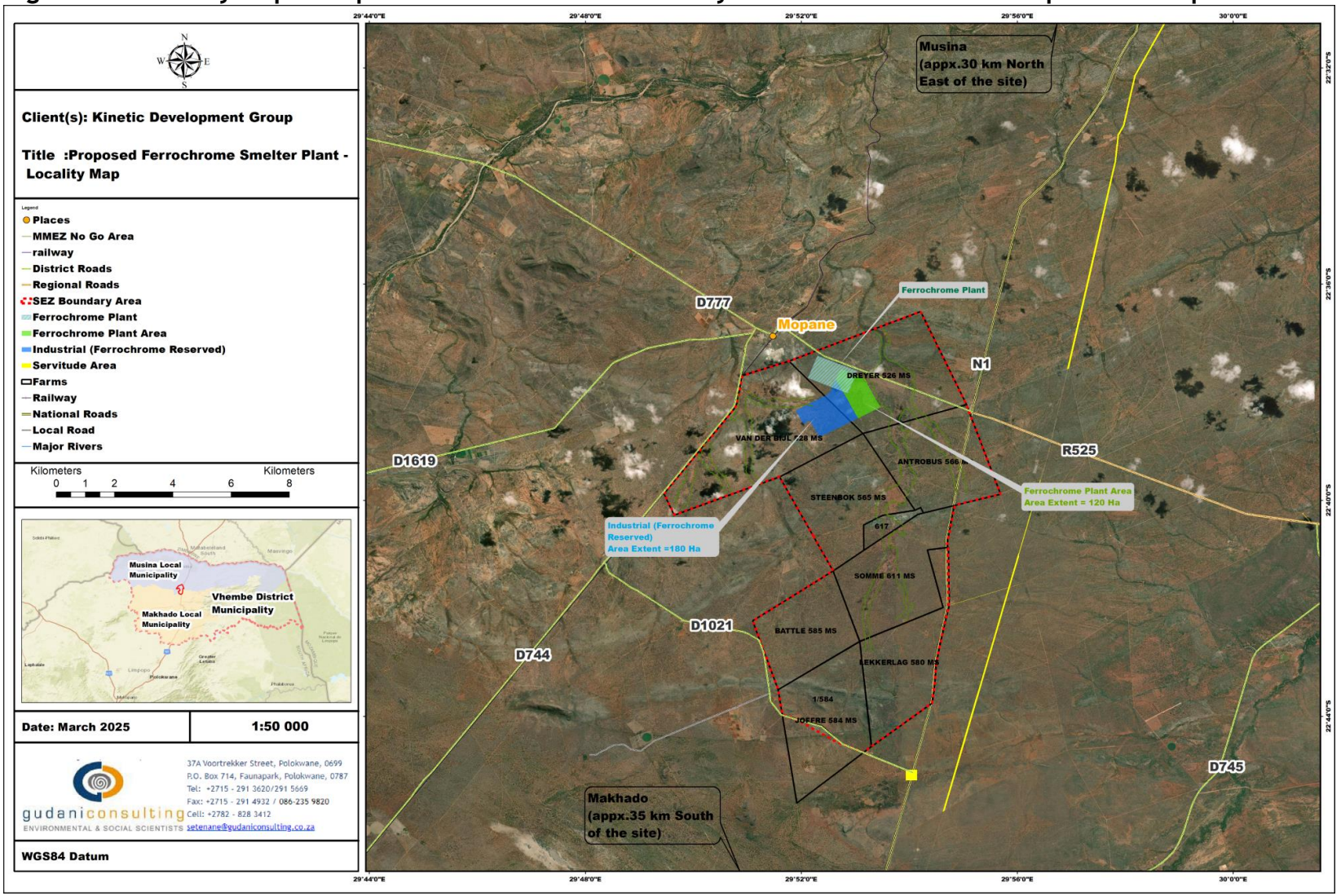


Figure 1c: Locality Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group

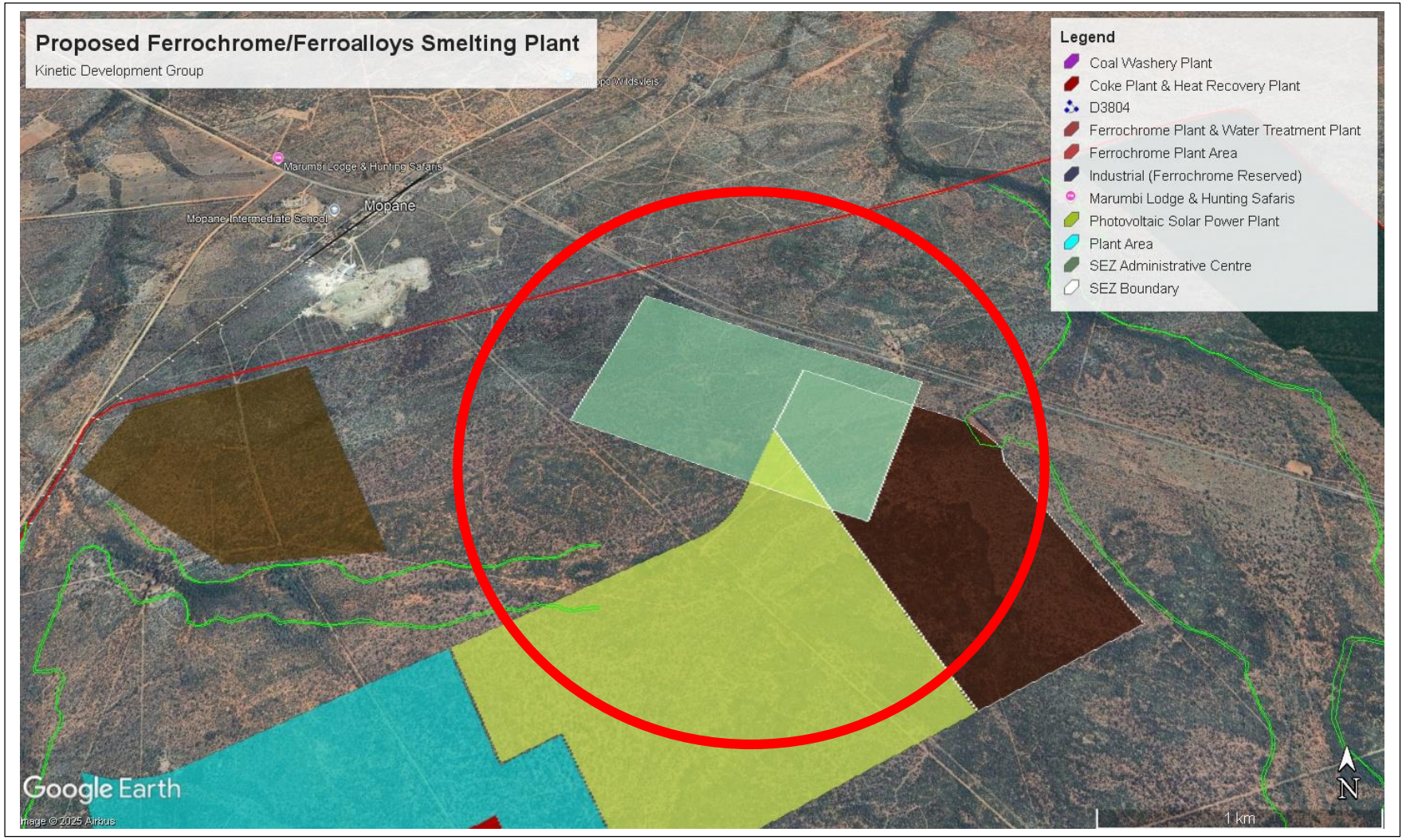
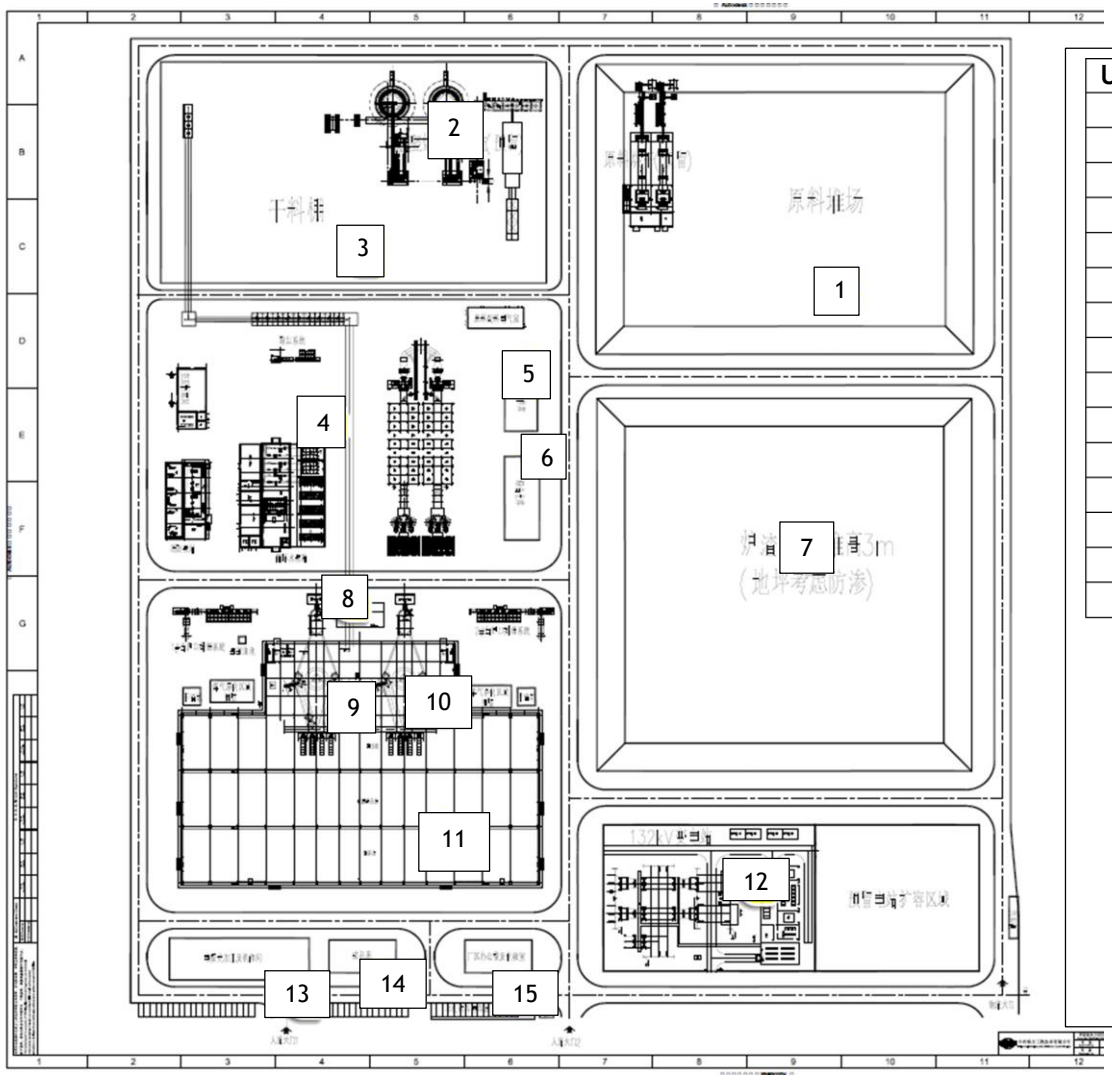


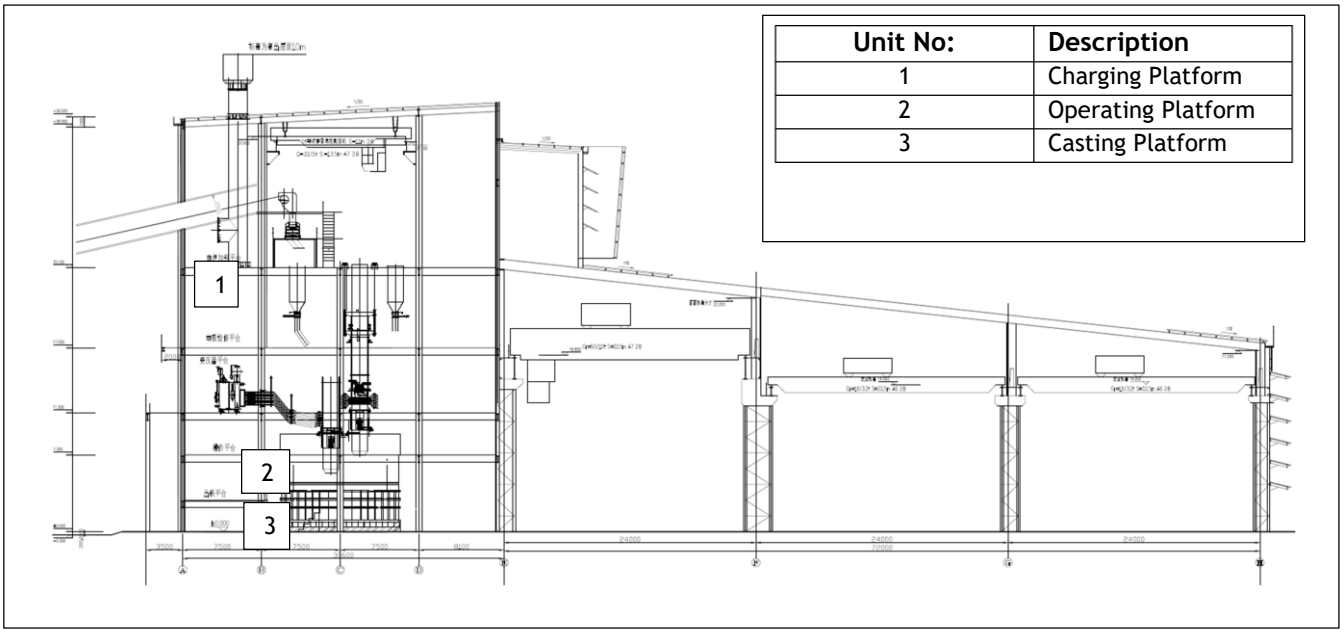
Figure 2a: Site Layout Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group

Figure 2b: Unit Layout Map – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group



Unit No:	Description
1	Raw Material Stock Area
2	Shift Furnace (Reserved)
3	Dry Materials Shed
4	De-dusting
5	Electric Room
6	Spare Shed
7	Slag Stock Area (Height 3m)
8	Circle Water Pump Station
9	Smelting Furnace 1
10	Smelting Furnace 2
11	Smelting Workshop
12	Substation
13	Maintenance House
14	Product House
15	Office and Lab

Figure 2c: Vertical View Smelting Workshop – Proposed Ferrochrome/Ferroalloys Smelter – Kinetic Development Group



Unit No:	Description
1	Charging Platform
2	Operating Platform
3	Casting Platform

2.3 Project Locality – Site Photos

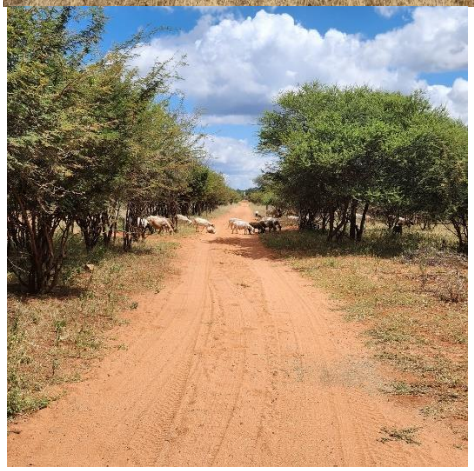


Plate 1: Kinetic Ferrochrome Smelter Site – MMSEZ Area

3.0 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

3.1 Listed and Specified Activities

The proposed activities identified in GNR 983, GNR 984 or GNR 985 and which accordingly require Environmental Authorization in terms of NEMA, are summarized below:

Table 4: Listed and Specified Activities to be Authorized

Relevant Government Notice	Listing Notice and Activity No:	Listing Activity Description:	Description	Applicability and Area Extend/Volume - Ha/m^2/m^3
GNR.983 December 2014	Listing Notice 1, Activity 9	*The development of infrastructure exceeding 1000 meters in length for the bulk transportation of water or storm water:* *(i) with an internal diameter of 0.36 meters or more; or* *(ii) with a peak throughput of 120 liters per second or more.*	Pipelines to the existing PCDs, Stormwater Management Structures	1800-3000m
GNR.983 December 2014	Listing Notice 1, Activity 10	*The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes.*	Pipelines to the existing PCDs	1800-3000m
GNR.983 December 2014	Listing Notice 1, Activity 28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, where the total land to be developed is bigger than 1 Hectare.*	Establishment of ferroalloys/ferrochrome smelter plant and associated infrastructure – office and residential facilities	300 Hectares
GNR.983 December 2014	Listing Notice 1, Activity 56	*The widening of a road by more than 6 meters, or the lengthening of a road by more than 1 kilometer:* *(i) where the existing reserve wider than 13.5 meters, or*	Construction of access and haul roads	1 – 5 km of Road

		(ii) where no reserves exists, where the road is wider than 8 meters..		
GNR.984 December 2014	Listing Notice 2, Activity 4	*The development of facilities or infrastructure for the storage, or storage and handling of dangerous goods, where such storage occurs in containers with a combined capacity of more 500 cubic meters.*	Bulk Hydrocarbons Storage Facilities	500m^3
GNR.984 December 2014	Listing Notice 2, Activity 6	*The development of facilities or infrastructure for any process or activity which requires a permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.*	Ferroalloys/ferrochrome smelter plant	300 Hectare
GNR.984 December 2014	Listing Notice 2, Activity 15	*Clearance of an area 20 hectares or more of indigenous vegetation.*	Vegetation Clearance for Establishment ferroalloys/ ferrochrome smelter plant, and associated infrastructure, office and residential facilities, ore stockpiles and discards stockpile/dumps	300 Hectares
GNR.921 November 2013	Category B Activity - 7	*The disposal of any hazardous waste on land.*	Establishment of stockpiles and Discards stockpile/Dumps.	10-20 Hectare (Waste Management)
GNR.921 November 2013	Category B Activity - 9	*Disposal of inert waste to land in excess of 25000 tons*	Establishment of stockpiles and Discards stockpile/Dumps.	10-20 Hectare (Waste Management)

Listed Activities, as published in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No.39 of 2004) proposed to be conducted at the proposed ferroalloys/ferrochrome smelter premises:

Category of Listed Activity	**Listed Activity 2:**	**Listed Activity Name**	**Listed Activity Description:**	**Applicability and Area Extend – Ha/m^2/m^3**
Category 2 Petroleum Industry	Sub-Category 2.2	Storage and Handling of Petroleum Products	All permanent immobile liquid storage tanks larger than 500 cubic meters cumulative tankage capacity at a site.	500 m^3
Category 4 Metallurgical Industry	Sub-Category 4.7	Electric Arc Furnace in Steel Making	Electric Arc Furnace in Steel Making	125 ktpa – 1000 000 tpa
	Sub-Category 4.9	Ferro-Alloys Production	Production of alloys of iron with chromium, manganese, silicon or vanadium.	125 ktpa – 1000 000 tpa
	Sub-Category 4.15	Process of Chromium, and Silicon	The metallurgical production and processing chromium and silicon and their compounds by the application of heat.	125 ktpa – 1000 000 tpa

3.2 Description of the Activities to be Undertaken

Kinetic Development Group Limited ("Power Development" or "The Group") was incorporated in the Cayman Islands in July 2010. In March 2012, it was listed on the main board of the Hong Kong Stock Exchange with the stock code of 1277. The group is a comprehensive coal enterprise, and the business covers the whole industry chain of coal production, washing, loading, transportation and coal trade.

Musina Makhado Special Economic Zone (MMSEZ) in the Vhembe District in Limpopo was designated by the South African Government as the preferred site for the location the SEZ. The South African Government through the Department of Trade and Industry (DTI) has designated the Musina-Makhado Special Economic Zone (MMSEZ) located in the Limpopo Province, Vhembe District and straddling between the two local municipalities of Musina and Makhado. In line with the Special Economic Zone Act, 2014 the Minister for the Department of Trade and Industry has issued an Operator Permit to facilitate investment. The MMSEZ is located closer to Beitbridge Border Gate, which is the second biggest port of entry in South Africa and a gateway to other SADC countries.

The Musina-Makhado Special Economic Zone comprises two sites, one focusing primarily on Energy and Metallurgy and the other on three sectors, i.e. general manufacturing, agro-processing and logistics.

The Vhembe district in the Limpopo Province is endowed with mineral resources such a diamond. Coking coal with potential for beneficiation. This Special Economic Zone (SEZ) is intended to accelerate economic growth, development and job creation in Limpopo through:

- Promoting Industrialisation
- Facilitating increased trade and investment
- Supporting the development if sustainable enterprises
- Ensuring Infrastructure Development

The MMSEZ enjoys the preferential tax treatment of the South African Special Economic Zone and all the preferential treatment of the South African policy of encouraging foreign investment. The South African government has issued an operating license to the South African Energy Management Base Co (SAEMB), Ltd. to develop and manage the Energy Management Special Economic Zone. Located in Limpopo Province, South Africa(RSA), covering an area of 60 square kilometers, the region is adjacent to Zimbabwe, Mozambique and Botswana.

The reserves of open-pit coke mines around the SAR (Special Administration Region / Special Economic Zone) are more than 10 billion tons. South Africa has more than 83% of the world, manganese resources account for more than 81% of the world, and the high-grade reserves of vanadium resources rank first in the world. There are other rich stainless steel raw material mine resources in the region: iron ore, silicon ore, nickel ore limestone, etc. The national railway, highway and power supply network run through the zone, 500 kilometers away from the large port terminal of Maputo, Mozambique. The Limpopo River is 30 kilometers away from the zone and is an important source of water for the zone.

3.2.1 Proposed Ferrochrome/Ferroalloys Smelter

Kinetic Development Group Limited (KDGL) proposes to establish the industrial and metallurgical activities in the mentioned farms below within the approved Musina-Makhado Special Economic Zone (MMSEZ) area, Musina and Makhado Local Municipalities, Vhembe District, Limpopo:

Applicant Name:	Proposed Activity Description:	Farms:	Zone/Stand:
Kinetic Development Group	Ferrochrome and Alloys smelter plant (125 000 – 1000 000 tons/year)	Dreyer 526 MS Van Der Bijl 528 MS	12, 31

The scale of the project is planned to the annual output of 125 000 to 1 000 000 tons, and 2 x 33,000 kVA semi-closed high carbon electric furnaces and their supporting facilities are built. Figure 2a outlined the general layout with all the eight (08) smelter units each with two (02) electric furnaces – 1 000 000 tons/year output. Figure 2b indicates each smelter unit in detail – 125 000 tons/year. The proposed smelter will commence with one unit (125 000 tons/year) and ramp-up with additional units over the next five (05) year to a maximum output capacity of 1 000 000 tons/year.

The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire protection, labour and training, project investment estimates, technical economy and evaluation.

Main facilities within the Project scope include:

- High-carbon ferrochrome production workshop
- Chromium furnace baking workshop (reserved)
- Raw materials, batching and feeding system
- Charcoal dry
- Furnace gas purification and dust removal system
- Dust removal system in the production area
- Compressed air preparation
- 132KV (power supply) substation and the capacitor compensation
- device
- Power supply and distribution, electrical control, automation
- instruments, telecommunications facilities
- Whole-plant control system
- Industrial TV monitoring system
- machine repair shop
- Electrode shell production workshop
- Water source is connected to the production plant purification

- water supply system
- Net ring water system
- Turbring water system
- Production and living water supply and drainage system
- Whole-plant fire protection system
- Ventilation and air-conditioning system
- General map of transport and roads, walls, gates
- Factory area office building
- Laboratory room
- Raw material storage yard, spare parts warehouse, finished product
- warehouse, etc
- Raw materials into the factory, finished products factory
- loadometer duty room
- Fire protection, safety, environmental protection and other basic
- facilities
- slag disposal area

3.2.2 Product Varieties

Ferrochrome (FeCr) is a ferroalloy composed of chromium and iron. It is an important alloy agent in steelmaking. According to different carbon content, Ferrochrome is divided into High Carbon Ferrochrome (carbon content of 4~8%), Medium Carbon Ferrochrome (carbon content of 0.5~4%), Low Carbon Ferrochrome or lc ferro chrome (carbon content of 0.15~0.50%), Micro Carbon Ferrochrome (with a carbon content of 0.06%), Ultra-Fine Carbon Ferrochrome (with a carbon content of less than 0.03%), as well as silicon-chromium alloy, nitride ferrochromium.

The design product of the proposed workshop is high carbon ferrochrome alloy. The chemical composition and brand of the product are in accordance with the national standard (GB / T 5683-2008)[1], as shown in Table 5.

[1] This standard specifies the technical requirements, test methods, inspection rules, packaging, storage and transportation, marking and quality certificates of ferrochromium. This standard applies to ferrochrome used as an alloy additive for steelmaking or casting, including micro-carbon ferrochrome, low-carbon ferrochrome, medium-carbon ferrochrome, high-carbon ferrochrome and vacuum-process micro-carbon ferrochrome.

Table 5: High (GB / T 5683-2008) Brand and Chemical Composition

the name of a shop	Chemical composition of the (%)									
	Cr			C	Si		P		S	
	scope	I	II		I	II	I	II	I	II
		Not less		Not greater than						
FeCr67C6.0	62.0-72			6.0	3.0		0.03		0.04	0.06
FeCr55C6.0		60.0	52.0	6.0	3.0	5.0	0.04	0.06	0.04	0.06
FeCr67C9.5	62.0-72			9.5	3.0		0.03		0.04	0.06
FeCr55C10.0		60.0	52.0	10	3.0	5.0	0.04	0.06	0.04	0.06

3.2.3 Raw Materials and Auxiliary Materials

The raw materials required for high-carbon ferrochrome projects are mainly ferrochrome block ore, silica (or dolomite) and reducing agent (coke and blue carbon). Ore must be graded before entering the furnace. The powder ore is baked into the furnace after the vertical furnace (reserved). The particle size distribution of the furnace raw materials should be reasonable.

Table 6: Typical South African Chromium Mineral Chemicals

Cr_2O_3	Fe	Cr/Fe	SiO_2	Al_2O_3	MgO	P	S	Shuifen	Fineness (mm)
42	19.1	1.5	8	12	13	0.006	0.007	3%	10~70

Table 7: Chemical Composition of Silica

Chemical Composition (%)			Fineness (mm)
SiO_2	Al_2O_3	P_2O_5	20~80 Of them less than 20mm are not more than 5%
>97	<1.0	0.02	

Table 8: Composition of Chemical Composition of Metallurgical Coke

Fixed Carbon	Ash Content	S	Fugitive Constituent	Shuifen	Fineness
>82%	<13%	≤0.6%	<2%	≯1%	5~25mm

Table 9: Electrode Paste and Chemistry Index - YB / T5215-2015[2]

Name	Closed Paste	
	No: 1	No: 2
Ash Content /%≤	4.0	6.0
Volatile Matter /%	12.0~15.5	12.0~15.5
Compressive Strength / MPa	18.0	18.0
Resistor / (μ Ω·m) ≤	65	75

[2] YB Professional Standard – Metallurgy - Electrode paste

Volume Density / (g / cm^3) ≥	1.40	1.40
Extensibility / %	5~20	5~20

Table 10a: Raw Material Consumption (In the Two Furnaces/Per Smelter Unit)

Raw Material	Unit Consumption t/t	Daily Dosage t/d	Annual Consumption t/a	Fineness (mm)
Chromium Block	2.000	760	250656	10-70
Coke	0.500	193	63416	5-25
Dinas Rock	0.174	66	21807	20-80
Carbon Paste	0.025	9	3133	-

*Note: The above consumption amount does not consider the loss amount.

Table 10b: Raw Material Consumption (Full Production)

Raw Material	Consumption t/t	Daily Dosage t/d	Annual Consumption t/a	Fineness (mm)
Chromium Block	16.000	6080	2 005 248	10-70
Coke	4	1544	507 328	5-25
Dinas Rock	1.392	528	174 456	20-80
Carbon Paste	0.2	72	25 064	-

Figure 4: Ferrochrome Production Process Flow

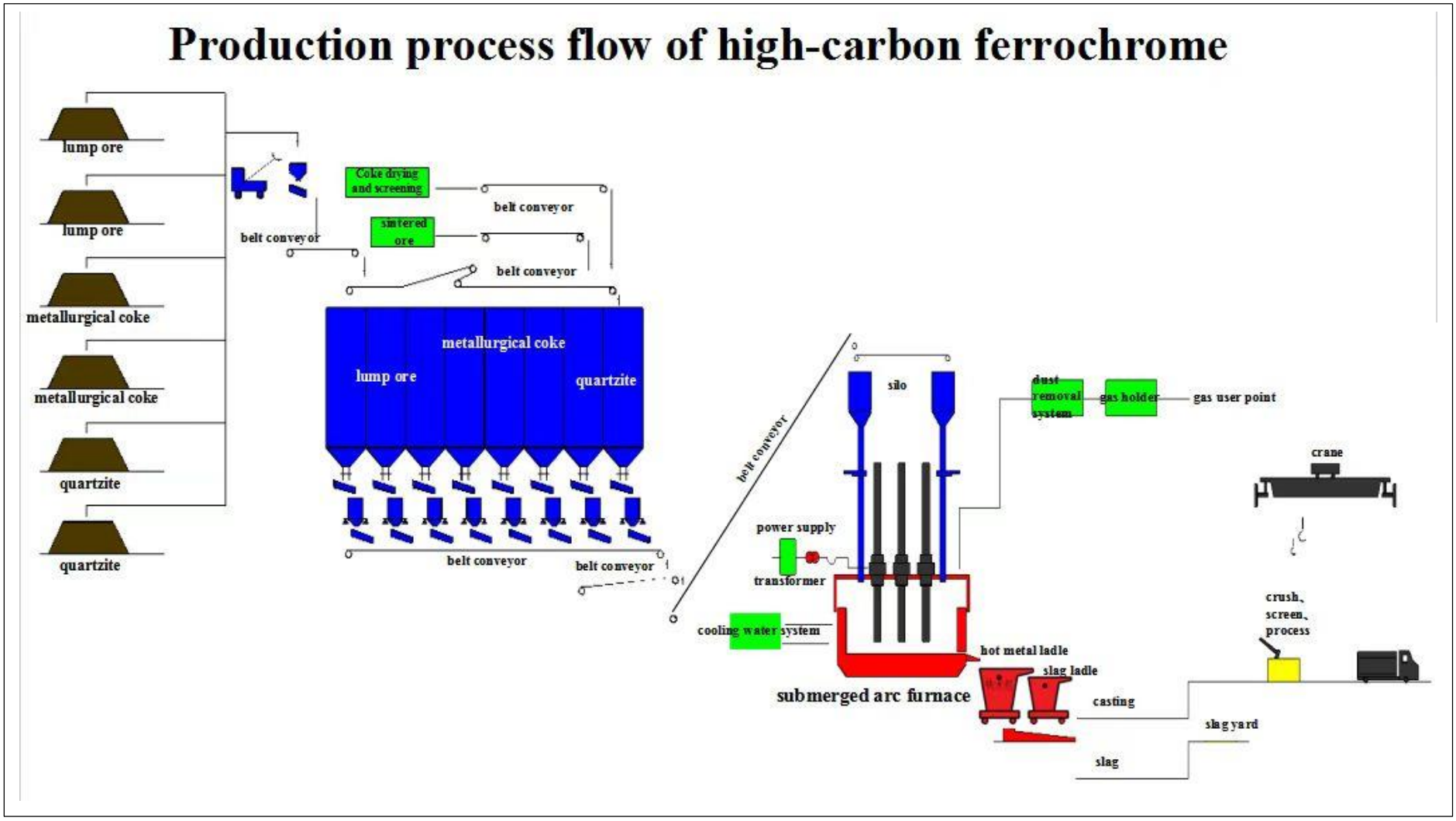


Table 11a: Material Balance Table

Inputs			Outputs		
	Quantity	**Scale**		**Quantity**	**Scale**
Chromium Block	100	77.90%	High Carbon Ferrochrome	50.23	39.13%
Carbonaceous Reducing Agent	23.89	18.61%	Bira Nest	42.36	33.00%
Slagging Constituent	4.48	3.49%	Gas (Conversion)	35.78	27.87%
Total	128.37	100%	Total	128.37	100%

Table 11b: Material Balance Table (Full Production)

Inputs			Outputs		
	Quantity	**Scale**		**Quantity**	**Scale**
Chromium Block	800	77.90%	High Carbon Ferrochrome	401.84	39.13%
Carbonaceous Reducing Agent	191.12	18.61%	Bira Nest	338.88	33.00%
Slagging Constituent	35.84	3.49%	Gas (Conversion)	286.24	27.87%
Total	1026.96	100%	Total	1026.96	100%

3.2.4 Ferrochrome Production Process

Two 33000 kVA semi-closed high carbon ferrochrome alloy electric furnaces will be arranged in one workshop (1 Unit). Semi-closed high carbon ferrochrome alloy electric furnace includes feeding and unloading, electrode operation, furnace, product casting and other processes. At full production there will be eight smelting units with two furnaces each.

High carbon ferrochrome alloy is a product of carbon reduction with chromium ore as raw material, silica as slag flux, and carbon reducing agent (coke) in the electro-heated furnace. It is an electro-thermal process of continuous melting and intermittent oven.

Qualified coke carbon, silica and ferrochromium block ore will be transferred by the belt conveyor to the daily material bin of the batching station for storage. Reserved chrome powder ore ball production facilities. After the batching the material will be transported to the electric furnace through the belt, and added to the bin, and be added to the furnace through the material pipe.

At 2.67 hour intervals, the iron port will be opened with the iron opening machine, the liquid ferrochrome alloy will flow into the molten iron bag, and the slag flows into the slag bag through the molten iron bag. The iron chartered car and the slag tank truck are pulled out by the electric iron truck into the pouring span, lifting the iron bag for slag picking treatment after casting. The cooled high carbon ferrochrome alloy is processed into qualified grain size in the finished product across the strong crushing line, and the product sieve is re-melted in the ingot mold.

The slag bag is lifted by a crane, the slag flows into the dry slag pool through the dry slag chute, and the cooled dry slag is sent to the dry slag storage area. The electrode shell manufactured from the electrode shell and the broken electrode paste transported from the electrode paste reservoir are raised from a 5-ton bridge crane to the +25.10m platform to add the long electrode shell and the electrode shell to supplement the regular consumption of the electrode in smelting.

Electrode hydraulic lifting and pressing can be automatic and manual realization, workshop feeding, high carbon ferrochrome alloy electric furnace feeding and high carbon ferrochrome alloy electric furnace condition control are controlled by PLC system.

3.2.5 Electric Furnace Production Capacity – Each Unit

- Iron exit system: three times per shift (iron exit interval time:
- 2.67h)
- Annual working time of electric furnace: 330 days.
- Annual shutdown time of electric furnace: 35 days.
- Among them: middle repair once a year, a 10 days.
- Minor repairs occur once a month, once for a day.
- Unplanned furnace shutdown, 7 days.
- In addition, overhaul once every 5 years, once every 30 days.
- Power factor cos φ: 0.82 (after compensation)
- Power grid fluctuation coefficient: 0.98.
- Time utilization coefficient: 0.91.
- Power consumption per unit product: 3,050 kWh / t
- Average hourly output of electric furnace (one set):
  $Q = \frac{33000 \times 0.82 \times 0.98 \times 0.91}{3050} = 7.91$ (t)

- Maximum hourly output of electric furnace (one set):
  $Q = \frac{33000 \times 0.82}{3050} = 8.87$ (t)

- Average daily output of electric furnace (one set):
  Q = 7.91 x 24 = 189.9 (t)

- Maximum daily output of electric furnace (one set):
  Q = 8.87 x 24 = 213 (t)

- Annual output of electric furnace (one set):
  Q = 189.9 x 330 = 62664 (t)

- Annual output of two (02) electric furnaces:
  Q = 62664 x 2 = 125328 (t)

3.2.6 Main Parameters of the Electric Furnace and Transformer

The main parameters of the electric furnace are shown in in Table 12 below:

Table 12: Main Parameters of the Electric Furnace

Item No:	Name:	Unit	Quantity
1	Furnace Diameter	mm	10800
2	Height of Furnace Shell	mm	4350
3	Furnace Diameter	mm	8800
4	Furnace Depth	mm	2700
5	Diameter of Electrode	mm	1270
6	Circle Diameter of the Electrode Pole Centre (adjustable)	mm	3600
7	Number of Iron Ports	Individual	2
8	Electrode Lift Speed	m/min	0.5
9	Electrode Current Density	A/cm^2	5.1

Table 13: Main Parameters of Electric Furnace Transformer

Item No:	Name:	Unit	Quantity
1	Transformer Rated Capacity	kVA	3 x 11000
2	Number of Transformer Stations (monophase transformer)	Short for Taizhou	3
3	Primary Side Voltage	kV	35
4	Secondary Side Voltage	V	250-400
5	Secondary Side Voltage Level		Grade 32 Grade difference of 5V
6	Common Voltage on Secondary Side	V	300
7	Common Current on Secondary Side	A	63510
8	Voltage Regulation Mode (Y/Δ changing-over)		Load Voltage Regulation
9	Number of Phases	Each Other	3
10	Supply Frequency	Hz	50

3.2.7 Structural Type of Electric Furnace

The structure type of the electric furnace is semi-closed, fully hydraulic and fixed electric furnace.

3.2.7.1 Furnace Shell, Lining and Electrode System

The furnace shell is cylindrical. The furnace two is with two furnace shell, 150° layout. Furnace lining is made of thermal insulation and refractory material.

A combined type of handle is used. Technical features: The combined handle completely innovates the traditional electric furnace structure, eliminates the copper tile and the holding lock, and replaces the contact element. This structure makes several wings on the outer surface of the electrode shell, and the current is introduced into the furnace through the wing of the electrode of the contact element; the electrode voltage discharge is composed of another clamp that can be clamped or released. Contact elements and clamps completely replace the role of copper tile and lock, which is more flexible than copper tile and lock, and the

material dosage is more economical. The Electrode lifting adopts hydraulic lifting cylinder lifting.

The release device uses a clamper. The holding force of the electrode depends on the elasticity of the butterfly spring. When releasing the electrode, the liquid pressure is used to overcome the elasticity of the spring. The piezoidal electrodes use both programmed pressure drop and manual forms.

3.2.7.2 Smoke Cover, Exhaust System and Charging System

Smoke hood is a device to collect and remove a large amount of flue gas and dust produced in the smelting process of electric furnace. The smoke cover adopts semi-closed low smoke cover. In order to prevent the smoke cover from deformation during transportation, the smoke cover plate can be separated and installed after transportation to the site. It is composed of water-cooled steel skeleton, water-cooled cover plate and side wall. The skeleton and the top cover are water-cooled, which also makes high-aluminium refractory castant, and the side wall of the hood is the inner-side of the water-cooled structure. Two flue gas export pipes are set in the smoke hood, and the flue gas is cooled by the air cooler before the bag dust collector, and the treated flue gas is discharged according to the standard. The cigarette hood is provided with three electrode opening holes. The smoke hood is a regular hexagonal structure, and the top of the smoke hood is composed of six top cover plates of the water-cooled structure and three central cover plates of the top of the water-cooled structure. The centre cover plate is sprayed with refractory castings.

In order to meet the requirements of uniform distribution and a large amount of furnace charge in a short time, each electric furnace is equipped with a preheating bin and the furnace top bin, and the bin is equipped with a feeding level indicator device. A total of 10 furnace material pipe, the material pipe into the furnace cover part of the water cooling.

3.2.7.3 Electric Furnace Short Net, Water-Cooled System and Hydrolytic System

The short net of electric furnace is pipe type, and the soft connection part is water-cooled cable. Compared with the plate short net, the current density is increased several times, and the weight of the corresponding short net is reduced a lot. At the same time, the short net, the conductive copper pipe on the electrode and the copper tile can form a cooling water loop, and the temperature of the tube short net is much lower than the plate short net. The electrical loss is correspondingly reduced, and the short net copper pipes are covered with insulation layer, which prevents the occurrence of short net short circuit accident.

The use of three single-phase transformers can make the current more balanced, solve the problem of bias, short network, short, small electric loss.

The body cooling of the electric furnace adopts the softening water closed circulation system, so that the cooling parts do not scale, prolong the service life of the cooling parts, and reduce the hot shutdown furnace.

Hydraulic station, as the power source of electrode lifting and electrode control, is composed of pump station, valve station and accumulator group.

3.2.8 Main Auxiliary Equipment of the Electric Furnace

The front smoke exhaust system is mainly composed of smoking cover, flue, flue butterfly valve and dust collector. There are two outlets of high carbon chromium electric furnace -150°, for each other. When one of the group is working, open the adjacent flue butterfly valve of the group, close the other group of oven flue butterfly valve, so that the smoke in front of the furnace. Two furnace outlets are staggered, sharing a set of furnace front smoke exhaust system.

The opening and blocking iron port machine is composed of guide rail, gun barrel, pitch device, walking device and air cylinder. Open the iron outlet to block the iron outlet in time after putting the iron water.

The furnace bottom fan is used to cool the furnace bottom to improve the service life of the furnace shell and the furnace bottom.

The iron outlet mode of high carbon chromium ferroelectric furnace adopts molten iron bag and slag bag mode. Each electric furnace produces iron once every 2.67 hours, and each electric furnace uses 4 molten iron bags and 4 slag bags.

3.2.9 Water Supply and Drainage Facilities

The design scope of water supply and drainage includes: 2×33000 kVA high carbon chromium electric furnaces, living and welfare facilities in the plant and the design of water supply and drainage pipe network in the plant.

The project uses the same water source for producing new water, fire-fighting and domestic water, and the supply amount of producing new water is 17m^3/h, the domestic water supply is 5m^3/h, water supply pressure not lower than 0.15MPa. This will translate to 136m^3/h and 40m^3/h of water supply at full production.

The water source comes from the boreholes to be drilled near the plant, and the source water is diverted to the newly built production and fire storage pool (the fire pool is shared with the new production and water storage pool), and then pressurized by the production water supply pump through the newly built production and fire water supply pipe for users. In case of fire, the starting fire pump group can supply fire water through the new production and fire water supply pipes, and the domestic water is directly supplied by the deep well pump in the well.

The drainage in the plant adopts the diversion system. The production drainage in the plant is reused, and the production wastewater will be zero discharge.

Domestic drainage is treated by septic tank and discharged into local municipal drainage network or reused. The rainwater in the plant is collected by the pipeline, and the initial rainwater is collected and discharged to the initial stage of the plant for rainwater collection and precipitation treatment.

The water supply and drainage pipe network of the new plant is connected to 1 meter outside the plant. According to the water technical requirements provided by

relevant process specialty, the total water consumption is 1456m^3/h, where the soft ring water is 1439m^3/h, the production of new water supplement 17m^3/h. This will translate to a total water consumption of 11 648m^3/h and supplement of 136m^3/h at full production. Production water reuse rate will be at 98.8%.

The domestic water volume is 5m^3/h, living displacement of 4m^3/h. The fire water is 20 L/s, and the outdoor fire water is 20 L/s. Similarly, these volumes will translate to 40m^3/h, living displacement of 32m^3/h at full production.

3.2.10 Ventilation and Dust Removal Facilities

The flue gas and dust generated in the newly built plant shall be treated; two electric furnaces shall be arranged in the electric furnace workshop, including one set of electric furnace; one set of dust removal system (for each electric furnace and total of two sets); dust removal facilities shall be provided for the feeding and ingredients system of the ground raw material field; and heating, ventilation and air conditioning design of public and auxiliary facilities of the whole plant.

Each electric furnace flue gas is set up with a flue gas purification system, and the dust-containing flue gas is discharged to the standard after negative pressure large bag filter. At the interface of the electric furnace, the exhaust cylinder will have three flanges on the main workshop. The two flue gas pipes are horizontally connected out and connected with the aggregate smoke pipe. In order to ensure the pressure of-100Pa in the smoke hood and the most economical system air volume, the fan motor is equipped with frequency converter to adjust the system air volume and fan speed.

The dust-containing flue gas is reduced to 230℃ by the air cooler, filtered by the front cyclone and the negative pressure large bag filter. The flue gas is discharged up to the standard. Every two sets of dust removal systems share one exhaust cylinder.

Table 14: Flue Gas Purification System Design Parameters – Per Smelting Unit

Furnace Gas Parameters					
Gas Capacity		**Gas Temperature**		**Dust Content**	
20 000 Nm^3/h		450 – 600 ℃		100 – 150 g/Nm^3	
Smoke Composition					
H_2O	**CO_2**		**O_2**		**N_2**
1.0%	3.0%		19.0%		77.0%
Composition of Soot					
SiO_2	**FeO**	**Al_2O_3**	**CaO**	**C**	**Mn**
15 - 30	~5	1 - 5	5 - 10	~10	~30
Dust Particle Size					
Fineness	<1		1 - 10		10 - 40
%	50 - 70		20 - 30		0 - 10

Each electric furnace flue gas is set up with a flue gas purification system, and the dust-containing flue gas is discharged to the standard after negative pressure large bag filter.

3.2.11 Power Supply and Distribution

The total calculated load of the electrical equipment required for the project is 55 303kW, and the annual power consumption is about 4.38 x 10^8 kWh, the compensated combined power factor is greater than 0.95. For Phase 1 - 2 Furnaces (125Ktpa) – 80 MW electric power will be needed. 640 MW electric power will be need at full production.

Most of the loads will be secondary loads, containing only a small amount of primary loads (mainly for the smelting furnace workshop crane, and part of the feed pump of the water system) and three types of loads. The project plans to build a 132 / 35kV substation in the plant area. Since the local power grid can only provide primary power supply for the project, in order to meet the needs of safe production, the following security measures are taken: the diesel generator is provided in the smelting workshop to provide security power supply for the primary load in the workshop; and the diesel generator pump in the circulating water pump station.

According to the load distribution and power supply, a new 35kV substation shall be built in the plant to supply power to six single-phase transformers of two 33 MVA smelting furnaces at 35kV, and two 12 MVA and 35 / 10kV step-down transformers shall be installed in the substation to supply power to the power load of each system at 10kV voltage level.

According to the South African Energy Metallurgical Special Economic Zone Development Plan (2019) - Eskom indicated that they will be able to supply 5 MW of the electricity required during year one. This will depend on the location of the main sub-station of the development. Discussions is in progress with Eskom. If feasible, a substation will be constructed within the development (following agreement with Eskom) to supply power during the first year of the development.

In line with the Eskom ten-year Transmission Development Plan, developments include extending the 400 kV and 275 kV networks as well establishing a 400/132 kV substation at Nzhelele, and integration of Medupi to Nzhelele 400 kV transmission line. This will increase power by 3 820 MVA and a further 9 500 MVA in the following years.

3.2.12 Laboratory and Testing Facilities

According to the construction content, production scale and process requirements of the project, a new central laboratory will be constructed.

The central laboratory will mainly undertake the physical performance and chemical composition analysis of incoming raw materials (chromium ore, coke, etc.), the furnace analysis of ferrochrome, the composition analysis of finished ferrochrome alloy and slag; the routine water quality analysis of whole water system; the inspection of electrode paste shall be considered externally. Details are shown in the following table:

Table 15: Raw and Finished Materials and Water Quality Analysis

Name	Analyse and test items	The number of analysis	Remarks
Raw Materials			
Dinas Rocks	Total analysis: SiO_2,CaO, Al_2O_3, FeO, MgO	The first batch of use to find problems	Each producing area
	Feed the silica: SiO_2	O.D.	Take the average sample
Chrome Ore	Total analysis: Cr_2O_3, FeO, Al_2O_3, CaO, MgO, SiO_2, P, S	The first batch of use to find problems	Each producing area
	Incoming chromium ore: Cr_2O_3	Each batch	Point of origin
	Feed the chromium ore: Cr_2O_3, H_2O	Each class once	Take the average sample
Coke	Full analysis: fixed carbon, volatile, ash and FeO, Al_2O_3, CaO, MgO, SiO_2, P, S and moisture	Once every month	Each producing area
	Factory incoming coke: fixed carbon, volatile, ash, moisture	Each batch	
	Feed the coke: H_2O	Each class once	Take the average sample
Dolomite	Full analysis: FeO, Al_2O_3, CaO, MgO, SiO_2, P, S, C	Once every month	Each producing area
	Feed lime: effective CaO	O.D.	
Finished Materials			
Name	**Analyse and test items**		**Remarks**
High Carbon Ferrochrome	Full analysis: Cr, C, Si, P, S, and Fe		Once every month
	Pre-furnace analysis: Cr, C, Si, P, S		Each furnace once
Bira Nest	total analysis: Cr_2O_3、SiO_2、CaO、MgO、Al_2O_3、P_2O_5、FeO、S		Once every ten days or once every half a month
	Published analysis: Cr_2O_3, SiO_2		Each furnace once and each class once
Water Quality			
Water quality index of the circulating water system	PH value, electrical conductivity, turbidity, total hardness, calcium hardness, total alkalinity, chloride ion, total iron, free chlorine, agent concentration		O.D.

The central laboratory will be a single-storey building, located close to the electric furnace workshop. It is mainly composed of raw material sample making room, finished product sample making room, drying and burning room, infrared carbon and sulphur room, chemical analysis room, balance color comparison room and warehouse, power distribution room, toilet, sample mail room and data processing room and other auxiliary rooms. The main working system of the central laboratory will be three shifts and two shifts, with a total of 13 people.

3.2.13 General Ferrochrome Plant Layout

According to the site situation, the whole factory area will be divided into 5 functional areas. They are: raw material storage area, public and auxiliary facilities area, main plant area, office area, 132kV substation area – See Figure 2b.

Raw material storage area mainly will have: dry material shed and block material shed. The public and auxiliary facilities will mainly include: vertical furnace (reserved), production area canteen bathroom, block batching room, comprehensive circulating water pump room, air pressing nitrogen room, motor shell processing and machine repair room.

The main plant area will mainly have the main workshop, hot furnace flue gas purification system, dry slag area. The office area mainly includes the office building, the living area canteen, the dormitory building, the comprehensive warehouse and so on.

3.2.14 Transportation

Coke, silica and ferrochrome block ore will be transported from the block material shed to the main workshop, with an annual transportation capacity of 330 116 tonnes.

The width of the new road is 7m and 4m respectively, the pavement adopts cement concrete pavement structure, the pavement structure layer will be: 240mm thick C30 concrete and 150mm thick cement stability layer and 180mm thick natural graded gravel. The turning radius is 12m, 9m and 6m respectively.

3.2.15 Pipe Network

The contents include: production and living water supply pipeline; drainage pipe; ventilation pipe; power cable; heating pipeline; and road lighting.

3.2.16 Greening and Fire Fighting

In order to beautify and improve the surrounding environment of the factory and create a beautiful, and pleasant production and living environment for employees, some flowers and trees suitable for local growth will be planted around the building, on both sides of the road and in the idle areas. The green area occupying rate is not less than 20%.

There will be circular roads or passageways around the building to meet the passage of fire-fighting vehicles. There will be fire water supply pipes and fire hydrants along the roads to meet the requirements of fire water use.

Build a 2.5m physical wall around the factory area. In the southeast side of the factory, there are three gates, one logistics gate and two personnel gates. In the southeast corner of the factory, a logistics gate is set at each gate. The personnel on duty will use four shifts of three hours. Labour will be 10 people.

3.2.17 Capital Investment and Labour Estimates

This project will be affiliated to Kinetic Development Group Limited (KDGL) trading as Kinetic Mining Development South Africa (Pty) Ltd According to the labour quota standard stipulated by the state and the personnel density required by the production equipment, the labour quota required by the project is 235 people. Labour will increase to 1 880 people at full production.

The process equipment for this project has a relatively high degree of automation, which requires the technical personnel and production workers to have a relatively high cultural quality and professional quality, and the training work is extremely important. During the preparation period, the training of the enterprise employees should be arranged, so that the trainees can be put into the equipment installation and debugging and trial production in time.

The main contents of technical training include production management training, application training of key technologies, operation and maintenance training of key equipment, quality control training, and safety training. The training objects include production workers, technicians and management personnel. Specific training measures:

- Organize theoretical knowledge learning to improve the level of cultural knowledge of the staff.
- Organize all kinds of new personnel for local training before the project is put into operation, and organize the assessment before taking-up the post, and select the best ones.
- Invite experts with practical experience to teach technology on site. Arrange technical personnel with practical experience to give lessons to cadres and workers in different positions to improve the professional quality of all staff.
- Equipment providers need to be responsible for the training for key positions.

After the completion of the project, the annual output of high carbon ferrochrome will be 125 300 tonnes, and future output expansion up to 1 000 000 tonnes. Table 16 below outlines the project capital and labour investment

Table 16a: Capital Investment and Labour Estimates – Per Unit

Construction Investment	R 868 778 500	
Interest During Construction	R 26 774 750	
Working Capital	R 389 956 000	
Labour Cost Per Annum (235)		R 52 875 000
Total Investment	**R 1 285 509 250**	**R 52 875 000**

Table 16b: Capital Investment and Labour Estimates – Full Production

Construction Investment	R 6 950 228 000	
Interest During Construction	R 214 198 000	
Working Capital	R 3 119 648 000	
Labour Cost Per Annum (1 880)		R 423 000 000
Total Investment	**R 10 284 074 000**	**R 423 000 000**

3.2.18 Energy Saving Options

- Reasonable layout, optimize the connection between the production process and process, adopt advanced energy saving and emission reduction, clean production technology, and minimize energy consumption.

- The electric furnace will adopt bellows pressure ring, forged copper tile, water-cooled cable and other new technologies, greatly reducing the hot furnace shutdown time, thus reducing the power consumption.

- According to the load capacity, power supply distance and distribution, and electrical equipment characteristics, rationally design the power supply and distribution system and select the power supply voltage; the substation shall be as close to the load centre as possible to shorten the distribution radius and reduce the line loss.

- According to the different requirements of the production process for water quantity, water pressure, water quality and water temperature, design a more reasonable water use process, stabilize the water quality of circulating water, use water-saving equipment as far as possible, reasonably control the concentration ratio of circulating water, and improve the reuse rate.

- The use of new water transmission pipe, eliminate the traditional cast iron pipe and galvanized pipe, in order to better achieve the pipeline does not leak, easy to operate and monitoring.

3.2.19 Sewerage Facility

A new sewage treatment plant (STP) or various package treatment plants will be constructed on Zone/Stand 21 (Dreyer 526 MS) that will accommodate the peak sewer flow that would be generated from the proposed SEZ developments. The desired STP storage volume will be calculated once the peak sewerage discharge has been determined and confirmed.

3.2.20 Stormwater and Drainage

The stormwater drainage of the site will be designed in accordance with the stormwater management/attenuation policy of the Musina and Makhado Local Municipalities as well as the Stormwater Management Best Practice Guideline by the Department of Water and sanitation (DWS). It is anticipated that stormwater from road carriageways and other impervious areas will be attenuated so that the post development flows do not exceed the pre-development flows for both 1 in 5-year and 1 in 25-year return periods. Therefore, on-site attenuation needs to be provided and the outflow from the required structures will discharge to the surface.

3.2.21 Roads and Access

Primary access to the proposed ferroalloy/ferrochrome smelter and MMSEZ South site is currently via the N1 main road from Makhado to Musina, which is situated

along the east of the site and allows north-south traffic movement. The secondary access to the site was identified as the R525, which is situated along the northern part of the site and allows east-west traffic movement and connectivity to the N1. Due to the prescripts of the SEZ guidelines, security and access control facilities will need to be provided at all access points to the MMSEZ South site – including the proposed smelter.

The characteristics of the two major roads adjacent to the site are illustrated below:

Road	Class	Road Reserve	Carriageway	Lanes	Condition
N1	R1 Principle Arterial	30m Typical Reserve 60 - 80m	Single	One Lane in each Direction	Good
R525	R3 Minor Arterial	30m – 40m Typical Reserve 30 - 50m	Single	One Lane in each Direction	Fair

Plate 2: Access Road and Rail – N1 Intersection, R525 Road and Mopane Rail

4.0 POLICY AND LEGISLATIVE CONTEXT

The following laws, regulations and documents in the table below have relevance to this ferrochrome smelter project:

Table 17: Legislative Context

Name	Overview	Permits/Licenses	Compliance	Administering Authority
Minerals and Petroleum Resources Development Act, (Act 28 of 2002)	This Act regulates the prospecting for and optimal exploitation, processing and utilization of minerals. The Act provides for the safety and health of persons concerned in mines and works. The Act also regulates the orderly utilization and the rehabilitation of the surface of land during and after prospecting and mining operations.	Mining Right, Mining Permit Prospecting Right	No authorisation is required	National and Provincial
National Environmental Management Act: (Act No. 107 of 1998)	The primary environmental framework Act. The purpose of the Act is to provide for effective protection and controlled utilisation of the environment.	Environmental Authorization for the proposed ferrochrome smelter and activities.	Complied with in terms of this EIA/EMP submission	National and Provincial
National Environmental Management: Biodiversity Act (Act 10 of 2004)	This Act controls the management and conservation of South African biodiversity within the framework of NEMA. The Act lists species that are threatened or require protection to ensure their survival in the wild, while requesting the activities, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival. The Act has listed flora and Fauna species.	A list has been published under Section 56 (1) of critically endangered, vulnerable and protected species and as such a permit is required prior to undertaking restricted activities in areas with the species.	Complied with in terms of this EIA/EMP submission	National and Provincial

Name	Overview	Permits/Licenses	Compliance	Administering Authority
National Spatial Biodiversity Assessment, 2004	The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on its biophysical characteristics, which are ranked according to priority levels.		Complied with in terms of this EIA/EMP submission	National and Provincial
National Forest Act	This provides for the management, utilisation and protection of forests through the enforcement of permitting requirements associated with the removal of protected tree species, as indicated in a list of protected trees.	Removal and/or translocation of endangered trees and plants	Complied with in terms of this EIA/EMP submission	National and Provincial
National Environmental Management: Protected Area Act (Act No.57 of 2003)	The Act makes provision for the protection and conservation of ecologically viable areas that show the country's biodiversity, natural landscapes. It also takes into account the declaration of the various categories of protected areas and envisages a national register of protected areas, with a simplified classification system of Special Nature Reserves, National Parks, Nature Reserves and Protected Environments. In addition, the Act brings in the concept of biological diversity protection and ecosystem management.		Complied with in terms of this EIA/EMP submission	National and Provincial
National Water Act (Act No 36 of 1998)	This Act aims to provide management of the national water resources to achieve sustainable use of water for the benefit of all water users. Section 21 states the water uses that require a license or authorisation.	Water use requirements for the proposed ferrochrome smelter and activities.	Complied with in terms of this EIA and IWULA submissions	National and Provincial

Name	Overview	Permits/Licenses	Compliance	Administering Authority
The National Environmental Management: Waste Act (Act No.59 of 2008)	In terms of the Waste Act, no person may commence, undertake or conduct a waste management activity except in accordance with: • The requirements or standards determined in terms of the Waste Act for that activity; and • A waste management license issued in respect of the activity, if a license is required.	The waste produced during the construction and handled during operations and storage thereof is within the minimum threshold specified in the listed activities Category B.	Complied with in terms of this EIA/EMP submission	National and Provincial
The National Environmental Management: Air Quality Act (Act No.39 of 2004)	The main objective of the Air Quality Act (NEMAQA) is the protection of the environment and human health, in a sustainable (economic, social and ecological) development framework, through reasonable measures of air pollution control.	Schedule of activities that require and atmospheric emission license has been published. The proposed activity is listed as having possible detrimental impact on air quality.	Complied with in terms of this EIA/EMP submission	National and Provincial
The hazardous Substance Act (Act No. 15 of 1973)	It was promulgated to provide for the control of substances which may cause injury, ill-health or death. Substances are defined as hazardous if their inherent nature is: toxic, corrosive, irritant, strongly sensitising, flammable and pressure generating (under certain circumstances) which may injure cause ill-health, or death in humans.	Minimum requirements of dealing with hazardous wastes should be followed when dealing with hazardous substances	Complied with in terms of this EIA/EMP submission	National and Provincial
The National Heritage Act (Act No. 25 of 1999)	Section 34 (1): No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the South African Heritage Resources Agency	Permits are required for any development that may affect heritage resources	Complied with in terms of this EIA/EMP submission	National and Provincial

Name	Overview	Permits/Licenses	Compliance	Administering Authority
	(SAHRA), or the responsible provincial resources authority. Sections 35 (4): No person may, without a permit issued by the SAHRA or the responsible heritage resources authority, destroy or damage, excavate, alter or remove from its original position, or collect, any archaeological material or object. Section 36 (3) No person may, without a permit issued SAHRA or a provincial heritage authority, destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal area administered by a local authority.	such as graves and old buildings.		
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	The Conservation of Agricultural Resources Act (CARA) Act 43, 1983) provides for the: • Protection of wetlands; and • Requires the removal of listed alien invasive species This Act also requires that any declared invader species must be controlled according to their declared invader status.	Removal of alien vegetation	Complied with in terms of this EIA/EMP submission	National and Provincial
Occupational Health and Safety Act 85 of 1993	The act aims to provide for the health and safety of persons at work and for the health and safety of persons about the use of plant and machinery; the protection of persons other than persons at		Complied with in terms of this EIA/EMP submission	National and Provincial

Name	Overview	Permits/Licenses	Compliance	Administering Authority
	work against hazards to health and safety arising out of or about the activities of persons at work.			
National Energy Act of 2008 and Electricity Regulation Act.	The purpose of the act is to ensure that diverse energy resources are available, in sustainable quantities and at an affordable price and to provides for integrated energy planning, increased generation and consumption of renewable energies, contingency energy planning, holding of strategic fuel stocks and carriers, provide appropriate energy infrastructure, data on energy, demand, supply and generation and establish institutions responsible for energy search.		No authorisation is required. Green energy will be proposed and implemented in terms of building designs and energy options at the detailed design stage.	National

5.0 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

Kinetic Development Group Limited ("Power Development" or "The Group") was incorporated in the Cayman Islands in July 2010. In March 2012, it was listed on the main board of the Hong Kong Stock Exchange with the stock code of 1277. The group is a comprehensive coal enterprise, and the business covers the whole industry chain of coal production, washing, loading, transportation and coal trade. The company will trade as Kinetic Mining Development South Africa (Pty) Ltd for the proposed ferrochrome smelter.

Musina Makhado Special Economic Zone (MMSEZ) in the Vhembe District in Limpopo was designated by the South African Government as the preferred site for the location the SEZ. The South African Government through the Department of Trade and Industry (DTI) has designated the Musina-Makhado Special Economic Zone (MMSEZ) located in the Limpopo Province, Vhembe District and straddling between the two local municipalities of Musina and Makhado. In line with the Special Economic Zone Act, 2014 the Minister for the Department of Trade and Industry has issued an Operator Permit to facilitate investment. The MMSEZ is located closer to Beitbridge Border Gate, which is the second biggest port of entry in South Africa and a gateway to other SADC countries.

The Musina-Makhado Special Economic Zone comprises two sites, one focusing primarily on Energy and Metallurgy and the other on three sectors, i.e. general manufacturing, agro-processing and logistics.

The Vhembe district in the Limpopo Province is endowed with mineral resources such a diamond. Coking coal with potential for beneficiation. This Special Economic Zone (SEZ) is intended to accelerate economic growth, development and job creation in Limpopo through:

- Promoting Industrialisation
- Facilitating increased trade and investment
- Supporting the development of sustainable enterprises
- Ensuring Infrastructure Development

The MMSEZ enjoys the preferential tax treatment of the South African Special Economic Zone and all the preferential treatment of the South African policy of encouraging foreign investment. The South African government has issued an operating license to the South African Energy Management Base Co (SAEMB), Ltd. to develop and manage the Energy Management Special Economic Zone. Located in Limpopo Province, South Africa(RSA), covering an area of 60 square kilometers, the region is adjacent to Zimbabwe, Mozambique and Botswana.

The reserves of open-pit coke mines around the SAR (Special Administration Region / Special Economic Zone) are more than 10 billion tons. South Africa has more than 83% of the world, manganese resources account for more than 81% of the world, and the high-grade reserves of vanadium resources rank first in the world. There are other rich stainless steel raw material mine resources in the region: iron ore, silicon ore, nickel ore limestone, etc. The national railway, highway and power supply network run through the zone, 500 kilometers away from the large port terminal of

Maputo, Mozambique. The Limpopo River is 30 kilometers away from the zone and is an important source of water for the zone.

The price of chromium ore used in the production of alloy in this project is $100 cheaper than Tianjin price excluding VAT, the price of electricity is 5 cents per kilowatt hour, and the price of coke is $250 per ton. The price of raw materials is significantly lower than that of domestic, so the alloy produced after the project is put into operation has low cost and has a strong competitiveness. High carbon-chrome iron water heat delivery production of stainless steel, reduce energy consumption, reduce the production cost of stainless steel.

The proposed ferrochrome/ferroalloys smelter will provide employment opportunities to 235 people for phase 1. This will translate to 1 880 people employed in the proposed ferrochrome smelter at full production. Labour will be mainly sourced local with both the Musina and Makhado Local Municipalities. The initial capital and labour investment for phase 1 will be R 1 285 509 250 and R52 875 000/year respectively into the two municipalities. Ramp-up and increase in production to 1 000 000 tons/year will translate to R 10 284 074 000 in capital investment and annual labour cost of R423 000 000/year.

The table below outlines the skills distribution required for the proposed smelter project:

Table 18: Proposed Labour Estimates and Distribution

Work Station		Phase 1	Full Production
		No: of Employees	No: of Employees
Raw Materials System	Direct Labour	40	320
	Admin Staff	2	16
Heat Furnace Workshop	Direct Labour	84	672
	Admin Staff	5	40
Workshop	Operating Personnel	10	80
	Admin Staff	2	16
Power Sub-Station	Operating Personnel	12	96
	Admin Staff	2	16
Inspection and Maintenance of Electrical Equipment	Inspection Personnel	9	72
	Admin Staff	2	16
Water System	Operating Personnel	9	72
	Admin Staff	2	16
Nitrogen Suppression Workshop	Operating Personnel	6	48
	Admin Staff	1	8
Dust Pelletizing System	Operating Personnel	6	48
	Admin Staff	1	8
Inspection and Laboratory	Operating Personnel	12	96
	Admin Staff	1	8
Truck Scale	Operating Personnel	6	48
Entrance Guard	Operating Personnel	9	72
Administration Staff	Admin Staff	12	96
Total Operating Personnel		**203**	**1624**

Total Administration Personnel	**32**	**256**
TOTAL LABOUR	**235**	**1 880**

The proposed ferrochrome smelter project will have medium to high negative impacts on the surrounding environmental aspects – mainly vegetation and biodiversity, groundwater, surface water, air quality, noise and visual aspects. Mitigation measures as outlined in Part B of this report will minimize and manage the said impacts.

6.0 MOTIVATION FOR THE PREFERRED DEVELOPMENT SITE AND THE PROCESS FOLLOWED

6.1 Proposed Development Footprint Alternatives Considered

6.1.1 The Property and Location Where the Activity will be Undertaken

Kinetic Development Group Limited (KDGL) proposes to develop and construct a new ferroalloys smelter plant and associated infrastructure within the approved Musina-Makhado Special Economic Zone (MMSEZ). The proposed ferroalloys smelter and activities will be on the farms Van Der Bijl 528 MS and Dreyer 526 MS - Zone/Stand 12 and 31. The MMSEZ site is situated near Mopane within the Musina and Makhado Local Municipalities, which fall within the jurisdiction of the Vhembe District Municipality, in Limpopo Province.

6.1.2 The Type of Activity to be Undertaken

The scale of the project is planned to the annual output of 125 000 tons, with 2 x 33,000 kVA electric furnaces and the supporting facilities are built. This capacity of for Phase 1 and comprise of one smelting unit at commencement of the project. Additional 7 units will be added over five years to ramp-up full production to 1 000 000 tons/year. The design shall include general, electric furnace smelting system, raw material system, pellet and roasting process, general transportation, power supply and distribution and electrical facilities (including 132kV transformer station), water supply and drainage system (water, turbidity circulating water system), including ventilation, dust removal, thermal and gas facilities, computer, telecommunications, mechanical repair, inspection, construction, structure, energy analysis and evaluation, environmental protection, occupational safety and health and fire protection, labour and training, project investment estimates, technical economy and evaluation.

6.1.3 The Design or Layout of the Activity

The proposed ferroalloys smelter and activities will be on the farms Van Der Bijl 528 MS and Dreyer 526 MS - Zone/Stand 12 and 31 and cover an area of 300 hectares – See Figure 2.

6.1.4 The Technology to be used in the Activity

High Carbon Ferrochrome / Charge Chrome are produced in Electric Arc Furnace. There will be two (02) furnaces a combined annual capacity of producing 125 KTPA of High Carbon Ferro Chrome – Per chrome smelting unit. The furnace will be stationary and is semi-closed on top. The process adopted is high temperature smelting process, in which chrome ore is reduced with the help of the reductant like coke. The gangue material in the ore is removed by suitable fluxing material. The raw materials like chrome ore, coke and fluxes are selected to obtain desired grade in the output as per the requirement of the customer. All the incoming raw materials are analyzed for quality before feeding into the furnace.

The charge mix containing chrome, coke and flux is taken into the furnace with the help of computerized batching system. The necessary heat required for a process is provided by electric energy to the charge through the electrodes. At the tip of the

electrode electric arcing takes place and generates high heat energy to smelt chrome ore into HC Fe Cr/ Charge Chrome with coke (carbon) as reducing agent. In the process of smelting, gangue content in chrome ore forms the slag whose composition and fluidity are maintained by flux addition. Both hot metal and slag are tapped at regular intervals depending upon the power consumption. The slag is granulated. The metal is handled through decantation process and skimming process before cast in the metal casting beds prepared with slag dust and plastic clay. The metal after cooling is handled manually into different size fractions as per the requirement of the customer. This is a continuous process in which charge mix is taken regularly and slag and metal taped at regular intervals. Stage-wise inspection is carried out to get the quality product.

6.1.5 The Operational Aspects of the Activity

Ferrochrome smelting is a metallurgical process that extracts chromium and iron from chromite ore using a reducing agent, typically coke or coal, in a submerged arc furnace. The process involves high-temperature reduction, resulting in molten ferrochrome alloy and slag. The alloy is then tapped from the furnace and solidified, while the slag is typically handled separately.

The primary source of chromium and iron, containing chromium oxide (Cr_2O_3) and iron oxide (FeO) are mixed coke or coal, which reacts with the oxygen in the ore to liberate the chromium and iron.

Quartz (SiO_2) is also added to lower the melting point of chrome ore during the smelting process, acting as a flux. The addition of quartz also ensure slag can be easily separated from the alloy. In the smelting of chromite ores, quartz is used alongside other fluxes like limestone to lower the melting point and ensure the slag is fluid enough to separate from the alloy.

Submerged arc furnaces (SAFs) will be used, where electrodes submerged in the charge create an electric arc that provides the necessary heat. The raw materials are fed into the furnace through a chute/conveyor belts.

At high temperatures (around 1600-1700°C), the reducing agent reacts with the chromite ore, causing the reduction of chromium oxide to metallic chromium and iron, while forming carbon dioxide gas. The molten ferrochrome alloy, along with the slag (a by-product of the impurities), collects in the hearth of the furnace. When sufficient ferrochrome and slag have accumulated, the tap hole is opened, and the molten mixture flows into a ladle or casting area.

The molten metal and slag are separated based on their densities. The ferrochrome is cast into molds or allowed to solidify in a casting area. The solidified ferrochrome is crushed and screened to produce the desired particle sizes.

Slag is often quenched with water, solidifying it into pieces that can be handled and disposed of for secondary usage. Ferrochrome slag, which is a by-product of ferrochrome production, has several valuable uses, primarily in civil engineering and construction. It can be utilized in road construction, as a component in concrete and cement, and for drainage applications. Additionally, it can be processed to recover metal values or used as a raw material for cement production.

6.1.6 The Option of Not Implementing the Activity

The inclusion of an alternative analysis is a specific requirement of the Integrated Environmental Management (IEM) procedure as underlined by the NEMA. The IEM procedure stipulates that the environmental investigation needs to consider feasible alternatives for any proposed development.

The proposed ferrochrome smelter project is within the already approved MMSEZ area. The No-Go option is the only other alternative identified during the scoping phase, which has also been discussed in detail as part of the EIA/EMP phase – including the mitigation hierarchy.

7.0 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

Public participation is a continuous two-way communication process aimed at promoting full public understanding of the processes and mechanisms through which environmental problems and needs are investigated and solved by the responsible agency. It is aimed at keeping the public informed about the status and progress of the studies conducted and the implications of the proposed project thereof as well as to document all issues, comments and concerns voiced by the public and their preferences regarding resource use and alternative development or management strategies and any other information and assistance relative to the operations decisions.

The Stakeholder Engagement Process as it is referred to by the Department of Forestry, Fisheries and Environment (DFFE) is a *"process leading to a joint effort by stakeholders, technical specialists, the authorities and the proponent who work together to produce better decisions than if they had acted independently"*. The process aims at improving *"communication between stakeholders – including the proponent – in the interest of facilitating better decision-making and or sustainable development"*.

The following public participation process for the ferrochrome smelter project was undertaken:

SCOPING PHASE
To identify the issues and concerns that need to be evaluated by specialist investigations. Issues are raised by stakeholders, the authorities, the EIA technical specialists as well as the proponent and captured in a Scoping Report. This report is handed to the authorities once stakeholders have had the opportunity to verify that their issues have been captured.
September 2024 to December 2024

↓

IMPACT ASSESSMENT PHASE
Specialist Studies are undertaken to investigate the issues of concern identified during the Scoping Phase by assessing the potential positive and negative impacts and recommending ways to maximise benefits and minimise negative impacts
March 2025 to June 2025

↓

INTEGRATION PHASE/COMPILE REPORT
To integrate the findings of all the Specialist Studies into an Environmental Impact and Management Report (EIMR) on which public comment is obtained before being finalised and handed to the authorities for decision-making
March 2025 to June 2025

↓

DECISION-MAKING PHASE
The EIA/EMP cannot in itself provide a decision. The decision is in the hands of the 'lead agent' which will be the Limpopo Department of Economic Development, Environment and Tourism, who will coordinate with the other authorities to ensure that a consensus decision is reached.
July 2025 – September 2025
Authority decision expected around end September 2025

Sustainable development requires some level of trade-off between economic growth, social equity and ecological integrity. The stakeholder engagement process provides an opportunity for Interested and Affected Parties (I&APs) to participate in an informed bases and ensure their needs and requirements are considered and

allows the decision-making authority/entity to understand to what degree stakeholders are willing to accept and live with the trade-offs involved.

7.1 Notification and Identification of Interested and Affected Parties (I&Aps)

Stakeholder engagement varies given the technical nature of the proposed activity, the geographical location, extent, duration, intensity and frequency of potential impacts associated with the activity in question, as well as the capacity of the receptive stakeholders to participate in the proposed project. The processes outlined below are specific to the proposed ferrochrome/ferroalloys smelter project. I&APs were identified through several mechanisms. These include:

- Meetings with non-governmental agencies, community-based organisations, local council representatives, and municipality;
- Placement of community notices, and distribution of background information documents (discussed separately).

All I&AP identified were registered on the stakeholder database. The public participation process endeavoured to ensure that individuals / organisations from referrals and networking were notified of the proposed ferrochrome/ferroalloys smelter project, in addition to efforts to notify and identify stakeholders at a geographical level.

7.2 Advertisements and Background Information Document (BID)

The newspaper advert was placed on the following newspaper informing and inviting members of the public and any other interested and affected parties (I&APs) about the environmental impact assessment process underway and to comment on the EIA/EMP Report for proposed ferrochrome/ferroalloys smelter project:

a) **Limpopo Mirror issue of Friday 13th September 2024;**
b) **Limpopo Mirror issue of Friday 27th June 2025**

In addition, pamphlet notices and background information documents (BID) were distributed for various stakeholders and I&APs adjacent to the proposed ferrochrome/ferroalloys smelter project site at Makhado, Musina and Mopane area. Distribution was done on the **02nd - 06th September 2024**.

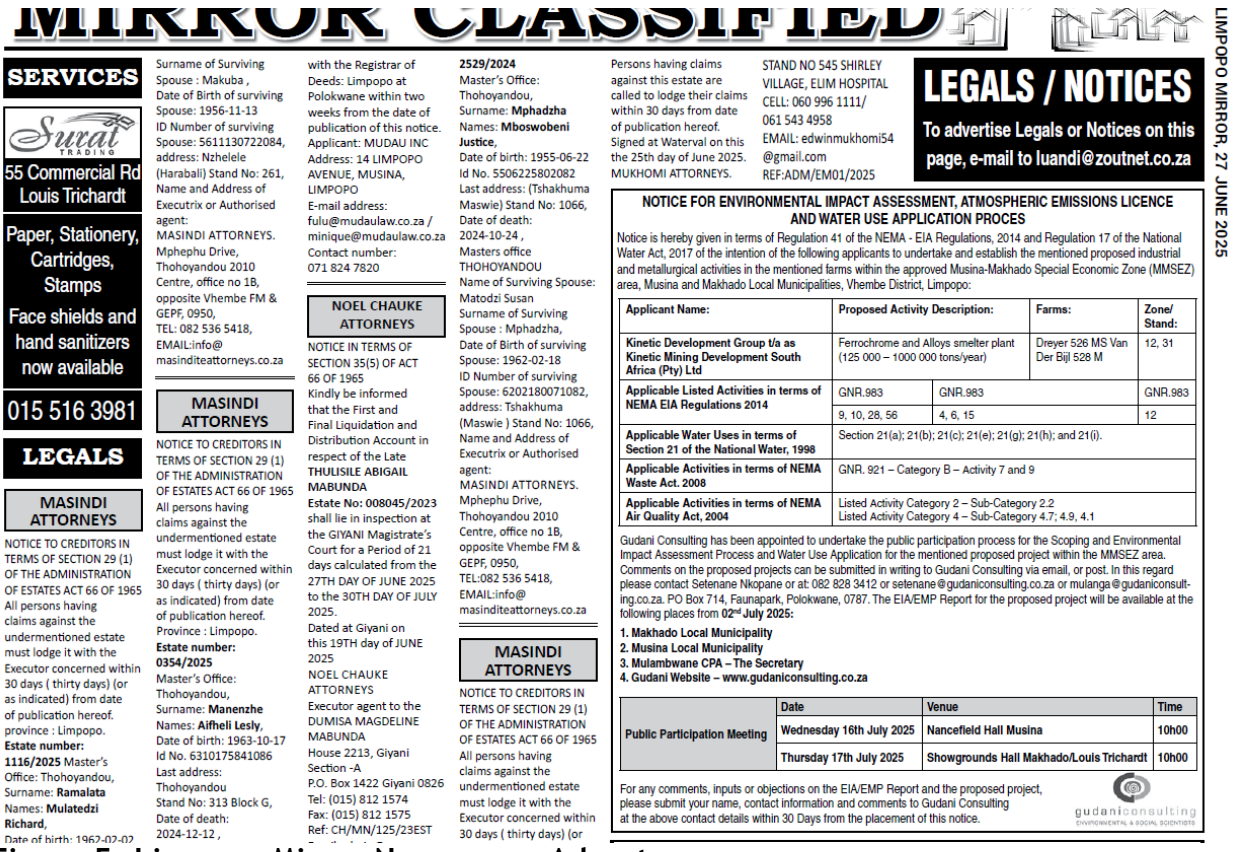
The purpose of a BID was to provide stakeholders and I&APs with introductory information on the proposed ferrochrome/ferroalloys smelter development, the environmental impact assessment and management programme (EIA/EMP) being compiled and the stakeholder engagement process. The BID also provided stakeholders who are interested in the proposed smelter development with the opportunity to register as stakeholders by way of requesting and completing the registration sheet distributed with the BID. Information on the registration sheet has been used to register stakeholders on a database to receive all project-related information and invitations to any meetings (if required). The registration sheet included a section for comments and raising issues, which allows stakeholders an opportunity to provide the consultants with written comments and feedback.

Pamphlets, consultation letters and BIDs were distributed at the following sites notifying/informing interested and affected parties about the EIA/EMP process.

- Makhado, Musina, and Mopane Areas and;
- BIDs were also handed over to adjacent residents and commercial entities;
- Ward Councillors and Committees.

7.3 Content of the Advertisements and Site Notices

Advertisements and notices indicated the public participation (PP) process being undertaken, the proposed smelter development, explanation of the EIA/EMP process, where further information on the project could be obtained and the manner in which representations in respect of the project can be made:



MIRROR CLASSIFIED

LIMPOPO MIRROR, 27 JUNE 2025

SERVICES

Surat TRADING
55 Commercial Rd
Louis Trichardt

Paper, Stationery, Cartridges, Stamps
Face shields and hand sanitizers now available

015 516 3981

LEGALS

MASINDI ATTORNEYS

NOTICE TO CREDITORS IN TERMS OF SECTION 29 (1) OF THE ADMINISTRATION OF ESTATES ACT 66 OF 1965
All persons having claims against the undermentioned estate must lodge it with the Executor concerned within 30 days (thirty days) (or as indicated) from date of publication hereof. province : Limpopo.
Estate number: 1116/2025 Master's Office: Thohoyandou, Surname: **Ramalata** Names: **Mulatedzi Richard,** Date of birth: 1962-02-02

Surname of Surviving Spouse : Makuba , Date of Birth of surviving Spouse: 1956-11-13 ID Number of surviving Spouse: 5611130722084, address: Nzhelele (Harabali) Stand No: 261, Name and Address of Executrix or Authorised agent: MASINDI ATTORNEYS. Mphephu Drive, Thohoyandou 2010 Centre, office no 1B, opposite Vhembe FM & GEPF, 0950, TEL: 082 536 5418, EMAIL:info@ masinditeattorneys.co.za

MASINDI ATTORNEYS

NOTICE TO CREDITORS IN TERMS OF SECTION 29 (1) OF THE ADMINISTRATION OF ESTATES ACT 66 OF 1965
All persons having claims against the undermentioned estate must lodge it with the Executor concerned within 30 days (thirty days) (or as indicated) from date of publication hereof. Province : Limpopo.
Estate number: 0354/2025
Master's Office: Thohoyandou, Surname: **Manenzhe** Names: **Aifheli Lesly,** Date of birth: 1963-10-17 Id No. 6310175841086 Last address: Thohoyandou Stand No: 313 Block G, Date of death: 2024-12-12 ,

with the Registrar of Deeds: Limpopo at Polokwane within two weeks from the date of publication of this notice. Applicant: MUDAU INC Address: 14 LIMPOPO AVENUE, MUSINA, LIMPOPO E-mail address: fulu@mudaulaw.co.za / minique@mudaulaw.co.za Contact number: 071 824 7820

NOEL CHAUKE ATTORNEYS

NOTICE IN TERMS OF SECTION 35(5) OF ACT 66 OF 1965
Kindly be informed that the First and Final Liquidation and Distribution Account in respect of the Late **THULISILE ABIGAIL MABUNDA** **Estate No: 008045/2023** shall lie in inspection at the GIYANI Magistrate's Court for a Period of 21 days calculated from the 27TH DAY OF JUNE 2025 to the 30TH DAY OF JULY 2025.
Dated at Giyani on this 19TH day of JUNE 2025
NOEL CHAUKE ATTORNEYS
Executor agent to the DUMISA MAGDELINE MABUNDA
House 2213, Giyani Section -A
P.O. Box 1422 Giyani 0826
Tel: (015) 812 1574
Fax: (015) 812 1575
Ref: CH/MN/125/23EST

2529/2024
Master's Office: Thohoyandou, Surname: **Mphadzha** Names: **Mboswobeni Justice,** Date of birth: 1955-06-22 Id No. 5506225802082 Last address: (Tshakhuma Maswie) Stand No: 1066, Date of death: 2024-10-24 , Masters office THOHOYANDOU Name of Surviving Spouse: Matodzi Susan Surname of Surviving Spouse : Mphadzha, Date of Birth of surviving Spouse: 1962-02-18 ID Number of surviving Spouse: 6202180071082, address: Tshakhuma (Maswie) Stand No: 1066, Name and Address of Executrix or Authorised agent: MASINDI ATTORNEYS. Mphephu Drive, Thohoyandou 2010 Centre, office no 1B, opposite Vhembe FM & GEPF, 0950, TEL:082 536 5418, EMAIL:info@ masinditeattorneys.co.za

MASINDI ATTORNEYS

NOTICE TO CREDITORS IN TERMS OF SECTION 29 (1) OF THE ADMINISTRATION OF ESTATES ACT 66 OF 1965
All persons having claims against the undermentioned estate must lodge it with the Executor concerned within 30 days (thirty days) (or

Persons having claims against this estate are called to lodge their claims within 30 days from date of publication hereof. Signed at Waterval on this the 25th day of June 2025. MUKHOMI ATTORNEYS.

STAND NO 545 SHIRLEY VILLAGE, ELIM HOSPITAL CELL: 060 996 1111/ 061 543 4958 EMAIL: edwinmukhomi54 @gmail.com REF:ADM/EM01/2025

LEGALS / NOTICES
To advertise Legals or Notices on this page, e-mail to luandi@zoutnet.co.za

NOTICE FOR ENVIRONMENTAL IMPACT ASSESSMENT, ATMOSPHERIC EMISSIONS LICENCE AND WATER USE APPLICATION PROCES

Notice is hereby given in terms of Regulation 41 of the NEMA - EIA Regulations, 2014 and Regulation 17 of the National Water Act, 2017 of the intention of the following applicants to undertake and establish the mentioned proposed industrial and metallurgical activities in the mentioned farms within the approved Musina-Makhado Special Economic Zone (MMSEZ) area, Musina and Makhado Local Municipalities, Vhembe District, Limpopo:

Applicant Name:	Proposed Activity Description:		Farms:	Zone/ Stand:
Kinetic Development Group t/a as Kinetic Mining Development South Africa (Pty) Ltd	Ferrochrome and Alloys smelter plant (125 000 – 1000 000 tons/year)		Dreyer 526 MS Van Der Bijl 528 M	12, 31
Applicable Listed Activities in terms of NEMA EIA Regulations 2014	GNR.983	GNR.983		GNR.983
	9, 10, 28, 56	4, 6, 15		12
Applicable Water Uses in terms of Section 21 of the National Water, 1998	Section 21(a); 21(b); 21(c); 21(e); 21(g); 21(h); and 21(i).			
Applicable Activities in terms of NEMA Waste Act. 2008	GNR. 921 – Category B – Activity 7 and 9			
Applicable Activities in terms of NEMA Air Quality Act, 2004	Listed Activity Category 2 – Sub-Category 2.2 Listed Activity Category 4 – Sub-Category 4.7; 4.9, 4.1			

Gudani Consulting has been appointed to undertake the public participation process for the Scoping and Environmental Impact Assessment Process and Water Use Application for the mentioned proposed project within the MMSEZ area. Comments on the proposed projects can be submitted in writing to Gudani Consulting via email, or post. In this regard please contact Setenane Nkopane or at: 082 828 3412 or setenane@gudaniconsulting.co.za or mulanga@gudaniconsulting.co.za. PO Box 714, Faunapark, Polokwane, 0787. The EIA/EMP Report for the proposed project will be available at the following places from **02nd July 2025:**

1. **Makhado Local Municipality**
2. **Musina Local Municipality**
3. **Mulambwane CPA – The Secretary**
4. **Gudani Website – www.gudaniconsulting.co.za**

	Date	Venue	Time
Public Participation Meeting	Wednesday 16th July 2025	Nancefield Hall Musina	10h00
	Thursday 17th July 2025	Showgrounds Hall Makhado/Louis Trichardt	10h00

For any comments, inputs or objections on the EIA/EMP Report and the proposed project, please submit your name, contact information and comments to Gudani Consulting at the above contact details within 30 Days from the placement of this notice.

gudaniconsulting ENVIRONMENTAL & SOCIAL SCIENTISTS

Figure 5: Limpopo Mirror Newspaper Advert

See the following sub-appendices of the Public Participation Report (Appendix 5 in this Report) for the contents of adverts and site notices:

a) Sub-Appendix 1 – Site Notices
b) Sub-Appendix 3 – Newspaper Adverts
c) Sub-Appendix 4 – Background Information Document (BID)

7.4 Placement of Advertisements and Site Notices

To inform the surrounding public, I&APs, communities and immediately adjacent landowners to the proposed project site about the EIA/EMP process and reports, site notices were placed at various places and locations which are visible and accessible within project site and business premises on the **04th - 06th September 2024** and **02nd July 2025.** Site notices were placed at the following points/sites:

Table 17: Site Notice Placements

	Town	Strategic Places
A3 Posters placed within the Makhado/Musina Area	Makhado Musina Mopane Chauba Tshikuwi 04th - 06th September 2024 01st and 02nd July 2025	▪ Makhado Municipal Offices ▪ Musina Municipal Offices ▪ Paradise Lodge ▪ Ha Mathavha ▪ Lekkerlag CPA Gate ▪ Atrobus Farm – Ha Vhakalaha ▪ Mopane Store ▪ Boxer Supermarket – Musina ▪ Spar Supermarket - Musina ▪ Musina Post Office ▪ Makhado Post Office ▪ Blue Bottle Liquor Store

Plate 3a: Site Notices Placed at Various Site Around the Project Area – EIA Phase

Plate 3a: Site Notices Placed at Various Site Around the Project Area – EIA Phase

Plate 3b: Site Notices Placed at Various Site Around the Project Area – Scoping Phase

7.5 Consultation Meetings

Consultation concerning the proposed ferrochrome/ferroalloys smelter project with the respective community committees, ward councillor, municipality, farmers, members of the public/community and I&APs were undertaken through a series of meetings, distribution of BIDs and site notices during September 2024. The comments received from I&APs thus far have been included in this Scoping Report and are captured in a Comments and Response Report accompanying this Scoping Report (Appendix 5).

MULAMBWANE CPA
The public participation meeting with the Mulambwane CPA, Mopane Community, and I&APs was undertaken on the **13th September 2024** at **11h00** and held at Lekkerlag Farm.

MUSINA AND MAKHADO
The second public participation meeting with the Mulambwane CPA, Makhado and Musina Communities, and I&APs will be undertaken on the **16th** and **17th July 2025** at **10h00** and held at the following venues:

- Musina Local Municipality – Nancefield Hall
- Makhado Local Municipality – Showgrounds Hall

The concept of open meetings is normally adopted to allow more interaction between project proponent and members of the public and entail one to one discussions and small group discussions, pictures and map illustrations about the proposed project and the EIA/EMP process and reports in pursuit of full comprehension by I&APs about the proposed project. The meeting minutes and comments from the comments and response table are attached in Appendix 5.

Salient and key points raised from I&Aps meetings include the following:

a) Water supply to the proposed metallurgical project;
b) Power supply to the proposed metallurgical project;
c) Proposed projects welcome in the area due to high employment – particularly to the youth;
d) Will there be enough raw coal supplies for the proposed ferrochrome smelter;
e) The communities must be afforded opportunities for provision of services such as transport, trucking and medical/clinic services;
f) Cumulative impacts assessment for the proposed ferrochrome smelter project – including climate change, health impacts and socio-economic.
g) The project area is a water scarce area and sources of water for the project must be explained.
h) Public participation process followed.
i) Vegetation clearance and impact on baobab trees.

Plate 4: Public Participation Meeting – 13th September 2024

7.6 Authority Participation

Authorities consultation was undertaken during **July 2024** as part of the consultation process with I&APs. EIA/EMP Report (this report) was drafted once the Scoping Report was accepted and approved by LDEDET on 10th March 2025. The following authorities were consulted:

a) Limpopo Department of Economic Development, Environment and Tourism (LDEDET)
b) Department of Water and Sanitation(DWS)
c) Department of Agriculture and Rural Development - LDARD
d) South African Heritage Resource Agency (SAHRA)
e) Musina Local Municipality (MuLM)
f) Makhado Local Municipality (MaLM)

The site inspection was undertaken with the LDEDET during October 2024. Other site inspections will be undertaken with any other Authority at a date to be determined by the said Department/s.

7.7 Document Review

The Scoping Report and EIA/EMP Reports (this report) was made available at public places for public review prior to finalisation. Stakeholders on the database were notified of the availability of the report via any of the following methods: telephone, email, what's up messaging. The reports were also made available at the LDEDET,

Musina and Makhado Local Municipalities and other relevant authorities. The reports can also be accessed as electronic copies on Gudani Consulting website – www.gudaniconsulting.co.za.

7.7.1 Scoping Report

The document review period for the Scoping Report was from **20th September 2024** to **08th November 2024**. A further extension on the document review was also given from **08th November 2024** to **08th December 2024**. Due to the **08th December 2024** falling on a Sunday, comments and reviews were still accepted on the **09th December 2024.**

7.7.2 EIA-EMP Report

The document review period for the EIA/EMP Report (this report) will be from **02nd July 2025** to **08th August 2025**.

7.8 Summary of Issues Raised by I&APs

The summary of issues raised by interested and affected parties and responses thereto is attached in Appendix 5 with the Public Participation Report. The said summary will be updated after the EIA/EMP phase consultation and submitted to LDEDET.

8.0 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE SITE – BASELINE ENVIRONMENT

8.1 Topography and Location

The horizontal configuration of the proposed Kinetic ferroalloys/ferrochrome smelter area is generally flat to undulating and irregular plains with hills and ridges. There are some non-perennial drainage courses in the area and no wetland units. Altitude varies from 300m to 700m. Drainage occurs in the north-easterly direction.

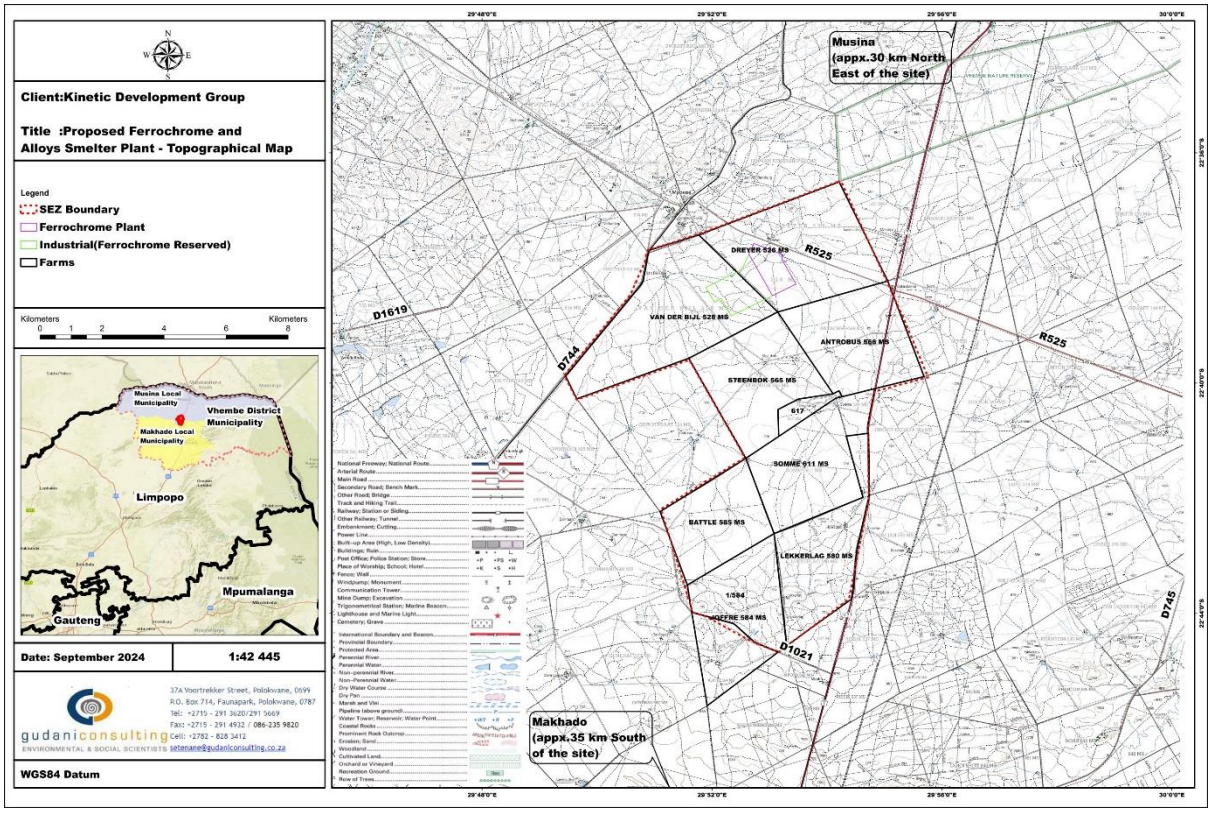


Plate 5: Undulating Topography - Kinetic Ferrochrome Smelter Project Area

8.2 Geology and Soils

8.2.1 Geology

The area falls within the 2228 Alldays 1:250 000 geology series maps. The area is underlain predominantly by three geological groups:

- Quaternary sands consisting of predominantly sandy soils. This group covers the largest surface area at the site.
- Beit bridge complex geological units consisting of the Gambu Group. These outcroppings in the centre of the site and at both the southern and northern borders of the site, consist mainly of calc-silicate rocks and marble; together with leucogneisses and subordinate pink hornblende granitoid gneiss, metaquartzite and amphibolite.
- The Karoo Supergroup is situated just south of the northern Gambu outcropping, below a fault line, is mainly from the undifferentiated Mikambeni and Madzaringwe formations consisting of mudstone, shale, carbonaceous shale, sandstone, conglomerate, coal seams; locally diamictite or conglomerate at base.
- Additionally, some diabase dykes exist within the site boundary and small sections of the Fripp and solitude formations near the Karoo supergroup layers dipping northward. The Fripp formation consists of course -grained felspathic sandstones and the Solitude formation of grey – purple mudrock with subordinate siltstone and sandstone.

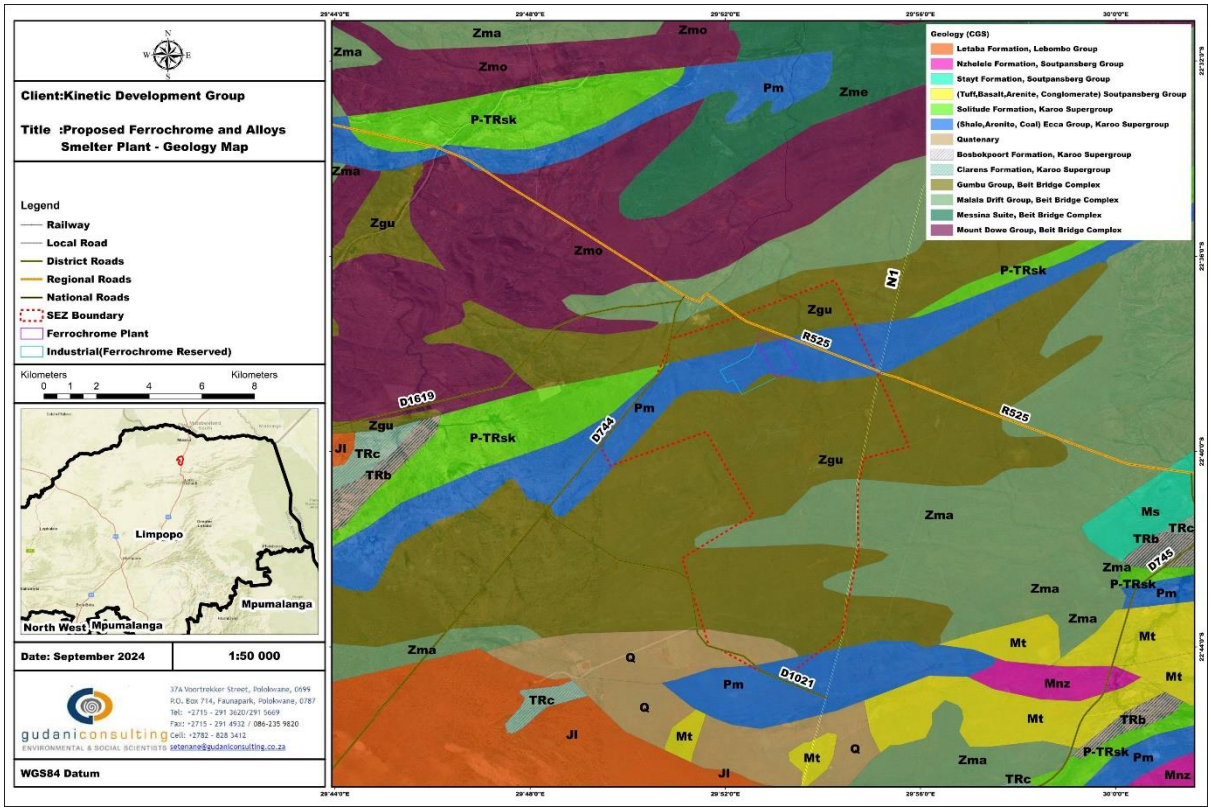


Figure 6: Geology of the Site and MMSEZ Area

8.2.2 Soils

The soil data was gathered and the soil forms were mapped by means of 163 auger holes for soil classification and 11 soil sampling points for chemical analyses. Soil physical properties develop over thousands of years and the soil chemical status is subject to minor seasonal variation and follow-up surveys during more seasons are not required. Relevant soil properties were noted at each auger observation and the soils were classified in a soil Form and Family according to the Taxonomic Soil Classification System for South Africa.

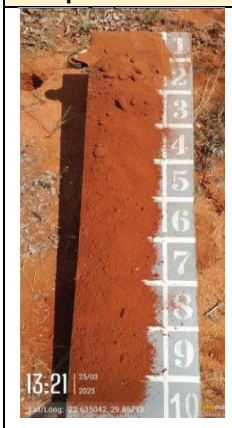
Deep Hutton	Shallow Hutton	Shallow Coega	Surface Coega	Deeper Coega
				

Plate 6: The Soil Profile within the Proposed Metallurgical Projects Area

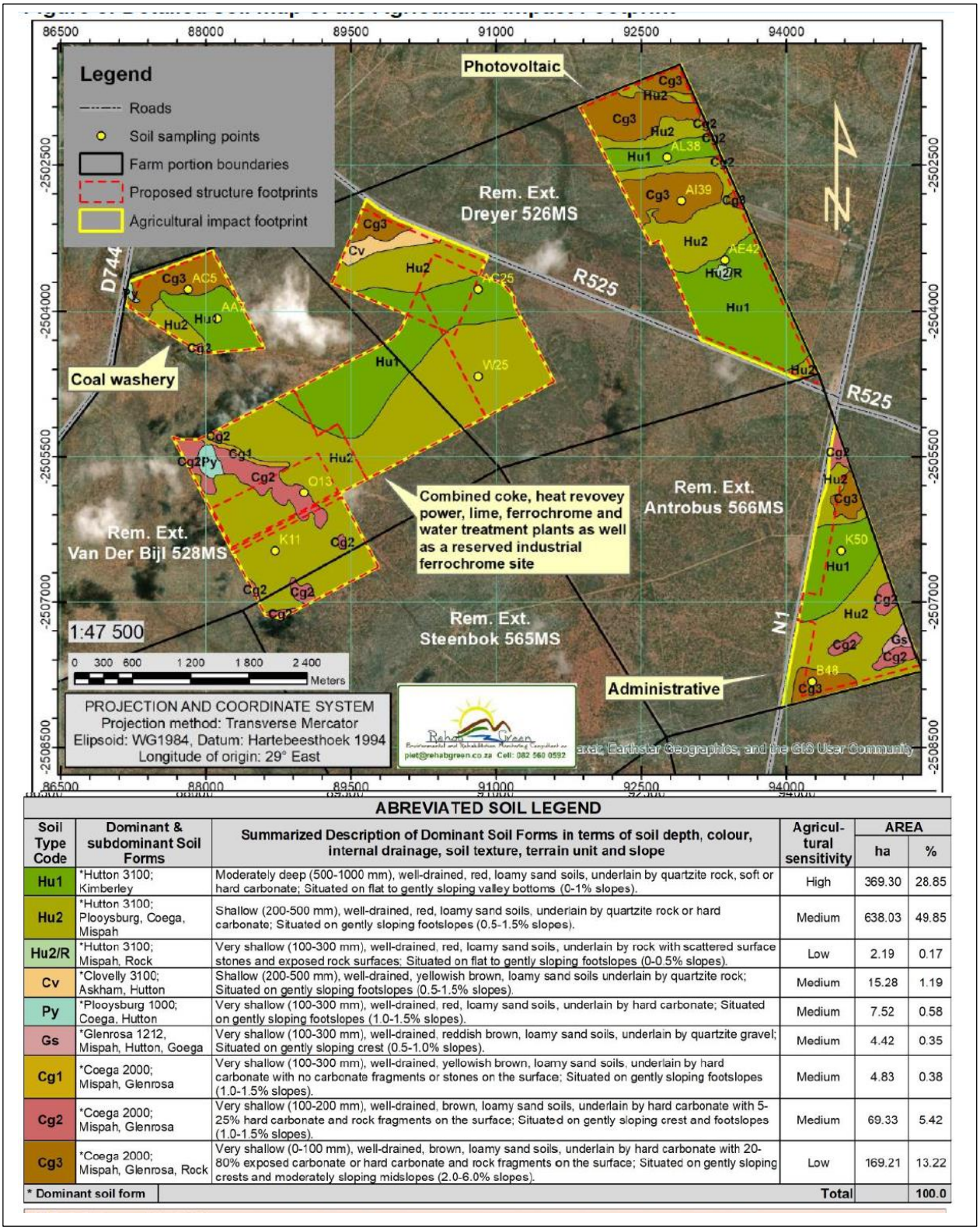
8.2.2.1 Soils

The gathered soil information was processed and a total of 9 soil types, based on dominant soil form, effective soil depth and internal draining characteristics were identified during field observations and were symbolized as: Hu1, Hu2, Hu2/R, Cv, Py, Gs, Cg1, Cg2 and Cg3. The extent of the soil types is shown in Figure 7.

Figure 7 contains an abbreviated soil legend. The full soil legend is shown as Table 20, which described the soils in terms of the following aspects:

- Dominant soil form and family and subdominant forms;
- An average effective depth range in mm;
- Clay content per horizon;
- A description of the terrain unit and slope range;
- A broad description of the dominant soil form in terms of the effective soil depth, internal drainage, soil colour and soil texture class;
- The land capability classification;
- Agricultural sensitivity classification; and
- The area and percentage comprised by each soil form.

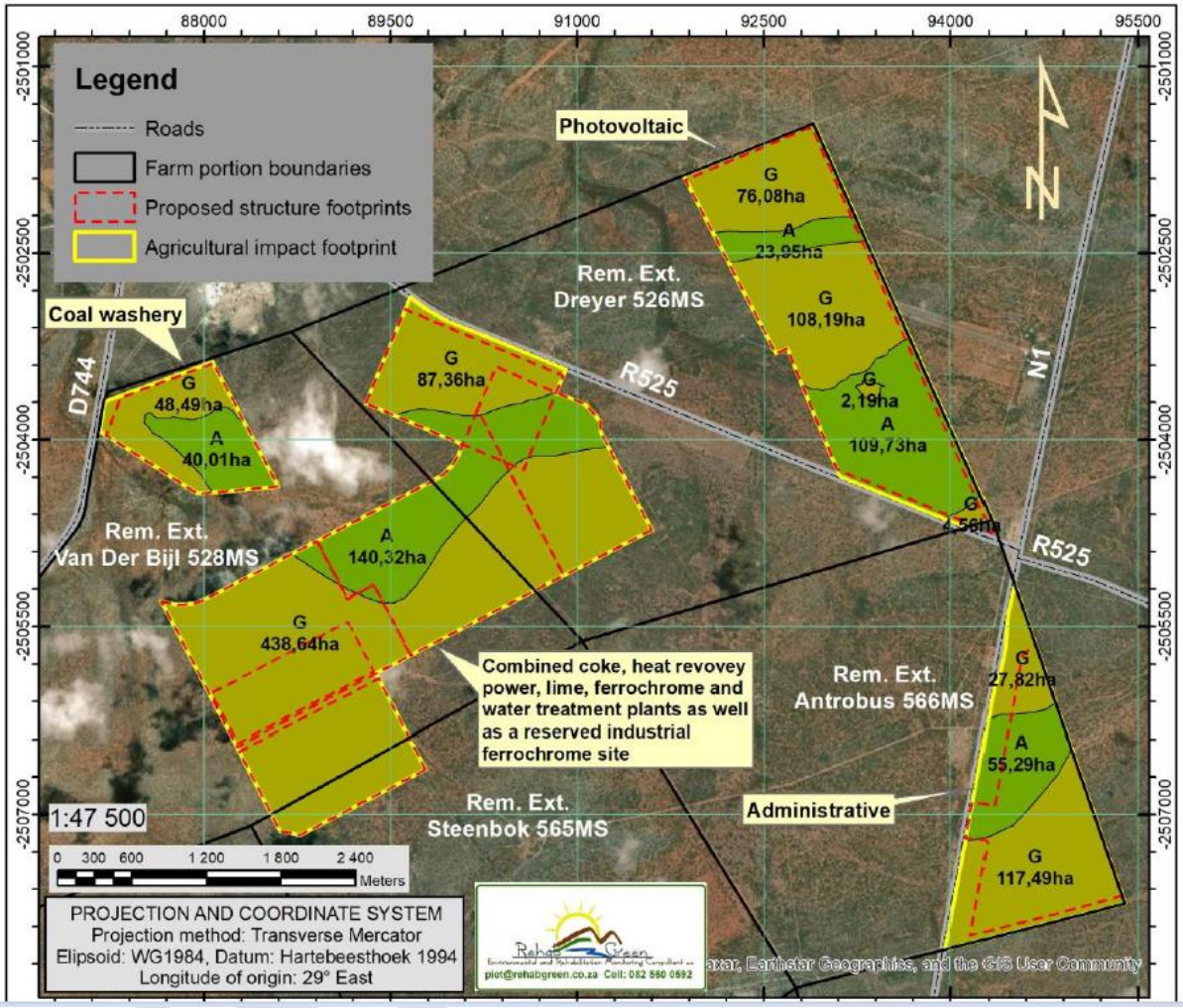
Figure 7: Soil Map – Proposed Ferrochrome Smelter Site and MMSEZ Area



ABREVIATED SOIL LEGEND

Soil Type Code	Dominant & subdominant Soil Forms	Summarized Description of Dominant Soil Forms in terms of soil depth, colour, internal drainage, soil texture, terrain unit and slope	Agricultural sensitivity	AREA ha	AREA %
Hu1	*Hutton 3100; Kimberley	Moderately deep (500-1000 mm), well-drained, red, loamy sand soils, underlain by quartzite rock, soft or hard carbonate; Situated on flat to gently sloping valley bottoms (0-1% slopes).	High	369.30	28.85
Hu2	*Hutton 3100; Plooysburg, Coega, Mispah	Shallow (200-500 mm), well-drained, red, loamy sand soils, underlain by quartzite rock or hard carbonate; Situated on gently sloping footslopes (0.5-1.5% slopes).	Medium	638.03	49.85
Hu2/R	*Hutton 3100; Mispah, Rock	Very shallow (100-300 mm), well-drained, red, loamy sand soils, underlain by rock with scattered surface stones and exposed rock surfaces; Situated on flat to gently sloping footslopes (0-0.5% slopes).	Low	2.19	0.17
Cv	*Clovelly 3100; Askham, Hutton	Shallow (200-500 mm), well-drained, yellowish brown, loamy sand soils underlain by quartzite rock; Situated on gently sloping footslopes (0.5-1.5% slopes).	Medium	15.28	1.19
Py	*Plooysburg 1000; Coega, Hutton	Very shallow (100-300 mm), well-drained, red, loamy sand soils, underlain by hard carbonate; Situated on gently sloping footslopes (1.0-1.5% slopes).	Medium	7.52	0.58
Gs	*Glenrosa 1212, Mispah, Hutton, Goega	Very shallow (100-300 mm), well-drained, reddish brown, loamy sand soils, underlain by quartzite gravel; Situated on gently sloping crest (0.5-1.0% slopes).	Medium	4.42	0.35
Cg1	*Coega 2000; Mispah, Glenrosa	Very shallow (100-300 mm), well-drained, yellowish brown, loamy sand soils, underlain by hard carbonate with no carbonate fragments or stones on the surface; Situated on gently sloping footslopes (1.0-1.5% slopes).	Medium	4.83	0.38
Cg2	*Coega 2000; Mispah, Glenrosa	Very shallow (100-200 mm), well-drained, brown, loamy sand soils, underlain by hard carbonate with 5-25% hard carbonate and rock fragments on the surface; Situated on gently sloping crest and footslopes (1.0-1.5% slopes).	Medium	69.33	5.42
Cg3	*Coega 2000; Mispah, Glenrosa, Rock	Very shallow (0-100 mm), well-drained, brown, loamy sand soils, underlain by hard carbonate with 20-80% exposed carbonate or hard carbonate and rock fragments on the surface; Situated on gently sloping crests and moderately sloping midslopes (2.0-6.0% slopes).	Low	169.21	13.22
* Dominant soil form			Total		100.0

Figure 8: Land Capability Map – Proposed Site



LEGEND: LAND CAPABILITY					
Land Capability Code	**Land Capability Class**	***Soil Types**	**Broad Soil Description**	**Area (ha)**	**Area (%)**
A	**Arable**	Hu1	Medium deep to deep, well-drained, red, loamy sand soils.	369.30	28.85
G	**Grazing**	Hu2, Hu2/R, Cv, Py, Gs, Cg1, Cg2, Cg3	Shallow, well-drained, red, loamy sand soils and very shallow, gravelly, brown, loamy sand soils.	910.82	71.15
Wet	**Wetland**	-	-	0	0
W	**Wilderness**	-	-	0	0
*See soil map, Figure 5			**Total**	**1280,1**	**100.0**

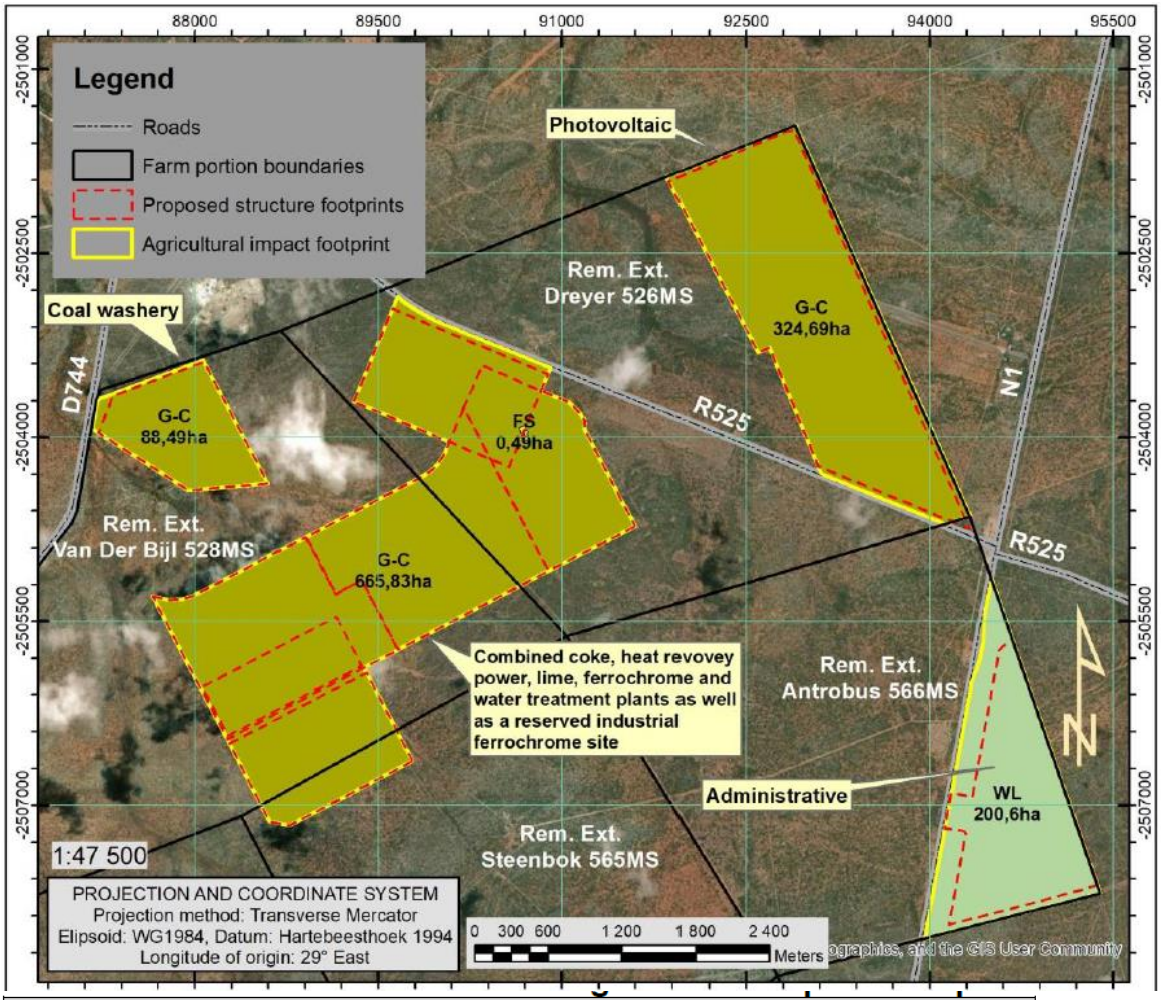
Table 20: Detailed Soil Legend of the Agricultural Impact Footprint

SOIL LEGEND									
Soil Type Code	Dominant soil form and family and other soil forms	Effective Soil Depth (mm)	Clay content per horizon	Terrain unit and slope percentage range	Summarized Description of Dominant Soil Form and associated terrain unit	Land Capability	Agricultural sensitivity	Area (ha)	Area (%)
Hu1	*Hutton 3100; Kimberley	500-1000	A: 9-12 B: 10-14	Wide stretched, weakly defined, flat to gently sloping valley bottoms (0-1% slopes).	Moderately deep (500-1000 mm), well-drained, red, loamy sand soils, underlain by quartzite rock, soft or hard carbonate.	Arable	High	369.30	28.85
Hu2	*Hutton 3100; Plooysburg, Coega, Mispah	200-500	A: 9-12 B: 10-14	Gently sloping footslopes (0.5-1.5% slopes).	Shallow (200-500 mm), well-drained, red, loamy sand soils, underlain by quartzite rock or hard carbonate.	Grazing	Medium	638.03	49.85
Hu2/R	*Hutton 3100; Mispah, Rock	100-300	A: 9-11 B: 9-11	Flat to gently sloping footslope (0-0.5% slopes).	Very shallow (100-300 mm), well-drained, red, loamy sand soils, underlain by rock with scattered surface stones and exposed rock surfaces.	Grazing	Low	2.19	0.17
Cv	*Clovelly 3100; Askham, Hutton	200-500	A: 9-11 B: 10-12	Gently sloping footslopes (0.5-1.5% slopes).	Shallow (200-500 mm), well-drained, yellowish brown, loamy sand soils underlain by quartzite rock.	Grazing	Medium	15.28	1.19
Py	*Plooysburg 1000; Coega, Hutton	100-300	A: 10-12 B: 10-12	Gently sloping footslopes (1.0-1.5% slopes).	Very shallow (100-300 mm), well-drained, red, loamy sand soils, underlain by hard carbonate.	Grazing	Medium	7.52	0.58
Gs	*Glenrosa 1212, Mispah, Hutton, Goega	100-300	A: 10-12	Gently sloping crest (0.5-1.0% slopes).	Very shallow (100-300 mm), well-drained, reddish brown, loamy sand soils, underlain by quartzite gravel.	Grazing	Medium	4.42	0.35
Cg1	*Coega 2000; Mispah, Glenrosa	100-300	A: 9-11	Gently sloping footslopes (1.0-1.5% slopes).	Very shallow (100-300 mm), well-drained, yellowish brown, loamy sand soils, underlain by hard carbonate with no carbonate fragments or stones on the surface.	Grazing	Medium	4.83	0.38
Cg2	*Coega 2000; Mispah, Glenrosa	100-200	A: 9-11	Gently sloping crest and footslopes (1.0-1.5% slopes).	Very shallow (100-200 mm), well-drained, brown, loamy sand soils, underlain by hard carbonate with 5-25% hard carbonate and rock fragments on the surface.	Grazing	Medium	69.33	5.42
Cg3	*Coega 2000; Mispah, Glenrosa, Rock	0-100	A: 9-11	Gently sloping crests and moderately sloping midslopes (2.0-6.0% slopes).	Very shallow (0-100 mm), well-drained, brown, loamy sand soils, underlain by hard carbonate with 20-80% exposed carbonate or hard carbonate and rock fragments on the surface.	Grazing	Low	169.21	13.22
*Dominant soil form							TOTAL	1280.1	100.0

8.2.2.2 Landuse

The current land uses are summarized in Figure 9, which shows that grazing and subsistence cattle farming occupies 1079.01 ha, which translates to 84.28% of the Agricultural Impact Footprint. The section to the east of the N1 that is earmarked for administrative proposes are 26 utilized for game farming, which occupies 200.6 ha and translates to 15.67% of the Agricultural Impact Footprint. A farmstead and cattle kraal occupy 0.49 ha, which translates to 0.04% of the Agricultural Impact Footprint.

Figure 9: Landuse Map – Proposed Site



LEGEND – CURRENT LAND USE				
Land Use Code	**Current Land Use**	**Unit Count**	**Area (ha)**	**Area (%)**
G-C	Grazing - Cattle	3	1079.01	84.28
WL	Wildlife	1	200.60	15.67
FS	Farmstead and cattle kraal	1	0.49	0.04
	TOTAL	**5**	**1280.10**	**100.0**

8.2.2.3 Hydropedological Assessment

All soil types within the Agricultural Impact Footprint are grouped in the recharge hydropedology category, based on their internal drainage characteristics. All soil types consist of well-drained soil horizons that does not transport water lateral within a horizon or expel water in valley bottoms during peak season, and therefore, no soil types are grouped in the interflow or responsive hydrogeological categories. The hydrogeological behavior of the soil in the Agricultural Impact Footprint does not contribute to water quantities in any water sources in the surrounding area. There are thus also no wetlands within the Agricultural Impact Footprint.

The Agricultural Impact Footprint consists of sporadic somewhat higher lying crests and midslopes, occupied by very shallow, gravelly and stoney soils of the Coega form. Very low infiltration and high runoff volumes from these higher lying areas causes, during intense raining events, surface runoff to concentrate in shallow, narrow surface drainage paths, that drains away within several hours. These surface drainage paths are not streams or wetlands, although some sections can quality as riparian zones.

8.2.2.4 Agricultural Sensitivity

The detailed soil map, indicating dominant soil forms and associated properties, serves as basis of the derived agricultural sensitivity map. The soil forms are grouped in land capability classes based on soil properties, topography and climate. The land capability layer is then refined by incorporating current land use practices in order to produce a final agricultural sensitivity map. The following principles were followed in deriving the final agricultural sensitivity:

High Agricultural Sensitivity:

- All deep, well-drained, loamy sand to sandy clay loam soils on slopes less than 7.1%, irrespective of current agricultural use.
- All shallow, well-drained soils (<500mm) utilized for crop farming.
- All currently cultivated fields (crop farming), irrespective of soil potential and type.
- All deep, high potential soils occupied by semi-permanent agricultural structures (structures without roofs and concrete foundations e.g. cattle kraals, bale storage camps etc.)
- All abandoned/vacant sections that maybe occupied by partly demolished structures, situated on deep, high potential soils and surrounded by crop farming or cultivated pastures.

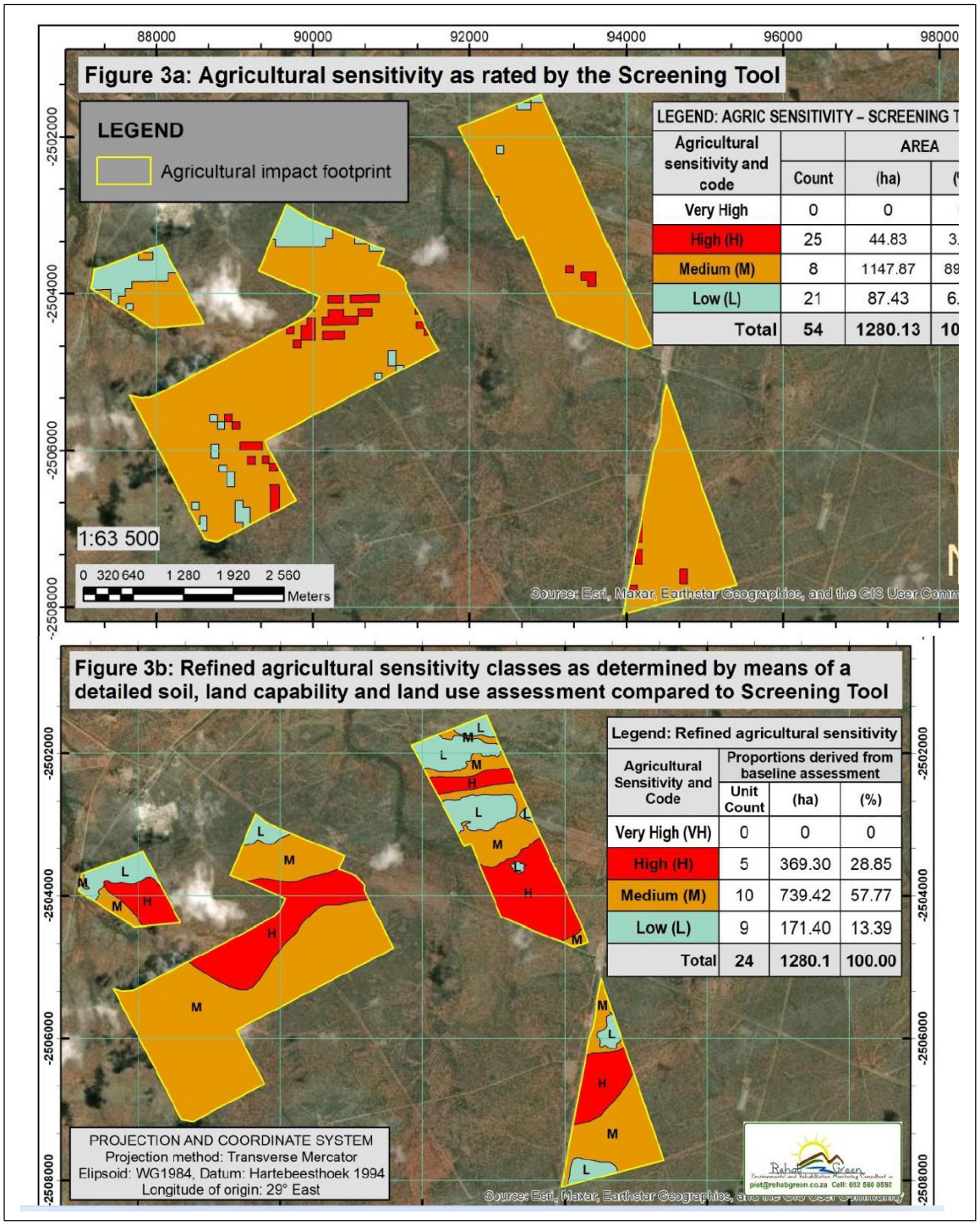
Medium Agricultural Sensitivity:

- All shallow, well-drained soils (<500 mm, without frequent rocky outcrops), not utilized for crop farming.
- All soils with impeded internal drainage, not suitable for crop farming but transformed to cultivated pastures.
- All soils with a pure sand texture but not subject to wetness.
- All soils on slopes between 7.1 and 14.3%.
- All deep, but highly dispersive soils.
- All soils occupied by permanent farming structures such as farmsteads and farming related buildings.

Low Agricultural Sensitivity:

- All shallow soils with frequent rocky outcrops or very shallow soils (>300mm) without rocky outcrops.
- All soils on slopes above 14.3%.
- All soils subjected to wetness to such a degree that crop farming is not possible and not previously transformed to cultivated pastures.
- All soils occupied by structures that prevent all agricultural related uses such as roads, railways, airstrips.
- All areas that are disturbed to such an extent that crop farming or pastures are not possible and only limited or no grazing potential remains.

Figure 10: Comparison of Agricultural Sensitivity Maps



The agricultural sensitivity of the agricultural impact footprint was evaluated by means of an intensive baseline field investigation, consisting of a detailed soil, land capability and land use assessment.

Table 21a: Comparison of Agricultural Sensitivity Ratings

Legend: Agricultural sensitivity comparison – Screening Tool vs Soil and land capability assessment						
Agricultural Sensitivity and Code	Screening Tool			Baseline assessment		
	Count	(ha)	(%)	Count	(ha)	(%)
Very High	0	0	0	0	0	0
High (H)	25	44.83	3.52	5	369.30	28.85
Medium (M)	8	1147.87	89.67	10	739.42	57.77
Low (L)	21	87.43	6.87	9	171.40	13.39
Total	**54**	**1280.1**	**100.0**	**24**	**1280.1**	**100.00**

The comparison in Table 21a as well as Figures 10 shows that the sensitivity ratings of the Screening Tool and those derived from the detailed baseline assessment differ to a fair degree, although both indicates that the Agricultural Impact Footprint is dominated by the medium sensitivity class. There are 2 crucial differences of which the first is that the high agricultural sensitivity class was found by the baseline assessment to be 28.85% and those of the Screening Tool 3.25%. This means that there are much larger areas with high agricultural sensitivity that need to be avoided as far as possible. The second difference is that the low agricultural sensitivity class was found by the baseline assessment to be 13.39% and those of the Screening Tool 6.87%. This means that there are much larger areas with low agricultural sensitivity that can be utilized for the project to lower the impact on agriculture.

8.2.2.5 Soil Fertility Status

A sample of the A-horizon of the dominant soil types was taken and the soil chemical results are shown in Table 21b. The original laboratory report is provided in Specialist Soil and Agriculture Report – Appendix 8.

The median values of the cations, potassium (K), calcium (Ca), magnesium (Mg) and sodium (Na) as well as phosphorus (P), sulphur (S) and pH were calculated and highlighted in orange at the bottom of Table 21b.

8.2.2.6 Soil Fertility Evaluation

The median concentration values of cations (K, Ca, Mg and Na) as well as phosphorus and pH (highlighted in orange, Table 21b) were compared to general fertility guidelines in Table 21c.

The median K concentration of 259 mg/kg is rated as high and the median Ca and Mg concentrations (936 and 146 mg/kg) are rated as medium-high, which indicate a

reasonably good fertility status in terms of cations. The median Na concentration of 9 mg/kg is low (which is positive) and indicates very little accumulation of sodium in the soil profile. The median ration of Ca to Mg is 2.8, which is ideal and reflect sufficient levels of Ca to buffer the destabilising effect of Mg on soil structure. The median P concentration of 5 mg/kg is low and indicates insufficient levels for pasture (10-20 mg/kg), as well as crop farming (30-50 mg/kg). The median soil acidity/alkalinity measured as pH(H_2O) is 6.5, which reflects slightly acid soil conditions, which is ideal for crop farming, pasture and grazing.

Table 21b: Soil Chemical Analyses

			Chemical properties													
			Extractable Cations								Acid. Sat. AmAc	S AmAc	Ca:Mg	R_S (resistance)	P Bray1	pH
Samp Point	Soil form	Depth (mm)	K	Ca	Mg	Na	K	Ca	Mg	Na						
			Ammonium acetate (mg/kg)				cmol(+)/kg				%	(mg/kg)	ratio	ohm	mg/kg	H_2O
B48	Cg	0-250	287	2482	86	10	0.7340	12.3852	0.7078	0.0435	-	2.84	17.71	-	11	7.8
K11	Hu	0-250	124	1138	243	17	0.3171	5.6786	2.0000	0.0739	-	2.42	2.86	-	5	6.2
K50	Hu	0-250	115	757	254	10	0.2941	3.7774	2.0905	0.0435	-	2.98	1.82	-	5	5.6
O13	Cg	0-250	269	1635	146	9	0.6880	8.1587	1.2016	0.0391	-	2.9	6.84	-	44	7.4
W25	Hu	0-250	433	936	310	9	1.1074	4.6707	2.5514	0.0391	-	3.12	1.84	-	3	6.5
AA7	Hu	0-250	232	547	145	9	0.5934	2.7295	1.1934	0.0391	-	3.02	2.3	-	5	5.7
AC5	Cg	0-250	266	2269	137	12	0.6803	11.3224	1.1276	0.0522	-	2.98	10.12	-	38	7.1
AC25	Hu	0-250	200	780	151	8	0.5115	3.8922	1.2428	0.0348	-	1.98	3.15	-	2	7
AE42	Hu	0-250	121	360	80	8	0.3095	1.7964	0.6584	0.0348	-	2.78	2.74	-	2	5.6
AI39	Cg	0-250	370	2904	143	8	0.9463	14.4910	1.1770	0.0348	-	3.21	12.36	-	19	7.9
AL38	Hu	0-250	259	706	247	8	0.6624	3.5230	2.0329	0.0348	-	3.15	1.74	-	4	6
Median			**259**	**936**	**146**	**9**	**-**	**-**	**-**	**-**	**-**	**2.98**	**2.8**	**-**	**5**	**6.5**
*Analyses done when pH is below 5.5																

Table 21c: Soil Fertility Compared to Broad Fertility Guidelines

		Guidelines		Current status rating		Preferred minimum/ideal range
Element or measurement	Unit	Low	High	Median value	Rating	
Potassium (K)	mg/kg	<40	>250	259	High	80-150
Calcium (Ca)		<200	>3000	936	Medium-high	600-1000
Magnesium (Mg)		<50	>250	146	Medium-high	80-150
Ca:Mg	Ratio	<2	>4	2.8	Ideal	2-4
Acid saturation	%	<10	>30	-	-	<20
Sodium (Na)	mg/kg	<50	>200	9	Low (positive in terms of sodicity)	<50
ESP	%	<6	>15	-	-	0-6
Resistance	ohm	<200	>300	-	-	>300
Phosphorus (P)	mg/kg	<5	>35	5	Low	*10-20 **30-50
pH(H_2O)	Very acid <=4.0 Acid 4.0-4.9 Moderately acid 5.0-5.9 Slightly acid 6.0-6.8 Neutral 6.9-7.2 Moderately alkaline 7.3-8.1 Strongly alkaline >=8.2			6.5	Slightly acid (ideal)	5-5.8(KCl) 6-6.8(H_2O)
* pastures ** crop farming						

8.2.2.7 Average Annual Crop and Livestock Yields

Average crop yields are estimated based on annual precipitation, soil properties and visual assessments of crops during the time of the soil assessment. The land use map shows that no crop farming takes place within the Agricultural Impact Footprint and Table 21d indicate that the annual crop production on the 4 farms within the Agricultural Impact Footprint is zero.

The approximate number of large stock units that are currently kept on the 4 farms that will be impacted by the proposed development are shown in Table 21e.

Table 21d: Medium Term Crop Yields (5 years)

Farms	Portion	Production unit/crop	Area (ha)	Estimated Medium term yield range (t/ha/a)	Average medium-term yield (t/ha/a)	Total average yield per annum (t)
Van der Bijl 528MS	Rem.Ext.	None	0	-	-	0
Dreyer 526MS	Rem.Ext.	None	0	-	-	0
Antrobus 566MS	Rem.Ext.	None	0	-	-	0
Steeenbok 565MS	Rem.Ext.	None	0	-	-	0

Table 21e: Medium Term Livestock Yields (5 years)

Farm	Portion	Production unit	Farm size (ha)	Current livestock units on farm	Current grazing load	Total offspring at 85% weaning rate per annum
Van der Bijl 528MS	Rem.Ext.	Cattle	1509.0	30	50 ha/lsu	25
Dreyer 526MS	Rem.Ext.	Cattle	1310.5	70	19 ha/lsu	59
Antrobus 566MS	Rem.Ext.	Cattle	979.7	60	16 ha/lsu	51
Steeenbok 565MS	Rem.Ext.	Cattle	1089.2	40	27 ha/lsu	34
		Total	**4888.4**	**200**	**12 ha/lsu** (average)	**169**

Table 21e indicate that a total 200 cattle (large stock units - lsu) are kept on the 4 farms. The table shows that the current grazing load varies from 16-50 ha per lsu. The annual offspring was calculated on the assumption of a pregnancy rate of 90%, a calving rate of 88% and a weaning rate of 85%, which translates to a total of 169 weaner calves.

8.3 Climate

The MMSEZ South site and proposed ferroalloys/ferrochrome smelter is situated in a semi-arid zone to the north of the Soutpansberg. The regional climate is strongly influenced by the east-west orientated mountain range which represents an effective barrier between the south-easterly maritime climate influences from the Indian Ocean and the continental climate influences (predominantly the Inter-Tropical Convergence Zone and the Congo Air Mass) coming from the north.

8.3.1 Rainfall

The rainfall in this area usually varies between 300 and 400 mm in summer, while experiencing very dry winters. The area is characterised by cool, dry winters (May to August) and warm, wet summers (October to March), with April and September being transition months. Temperature ranges from 0.9°C to 39.9°C and the area is generally frost free (Mucina and Rutherford, 2006).

8.3.2 Temperature

Average monthly minimum and maximum temperatures for the Tshipise weather station (No. 0766277 1) some 32 km south-east of the SEZ area are shown in the table below. Average daily maximum and minimum summer temperatures (November to February) at the weather station range between ~33°C and ~20°C, while winter temperatures (May to August) range between ~28°C and ~7°C respectively. The high average temperatures are reflected by the fact that the minimum average daily summer temperature is a high 20°C and the minimum average daily winter temperature does not dip below 7°C.

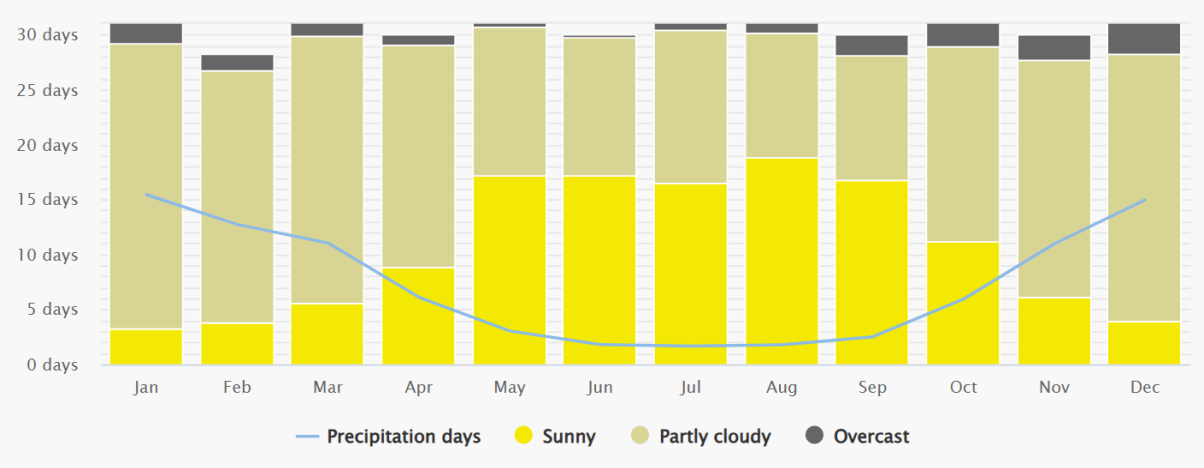


Figure 11: Annual Rainfall Figures in Days

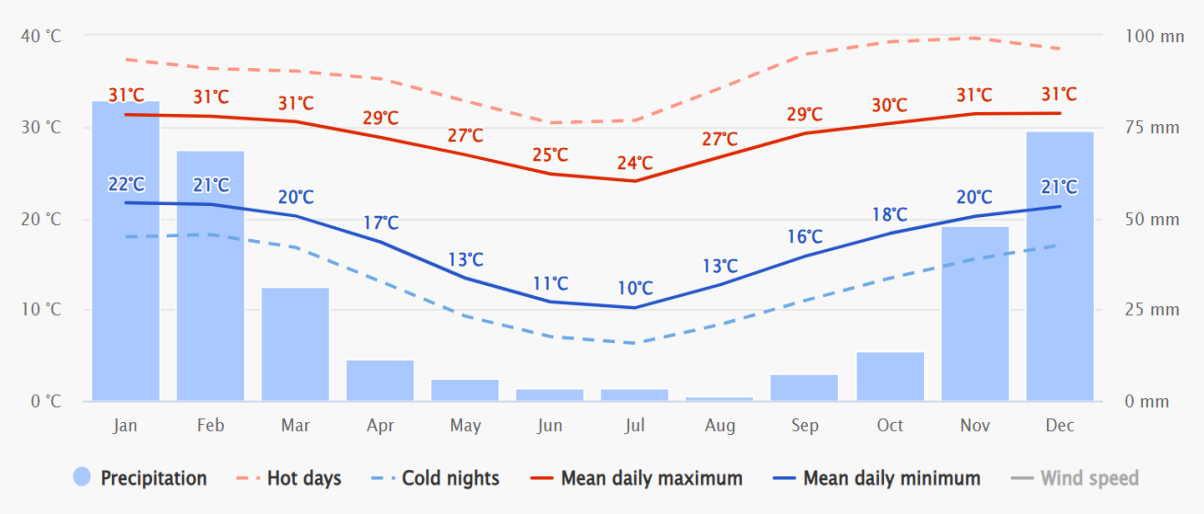


Figure 12: Tshipise Annual Precipitation (mm) and Temperatures (° C)

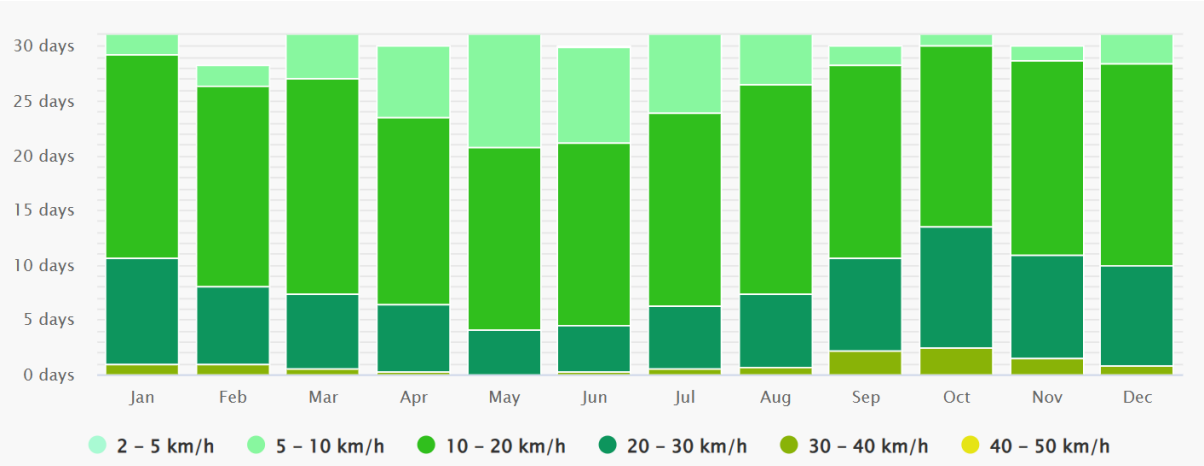


Figure 13: Wind Speeds in Days Per Annum

8.3.3 Wind Direction

Based on an evaluation of the meteorological data obtained from the South African Weather Services, the following deductions regarding the prevailing wind direction and wind frequency can be assessed. Looking at the figure below, the predominant wind direction in Makhado area is mainly from the south-eastern region. Secondary winds are noted from the eastern region. The highest frequency of wind speeds lies between 0.5 and 2.1 m/s which occurred for 42% of the time. The second highest wind class 2.1 to 3.6 m/s occurs 34% of the time. The wind regime for the MMSEZ area is dominated by easterly flow fields. The east-north easterly wind flow is more dominant during the day, with increased flow from the east-southeast during night-time conditions.

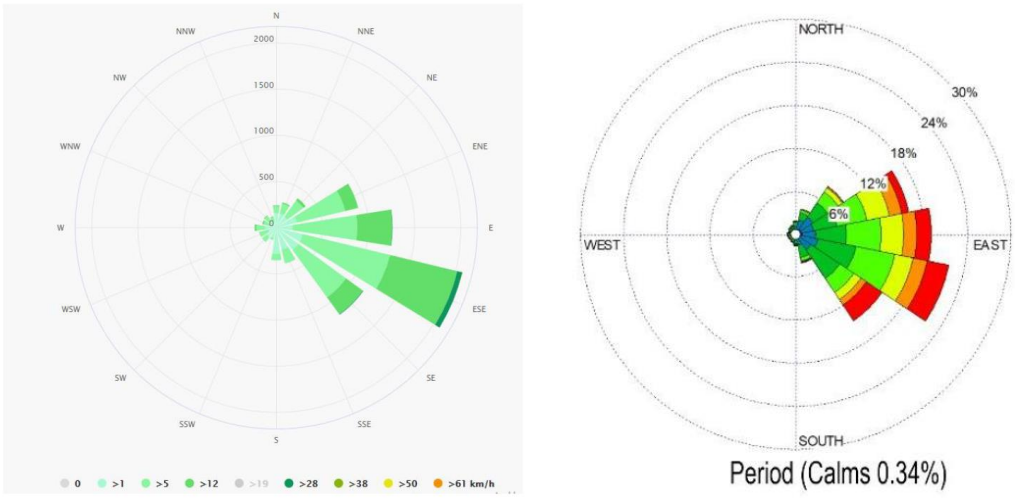


Figure 14: Wind Rose for Makhado and Mopane Area

8.4 Ecology and Biodiversity

8.4.1 Vegetation / Flora

8.4.1.1 Vegetation Type

The study sites are located within Musina Mopane Bushveld (Vegetation Type SVmp 1) and a small part in Limpopo Ridge Bushveld (SVmp 2) (Mucina and Rutherford 2006, 2017). Within these vegetation types about 1-3% have been transformed by development or cultivated land and only 2% is statutorily conserved, though these vegetation types are extensively protected in many private nature reserves and cattle and game farms within the Vhembe Biosphere Reserve.

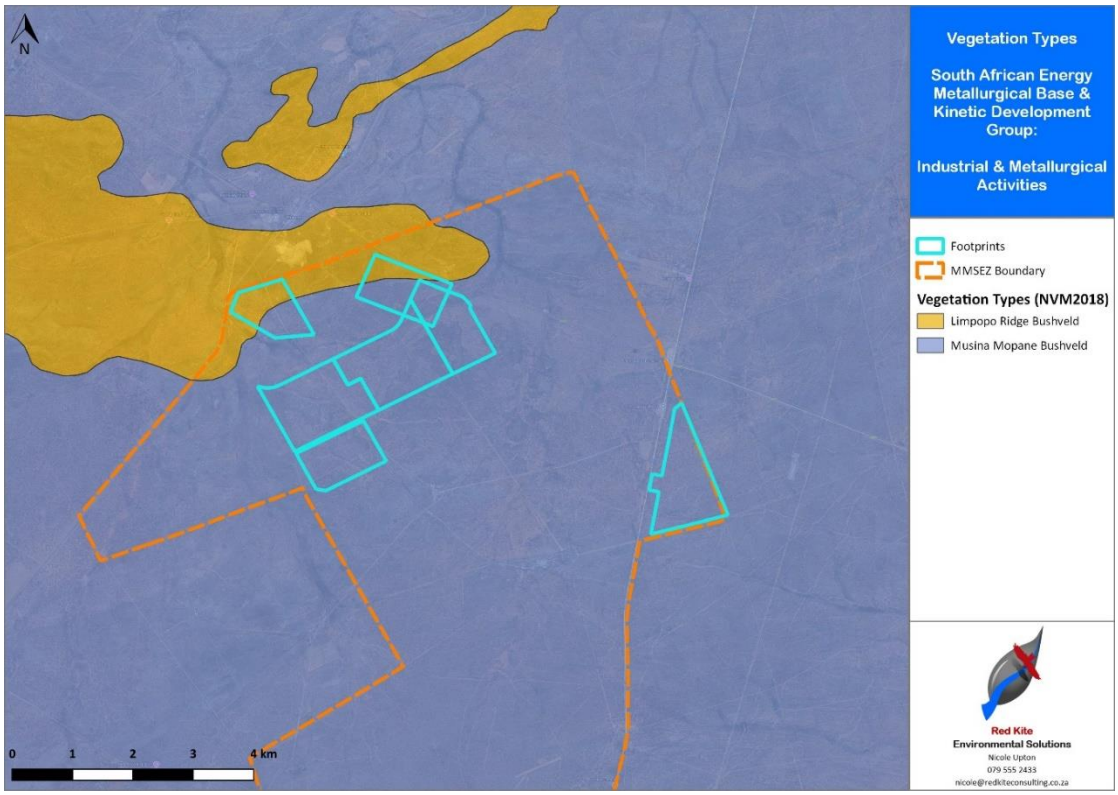


Figure 15: Vegetation Type Associated with the Project Footprint

8.4.1.2 Threatened Ecosystems

According to The Revised National List of Ecosystems that are threatened and in need of protection (Government Gazette Notice No. 2747 of 2022), both the Musina Mopane Bushveld and Limpopo Ridge Bushveld are not regarded as a threatened ecosystem, and are therefore regarded as a Least Threatened ecosystem.

8.4.1.3 Critical Biodiversity Areas (CBA) and Ecological Support Areas (ESA)

All the sites – including the proposed ferrochrome smelter - fall within Ecological Support Area 1 (ESA 1) – See Figure 16 below. ESA1 areas are natural, near natural or degraded areas supporting CBA's by maintaining ecological processes (LEDET 2013). In this case the ESA area is very widely distributed and covers the Vhembe Biosphere Reserve.

Critical Biodiversity Areas (CBAs): Critical Biodiversity Areas are those areas (outside of Protected Areas) that are required to meet biodiversity targets for biodiversity pattern (species and ecosystems) and ecological processes. They should remain in a natural state that is maintained in good ecological condition. CBAs are areas of high biodiversity value, but are often also at risk of being lost through biodiversity-incompatible land-use practices. CBAs include, inter alia, Critically Endangered Ecosystems and critical linkages (corridor pinch-points) to maintain connectivity.

Ecological Support Areas (ESAs): Ecological support areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of critical biodiversity areas or for generating or delivering important ecosystem services. They support landscape connectivity and resilience to climate change adaptation. ESAs need to be maintained in at least an ecologically functional state. The proposed ferroalloys/ferrochrome smelter area falls under this category.

Protected Areas: These are national assets that serve as nodes in South Africa's ecological infrastructure network, protecting ecosystems that deliver important services to people, such as the production of clean water, flood moderation, prevention of erosion, and the aesthetic value of the landscape.

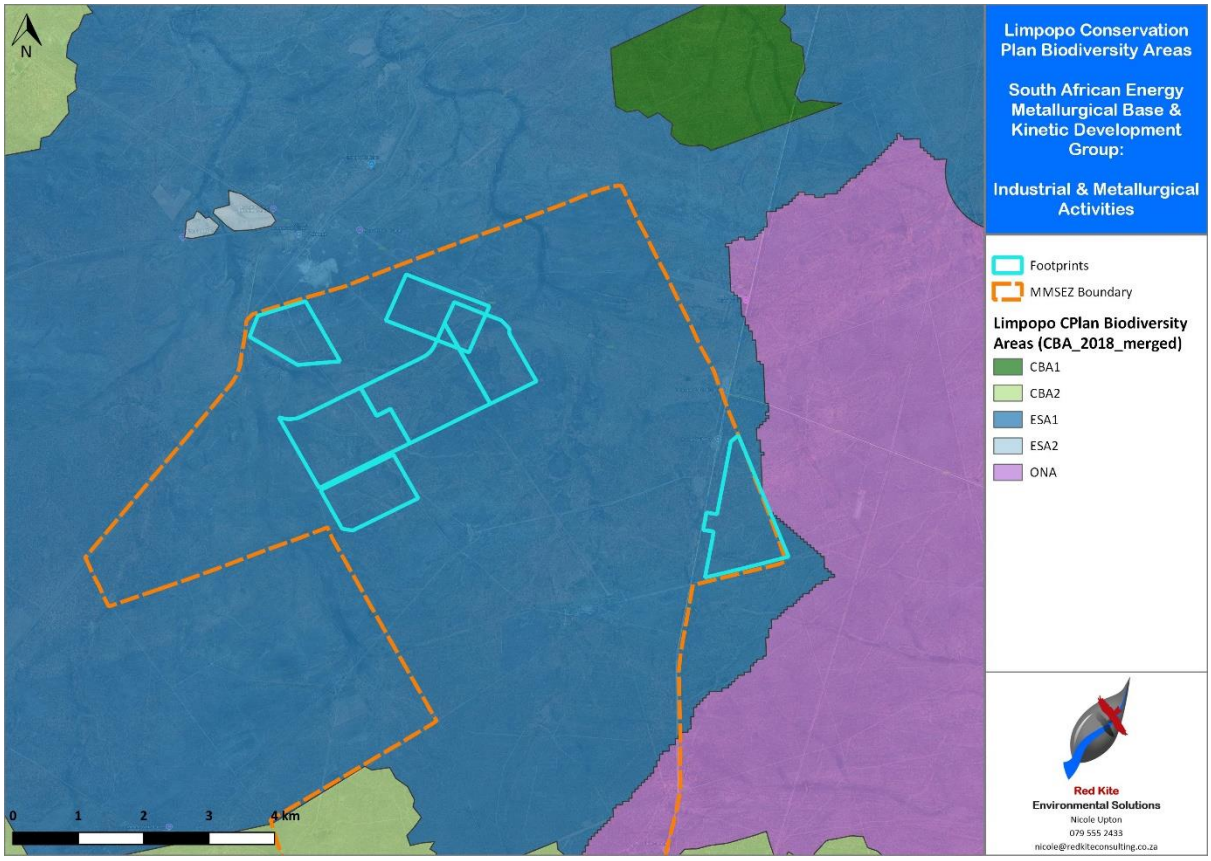


Figure 16: Limpopo Conservation Plan Biodiversity Areas - Project Footprint

Other Natural Areas (ONA): These are natural areas that have not been selected to meet biodiversity pattern or ecosystem process targets, or to support the functioning of Critical Biodiversity Areas. Despite this, they are not without 'value'. ONAs often retain much of their natural character and may contribute significantly to maintenance of viable species populations and natural ecosystem functioning, and may provide important ecological infrastructure and ecosystem services. They are not, however, prioritized for immediate conservation action, unless CBAs or ESAs are lost, or impacting activities within the ONAs impact negatively on other areas.

Loss of this biodiversity may pose serious risks to the health and socio-economic aspects of life for future generations. The establishment and management of an extensive and representative system of protected areas is thus a critical strategy in the conservation of South Africa's biodiversity and ecosystems. Developments within areas adjacent to or within protected areas could have far-ranging detrimental consequences as far as impacts on these areas are concerned. The proposed development areas do not traverse any either a formal or informal protected area.

8.4.1.4 Protected Conservation Areas

The project site is located in the Vhembe Biosphere Reserve. However, the proposed project footprint does not fall within the core or buffer areas of the biosphere reserve, but is located within the transitional zone, where sustainable development may be supported.

Apart from being located within the Vhembe Biosphere Reserve, and therefore also in Ecological Support Area 1, several private nature reserves occur in close vicinity

of the proposed development sites, in particular the Boabab Private Nature Reserve and the Averel Private Nature Reserve. Several other private nature reserves occur in the region. The site is not located in any National Protected Expansion Area.

The site is not located in any National Protected Expansion Area.

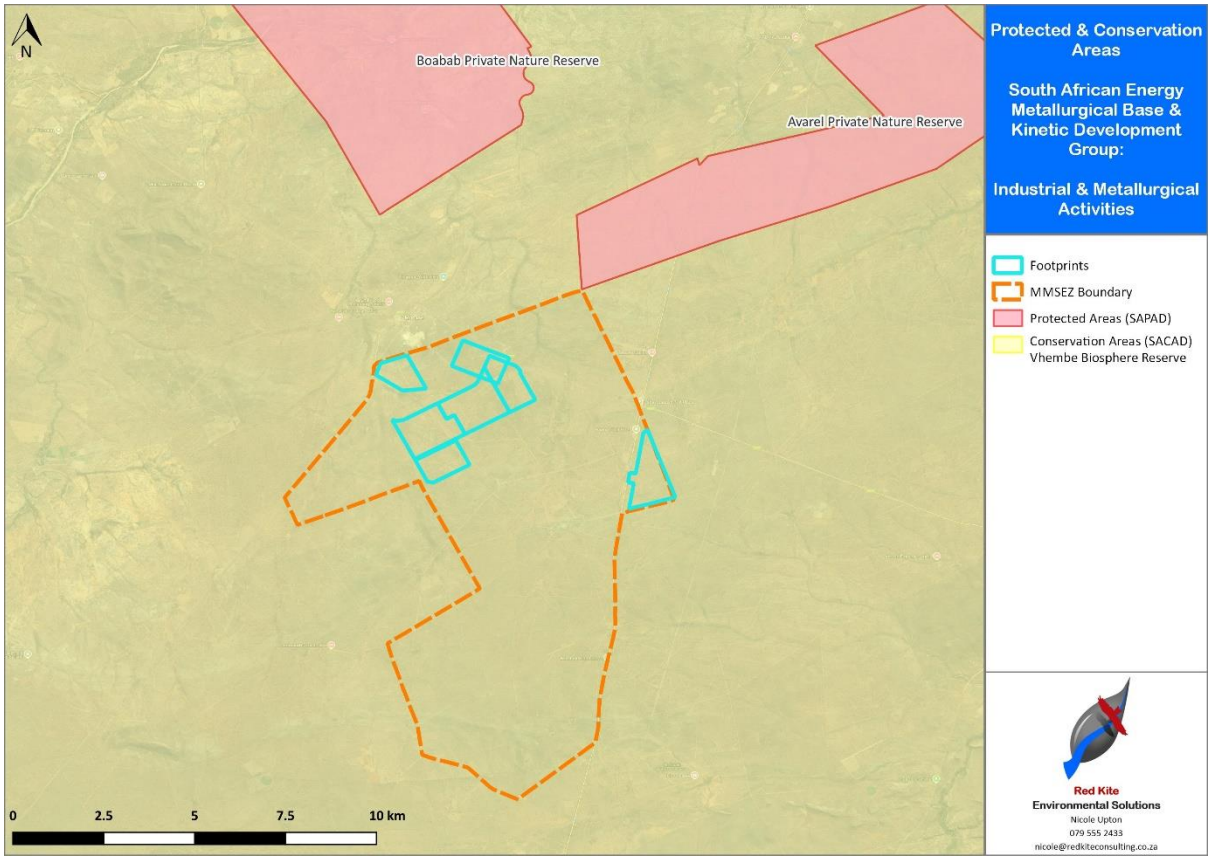


Figure 17: The Project Site in Relation to Conservation and Protected Areas

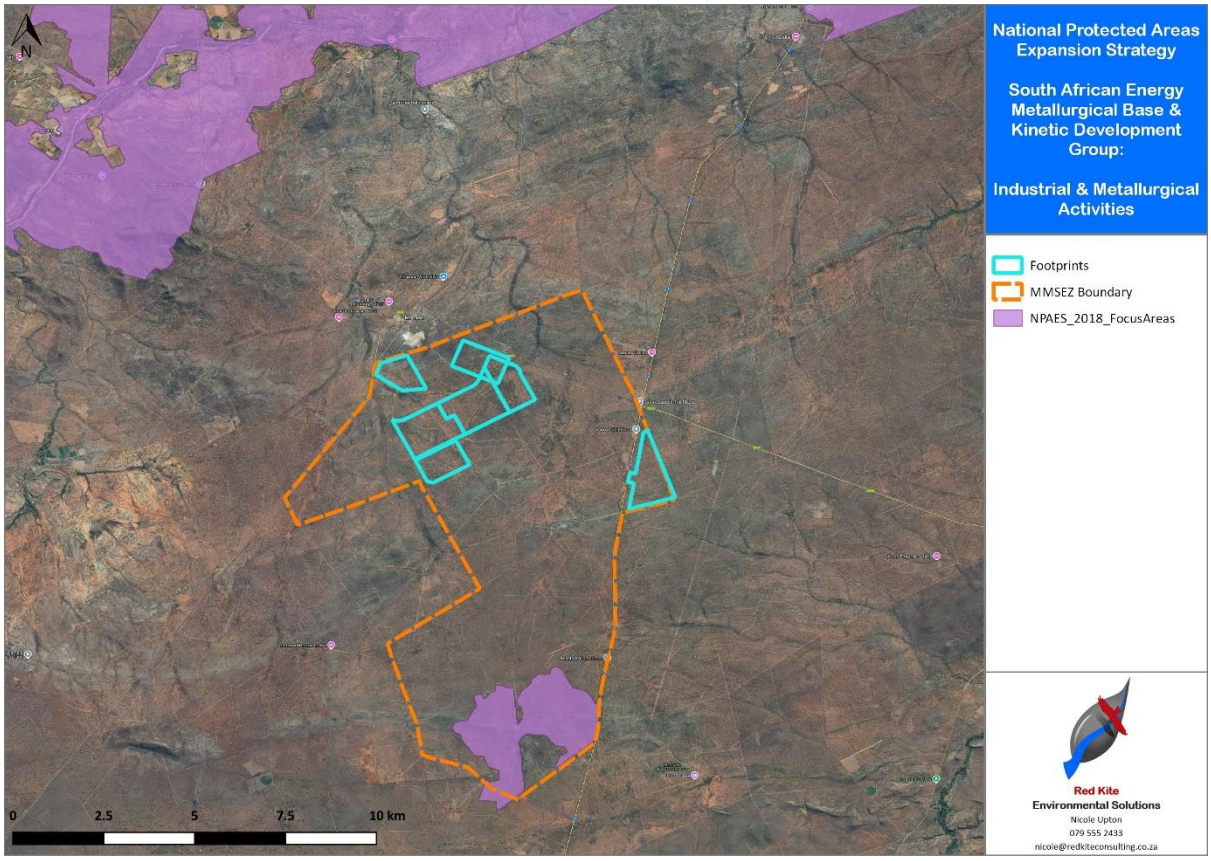


Figure 18: Propose Project Footprint in Relation to NPAES Areas

8.4.1.5 Vegetation of the Site

The vegetation on the site is broadleaf savanna located on irregular slightly undulating plains with a variety of soil types. The vegetation of the Musina Mopane Bushveld is mostly open to dense treeveld or dense shrubveld dominated by *Colophospermum mopane*. Dense thickets of *Terminalia prunioides* occur locally. A conspicuous feature is the presence of large (and young) individuals of *Adansonia digitata*.

Plate 7: A General View of the Colophospermum Mopane Bushveld

A variety of trees and shrubs may occur scattered in the vegetation, for example *Combretum apiculatum, Sclerocarya caffra, Senegalia nigrescens, Senegalia erubescens, Dichrostachys cinerea,* several *Commiphora* species and *Grewia* species. Whilst it is possible to visually recognise different sub-communities based on the prominence of any of the above-mentioned woody species, these sub-communities are floristically very similar, and they occur in a mosaic distribution pattern. As the boundaries between the plant communities are often diffuse and gradual it is very difficult to map them at this scale. However, the major plant communities differ considerably in height and tree density, and structural types, can easily be mapped.

The herbaceous layer is often poorly developed probably due to over-utilization over a longer time-period. Widespread grass species include *Aristida congesta, Aristida adscendens, Schmidtia pappophoroides, Stipagrostis uniplumis, Eragrostis lehmanniana and Eragrostis pallens*. Forbs are sparse and never dominant. Widespread species include *Melhania acuminata, Ocimum americanum, Hibiscus micranthus, Blepharis subvolubilis and Evolvulus alsinoides*.

The vegetation on the hilly areas of the Limpopo Ridge Bushveld is also characterized by Colophospermum mopane, but species such as *Kirkia acuminata, Cataphractes alexandri, Combretum apiculatum and Terminalia prunioides* are also prominent (Du Plessis 2001). The grass and forb layers are often sparse with only few species present.

Five plant communities were identified and mapped. The ecological sensitivity, conservation value and sizes of the communities are given in the table below.

Table 22: List of Plant Communities with Ecological Sensiti

Plant Community	Sensitivity	Conservation Value	Size (ha)
1.Colophospermum mopane Dense Bushveld on marble	Medium-Low	Medium	394
2. Colophospermum mopane Open Bushveld on arenite	Medium	Medium-High	353
3. Colophospermum mopane Plain Bushveld on shallow washes	Medium-High	Medium-High	55
4. Drainage Lines	High	High	52
5. *Colophospermum mopane* Ridge Bushveld	Medium-High	High	43
6. Disturbed Areas	Low	Low	4
Total Hectares			**901**

The *Colophospermum mopane* Dense Bushveld is mainly located in the southern, eastern and western parts of the site, while the *Colophospermum mopane* Open Bushveld area is situated centrally in the northern parts. *Colophospermum mopane* Ridge Bushveld covers a very small area, limited to the far northern part of the sites. *Colophospermum mopane* Plain Bushveld is limited to small patches of shallow washes on plains, that may be regarded as shallow, surface drainage lines.

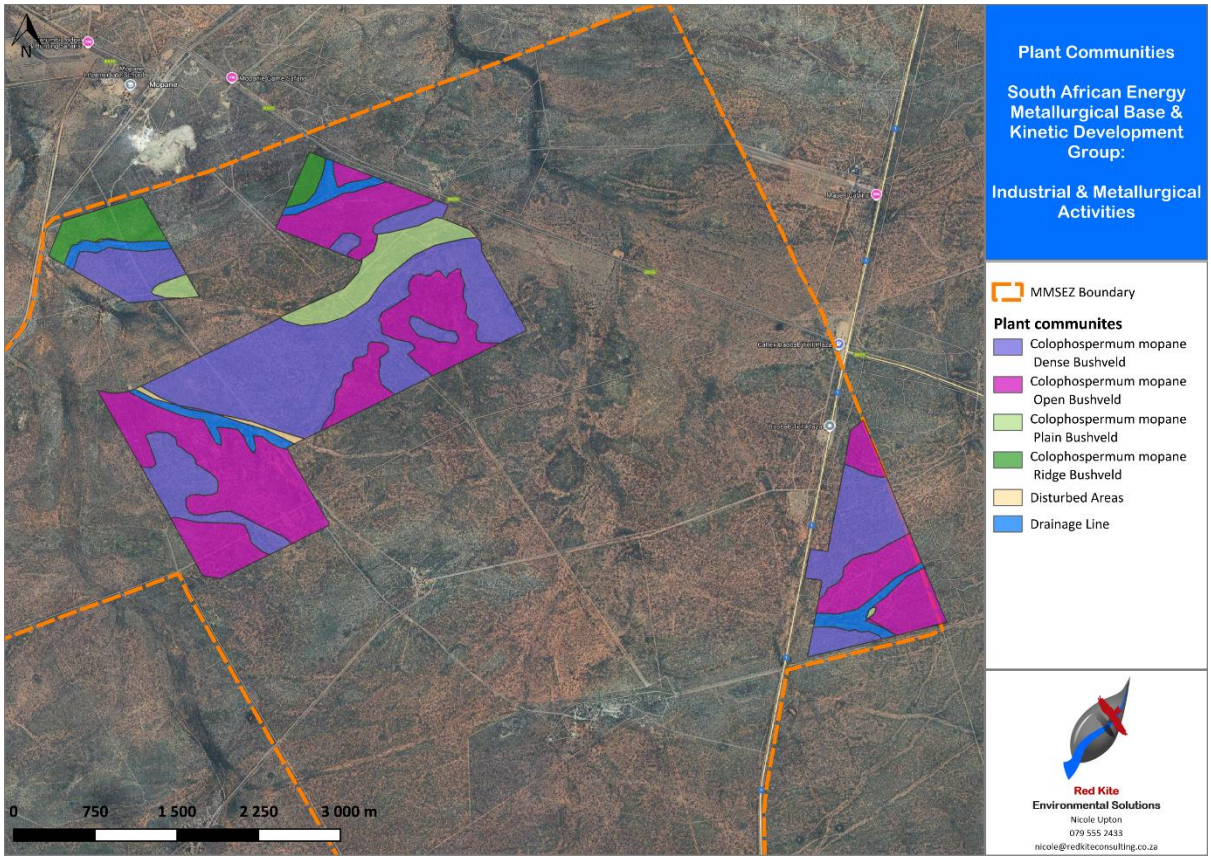


Figure 19: Vegetation Types Delineated for the Project Footprint

8.4.1.6 Colophospermum Mopane Dense Bushveld on Marble

The *Colophospermum mopane* Dense Bushveld, an area of 394 hectares, is located on flat or slightly undulating terrain, on two east-west stretching bands of **marble gravel** in the northern and southern parts of the site, intersected by a band of arenite that stretches east-west through the centre of the site. The soils are mostly gravelly and shallow. The 4-6 m tall tree layer is very dense, covering up to 80%. *Colophospermum mopane* is totally dominant, leaving little room for other woody species, while the herbaceous layer is scanty and species-poor. Other woody species such as *Terminalia prunioides, Grewia bicolor, Grewia flavescens* and *Combretum apiculatum,* may occur in dense stands.

Under the dense trees the herbaceous layer is poorly develop, with a few scanty grasses, and limited forbs. This aspect limits the suitability of the habitat for larger grazing animals.

Table 23: Summary of the Colophospermum Mopane Dense Bushveld

Community 1: *Colophospermum mopane* Dense Bushveld			
Status	Primary, dense woodland, somewhat utilised		
Soil	Light brown to reddish, sandy loar	**Rockiness**	0-5%
Conservation Valu	Medium	**Sensitivity:**	Medium-Low
Species richness	Medium	**Need for rehabilitation**	Low
Dominant spp.	*Colophospermum mopane, Terminalia prunioides, Grewia bicolor, Grewia flavescens, Commiphora glandulosa*		

Plate 8: Colophospermum Mopane Dense Bushveld

Table 24: Number of Species Recorded - Colophospermum Mopane Dense Bushveld

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and Shrubs	15	0	15	0	2	2
Grasses	5	0	5	0	0	0
Forbs	14	0	14	0	0	0
Total	34	0	34	0	1	1

The species richness is Medium, with a rather limited individuals of the protected trees *Adansonia digitata and Sclerocarya birrea*. No other threatened or rare species were recorded. The Medium-Low ecological sensitivity is due to the poor development and low species richness of the herbaceous layer and consequently lower potential to carry large numbers of grazer animals.

8.4.1.7 Colophospermum Mopane Open Bushveld on Arenite

The *Colophospermum mopane* Open Bushveld is mainly located on the east-west stretching band of arenite, on deep sandy soils, in the central part of the site. This area covers 353 hectares. The tree layer is 3-4 m tall and is fairly open, covering only 20-40%. *Colophospermum mopane* is dominant, and several other woody species occur, though the woody species composition is very similar to that of the *Colophospermum mopane* Dense Bushveld. The most prominent other woody species are *Terminalia prunioides, Grewia bicolor* and *Grewia flavescens*. The herbaceous layer is however better developed with higher grass cover and more forb species than in the *Colophospermum mopane* Dense Bushveld.

This Open Bushveld plant community is highly suitable for larger grazing animals and therefore has a higher conservation value.

Plate 9: The Colophospermum Mopane Open Bushveld

Table 25: Summary of the Colophospermum Mopane Open Bushveld

Community 2: *Colophospermum mopane* Open Bushveld			
Status	Primary, low-open to dense woodland, somewhat utilised		
Soil	Light brown to reddish, sandy loam sometimes with surface gravel	**Rockiness**	0-5%
Conservation Value	Medium-High	**Sensitivity:**	Medium
Species richness	High	**Need for rehabilitatio**	Low
Dominant spp.	*Colophospermum mopane, Terminalia prunioides, Grewia bicolor, Grewia flavescens, Commiphora pyracanthoides*		

Table 26: Number of species Recorded - Colophospermum Mopane Open Bushveld

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	20	0	20	0	3	3
Grasses	9	0	9	0	0	0
Forbs	19	0	19	0	0	0
Total	48	0	48	0	2	2

The species richness is High, with a scattered individuals of the protected trees *Adansonia digitata*, *Sclerocarya birrea* and *Boscia albitrunca*. No other threatened or rare species were recorded. The ecological sensitivity analysis indicates Medium sensitivity.

8.4.1.8 Colophospermum Mopane Plains Bushveld on Shallow Washes

The *Colophospermum mopane* Plains Bushveld is restricted to sandy washes in the central-eastern part of the study site, and a small patch in Administration office site. The area covers 55 hectares. This bushveld is up to 6 m tall dense, covering about 60%. It seems that these washes act as a shallow drainage line from the water shed towards larger drainage lines to the east and west.

Colophospermum mopane is dominant, with other woody species *Terminalia prunioides*, *Commiphora pyracanthoides*, *Grewia flavescens* and Senegalia nigrescens. Under the bushes the herbaceous layer is poorly develop, with a few scanty grasses, and limited forbs.

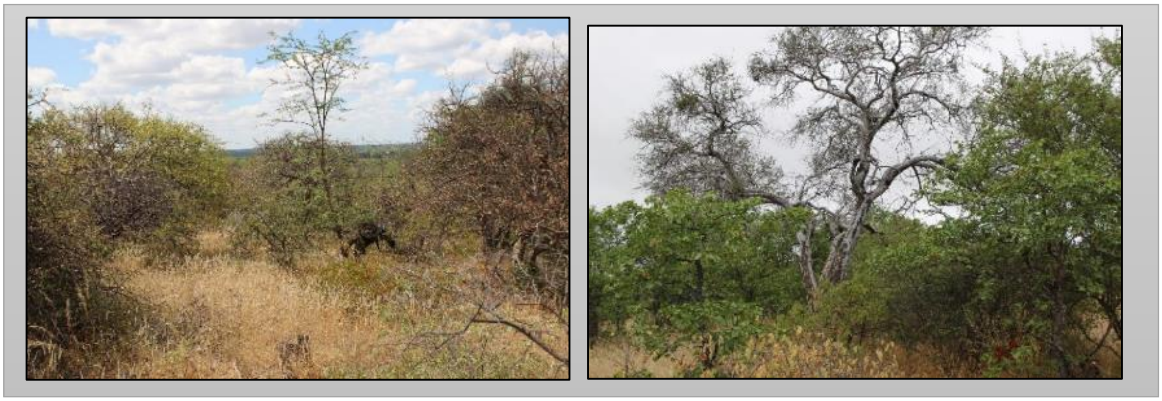


Plate 10: Colophospermum Mopane Plains Bushveld

Table 27: Summary of the Colophospermum Mopane Plains Bushveld

Community 3: *Colophospermum mopane* Plains Bushveld			
Status	Primary, dense woodland, somewhat utilised washes on plain		
Soil	Light brown to grey deep, Sand	**Rockiness**	0%
Conservation Value	Medium-High	**Sensitivity:**	Medium-High
Species richness	Medium (close to High)	**Need for rehabilitation**	Low
Dominant spp.	*Colophospermum mopane, Terminalia prunioides, Vachellia tortilis, Grewia flavescens*		

Table 28: Number of Species Recorded - Colophospermum Mopane Plains Bushveld

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	16	0	16	0	3	3
Grasses	7	0	7	0	0	0
Forbs	13	0	13	0	0	0
Total	36	0	36	0	3	3

The species richness is Medium, with a limited individuals of the nationally protected trees *Adansonia digitata*, *Sclerocarya birrea* and *Boscia albitrunca* and the provincially protected *Boscia foetida* present in this plant community. No other threatened or rare species were recorded. The ecological sensitivity analysis indicates Medium-High sensitivity due to the washes being shallow drainage lines, connecting to the no-go areas.

8.4.1.9 Drainage Lines

Dense mixed bushveld occurs in and along the shallow, seasonally dry Drainage Lines that flow in an easterly direction towards a larger drainage line. The area covers 52 hectares. The plant species composition of the Drainage Line watercourses is not much different from that of the *Colophospermum mopane* Dense Bushveld but is somewhat taller. This dense mixed bushveld is up to 6-7 m tall and covers 60-80%.

Plate 11: The Taller and Denser Vegetation of a Drainage Line in the Background

Table 29: Summary of the Drainage Lines

Community 3: Drainage lines			
Status	Primary riparian bush in and along dry watercourses		
Soil	Light brown sandy loam	**Rockiness**	0-10%
Conservation Value	High	**Sensitivity:**	High
Species richness	High	**Need for rehabilitation**	Low
Dominant spp.	*Colophospermum mopane*		

Table 30: Number of Species Recorded – Drainage Lines

	Indigenous	**Aliens / Weeds**	**Total**	**Red Data**	**Protected**	**Medicinal**
Trees and shrubs	15	0	15	0	1	1
Grasses	6	0	6	0	0	0
Forbs	14	0	14	0	0	0
Total	35	0	35	0	1	1

The species richness is Medium, with no red data species, but the sensitivity High. There is a possibility that a few individuals of the protected tree *Sclerocarya birrea* are locally present. No other threatened or rare species were recorded. The ecological sensitivity analysis indicates High sensitivity, as all watercourses are protected by law.

8.4.1.10 Musina Ridge Bushveld

Two small patches of Musina Ridge Bushveld are present on foot-slopes of low ridges in the far northern part of the study site. The total area covered is only 43 hectares. This vegetation is up to 4 m tall dense, bush, with a cover of about 70%. The soil surface is covered by small stones and gravel.

Colophospermum mopane, with other woody species such as *Terminalia prunioides, Commiphora mollis, Combretum apiculatum Commiphora pyracanthoides* and *Grewia flavescens,* are prominent. Under the bushes the herbaceous layer is poorly develop, with a few scanty grasses, and limited forbs.

Plate 12a: Dense Shrubby Vegetation on the foot-slope in Musina Ridge Bushveld

Plate 12b: The Rocky Nature of the Musina Ridge Bushveld

Table 31: Summary of the Musina Ridge Bushveld

Community 4: Musina Ridge Bushveld			
Status	Primary, dense woodland on the foot-slope of a small hill		
Soil	Light brown to grey, Sandy loam	**Rockiness**	20-30%
Conservation Value	High	**Sensitivity:**	Medium-High
Species richness	High	**Need for rehabilitation**	Low
Dominant spp.	*Colophospermum mopane, Terminalia prunioides, Vachellia tortilis, Grewia flavescens,*		

Table 32: Number of Species Recorded – Musina Ridge Bushveld

	Indigenous	Aliens / Weeds	Total	Red Data	Protected	Medicinal
Trees and shrubs	14	0	14	0	0	0
Grasses	5	0	5	0	0	0
Forbs	10	0	10	0	0	0
Total	29	0	29	0	0	0

The species richness is Medium. No threatened or rare species were recorded on the relatively small site. The ecological sensitivity analysis indicates Medium-High sensitivity for the Limpopo Ridge Bushveld.

8.4.1.11 Disturbed Area

A mappable disturbed area (4 ha) where the vegetation was cleared long ago, occurs in the eastern part of the site. Other small patches, particularly roads, tracks or cleared area (firebreaks) along fence-lines occur scattered over the site, but these are not mappable on the scale used. Some cleared areas are currently covered by grass, while small shrubby individuals of some woody species, particularly *Colophospermum mopane* and *Vachellia tortilis* became established in the area.

The ecological sensitivity is regarded to be Low.

8.4.1.12 NEMBA/TOPS Plant Species

These species are evaluated against the list published in Department of Environmental Affairs and Tourism Notice No. 2007, Government Gazette 574 of 2013 and Notice 256 of 2015 and National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act 10 of 2004).

No NEMBA/TOPS plant species occur on the site.

8.4.1.13 Nationally and Provincially Protected Trees

The National Forest Act, 1998 (Act No. 84 of 1998) enforces the protection of several indigenous trees. The removal, thinning or relocation of protected trees will require a permit from the DFFE.

Protected trees do occur on the site, individuals of the nationally protected *Adansonia digitata* (Baobab), *Sclerocarya birrea* (Marula), *Boscia albitrunca* (Shepard's tree) were noted. A permit from the Dept Forestry will be needed if any of these trees should be removed or even pruned or cut. Fairly large Marula trees can be transplanted successfully, if needed.

The provincially protected tree *Boscia foetida* occurs on the site.

8.4.1.14 Alien and Invasive Plant Species

No woody alien and invasive species were recorded on the site.

8.4.1.15 Medicinal Plants

Only medicinal plants listed by Van Wyk, Van Oudtshoorn & Gericke (2005), and rare medicinal plants as indicated by Williams, Victor & Crouch (2013) or other well-

known species were indicated with the letter "M" in the list of species for each plant community.

8.4.1.16 Flora Species of Conservation Concern (SCC)

Red Data listed plant species and Orange listed plant species (= plant species of conservation concern) are those plants that are important for South Africa's conservation decision making processes. These plants are nationally protected by the National Environmental Management: Biodiversity Act (Raimondo *et al*, 2009).

Threatened species (Red Data listed species) are those that are facing high risk of extinction, indicated by the categories Critically Endangered (CE), Endangered (EN) and Vulnerable (VU). Species of Conservation Concern include the Threatened Species (Raimondo *et al*, 2009).

Additionally, the Orange listed categories are Near Threatened (NT), Data Deficient (DD), (DDT = lack of taxonomic data), Critically Rare (CR), Rare (R) and Declining (D). This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009 upgraded on SANBI website).

8.4.2 Fauna

8.4.2.1 Mammals

Within the biome, the local occurrences of mammals are closely dependent on broadly defined habitat types: terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges. From a mammal habitat perspective, it was established that three of the four major habitats are naturally present on the study site. The dense bushveld offers abundant arboreal habitat. The trees offer refuge for arboreal mammals. The open bushveld provides good terrestrial habitat. Natural rupicolous habitats are limited within the study site, with small stones and gravel limited to the small Limpopo Ridge Bushveld area. Rupicolous habitats could offer nooks and crannies as refuge for some small common rupicolous mammals. Permanently wet ecosystems do not occur on the study site, except maybe for very limited, small, man-made dams. No wetland-associated vegetation cover occurs on the study site. Only a few termitaria were recorded. These structures are good indicators of the occurrence of certain small mammals.

As is typical for Mopaneveld, the basal cover was relatively poor at the time of the site visit. Pioneer grasses and forbs were prominent but would, on a local scale, provide adequate nourishment and cover for small terrestrial mammals. In general, the site area does not support the presence of many species or high population densities for most of the larger or medium-sized mammal species.

The study site does not have caves suitable for cave-dwelling bats. The rock crevices on or near the site may act as substitute for daytime roosts. Baobab trees provide special habitat for many animal species, also certain bat species. It is likely that common bats commute from roosting sites elsewhere to hawk for insects on or near the study site.

Connectivity with areas around the study site is good, though interrupted by a limited road network.

The close-by nature reserves and game farms offer secure habitat for many mammal species, some of which may from time-to-time venture into the area of the study site. However, these reserves and farms are well fenced, limiting movement of larger mammals.

Observed and Expected Mammals
Small mammals are not obvious in the grassland, savanna or bush. Large and medium-sized mammals (such as buffalo, blue wildebeest, black wildebeest, red hartebeest, eland, waterbuck, plains zebra, white rhino, lion, cheetah and spotted hyena) have long ago been eradicated from the human-occupied areas and are now only seen in certain nature conservation areas and game farms. However, several small to medium-sized mammal species are expected in many Mopaneveld localities. These include several species of rodents, mongooses, porcupine, aardvark, common duiker, steenbok, kudu, impala, caracal, African wild cat and black-backed jackal and even cheetah and leopard.

Most of the species of the resident diversity are common and widespread (viz. aardvark, rock hyrax, scrub hare, African mole-rat, black-backed jackal, common duiker, Multimammate mouse and gerbils). Many of the species listed are robust, some with strong pioneering capabilities allowing them to invade and occupy new habitats. The reason for their survival success is predominantly seated in their remarkable reproduction potential (e.g. multimammate mice), and to a lesser extent their reticent and cryptic nature (e.g. scrub hares, genets and mongooses).

Exotic feral and domesticated mammal species are expected to occur on the study site (e.g. house mice, house rats, cats, dogs, goats, pigs and cattle) since these species are normally associated with humans.

The table below provides information on mammal species that may from time-to-time occur in the area of the site.

It is estimated that about 80 mammal species may from time to time occur on the site or in the vicinity of the site area. Of these species 13 are small rodents and 25 are bats.

Red Listed Mammals Species
As is typical for Mopaneveld, the basal cover was relatively poor at the time of the site visit. Pioneer grasses and forbs were prominent but would, on a local scale, provide adequate nourishment and cover for small terrestrial mammals. In general, the site area does not support high population densities for most of the larger or medium-sized mammal species.

Aardvark, Brown hyaena, African Civet and Steenbok were observed on neighbouring farms (Bathusi Environmental Consulting 2018).

The Southern African hedgehog, Honey badger and African weasel do occur in this quarter degree square and there is a possibility that these species may occasionally

be found on the study site. Although generally rare, there is a small possibility that the Ground pangolin may from time to time occur on the site.

Leopard, Serval and large Red Data antelopes such as Tsessebe, Roan antelope and Sable antelope may occur on nature reserves or game farms in the Mopaneveld region and may rarely visit the site area. It is also possible that South Africa galago, Aardwolf and Selous mongoose may rarely visit the study site.

Due to the lack of rupicolous habitat on the study site, Mountain reedbuck and Grey rhebok do not occur on the site.

The drainage lines on the site are too small, shallow and non-perennial, seldom with feeble flow of water, therefore the African clawless otter, the Spotted-necked otter and the Robert's Marsh Rat (African marsh rat) do not occur on or near the study site. Considering the absence of wetlands most Red Listed bats should not occur on or near the sites. The near-threatened Smither's horseshoe bat was recorded by Bathusi Environmental Consulting (2018) on a neighbouring farm. There is slim chance for the Wood's slit-faced bat may fly sporadically over the site.

None of the species claimed to be residents of the study site and surrounding areas are endemic to Limpopo.

No other Red Data or sensitive species are deemed present on the site, either since the site falls outside the distributional ranges of some species or does not offer suitable habitat(s). The site falls outside the natural distribution range of some Red Data mammal species, and they do not occur on the site. These include Juliana's golden mole, Yellow golden mole, Gunning's golden mole; Four-toed elephant-shrew; Samango or Sykes monkey, Swamp musk shrew, Maquassie musk shrew, Commerson's roundleaf bat; Peak-saddle horseshoe bat; Swinny's horseshoe bat; Damara woolly bat; Red duiker, Suni and Oribi.

The red data or protected species Aardvark, Brown hyaena, African Civet and Steenbok were observed on neighbouring farms (Bathusi Environmental Consulting 2018). The Southern African hedgehog, Honey badger and African weasel do occur in this quarter degree square and there is a possibility that these species may occasionally be found on the study site. Although generally rare, there is a small possibility that the Ground pangolin may from time to time occur on the site. Leopard, Serval and large Red Data antelopes such as Tsessebe, Roan antelope and Sable antelope may occur on nature reserves or game farms in the Mopaneveld region and may rarely visit the site area. It is also possible that South Africa galago, Aardwolf and Selous mongoose may rarely visit the study site. Due to the lack of rupicolous habitat on the study site, Mountain reedbuck and Grey rhebok do not occur on the site.

A conclusion is that the proposed development would not seriously affect the mammal populations of the Mopaneveld. The proposed development may be supported.

8.4.2.2 Avifauna

The site of the proposed development does not fall within an Important Bird and Biodiversity Area (IBA) (Marnewick *et al*. 2015).

The habitats occupied by flighted birds differ from those of most terrestrial vertebrates in being explicitly three-dimensional, especially for aerial-feeding species and in the airspace above landscapes with low relief and short vegetation. The avian habitat on the site is primarily low Mopane bushveld with varying tree and bush density, the ground cover being open, dry grassland. Due to the absence of aquatic habitat birds which are dependent on this particular habitat were omitted from the list in the table below.

The aerial mobility of birds also demands paying attention to the principal habitats surrounding the study site and their conservation status, not just those along the immediate borders but also more distant habitats that might provide sources for species visiting the site and sinks for those breeding on site.

Birds are also a relatively visible and audible group of homeothermic vertebrates, active throughout the year, and with habitat preferences that can be evaluated from experience, by reference to the comprehensive literature available and by the subset of species that can be detected by a field survey during a particular season and time of day.

Expected and Observed Bird Species
The site can hold a bird community typical of mopane woodland habitats in the northern part of Limpopo Province. The surrounding area generally consists of game farms, and the avian habitats here are mostly in good condition. The Limpopo Valley is characterized by the presence of large raptors that require large areas of unbroken habitat. Due to the relatively homogeneous nature of the Mopaneveld, avifaunal conservation value of the site is also relatively low.

A total of 264 bird species are considered likely to, from time to time, occur at the site. However, according to SABAP 2 a total of only 65 species were recorded on this Pentad. Of these, 34 (52%) were recorded on the site during the site visit.

In this report attention is focussed on the 28 threatened or near-threatened species (Taylor, Peacock & Wanless, 2015) that may occur in the general area, as well as the species listed by the Screening Tool as sensitive for the area of the study site.

Red Listed Bird Species
A total of 28 threatened or near-threatened species (Taylor, Peacock & Wanless, 2015) were previously recorded for the region. The nature of the study site makes it unlikely that most of these species ever occur here. Many of these can be ruled out on the basis of habitat characteristics. Species typically inhabiting aquatic habitats should not occur on the site due to the absence of this habitat.

Several species of significant conservation concern could potentially occasionally be present at the site. These include the vultures and raptors like African White-backed Vulture (*Critically Endangered*), Cape Vulture (*Endangered*), Bateleur (*Endangered*), Martial Eagle (*Endangered*), Tawny Eagle (*Endangered*), Verreauxs' eagle (Vulnerable) and Lanner Falcon (*Vulnerable*). Species like the Secretarybird

(*Vulnerable*) and European Roller (*Near Threatened*) may also from time to time occur on or near the site. In addition, the presence of the *Endangered* Southern Ground-hornbill cannot be ruled out. This species has been recorded with relatively high reporting rates in several pentads along the N1 between Musina and the Soutpansberg, and along the Limpopo Valley, although it is likely to avoid areas close to urbanization.

However, there are not many full protocols for the Pentad and for most Red Data species the nature of the site is such that their occurrence is extremely unlikely. Due to the limited extent and quality of the habitats, half the species are expected to be at best erratic visitors and the other half are only expected as infrequent vagrants, their inclusion being primarily due to the Precautionary Principle. As can be seen from the estimates of the habitats as support for the basic requirements of the species, they are considered at best as only mediocre for all the threatened species. The odd Red Data eagle and Red Data vulture use the airspace above by fly over the site, but the area is unlikely to be an important hunting or scavenging habitat.

The development of site should not affect the Bateleur or Tawny Eagle species survival as a species. From an avifaunal perspective, the conservation status of this site is low. At a broader spatial scale, the site is located in widespread mopane bushveld, therefore the ultimate impact of the development on birds is considered to be low and the development can be supported.

8.4.2.3 Herpetofauna

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types: terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges. From a herpetological habitat perspective, it was established that two of the four major habitats are naturally present on the study site, namely terrestrial and arboreal. Rupicolous habitats were scares on the site. These rupicolous habitats offer nooks and crannies as refuge for some small common rupicolous herpetofauna species.

A few termitaria were observed. These structures are good indicators of the occurrence of some herpetofauna species. At the time of the site visit the basal cover was poor in many places but could provide adequate cover for small herpetofauna species.

No wetland-associated vegetation cover occurs on the study site; therefore, Amphibia is scarce on the site.

Natural arboreal habitat is abundant on the study site. The larger trees may offer refuge for arboreal herpetofauna like tree agamas and flap-neck chameleons. Due to firewood collection, there are no dead logs, which could have provided shelter and food for herpetofauna. No important wetland-associated vegetation cover occurs on the site. Connectivity with areas around the study site is good but interrupted by roads.

Expected and Observed Reptile Species Richness

The species assemblage is typical of what can be expected in Mopaneveld, with sufficient terrestrial and arboreal habitat to sustain populations of some species. Most of the species of the resident diversity are common and widespread (viz. leopard tortoise, Turner's gecko, common dwarf gecko, rainbow skink, variable skink, common giant plated lizard, puff adder, Southern African python, western yellow-bellied sand snake, snouted cobra, Mozambique spitting cobra, southern twig snake.

The Arboreal habitat is typical of a savanna assemblage. Larger trees are interspersed with dense stands of scrub. The larger trees may offer refuge to tree-living reptiles like Bradfield's dwarf gecko, common dwarf gecko, tree agamas, boomslang, twig snakes and flap-neck chameleons. There are dead logs, which could provide shelter and food for some herpetofauna.

Due to the terrestrial sand habitat, four species of amphisbaenians or worm lizard were added to the species list.

Due to the absence wetland and of large natural rupicolous habitat on the study site certain species were omitted from the species list, which include tiger gecko, common girdled lizard, Zimbabwe flat lizard, common giant plated lizard and southern rock agama.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this site.

A list of reptile species expected to occur on the site, or in the vicinity of the site, is given in the table below. A high number of 99 reptile species may occur in this bushveld type where the study site is located. The presence of six reptile species was confirmed, but more species have a high possibility to occur in the area.

Threatened Reptile species

Seven Threatened Reptile species are listed for the area of the study site. Five of the seven listed threatened reptile species may occur in the area of the site.

Table 33: Red Data, NEMBA and LEMA Listed Reptile Species

Species	Scientific Name	Red Data IUCN	NEMBA	LEMA	Endemism	Likelihood of occurrence
Nile crocodile	*Crocodylus niloticus*	VU	PR	Specially protected	No	Unlikely
Muller's velvet gecko	*Homopholis mulleri*	VU			Yes	Likely

Species	Scientific Name	Red Data IUCN	NEMBA	LEMA	Endemism	Likelihood of occurrence
Soutpansberg rock lizard	*Vhembelacerta rupicola*	NT			Yes	Unlikely, – restricted to Soutpansberg
Soutpansberg worm lizard	*Chirindia langi occidentalis*)	VU			Yes	Small Possibility, restricted to Soutpansberg
Stripe-bellied legless skink	*Acontias kgalagadi subtaeniatus*	DD			Yes	Small possibility
Southern African python	*Python natalensis*	LC	PR	Protected	No	Present on neighbouring farm
Black file snake	*Gonionotophis nyassae*	LC		Protected	No	Possible

Muller's velvet gecko's (*Homopholis mulleri*) status is *Vulnerable* (Branch, 2014). It is endemic to the Limpopo Province and is mainly restricted to Mopane Veld around the Soutpansberg. This species is known to shelter in holes in trees (Branch, 2014a), which do occur on the study site. A high possibly exists that this species may occur on the site.

The status of the Soutpansberg rock lizard (*Vhembelacerta rupicola*) is *Near Threatened* (Turner 2014). This species occurs on rocky outcrops, scree slopes and bedrock in wooded savannah on or near the Soutpansberg Range. It is unlikely that this species could occur on the study site.

The status of the Soutpansberg worm lizard (*Chirindia langi occidentalis*) is *Vulnerable* (Measey, 2014). This species is endemic to the low-lying areas of the Soutpansberg in northern Limpopo. A possibly exists that this species may occur on the sandy habitats on the site.

The status of the Stripe-Bellied Legless Skink (*Acontias kgalagadi subtaeniatus*) is *Data Deficient* (Bauer, 2014) and it is endemic to northern Limpopo Province in South Africa. A small possibly exists that this species may occur on the site.

The Southern African python (*Python natalensis*) does occur in the area. According to Bradley (1990), Southern African pythons favour moist, rocky, well-wooded valleys, plantations or bush country, but seldom if ever stray far from permanent water. The study site itself does provide suitable habitat for the Southern African python, and the study site is large enough to support a viable population. It is often estimated that a single python needs at least 100 ha area to forage. Populations of Southern African pythons live on nearby properties and some individuals may migrate to and from the study site. The Southern African python's national status has changed from Vulnerable (Branch, 1988) to regional Least Concern (Alexander, 2014), although it is currently still a ToPS-listed species (Threatened or Protected Species).

The study site falls inside the natural range of the Nile crocodile (*Crocodylus niloticus*), but the drainage lines are only temporary and do not provide permanent water for crocodiles.

The study site falls outside the natural range of woodbush flat gecko (Afroedura multiporis multiporis), granite dwarf gecko (Lygodactylus graniticolus), Methuen's dwarf gecko (Lygodactylus methueni), Makgabeng dwarf gecko (Lygodactylus nigropunctatus montiscaeruli), Waterberg Dwarf Gecko (Lygodactylus waterbergensis), Coppery Grass Lizard (Chamaeasaura aenea), Large-scaled Grass Lizard (Chamaesaura macrolepis), unexpected flat lizard (Platysaurus intermedius inopinus), orange-throated flat lizard (Platysaurus monotropis), Fitzsimons' flat lizard (Platysaurus orientalis fitzimonsi), northern crag lizard (Pseudocordylus transvaalensis), Richard's legless skink (Acontias richardi), Woodbush legless skink (Acontias rieppeli), White-bellied dwarf burrowing skink (Scelotes limpopoensis albiventris), striped harlequin snake (Homoroselaps dorsalis) and giant bullfrogs (Pyxicephalus adspersus) and these species should not occur on the study site.

8.5 Surface Water

8.5.1 Eco Region

According to the delineation of Ecoregions within South Africa, the area falls within the Limpopo Plain Ecoregion (Level 1 Ecoregion). Plains and lowlands characterize this ecoregion with a low to moderate relief and vegetation consisting mostly of Bushveld types and Mopane veld, characterises this region. This is generally a low laying, dry to arid, hot region with virtually no perennial streams originating in the area itself. Perennial rivers that traverse this region include the Crocodile (west), Marico, Mokolo, Lephalala, and Mogalakwena.

Other general characteristics of the Ecoregion are as follows:

- Mean annual precipitation: Low to arid.
- Coefficient of variation of annual precipitation: Moderately high to high
- Drainage density: Mostly low but with some areas in the north having a high drainage density.
- Stream frequency: Mostly low to medium, but high in north-eastern areas.
- Slopes <5%: Generally, >80% of the area.
- Median annual simulated runoff: Very low to low.
- Mean annual temperature: High to very high
- Size = 39383.5 km^2

Table 34: Ecoregion Attributes (Department of Water Affairs, 2005)

Main attributes	Limpopo Plain Ecoregion
Terrain Morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief;** Plains; moderate relief; Lowlands; Hills and Mountains; moderate and high relief; Closed hills; Mountains; moderate and high relief (limited)
Vegetation types (dominant types in bold) (Primary)	**Mopane Bushveld; Sweet Bushveld; Mixed Bushveld;** Waterberg Moist Mountain Bushveld; Clay Thorn Bushveld; Kalahari Plains Thorn Bushveld
Altitude (mamsl)	300-1100 (1100-1300 limited)

MAP (mm)	200 to 600
Coefficient of variation (% of annual precipitation)	25 to 40
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to mid-summer
Mean annual temp (°C)	18 to 22
Mean daily max temp (°C) Feb.	26 to 32
Mean daily max temp (°C) July	20 to 24
Mean daily min temp (°C) Feb.	16 to 20
Mean daily min temp (°C) July	2 to >10
Median annual simulated runoff (mm) for quaternary catchment	<5 to 60 (60 - 100 limited)

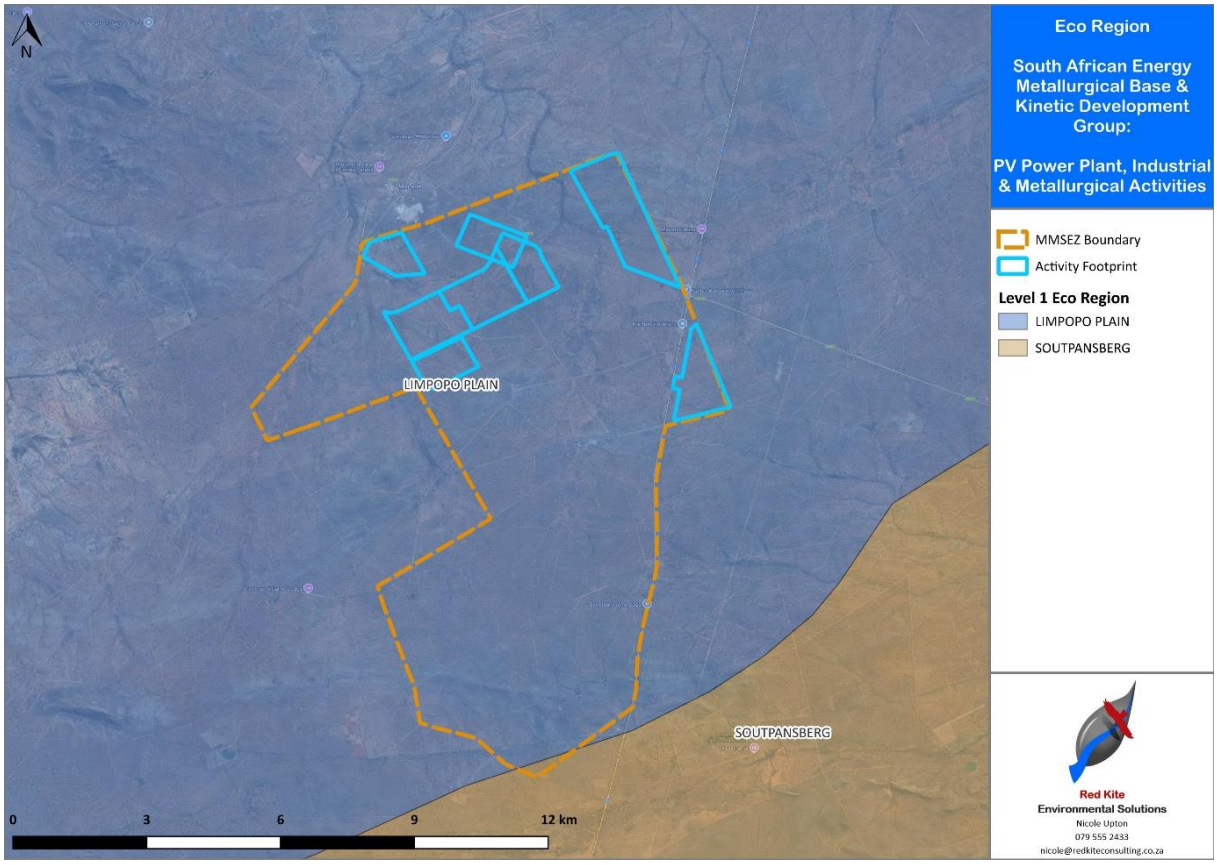


Figure 20: Eco Region for the Project Area

8.5.2 Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project is a multi-partner project between the Council for Scientific and Industrial Research (CSIR), the Water Research Commission, the South African National Biodiversity Institute, the Department of Forestry, Fisheries and the Environment, the South African Institute of Aquatic Biodiversity and South African National Parks. The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development (Nel, et al., 2011).

The FEPA project has three inter-related components:

- A technical component to identify a national network of freshwater conservation areas;
- A national governance component to align DFFE and DWS policies and approaches for conserving freshwater ecosystems; and
- A sub-national governance and management component that conducts case studies to demonstrate how NFEPA outcomes can be implemented (Nell *et al*, 2011).

The project area is located in the A71K quaternary catchment, which is designated as a Freshwater Ecosystem Priority Area (FEPA).

Fish sanctuaries for rivers in a good condition (A or B ecological category) were identified as FEPAs, and the whole sub-quaternary catchment was included. Phase 2 FEPAs in moderately modified rivers (C ecological category) were identified for those river ecosystem types that could not achieve a biodiversity target in good condition rivers. The condition of these Phase 2 FEPAs should not be degraded further, as they may in future be considered for rehabilitation once good condition FEPAs (in an A or B ecological category) are considered fully rehabilitated.

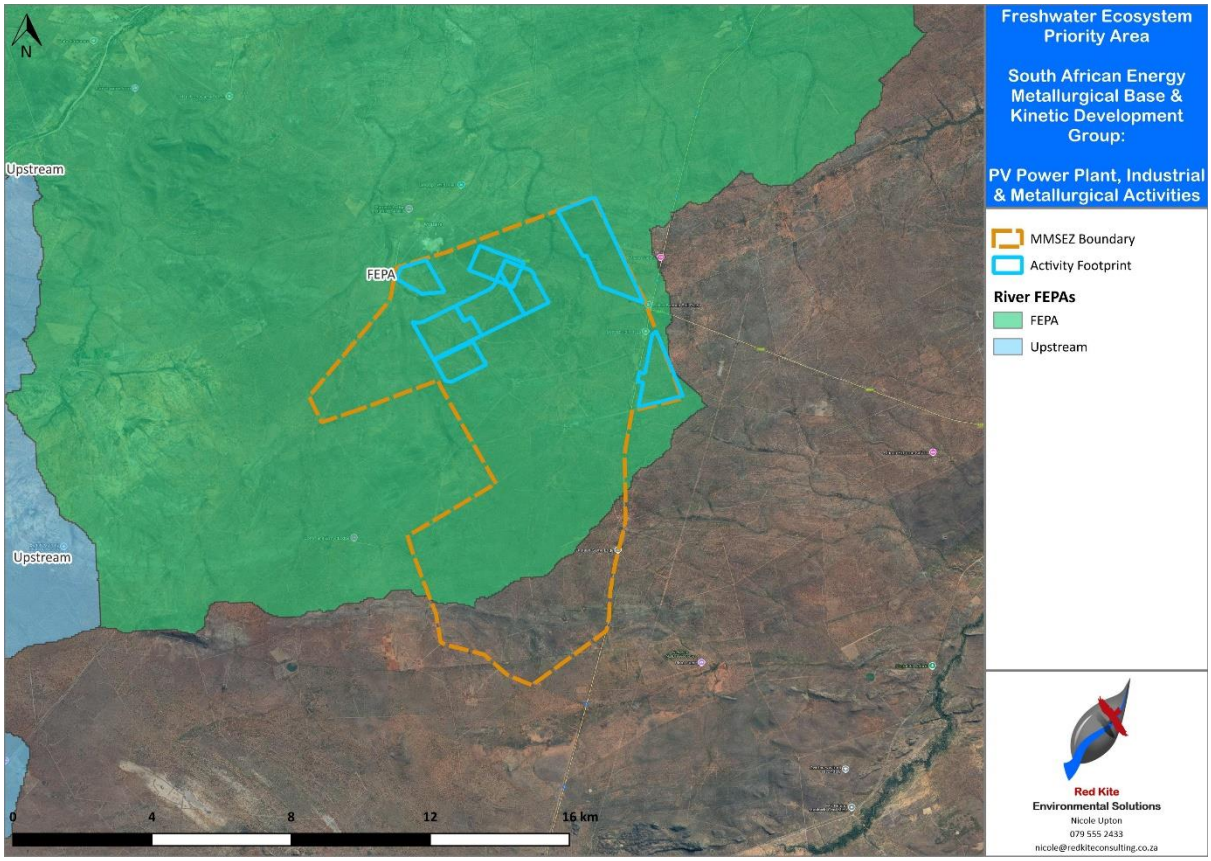


Figure 21: Freshwater Ecosystem Priority Areas for the Project Area

8.5.3 Catchment

The project area is located in the A71 tertiary catchment within the Limpopo Water Management Area (WMA) North, specifically in the A71K quaternary catchment. The major river in catchment A71K is the Sand River. The Sand River flows from south to

north and drains into the Limpopo River at the South African and Zimbabwe border, 7 Km east of Musina.

The Limpopo WMA forms part of the Limpopo River basin, which spans the four countries of Botswana, Zimbabwe, South Africa and Mozambique. The WMA includes the following major rivers: Limpopo River, Matlabas River, Mokolo River, Lephalala River, Mogalakwena River, Sand River and Nzhelele River and includes the following major dams:

- Cross Dam, in the Nwanedi River
- Doorndraai Dam, in the Sterk River
- Glen Alpine Dam, in the Mogalakwena River
- Luphephe Dam, in the Luphephe River
- Mokolo Dam, in the Mokolo River
- Mutshedzi Dam, in the Mutshedzi River
- Nwanedi Dam, in the Nwanedi River
- Nzhelele Dam, in the Nzhelele River

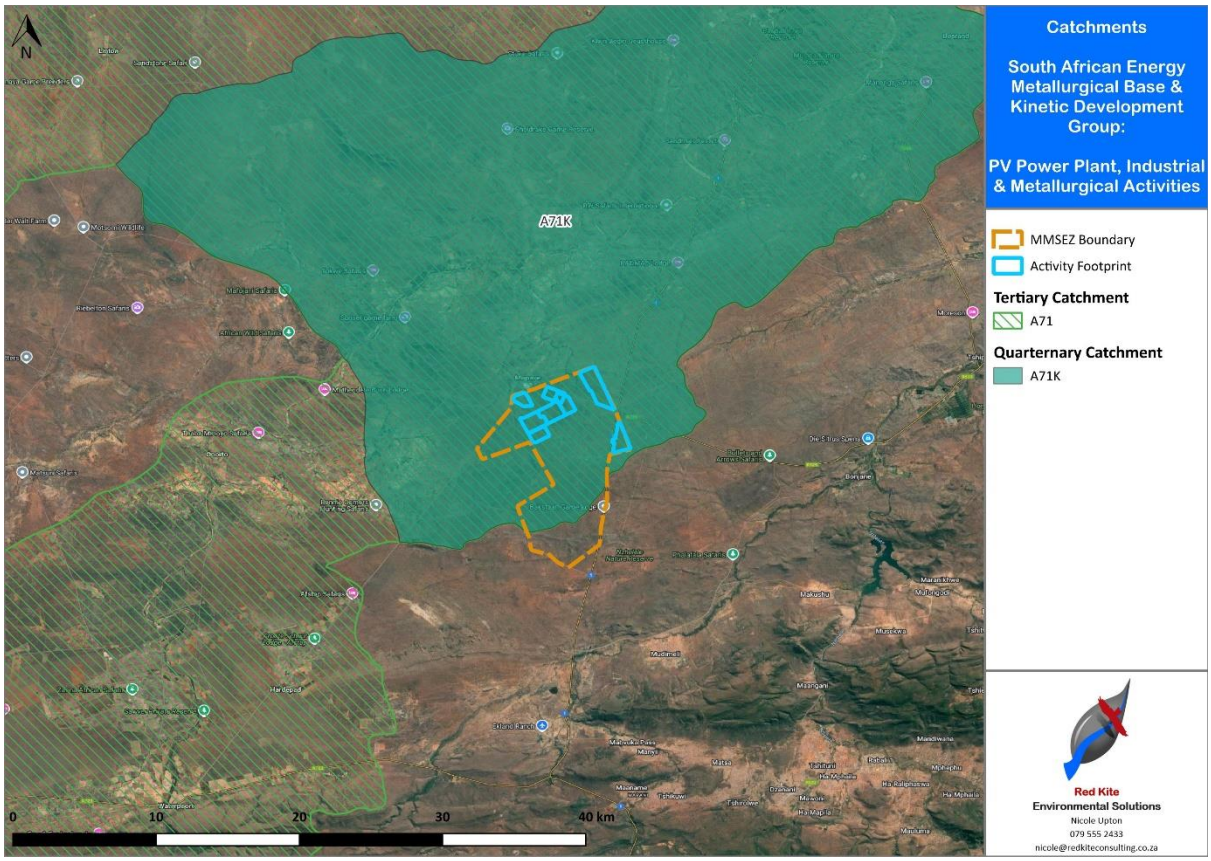


Figure 22: Quaternary Catchment A71K

8.5.4 Present Ecological State, Importance and Reserve

The details are summarised in the table below were sourced from the Determination of Water Resource Classes, Reserve and Resource Quality Objectives for Secondary Catchments A5-A9 within the Limpopo Water Management Area (WMA 1) and Secondary Catchment B9 in the Olifants Water Management Area (WMA 2),

Department of Water and Sanitation (March 2024). Not all aspects of the quaternary catchment have been identified and classified as this is an ongoing DWS project.

Table 35: PES, EIS and Reserve Data for Catchment

Component	A71K
River	Sand
EWR Site	SAND-A71K-R508B
Present Ecological Status (PES)	Class C
Recommended Ecological Status (REC)	Class C

Table 36: Classification of River Health Assessment Classes

Class	Description	% Change from Natural
A	Still in a natural condition.	>92 -100
A/B		>88 - 92
B	Slightly modified. A small change in natural habitats and biota has taken place but the ecosystem functions are essentially unchanged from natural.	>82 - 88
B/C		>78 - 82
C	Moderately modified from natural. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still unchanged.	>62 - 78
C/D		>58 - 62
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	>42 - 58
D/E		>38 - 42
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 - 38
F	Critically/Extremely modified. The system has been critically modified with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed, and the changes are irreversible.	<20

8.5.5 Surface Water Quality

There was no surface flow within the project area at the time of this study and therefore no surface water samples were taken and analysed to form a baseline. As with the classification and reserve determination, quality objectives are yet to be set for the catchment by DWS.

Instead, the South African Water Quality Guidelines Volume 7, Aquatic Ecosystems (DWAF, 1996) was used as a baseline Target Water Quality Range (TWQR) until the Resource Quality Objectives are identified by DWS.

Table 37: Target Water Quality Range (TWQR) - Aquatic Ecosystems

Variable	Unit	Aquatic Ecosystems
Aluminium (Al)	mg/ℓ	<0.01
Ammonia (NH_3)	mg/ℓ	<0.007
Arsenic (As)	mg/ℓ	<0.01
Cadmium (Cd)	mg/ℓ	<0.0004
Chlorine (Cl_2)	mg/ℓ	<0.0002
Trivalent Chromium (Cr III)	mg/ℓ	<0.012
Hexavalent Chromium (Cr VI)	mg/ℓ	<0.007

Variable	Unit	Aquatic Ecosystems
Copper (Cu)	mg/ℓ	<0.0014
Cyanide (CN)	mg/ℓ	<0.001
Fluoride (F)	mg/ℓ	<0.75
Iron (Fe)	mg/ℓ	<10% Variation
Lead (Pb)	mg/ℓ	<0.0012
Manganese (Mn)	mg/ℓ	<0.18
Mercury	mg/ℓ	<0.00004
Nitrate (NO3) and Nitrite (NO2)	mg/ℓ	<0.5
pH - Value	@ 25°C	<5% Variation
Phenol	mg/ℓ	0.03
Orthophosphate (PO4)	mg/ℓ	<15% Variation
Selenium (Se)	mg/ℓ	<0.002
Temperature	^{O}C	<10% Variation
Total Dissolved Solids (TDS)	mg/ℓ	<15% Variation
Total Suspended Solids (TSS)	mg/ℓ	<10% Variation
Zinc (Zn)	mg/ℓ	<0.002

8.5.6 Surface Water Resources and Drainage Systems

Multiple drainage lines were identified within and around the project site. Activities were planned to avoid the major drainage lines and farm dams. All drainage lines in and around the activities are non-perennial.

The site drains through two non-perennial unnamed tributaries of the Sand River on the north-eastern and north-western sections of the site. These drainage lines converge north of Mopane before the confluence with the Sand River further north.

The Sand River continues north-east for approximately 40 km before draining into the Limpopo River at the South Africa and Zimbabwe border. The Limpopo River continues as the South African border up to Mozambique, where it continues south-east through Mozambique and drains into the Indian Ocean. Figure 23 below, depicts the surface water resources surrounding the operation footprint.

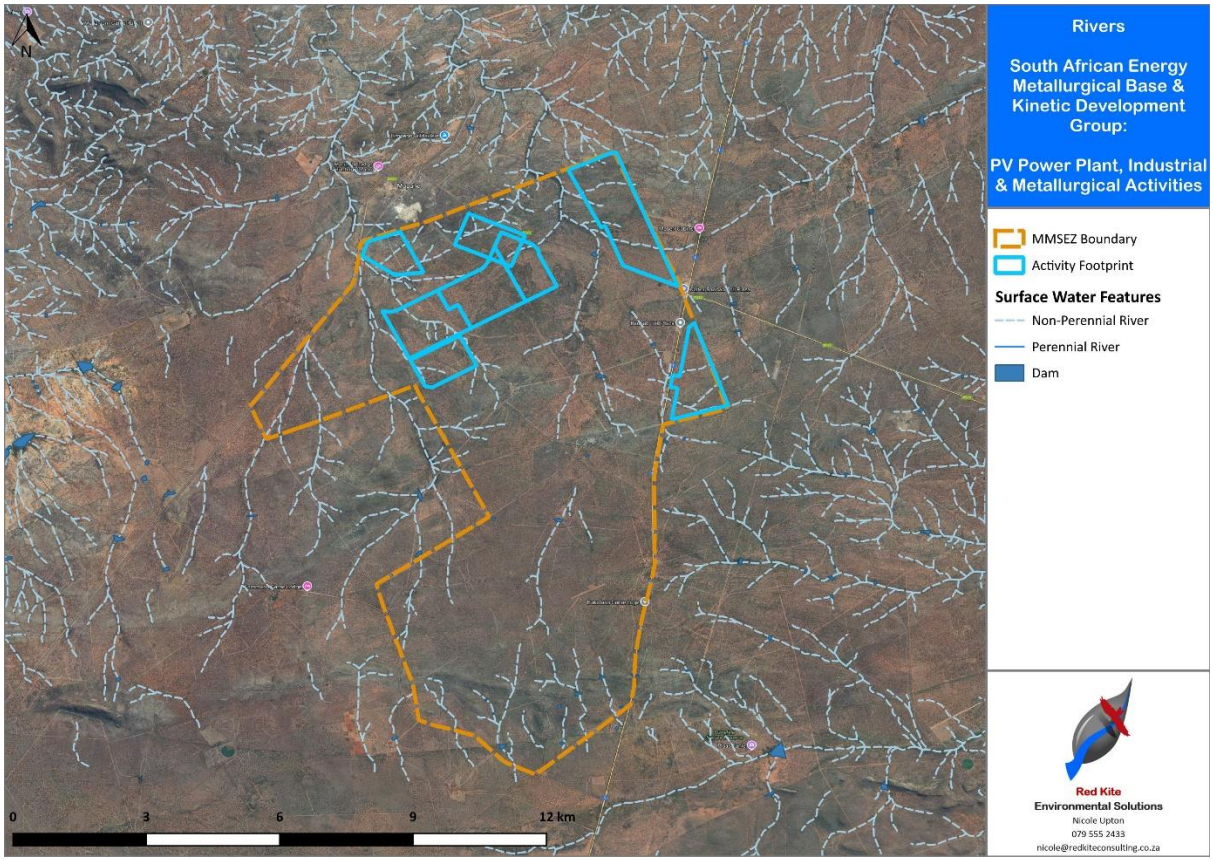


Figure 23: Surrounding Surface Water Resources – Project Area

8.5.7 Current Water Users

The project area is largely undeveloped with limited mining and livestock being the main uses in the areas surrounding the sites. On a macro level, agriculture developments are found next to the Sand River. Overall, the current surface water uses in the area are very limited.

8.5.8 Wetlands and Sensitivity

There are no wetlands within 500m of the project footprint, which is supported by the 1:50000 ortho-maps, as well as the NFEPA database.

The drainage lines found on site are all non-perennial, and are expected to only containing water during and shortly after heavy rain events. Due to the limited rainfall and high evaporation in the area, riparian and wetland areas will be unlikely. Drainage lines are expected to only have denser vegetation consistent with the surrounding areas – See Figure 23 above.

No significant watercourses, riparian areas or wetlands are located within 100 m of the project footprint, based on the study. Impacted drainage lines are non-perennial and are expected to be of medium sensitivity. Therefore, in terms of surface water features, the entire project footprint and 100 m project area buffer is expected to be of medium sensitivity.

8.6 Groundwater

8.6.1 Groundwater Setting

8.6.1.1 Geohydrology and Aquifers

According to the 1:500 000 General Hydrogeological Map the rocks underlying the site typically act as secondary aquifers (intergranular and fractured rock aquifers). However, the multi-layered weathering system present on these rocks could prove to have up to two aquifer systems present in the form of a shallow, saprolitic aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and an intergranular and fractured bedrock aquifer.

Unsaturated Zone - Shallow, Aquifer

The main source of recharge into the shallow aquifer is rainfall that infiltrates the aquifer through the unsaturated (vadose) zone. Vertical movement of water is faster than lateral movement in this system as water moves predominantly under the influence of gravity.

Saturated Zone – Intergranular & Fractured, Bedrock Aquifer

The undifferentiated Mikambeni and Madzaringwe geological layers act as fractured aquifers. The Gumbu geological group act as an intergranular and fractured aquifer. Groundwater occurs mainly in faults and associated shear zones as well as fractured contact zones between mafic and acidic rocks and dyke contacts.

8.6.2 Groundwater Availability and Recharge

The analysis of 79 borehole records within the Mikambeni and Madzaringwe geological layers indicates that 32% of the yields are between 0.5 and 2l/s, 29% are less than 0.5l/s and 40% are more than 2l/s. However, the Gumbu geological group yield analysis shows that 75% of the successful boreholes yield less than 2ℓ/s. Due to the low and erratic rainfall in this area, together with periodical droughts and the dense vegetation in places, recharge events are very irregular. These factors, together with abstraction contributed significantly to the generally deep-water levels (30-60m) occurring in the area. The Gumbi Geological Unit is the dominant underlying formation in the area, which generally exhibits low groundwater potential. The overall area in general, therefore ha a low groundwater potential.

Recharge to the shallow, unconfined aquifer was calculated using the RECHARGE program developed by the Institute for Groundwater Studies at the University of the Free State, South Africa. The calculated recharge percentage using a certainty of 3 and higher equates to approximately 2% of annual precipitation.

Table 38: Recharge Calculation for the Shallow Unconfined Aquifer

Recharge Estimation			
Method	**Mm/a**	**% of Rainfall**	**Certainty Very High = 5 Low = 1**
Chloride	1	0.4	3
Various Schematic Maps			

Soil	19.2	5.9	2
Geology	13.0	4.0	3
Vegter	3.0	0.9	3
Acru	10.0	3.1	3
Harvest Potential	6.0	1.8	3

8.6.3 Hydrocensus

The national groundwater archive was utilized to identify the locations of existing boreholes within the surrounding area of the site. Locals and residents were questioned for any additional boreholes that might not be reported in the groundwater archive. A total of 14 locations were visited based on the gathered information.

Out of these, only 11 locations had boreholes where water level measurements could be taken. Three boreholes were found to be either dry or blocked. An electrical contact water level meter (dipmeter) was used to determine water level in the boreholes and the depth of the boreholes. The depth of boreholes with installed pumps could not be measured. A summary of the collected hydrocensus data is presented in Table 39 and a hydrocensus map in Figure 24.

Table 39: Hydrocensus Data Summary

Borehole ID	Longitude	Latitude	Elevation	WL (mbgl)	WL mamsl (mamsl)	Coller Height (m)	Water Use	Pump Installed	Owner	Comment
KB01	29.92162	-22.628882	681.7993	25.6	656.1993	0	Domestic & Livestock	Submersible	Hennie Erwee	Borehole at guesthouse, several more boreholes on property with only one surveyed.
KB02	29.919056	-22.64075	692.2986	26.14	667.0386	-0.44	Domestic	Submersible	Ashtron Energies	Water is of poor quality, not used for drinking.
KB03	29.882789	-22.624	681.0763	29.74	651.0763	0.13	Domestic & Livestock	Submersible	Thomas Sthagathaga	Water is of poor quality, not used for drinking.
KB04	29.863774	-22.615368	675.074	30.99	642.284	0.9	Sample Only	None	Public	Green Monitoring well next to the R525 near Mopane
KB05	29.846882	-22.622381	658.5936	NM	NM	NM	Domestic	Submersible	Mopane Intermediate School	Borehole Buried
KB06 (H18-0579)	29.854299	-22.61567	662.8	17.34	645.04	0.21	Domestic	Submersible	Mopane Intermediate School	BH used by school as drinking water supply.
KB07	29.871034	-22.631684	682.4738	28.97	653.0838	0.21	Not in use	None	Mulambwane CPA	Borehole not in use
KB08 (BH08)	29.85305	-22.636207	670.8857	19.35	651.2357	0.15	Domestic & Livestock	Submersible	Mulambwane CPA	
KB09	29.882203	-22.630405	674.3868	20.1	653.1268	0.58	Domestic & Livestock	Submersible	Mulambwane CPA	
KB10	29.889789	-22.667204	706.2468	33.42	672.4068	0.21	Not in use	None	Mulambwane CPA	Borehole not in use
KB11 (BH09)	29.899544	-22.656575	694.215	21.36	672.035	0.41	Domestic & Livestock	Submersible	Mulambwane CPA	Borehole used for drinking water
KB12	29.876626	-22.687902	720.8456	32.49	688.2356	0.06	Not in use	None	Mulambwane CPA	Borehole not in use
KB13	29.913014	-22.652005	695.5615	NM	NM	NM	Domestic	Submersible	Ashtron Energies	Borehole locked, could not access.
KB14	29.917632	-22.646846	700.1092	NM	NM	NM	Domestic	Submersible	Boabab Toll Plaza	Dipmeter stuck/stopped at 39mbgl
NM: Not Measured										

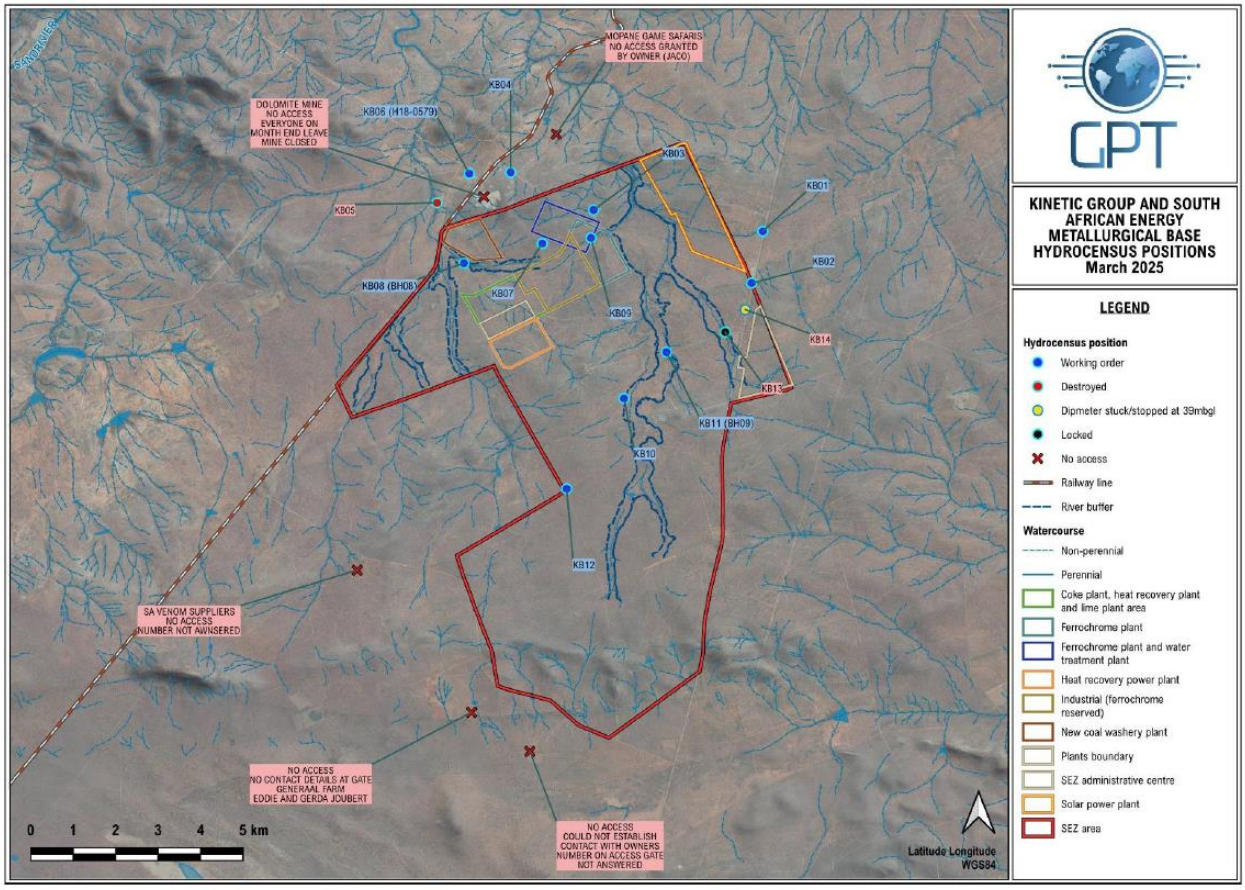


Figure 24: Hydrocensus Map

8.6.4 Groundwater Levels

The water levels ranged between 17.34 mbgl and 33.42 mbgl with an average of 25.95 mbgl.

Table 40: Groundwater Levels

Borehole ID	WL (mbgl)
KB01	25.6
KB02	26.14
KB03	29.74
KB04	30.99
KB06 (H18-0579)	17.34
KB07	28.97
KB08 (BH08)	19.35
KB09	20.1
KB10	33.42
KB11 (BH09)	21.36
KB12	32.49

A correlation coefficient was calculated from the hydrocensus points with available water level data. This relationship helps distinguish between boreholes with static water levels and those with anomalous levels due to disturbances like pumping or local hydrogeological heterogeneities. Generally, a good correlation should exist between topography and static groundwater level.

A correlation of 0.898 was calculated using the boreholes, indicating a strong correlation (Figure 25). This correlation between groundwater levels and elevation can be used for quick estimations of expected groundwater levels at various elevations within the vicinity of the site.

A groundwater flow map was created using the available groundwater levels during the hydrocensus, the map is depicted in Figure 26, and displays that the general groundwater flow direction is to the north of the site.

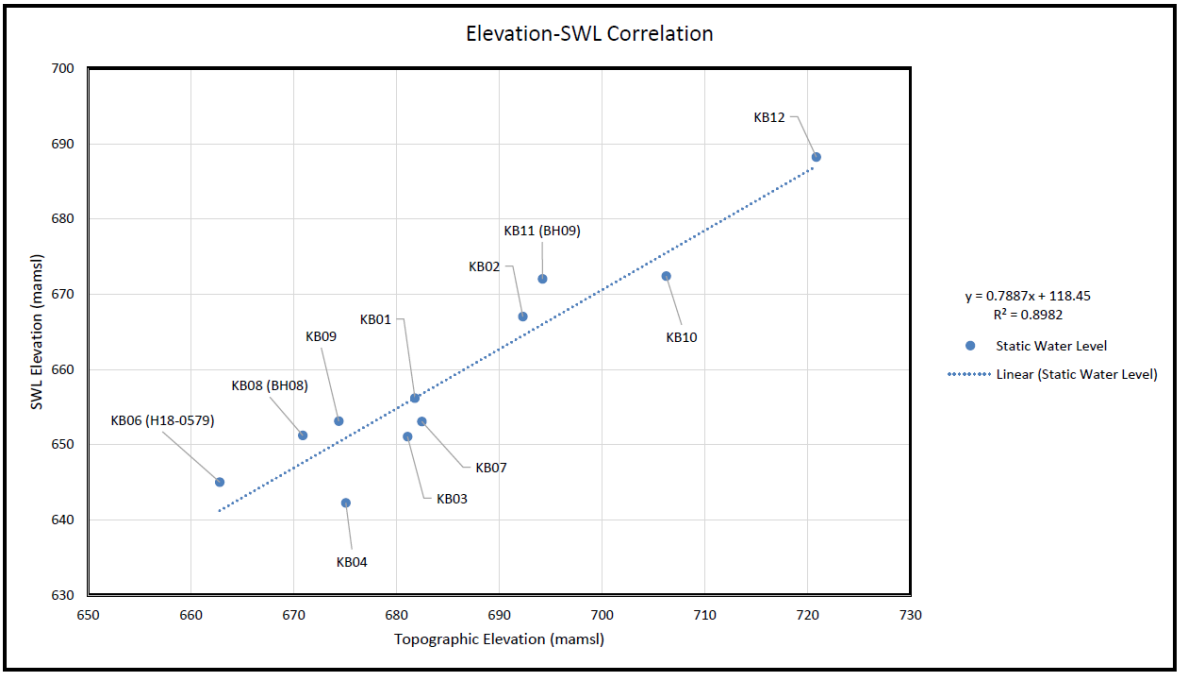


Figure 25: Correlation Graph of Topography vs Available Groundwater Levels

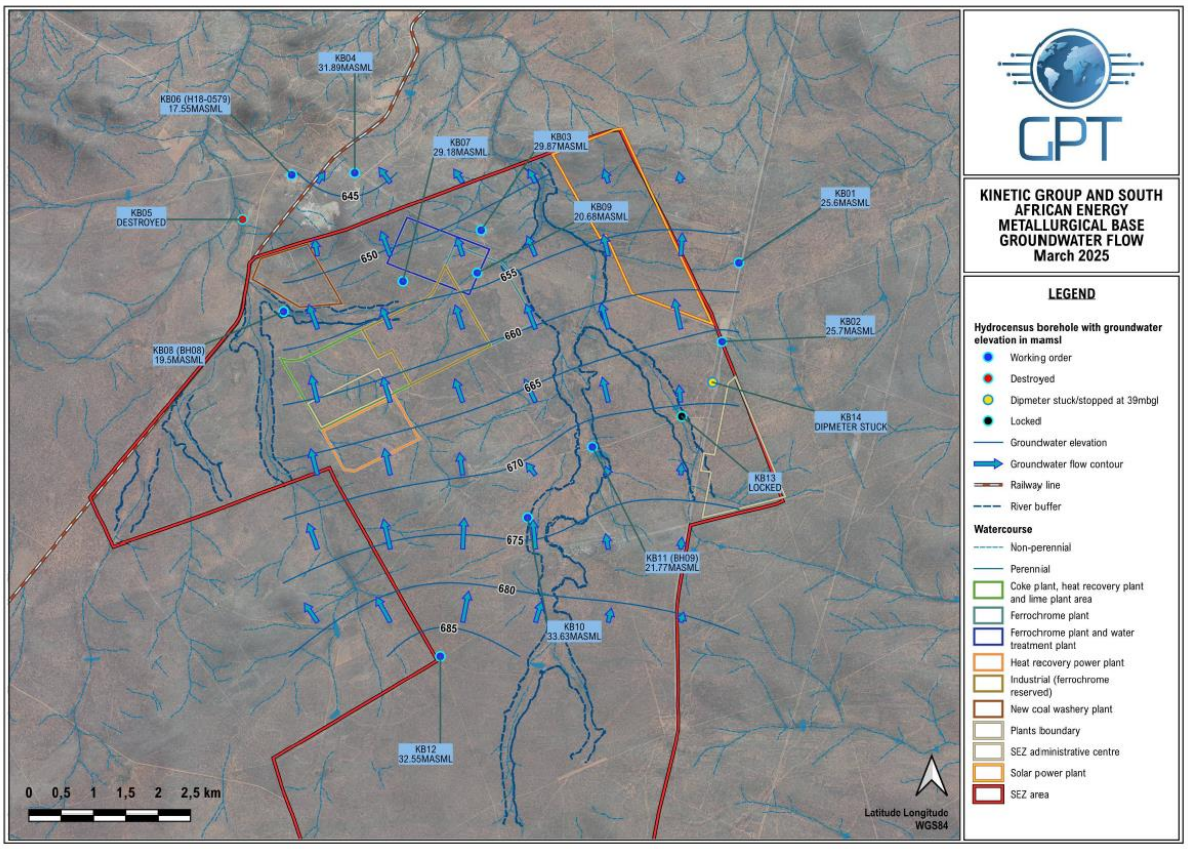


Figure 26: Groundwater Flow Map

8.6.5 Potential Groundwater Contaminants

A ferrochrome plant is a facility that produces ferrochrome, an alloy of iron and chromium primarily used in the steel industry. The production process typically involves smelting chromite ore with coke or coal at high temperatures in a submerged arc furnace. This process results in the generation of various waste products, including slag, dust, and effluent, which pose potential environmental risks, particularly to groundwater resources.

At a ferrochrome smelter, potential sources of groundwater contamination are primarily associated with the storage, handling, and disposal of raw materials, process residues, and waste products. However, the most significant source of contaminants is the slag produced during the smelting process. Slag is the stony waste matter separated from metals during smelting or refining, and its disposal is a key concern due to its chemical composition and potential to leach hazardous substances. There is a tendency for metal industry leachates to include elevated concentrations of the following constituents:

- Heavy metals, particularly hexavalent chromium
- Fluoride
- Ammonia
- Sulphate
- Sodium

There exists the potential for heavy metals—especially Cr(VI)—to be progressively released through the weathering of slag materials. These elements may then be transported by acidic leachates. Potentially harmful leachates from the ferrochrome slag facility are characterised by hexavalent chromium [Cr(VI)].

Chromium is commonly used in the production of alloys and corrosion-resistant steel and iron. This metal is particularly dangerous since it accumulates in many organisms (Duffus, 1980). It is said that chromium is involved in fatty acid metabolism in humans. It is also an essential element needed for the proper functioning of insulin (Kempster and Smith, 1985). Chromium (III) is less readily absorbed via the gastrointestinal tract than chromium (VI). Consequently, the toxic effects of chromium are usually caused by the hexavalent form. Acute effects from oral exposure include the corrosion of the gastrointestinal tract and kidney necrosis (Rudd, 1987). Furthermore, the hexavalent form of chromium is recognised as a mammalian carcinogen. It should be noted that chromium (III) compounds are more toxic to fish than the hexavalent compounds.

Chromium is normally present in the environment as poorly soluble trivalent salts of low toxicity (Rudd, 1987). Since chromium (III) may be oxidised to the more toxic hexavalent form, it is suggested that the standards for drinking water should be expressed in terms of the total chromium concentration (Schroeder and Lee, 1975). The rate at which chromium (III) is oxidised under normal conditions is uncertain. However, oxidation of this element is likely to be accelerated during the chlorination of drinking water.

8.6.6 Groundwater Quality

Six water samples were selected from boreholes found during the hydrocensus. The locations were selected based on their spatial relevance to the potential development area. The analysis mainly serves as a baseline reference for current constituent levels present within the aquifer at the site.

The chemical results of these samples were compared to the maximum recommended concentrations for drinking water, as outlined in SANS 241-1:2015 target water quality limits, as well as the Department of Water Affairs and Forestry (DWAF) guidelines for domestic use and industrial use. The drinking water limits, and domestic use limits provide an indication of suitability of water use for domestic purposes. The industrial use limits help assess the suitability of the water available for various industrial processes. Any exceedances do not imply that the aquifer or groundwater has been contaminated, it provides a baseline of the current groundwater status quo before any developments took place.

The results of the screening for groundwater are presented in Table 41, Table 42, Table 43 and discussed in the sections below:

The groundwater quality at the site exceeds several guideline limits for drinking, domestic and industrial applications. The water is can therefore generally be classified as having poor-quality and can be considered brackish, with elevated concentrations of dissolved salts.

8.6.6.1 Pie Diagrams

The pie diagrams (Figure 27) show both the individual ions present in a water sample and the total ion concentrations in meq/l or mg/l. The scale for the radius of the circle represents the total ion concentrations, while the subdivisions represent the individual ions. It is very useful in making quick comparisons between waters from different sources and presents the data in a convenient manner for visual inspection. From the tables and figures the following can be deduced:

Borehole KB07, located to the north of the site, exhibits the comparatively highest total ion concentration and is characterized by a Sodium/Magnesium–Chloride-type water. Similarly, boreholes KB06 and KB09 also display a Sodium/Magnesium signature; however, their anionic composition reflects a more balanced ratio between chloride and bicarbonate. KB03, while also showing a large chloride presence, is predominantly influenced by a bicarbonate anion signature. In contrast, KB11, located to the south of the site, has the lowest total ion concentration and is dominated by a Bicarbonate–Sodium water type.

8.6.6.2 Classed Concentration Maps

The concentrations of three constituents; chloride, sodium, and sulphate were mapped across the analysed boreholes. These concentrations were compared against the target water quality ranges for domestic use, and the results were classified accordingly on the maps. The maps are used to spatially illustrate the distribution of some constituents that exceed the limits specified in the domestic water use guidelines is several boreholes. The maps are shown in Figure 28, Figure 29 and Figure 30.

The maps indicate that KB07, followed by KB06, are the boreholes with the most frequent exceedances of the Target Water Quality Range (TWQR) limits. It is also evident that constituent concentrations generally increase toward the north of the site, while the borehole to the south exhibit overall better water quality in comparison to the domestic TWQR thresholds.

Table 41: Water Qualities Compared to SANS 241-1:2015 Guidelines for Drinking Water.

Determinant	Risk	Unit	Standard limits	KB03	KB06	KB07	KB08	KB09	KB11
Physical and aesthetic determinants									
Total dissolved solids	Aesthetic	mg/L	1 200	2233	2345	7665	1785	1983	1023
Conductivity at 25 °C	Aesthetic	mS/m	170	319	335	1095	255	283.3	146.1
pH at 25 °C [b]	Operational	pH units	5 to 9.7	7.61	8.11	7.17	7.63	7.56	7.81
Chemical determinants – macro-determinants									
Nitrate as N (NO_3 - N)	Acute health	mg/L	11	BDL	BDL	BDL	BDL	BDL	BDL
Nitrite as N (NO_2 - N)	Acute health	mg/L	0.9	BDL	BDL	BDL	BDL	BDL	BDL
Combined nitrate plus nitrite (NO_3+NO_2)	Acute health		1	BDL	BDL	BDL	BDL	BDL	BDL
Sulfate as SO_4^{2-}	Acute health	mg/L	500	186	280.8	986.8	170.3	187.7	37.49
	Aesthetic	mg/L	250	186	280.8	986.8	170.3	187.7	37.49
Fluoride as F^-	Chronic health	mg/L	1.5	1.51	2.12	1.21	1.64	1.61	1.44
Ammonia as N	Aesthetic	mg/L	1.5	0.34	0.08	0.31	0.08	0.32	0.06
Chloride as Cl^-	Aesthetic	mg/L	300	489.2	622.1	2849	359.6	491.4	92.03
Sodium as Na	Aesthetic	mg/L	200	309.1	225.2	837.5	223.1	238.8	169
Zinc as Zn	Aesthetic	mg/L	5	0.07	BDL	BDL	0.06	BDL	0.07
Chemical determinants – micro-determinants									
Arsenic as As	Chronic health	mg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Boron as B	Chronic health	mg/L	2.4	0.95	0.86	BDL	0.71	0.73	BDL
Copper as Cu	Chronic health	mg/L	2	0.23	0.05	BDL	BDL	BDL	0.05
Iron as Fe	Aesthetic	mg/L	0.3	0.08	BDL	BDL	BDL	BDL	BDL
Lead as Pb	Chronic health	mg/L	0.01	BDL	BDL	BDL	BDL	BDL	BDL
Manganese as Mn	Aesthetic	mg/L	0.1	0.05	BDL	BDL	BDL	BDL	BDL
Nickel as Ni	Chronic health	mg/L	0.07	BDL	BDL	BDL	BDL	BDL	BDL
Aluminium as Al	Operational	mg/L	0.3	0.13	0.16	BDL	0.07	0.13	0.53
Microbiological determinants									
E. coli [a] or faecal coliforms [b]	Acute health	cfu/100 mL	0	0	0	0	46	0	72
Total coliforms [d]	Operational	cfu/100 mL	10	150	1720	41700	280000	300	510000
BDL = Below Detection Limit									
Exceed Risk Limit									

Table 42: Water Qualities Compared to DWAF Domestic Use Guidelines

Water Quality Constituents		KB03	KB06	KB07	KB08	KB09	KB11	TWQR	Tolerable	Exceeding TWQR
Total Alkalinity	M Alk. [mg/l CaCO3]	782.50	515.00	745.00	565.00	510.00	577.50	*Not available*		
Aluminium	Al [mg/l]	0.13	0.16	BDL	0.07	0.13	0.53	0 - 0.15	0.15 - 0.5	> 0.5
Ammonia	NH_3 [mg/l]	0.34	0.08	0.31	0.08	0.32	0.06	0 - 1.0	1.0 - 10	> 10.0
Arsenic	As [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	0 - 10	10 - 200	> 200
Boron	B [mg/l]	0.95	0.86	BDL	0.71	0.73	<0.5	*Not available*		
Calcium	Ca [mg/l]	64.16	156.90	393.60	84.66	83.52	43.58	0 - 32	32 - 80	> 80
Chloride	Cl [mg/l]	489.20	622.10	2849.00	359.60	491.40	92.03	0 - 100	100 - 600	> 600
Chromium	Cr [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	0 - 0.050		> 0.050
Copper	Cu [mg/l]	0.23	0.05	BDL	BDL	BDL	0.05	0 - 1	1 - 30	> 30
Electrical Conductivity	EC [mS/m]	319.00	335.00	1095.00	255.00	283.30	146.10	*Not available*		
Fluoride	F [mg/l]	1.51	2.12	1.21	1.64	1.61	1.44	0 - 1.0	1.0 - 1.5	> 1.5
Iron	Total Fe [mg/l]	0.08	BDL	BDL	BDL	BDL	BDL	0 - 0.1	0.1 - 1.0	> 1.0
Lead	Pb [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	0 - 10	10 - 50	> 50
Magnesium	Mg [mg/l]	168.20	197.30	758.90	128.40	145.50	64.29	0 - 30	30 - 70	> 70
Manganese	Mn [mg/l]	0.05	BDL	BDL	BDL	BDL	BDL	0 - 0.05	0.05 - 1.0	> 1.0
Nickel	Ni [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
Nitrate	NO_3 as N [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	0 - 6		> 6
pH	pH units	7.61	8.11	7.17	7.63	7.56	7.81	6.0 - 9.0		9
Potassium	K [mg/l]	22.49	16.12	55.27	19.57	16.68	9.25	0 - 50	50 - 100	> 100
Sodium	Na [mg/l]	309.10	225.20	837.50	223.10	238.80	169.00	0 - 100	100 - 200	> 200
Sulphate	SO_4 [mg/l]	186.00	280.80	986.80	170.30	187.70	37.49	0 - 200	200 - 400	> 400
Total Dissolved Solids	TDS [mg/l]	2233.00	2345.00	7665.00	1785.00	1983.00	1023.00	0 - 450	450 - 1 000	> 1000
Zinc	Zn [mg/l]	0.07	BDL	BDL	0.06	BDL	0.07	0 - 3	3 - 10	> 10

BDL: Below Detection Limit

TWQR- Target water quality range

Tolerable - Suitable for short-term intake,
in some instances health problems can occur during extensive long-term intake
in sensitive individuals such as infants

Exceeding TWQR- Exceedance of target water quality range may lead to adverse affects

Table 43: Water Qualities Compared to DWAF Industrial Use

Water Quality Constituents		KB03	KB06	KB07	KB08	KB09	KB11	TWQR	Moderate	Exceeding TWQR
Total Alkalinity	M Alk. [mg/l CaCO3]	0.00	515.00	745.00	565.00	510.00	577.50	0 - 50	50 - 120	> 120
Aluminium	Al [mg/l]	0.13	0.16	BDL	0.07	0.13	0.53	*Not available*		
Ammonia	NH_3 [mg/l]	0.34	0.08	0.31	0.08	0.32	0.06	*Not available*		
Arsenic	As [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
Boron	B [mg/l]	0.95	0.86	BDL	0.71	0.73	<0.5	*Not available*		
Calcium	Ca [mg/l]	64.16	156.90	393.60	84.66	83.52	43.58	*Not available*		
Chloride	Cl [mg/l]	489.20	622.10	2849.00	359.60	491.40	92.03	0 - 20	20 - 50	> 50
Chromium	Cr^{6+} [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
Copper	Cu [mg/l]	0.23	0.05	BDL	BDL	BDL	0.05	*Not available*		
Electrical Conductivity	EC [mS/m]	319.00	335.00	1095.00	255.00	283.30	146.10	*Not available*		
Fluoride	F [mg/l]	1.51	2.12	1.21	1.64	1.61	1.44	*Not available*		
Iron	Total Fe [mg/l]	0.08	BDL	BDL	BDL	BDL	BDL	*Not available*		
Lead	Pb [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
Magnesium	Mg [mg/l]	168.20	197.30	758.90	128.40	145.50	64.29	*Not available*		
Manganese	Mn [mg/l]	0.05	BDL	BDL	BDL	BDL	BDL	*Not available*		
Nickel	Ni [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
Nitrate	NO_3 as N [mg/l]	BDL	BDL	BDL	BDL	BDL	BDL	*Not available*		
pH	pH units	7.61	8.11	7.17	7.63	7.56	7.81	7.0 - 8.0	6.0-7, 8.0-9.0	<6, >9
Potassium	K [mg/l]	22.49	16.12	55.27	19.57	16.68	9.25	*Not available*		
Sodium	Na [mg/l]	309.10	225.20	837.50	223.10	238.80	169.00	*Not available*		
Sulphate	SO_4 [mg/l]	0.00	280.80	986.80	170.30	187.70	37.49	0 - 30	30 -150	> 150
Total Dissolved Solids	TDS [mg/l]	2233.00	2345.00	7665.00	1785.00	1983.00	1023.00	0 - 100	100 - 450	> 450
Zinc	Zn [mg/l]	0.07	BDL	BDL	0.06	BDL	0.07	*Not available*		

BDL: Below Detection Limit

TWQR- Target water quality range

Moderate damage or interference with processes or impairment of product quality

Exceeding TWQR- Significant damage or interference with processes or impairment of product quality

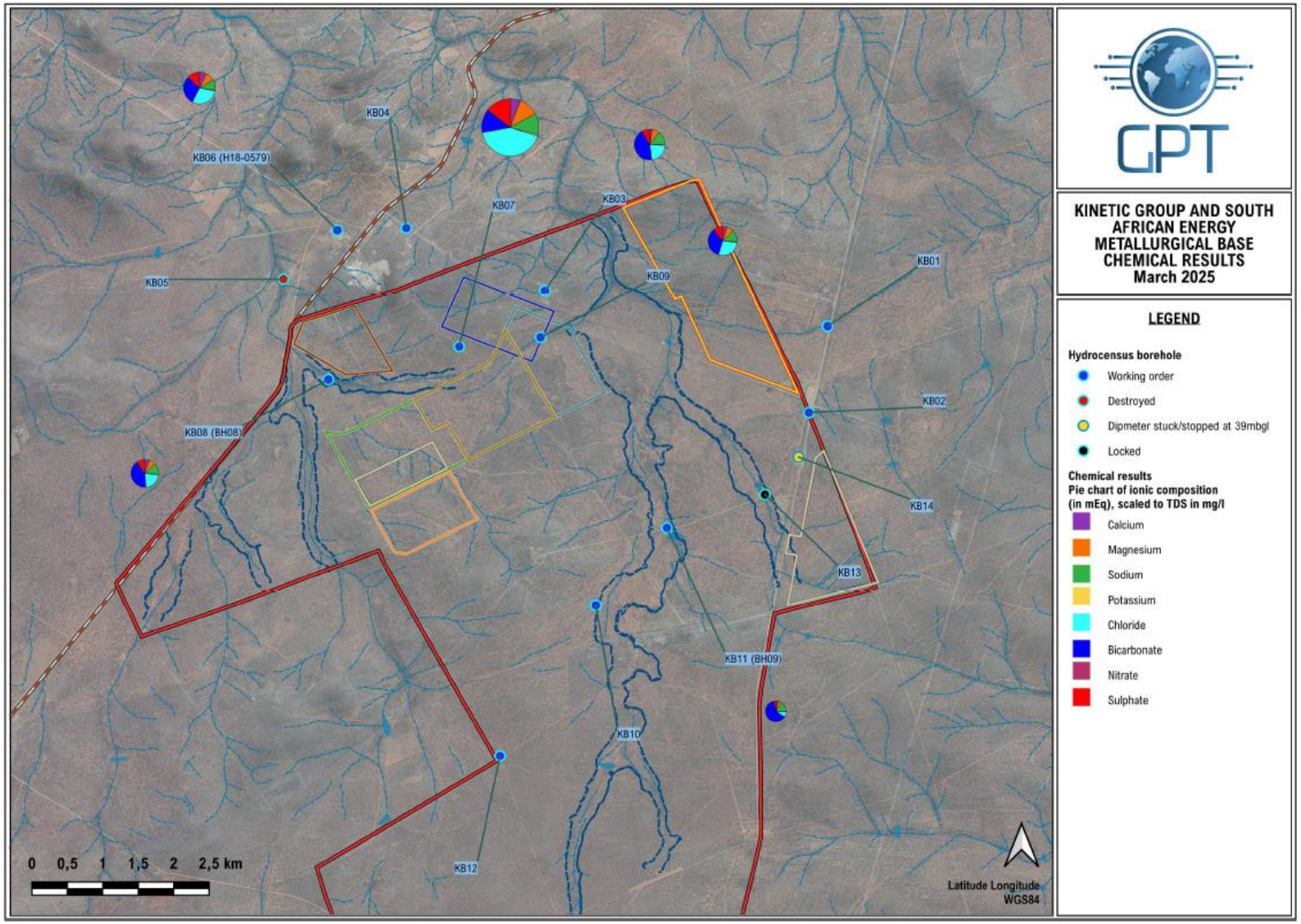


Figure 27: Groundwater and Surface Water Pie Diagram

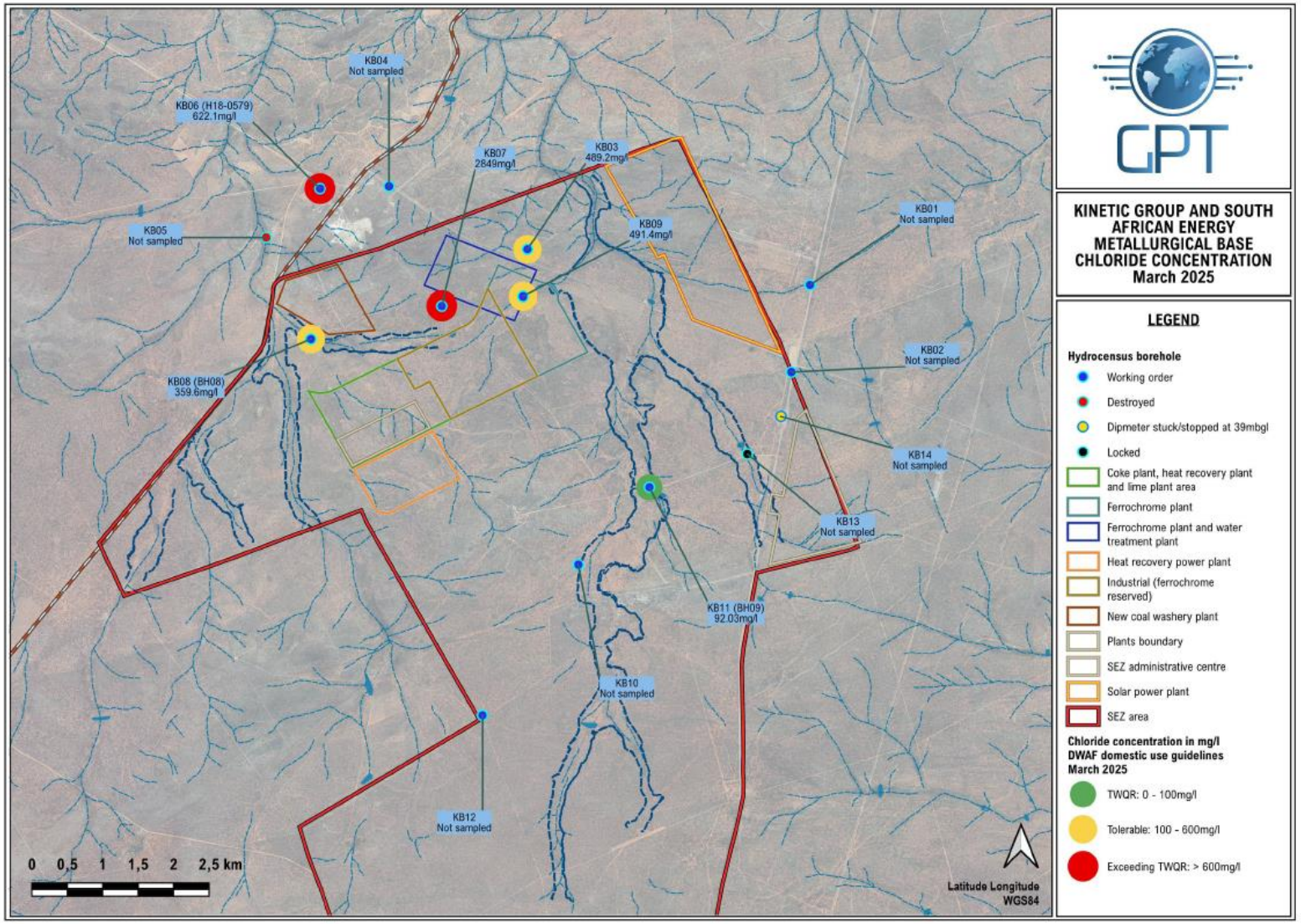


Figure 28: Chloride Classed Concentration Map

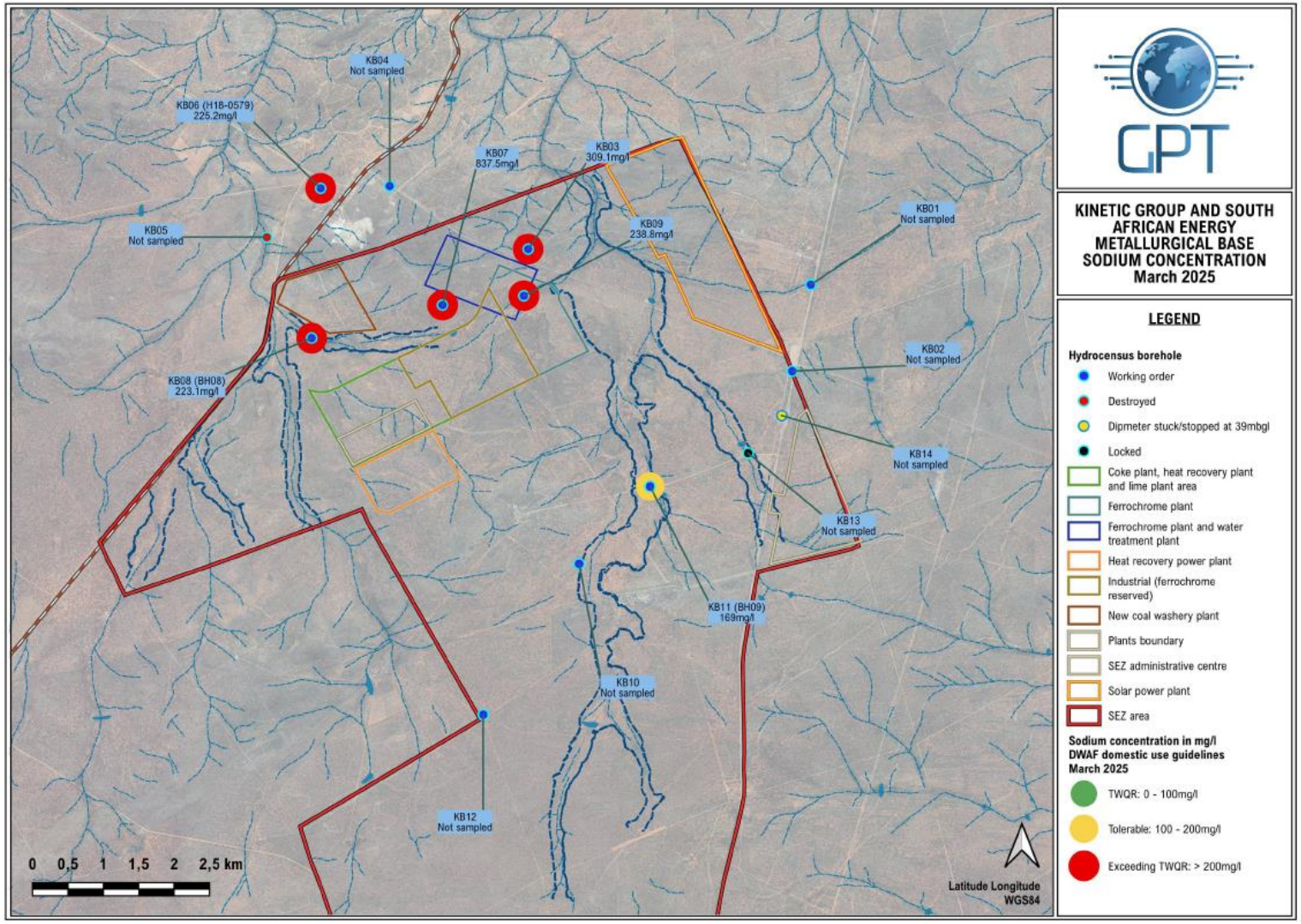


Figure 29: Sodium Classed Concentration Map

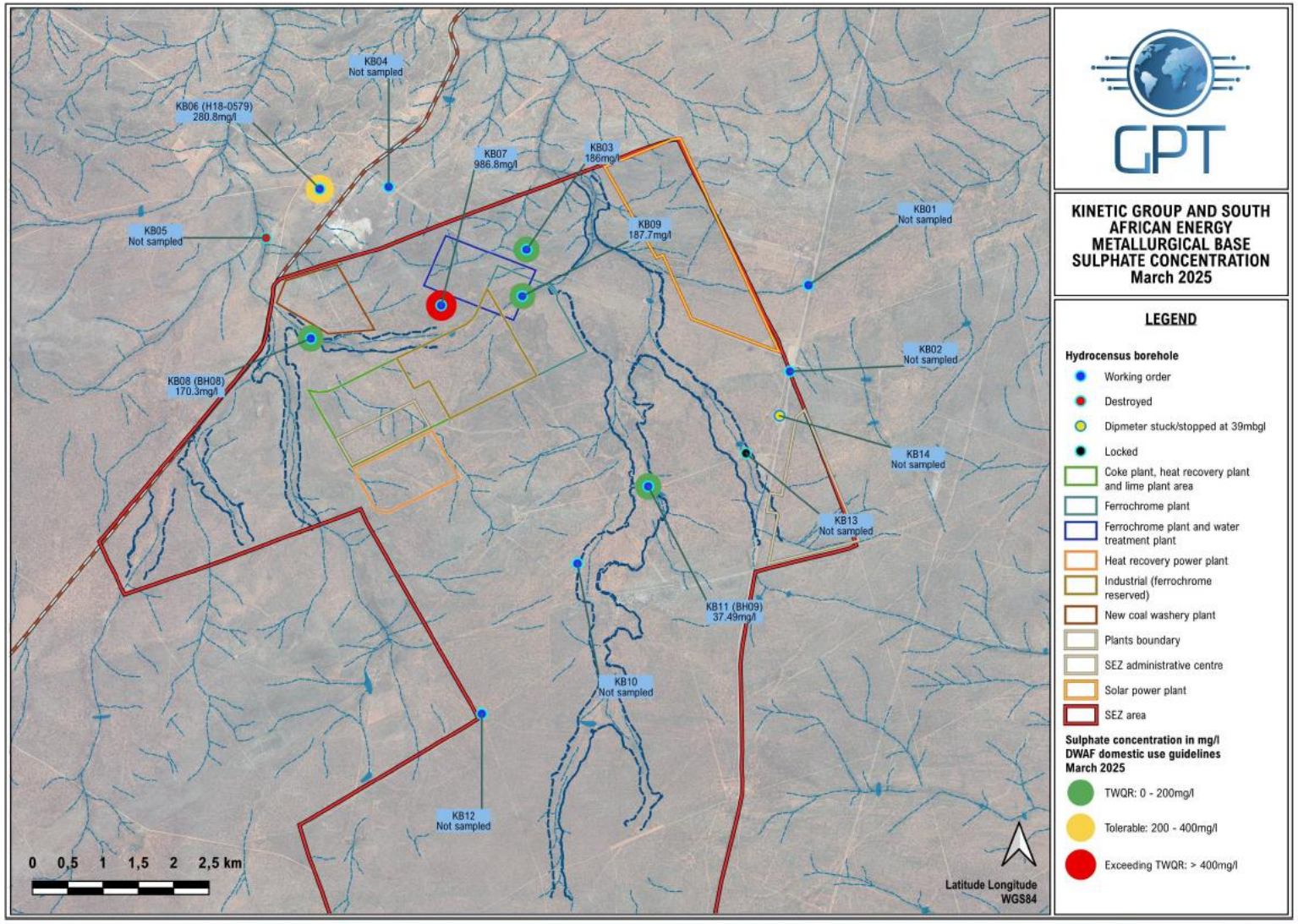


Figure 30: Sulphate Classed Concentration Map

8.6.7 Aquifer Characterization

The term aquifer refers to a strata or group of interconnected strata comprising of saturated earth material capable of conducting groundwater and of yielding usable quantities of groundwater to boreholes and /or springs (Vegter, 1994). In the light of South Africa's limited water resources it is important to discuss the aquifer sensitivity in terms of the boundaries of the aquifer, its vulnerability, classification and finally protection classification, as this will help to provide a framework in the groundwater management process.

8.6.7.1 Aquifer Vulnerability

Aquifer vulnerability assessment indicates the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Stated in another way, it is a measure of the degree of insulation that the natural and manmade factors provide to keep contamination away from groundwater.

- Vulnerability is high if natural factors provide little protection to shield groundwater from contaminating activities at the land surface.
- Vulnerability is low if natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation.

The following factors have an effect on groundwater vulnerability:

- Depth to groundwater: Indicates the distance and time required for pollutants to move through the unsaturated zone to the aquifer.
- Recharge: The primary source of groundwater is precipitation, which aids the movement of a pollutant to the aquifer.
- Aquifer media: The rock matrices and fractures which serve as water bearing units.
- Soil media: The soil media (consisting of the upper portion of the vadose zone) affects the rate at which the pollutants migrate to groundwater.
- Topography: Indicates whether pollutants will run off or remain on the surface allowing for infiltration to groundwater to occur.
- Impact of the vadose zone: The part of the geological profile beneath the earth's surface and above the first principal water-bearing aquifer. The vadose zone can retard the progress of the contaminants.

The Groundwater Decision Tool (GDT) was used to quantify the vulnerability of the aquifer underlying the site using the below assumptions:

- Depth to groundwater below the site was estimated from water levels measured during the hydrocensus inferred to be at mean of ~25.95 mbgl.
- Groundwater recharge of 6.19 mm/a (1.9% recharge).
- Northern Karoo vadose zone.
- Gradient of 1.3% were assumed and used in the estimation.

The aquifer vulnerability for a contaminant released from surface to a specified position in the groundwater system after introduction at some location above the uppermost aquifer was determined using the criteria described below and assuming a worst-case scenario:

- Highly vulnerable (> 60), the natural factors provide little protection to shield groundwater from contaminating activities at the land surface.

- Medium Vulnerable = 30 to 60%, the natural factors provide some protection to shield groundwater from contaminating activities at the land surface, however based on the contaminant toxicity mitigation measures will be required to prevent any surface contamination from reaching the groundwater table.
- Low Vulnerability (< 30 %), natural factors provide relatively good protection and there is little likelihood that contaminating activities will result in groundwater degradation
- The GDT calculated a vulnerability value of **34%**, which is **medium**.

8.6.7.2 Aquifer Classification

The aquifer(s) underlying the subject area were classified in accordance with "A South African Aquifer System Management Classification, December 1995." The main aquifers underlying the area were classified in accordance with the Aquifer System Management Classification document. The aquifers were classified by using the following definitions:

- Sole Aquifer System: An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
- Major Aquifer System: Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (Electrical Conductivity of less than 150 mS/m).
- Minor Aquifer System: These can be fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large quantities of water, they are important for local supplies and in supplying base flow for rivers.
- Non-Aquifer System: These are formations with negligible permeability that are regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.

Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a "Sole Aquifer System", based on the fact that the local population is dependent on groundwater.

In order to achieve the Aquifer System Management and Second Variable Classifications, as well as the Groundwater Quality Management Index, a points scoring system as presented in Table 44 and Table 45 was used.

As part of the aquifer classification, a Groundwater Quality Management (GQM) Index is used to define the level of groundwater protection required. The GQM Index is obtained by multiplying the rating of the aquifer system management and the aquifer vulnerability. The GQM index for the study area is presented in Table 46.

The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as **medium.**

Table 44: Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	6
Major Aquifer System:	4	
Minor Aquifer System:	2	
Non-Aquifer System:	0	
Special Aquifer System:	0 - 6	
Second Variable Classification (Weathering/Fracturing)		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

Table 45: Groundwater Quality Management (GQM) Classification System

Aquifer System Management Classification		
Class	Points	Study area
Sole Source Aquifer System:	6	6
Major Aquifer System:	4	
Minor Aquifer System:	2	
Non-Aquifer System:	0	
Special Aquifer System:	0 - 6	
Aquifer Vulnerability Classification		
Class	Points	Study area
High:	3	
Medium:	2	2
Low:	1	

The level of groundwater protection based on the Groundwater Quality Management Classification:

GQM Index = Aquifer System Management x Aquifer Vulnerability
= 6 x 2 = 12

Table 46: GQM Index for the Study Area

GQM Index	Level of Protection	Study Area
<1	Limited	
1 - 3	Low Level	
3 - 6	Medium Level	
6 - 10	High Level	
>10	Strictly Non-Degradation	12

8.6.8 Aquifer Protection Classification

A Groundwater Quality Management Index of 12 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a Strictly Non-Degradation protection is required for the aquifer. Reasonable and sound groundwater protection measures based on the modelling will therefore be recommended to ensure that no cumulative pollution affects the aquifer, even in the long term.

DWS's water quality management objectives are to protect human health, carrying capacity of the environment and the environment. Therefore, the significance of this aquifer classification is that measures must be taken to limit the risk to the following environments.

- The protection of the underlying aquifer.

8.6.9 Conceptual Site Model (CSM) – Contamination Risk

The CSM is one of the primary planning tools that can be used to support the decision-making process and managing groundwater on a large scale. The site-specific details regarding the CSM for MMSEZ area, Mopane include:

- **Geology:** The site is predominantly underlain by Quaternary sandy soils, which form the main surface cover. Bedrock geology comprises outcrops of the Beit Bridge Complex (Gambu Group) in the central, northern, and southern areas, characterized by calc-silicate rocks, marble, leucogneisses, hornblende granitoid gneiss, metaquartzite, and amphibolite. South of the northern Gambu outcrop and beneath a fault line, the Karoo Supergroup is present, consisting of undifferentiated Mikambeni and Madzaringwe Formations with mudstone, shale, carbonaceous shale, sandstone, coal seams, and basal diamictite or conglomerate.
- **Aquifer Description:** The multi-layered weathering system present on the geology could prove to have up to two aquifer systems present in the form of a shallow, saprolitic aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and an intergranular & fractured bedrock aquifer.
- **The calculated recharge percentage** equates to approximately 2% of annual precipitation. Which is very low.
- **Static water level:** The water levels ranged between 17.34 mbgl and 33.42 mbgl with an average of 25.95 mbgl.
- **Rainfall:** The average annual rainfall (1970-2024) for the general site location is 325.8 mm per year.
- **Groundwater flow direction:** The groundwater flow direction is in a general northern direction.
- **Water Quality:** Groundwater quality at the site exceeds several guideline limits for drinking, domestic and industrial applications. The water is generally classified as poor-quality and brackish, with elevated concentrations of dissolved salts.
- **Receptors:** Possible receptors are on-site water users.

A notably thick vadose zone, conservatively estimated at a minimum of 15m and potentially exceeding 30m in certain areas, underlies the site. This unsaturated zone, coupled with the region's low effective recharge rates and relatively low annual rainfall (by South African standards), significantly limits the vertical migration potential of contaminants. Under typical conditions, and in the absence of significant contaminant volumes or continuous pollutant sources, contaminants are expected to undergo attenuation, dispersion, and degradation within the vadose zone. This provides a natural protective barrier to the underlying aquifer, reducing the likelihood of groundwater contamination from surface-based activities.

The Groundwater Decision Tool (GDT) calculated an aquifer vulnerability value of 34%, categorised as medium. This value is slightly above the 30% threshold, which indicates that the aquifer's natural characteristics are generally effective in limiting contamination risk. A previous study conducted by WSM-Leshika in June 2021, using the DRASTIC method, also concluded that the aquifer vulnerability ranges from low to very low. However, it is important to note that this conclusion was based on the assumption of dry deposition, which may not be applicable in scenarios involving liquid waste, where the potential for contaminant mobility and infiltration is higher.

In support of the above, the client has confirmed that all waste and raw material stockpiles will be stored on hardstand surfaces with integrated wastewater management systems. These engineered controls significantly reduce the likelihood of contaminant infiltration by disrupting the pathway to the vadose zone. The combination of impermeable surfaces and controlled stormwater management systems serves to further minimise the risk of percolation and subsurface transport. Based on these factors, it is both scientifically and reasonably concluded that the risk of groundwater contamination is minimal under the proposed operational conditions. Any leachate that might be generated is expected to dissipate or degrade within the vadose zone, without reaching the water table.

8.6.10 Groundwater Flow and Transport Modelling

The numerical groundwater flow model is constructed and simulated to aid in decision making processes and environmental management. The purpose of the numerical model is to develop a tool that can be used to assess the impact, as a result of the abstraction from the water supply boreholes.

8.6.10.1 Model Set-Up and Boundaries

The model domain is irregularly shaped with dimensions of ~62 km by ~28 km in the horizontal direction. The modelling area was discretised by a 224 x 227 grid in the x and y direction, respectively, resulting in 179 624 active cells for the model grid. A grid refinement of 50 m x 50 m was applied with gradually coarser grid cell sizes to a maximum size of 2 000 m x 2 000 m away from the site to reduce model run time. Along the vertical direction the model consists of four (4) layers.

Boundaries were chosen far enough removed from site boundaries not to be affected by boundary conditions. These boundaries are described in Table 47 and shown in Figure 31b.

8.6.10.2 Groundwater Elevation and Gradient

The calibrated static water levels as modelled have been contoured (Figure 33). Groundwater flow direction should be perpendicular to these contours and inversely proportional to the distance between contours. As can be expected, the groundwater flow is mainly from topographical high to low areas, eventually draining to the local streams.

8.6.10.3 Groundwater Sources and Sinks

Although the most relevant aquifer parameters are optimised by the calibration of the model, many parameters are calculated and/or judged by conventional means. The fixed assumptions and input parameters were used for the numerical model of this area – Table 47.

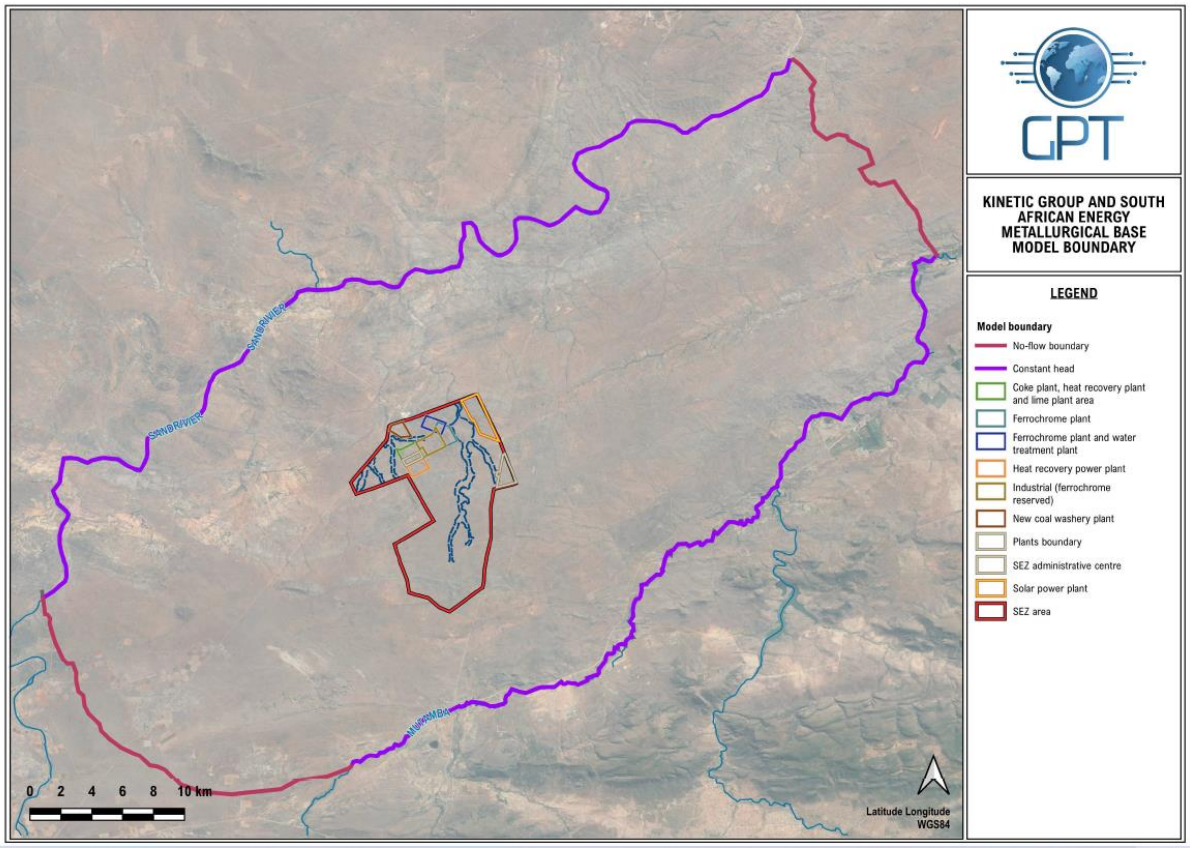


Figure 31: Model Boundary and Boundary Conditions

Table 47: Input Parameters to the Numerical Flow Model

Model Parameter	Value	Unit	Reason
Recharge to the aquifer	0.00000893	m/d	Calculated
Evapotranspiration	0.00628	m/d	Calculated
Boundaries	Topographic water divides	-	Natural boundaries at the site that would potentially include modelled impacts.
Refinement	50	m	Based on the scale of the project area and limiting the cells per layer to less than 100k
Grid dimensions	224 x 227	Number	Product of the grid refinement
Hydraulic anisotropy (vertical)	10	-	Anderson et al. (2015)
Effective porosity	15 declining to 2 with depth in each layer	%	Wang et al. (2009)
Layers	4	Number	Depth of proposed abstraction boreholes ranges from 42 to 66 mbgl.
Longitudinal dispersion	50	m	Schulze-Makuch (2005)
Head error range	13	m	Calculated as 10% of the difference between the maximum and minimum calculated head elevations

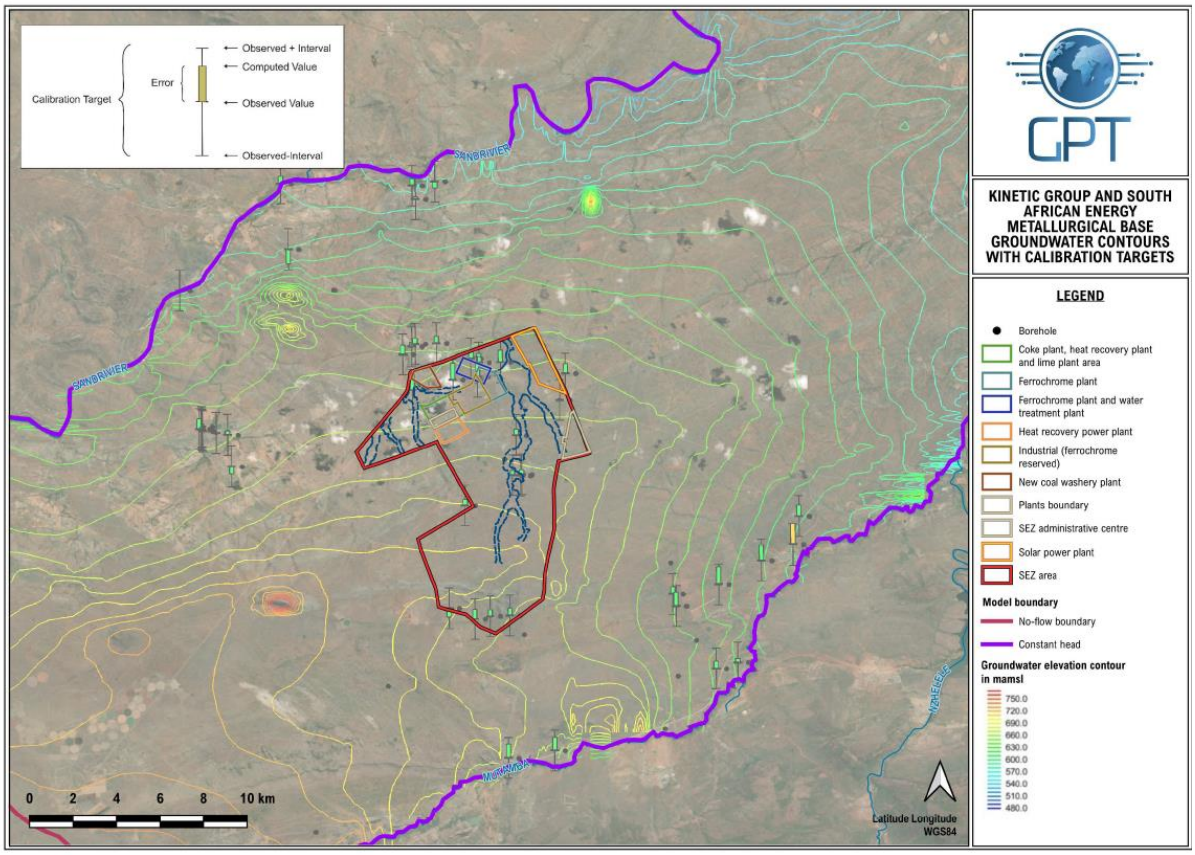


Figure 32: Groundwater Calibration Results

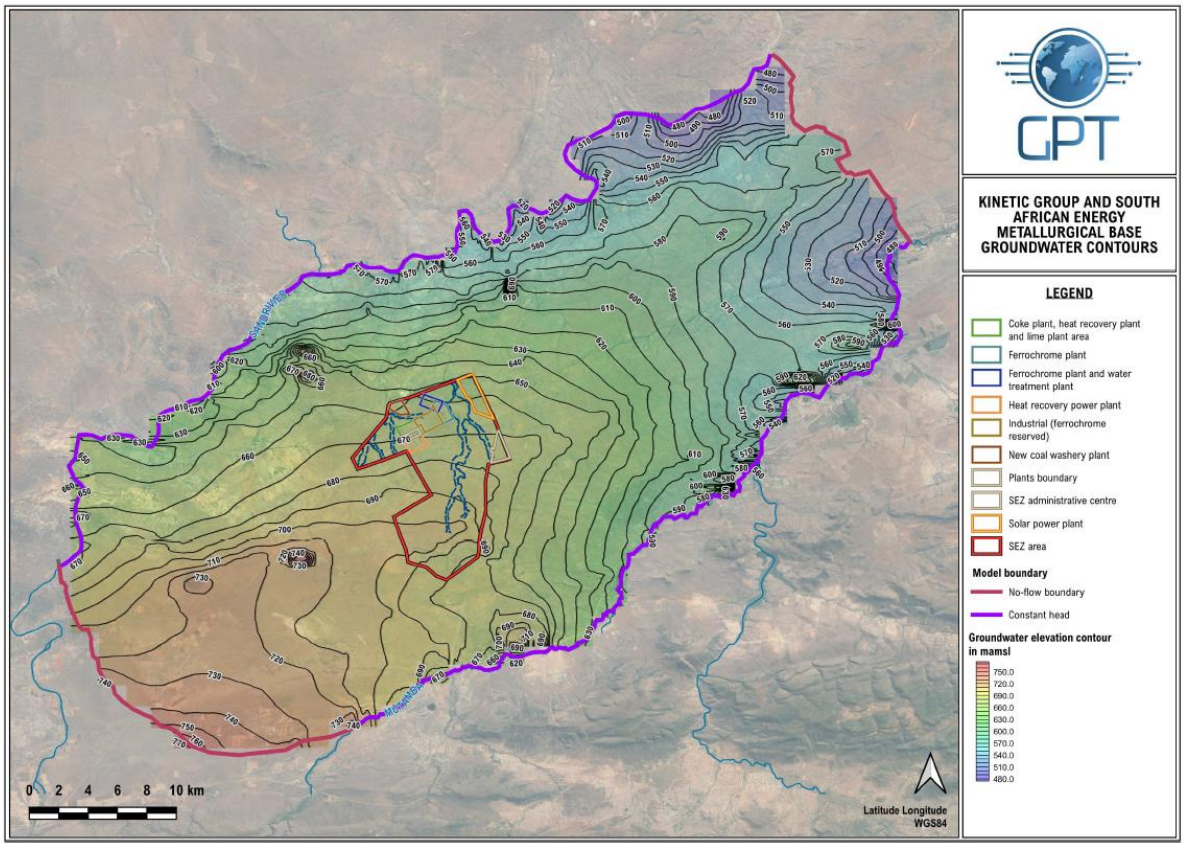


Figure 33: Modelled Groundwater Contours

8.6.10.4 Conceptual Model Input

For this study, the subsurface was envisaged to consist of the following hydrogeological units.

- The upper few metres below surface consist of completely weathered material also referred to as regolith. This layer is anticipated to have a reasonable high hydraulic conductivity, but in general unsaturated.
- The next few tens of meters can be subdivided into two aquifer systems comprising of highly to moderately fractured lithologies with a lower hydraulic conductivity compared to the overlying weathered material. The permanent groundwater level resides in this unit and is about 20 to 30 meters below ground level. The groundwater flow direction in this unit is influenced by regional topography. The hydraulic conductivity of this aquifer was estimated to range from 0.45 to 0.8 m/d.
- Below a few tens of meters, the fracturing of the aquifer is less frequent and fractures less significant due to increased pressure. This results in an aquifer of lower hydraulic conductivity and very slow groundwater flow velocities.

8.6.10.5 Calibration of the Numerical Model

Water level data obtained during both the desktop review and hydrocensus was used to calibrate the numerical groundwater flow model. The results obtained during the calibrated model were used as initial conditions to simulate drawdown impacts. A fit was obtained for the measured groundwater levels (Figure 34).

All other parameters were unchanged, with values as listed in the paragraphs above. The calibration error statistics can be seen in Table 49. The head error was below 5 meters, which can be regarded as sufficient.

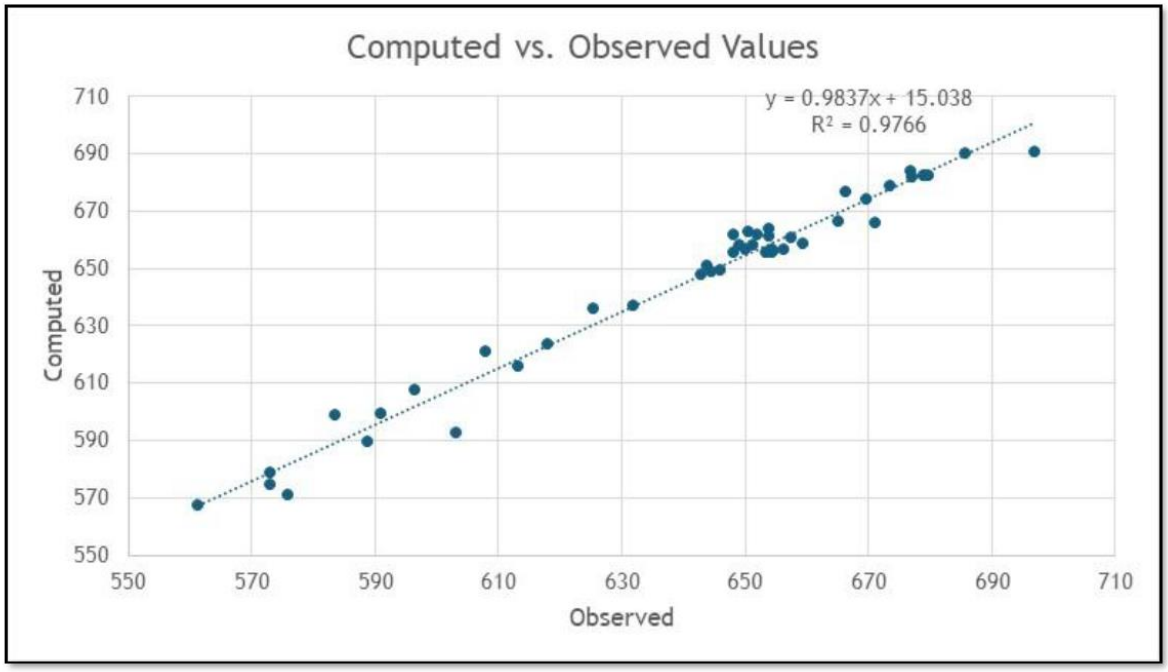


Figure 34: Water Level Calibration Graph

Table 48: Optimal Calibrated Aquifer Parameters

Aquifer	Model layer	Layer thickness (m)	Porosity (%)	Hydraulic conductivity (m/d)
Regolith	Layer 1	15	0.15	0.8
Highly Fractured Aquifer	Layer 2	30	0.1	0.45
Moderately Fractured Aquifer	Layer 3	35	0.05	0.009
Slightly Fractured Aquifer	Layer 4	20	0.02	0.0009

Table 49: Calibration Statistics

Description	Value
Mean Residual (Head)	-4.59
Mean Absolute Residual (Head)	5.80
Root Mean Squared Residual (Head)	6.90

8.7 Noise

The word "noise" is generally used to convey a negative response or attitude to the sound received by a listener. There are four common characteristics of sound, any or all of which determine listener response and the subsequent definition of the sound as "noise". These characteristics are:

- Intensity;
- Loudness;
- Annoyance; and
- Offensiveness.

Of the four common characteristics of sound, intensity is the only one that is not subjective and can be quantified. Loudness is a subjective measure of the effect sound has on the human ear. As a quantity it is therefore complicated, but has been defined by experimentation on subjects known to have normal hearing.

The annoyance and offensive characteristics of noise are also subjective. Whether or not a noise causes annoyance mostly depends upon its reception by an individual, the environment in which it is heard, the type of activity and mood of the person and how acclimatised or familiar that person is to the sound.

8.7.1 Surrounding Landuse, Roads and Other Industries

The area in the vicinity of the proposed development is currently classified as Vacant or Unspecified. Previous site visits revealed that the area is mainly wilderness with game ranches forming a large part of the agricultural activities (game and cattle farming). Some of the farm's focus on the tourism and hunting industry. The small town of Mopane is located to the north-west on the border of the focus area.

The focus area is roughly enclosed by the N1 Musina - Makhado, the D1021 on the south, the Musina – Makhado Railway Line and the D744 road (running parallel to the railway line) to the west and the R525 to the north. The railway line is aligned in a north-south direction and reported to carry 4 trains per day.

The Syferfontein Dolomite operates a quarry just south of Mopane, north-west of the project area.

8.7.2 Existing Ambient Sound and Noise Levels

Ambient sound levels were previously measured during 4 – 5 July 2013, 23 – 25 January 2018 as well as 7 – 8 March 2019, with the measurements including long-term semi-continuous as well as a number of short-term readings. These measurements are detailed in the report De Jager (2020), which was done for the larger MMSEZ project, with the sound levels summarized in Figure 35. These measurements resulted in more than 500 daytime as well as 288 night-time measurements. Based on the arithmetic average of these measurements:

- The impulse-weighted daytime sound levels was 43.8 dBA, with the fast-weighted daytime sound levels was 38.5 dBA; and
- The impulse-weighted night-time sound levels was 40.9 dBA, with the fast-weighted night-time sound levels was 35.8 dBA.

Considering the ambient sound levels measured onsite, as well as the developmental character of the area, the acceptable zone rating level would be typical of a **rural area** (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008 for most of the area. Rating levels will be higher in an area up to 500m from the N1, mainly due to traffic noises from the national road. The rating levels would also be higher in the town of Mopane, due to the activities of the existing Syferfontein Dolomite quarry.

8.7.3 Rating Levels and Recommended Noise Limits

The development of the ferrochrome smelter project will result in changes in the ambient sound levels during the construction and operational phases. Considering the developmental character of the area, this report will initially consider the requirements of the National Noise Control Regulations (NCR), requiring that a project not change ambient sound levels with more than 7 dBA. Based on the arithmetic average of these measurements:

- The impulse-weighted daytime sound level was 43.8 dBA, with the fast-weighted daytime sound levels was 38.5 dBA. This could set an upper daytime noise limit ranging between 45 and 50 dBA; and
- The impulse-weighted night-time sound levels was 40.9 dBA, with the fast-weighted night-time sound levels was 35.8 dBA. This could set an upper night-time noise limit ranging between 43 and 50 dBA.

In addition, the project must also consider the requirements of the World Health Organization (“WHO”) and the International Finance Corporation (“IFC"), with the IFC recommending upper noise limits of:

- 55 dBA for the daytime period; and
- 45 dBA for the night-time period.

Based on both the requirements of the NCR as well as the WHO and IFC, this assessment will recommend upper noise limits of:

- 50 dBA for the daytime period; and
- 45 dBA for the night-time period.

8.7.4 Environmental Sensitivity – Noise Theme

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool. Potential noise-sensitive areas with a "very high" sensitivity were obtained from the online screening tool using the *Utilities Infrastructure => Electricity => Generation => Renewable => Wind* category, with the potential noise-sensitive areas illustrated on **Figure 36**.

For the most part, noise sensitivities in the area as mapped by the Screening Tool were verified on site. The Noise Specialist Study has been undertaken in accordance with the requirements of GNR320 as part of the EIA.

8.7.5 Potential Noise-Sensitive Receptors and No-Go Area

An assessment of the site was done using available aerial images (GoogleEarth®) to identify potential dwellings that could be considered to be noise-sensitive receptors (NSR), supported by information gained during site visits in 4 – 5 July 2013, 23 – 25 January 2018 as well as 7 – 8 March 2019. Identified NSR are depicted in Figure 37 and 38.

Generally, noises from typical industrial projects (noise-generating infrastructure):

- Could be significant within 500m, with any NSR4 staying within 500m from such activities being subject to noises that may be of a sufficient level to be considered disturbing both day at night. There is one NSR staying within this 500m buffer area (NSR09);
- Could be high up to a distance of 1,000 m from project infrastructure, and noise levels may be sufficiently high to be considered disturbing at night. There is one NSR staying within this buffer area (NSR05); and
- Could be clearly audible at a distance of approximately 2,000m from project infrastructure at night, though the noise level is unlikely to be considered disturbing or annoying. There are a number of NSR staying further than 1,000m, but within 2,000m from project activities.

8.7.6 Potential Noise Sources – Construction Phase

Depending on the activity, construction activities may take between 12 and 24 months, with this assessment considering a potential scenario where simultaneous construction activities may take place at the Ferrochrome Plant. It is assumed that construction will include the following principal activities at three different areas:

- Site survey and preparation;
- Transport of components and equipment to site – all components will be brought to site in sections by means of flatbed trucks. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g., excavators, trucks, graders, compaction equipment, cement trucks, etc.). The transportation of ready-mix concrete to site or the materials for onsite concrete batching will result in a temporary increase in heavy traffic;
- Establishment of site entrance, internal access roads, contractor's compound and security fencing;

- Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construction of required foundations at the plant and other infrastructure;
- The establishment of various infrastructure components; and
- Testing and the commissioning of the processes.

Construction activities will take place at various locations, at different times, with equipment operating under different loads (generating different noise levels). It should be noted that noise levels generated by such industrial projects is generally significantly less than the operational phase.

There are a number of factors that determine the audibility as well as the potential of a noise impact on receptors. Maximum noises generated can be audible over a large distance, however, are generally of very short duration. If maximum noise levels however exceed 65 dBA at a receptor, or if it is clearly audible with a significant number of instances where the noise level exceeds the prevailing ambient sound level with more than 15 dB, the noise can increase annoyance levels and may ultimately result in noise complaints. Potential maximum noise levels generated by various construction equipment as well as the potential extent of these sounds are presented in Table 50.

Average or equivalent sound levels are another factor that impacts on the ambient sound levels and is the constant sound level that the receptor can experience. Typical PWL associated with various activities that may be found at a construction site is presented in Table 51. A worst-case scenario will be evaluated, considering a number of general noise sources at each project area, emitting 108.8 dBA (re 1 pW) at a number of locations. It is assumed that general noise sources will have an acoustic usage factor of 100%.

To account for undefined construction noises sources, area noise sources (emitting 65 dBA/m^2 re 1 pW) are included over the full foot-print of the major project infrastructure.

This assessment in addition considered an average of 20 each heavy road vehicles (HRV) and light-delivery vehicles (LDV) per hour, along a conceptual route. This will allow for 120 vehicles travelling between the N1 road and the Ferrochrome plant. It is assumed that all vehicles will travel at an average speed of 60 km/hr.

8.7.7 Potential Noise Sources – Operational Phase

As with any large industrial project, there will be thousands of activities and equipment that could generate noise, with the assessment mainly focusing on the main equipment or activities that would generate 95% of the noise. Activities and equipment generating low levels will not be considered, instead using an area noise source over the project footprint to account for such minor noise sources. As the layout as well as the various noise sources are not defined during the EIA process, this assessment will consider the information gained from similar projects where noise levels were measured.

As noise noises were not defined, this assessment will not consider acoustic usage factors (AUF), assuming that all equipment generate noise 100% of the time, assuming worst-case PWLs for the various equipment and activities. In addition, the potential effects of buildings were not considered (which will absorb, reflect, etc. acoustic energy). This approach would result in the over-modelling of potential noise levels, in line with the precautious principle, used in instances where project information is not well defined.

A ferrochrome smelter is a metallurgical facility that produces ferrochrome, an alloy of chromium and iron, primarily used in stainless steel production. The smelting process typically involves carbothermic reduction of chromite ore ($FeCr_2O_4$) in a Furnace. The main equipment associated with a ferrochrome smelter include:

- Raw Material Handling and Preparation, which includes crushing and screening units, dryers and the blending of reactants (chromite ore and coke);
- Furnaces, which includes the furnace shell, cooling, charging and tapping systems;
- Slag and Metal Handling, including the ladle cars and transfer ladles, slag granulation and crushing units and casting units;
- Off-gas and Emission Control, including ducting, baghouse and scrubbers as well as induced-draft fans; and
- Auxiliary Equipment, such as power supply and distribution, process control and automation systems, cooling towers / heat exchangers, compressed air systems and fire protection systems.

For modelling, the following noise sources were included:

- An area noise source of 750,000 m^2 to account for undefined noise sources;
- Various conveyors and conveyor transfer points;
- Raw material handling and blending (material receiving, crushing, blending, etc.)
- Numerous furnaces and chimneys;
- Smelter buildings;
- Air handling units (cooling and air handling); and
- Bag houses.

8.7.8 Potential Noise Sources – Future Noise Scenario

While there are numerous activities that can take place during the decommissioning stage, the potential noise impact will only be discussed in general. This is because the noise impacts associated with the decommissioning phase is normally less than both the construction and operational phases for the following reasons:

- Final decommissioning normally takes place only during the day, a time period when existing ambient sound levels are higher, generally masking most external noises for surrounding receptors; and
- There is a lower urgency of completing this phase and less equipment remains onsite (and are used simultaneously) to affect the final decommissioning.

Table 50: Potential Maximum Noise Levels Generated by Various Equipment

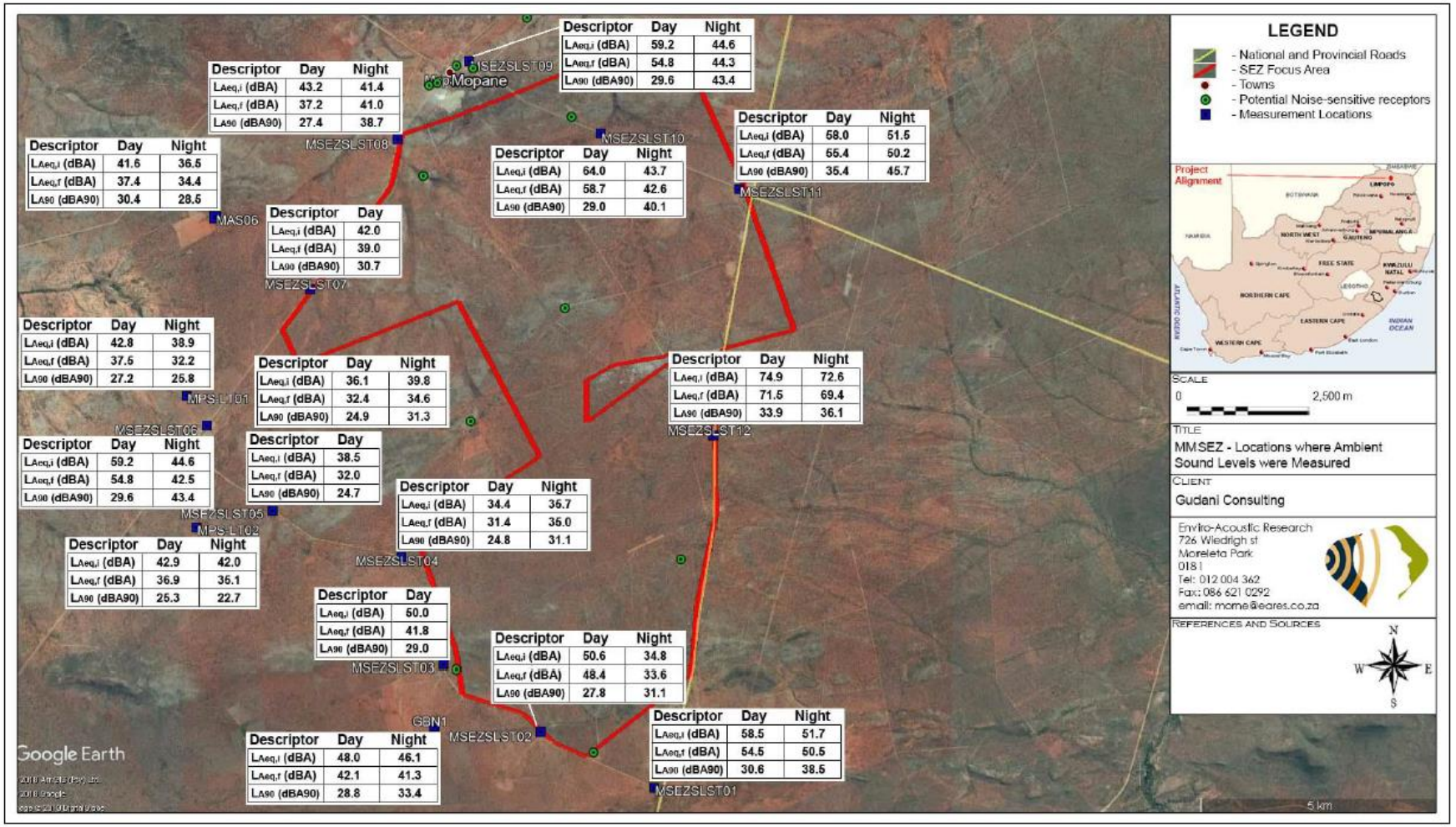
Equipment Description[5]	Impact Device?	Maximum PWL (dBA)	Operational Noise Level at given distance considering potential maximum noise levels (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
			5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Auger Drill Rig	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Backhoe	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compactor (ground)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Compressor (air)	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Concrete Batch Plant	No	117.7	92.7	86.7	80.6	72.7	66.7	63.1	60.6	57.1	52.7	49.2	46.7	40.6
Concrete Mixer Truck	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Concrete Pump Truck	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Concrete Saw	No	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Crane	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Dozer	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Drill Rig Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Drum Mixer	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Dump Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Excavator	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Flat Bed Truck	No	118.7	93.7	87.7	81.6	73.7	67.7	64.1	61.6	58.1	53.7	50.2	47.7	41.6
Front End Loader	No	114.7	89.7	83.7	77.6	69.7	63.7	60.1	57.6	54.1	49.7	46.2	43.7	37.6
Generator (<25KVA)	No	104.7	79.7	73.7	67.6	59.7	53.7	50.1	47.6	44.1	39.7	36.2	33.7	27.6
Grader	No	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Mounted Impact Hammer	Yes	124.7	99.7	93.7	87.6	79.7	73.7	70.1	67.6	64.1	59.7	56.2	53.7	47.6
Rivit Buster/Chipping Gun	Yes	119.7	94.7	88.7	82.6	74.7	68.7	65.1	62.6	59.1	54.7	51.2	48.7	42.6
Sonic Pile Driver	Yes	124.2	99.2	93.2	87.2	79.2	73.2	69.6	67.2	63.6	59.2	55.7	53.2	47.2
Slurry Trenching Machine	No	116.7	91.7	85.7	79.6	71.7	65.7	62.1	59.6	56.1	51.7	48.2	45.7	39.6
Vibratory/Impact Pile Driver	No	129.7	104.7	98.7	92.6	84.7	78.7	75.1	72.6	69.1	64.7	61.2	58.7	52.6

Table 51: Potential Equivalent Noise Levels Generated by Various Equipment

Equipment Description	Equivalent (average) PWL, (dBA)	Operational Noise Level at given distance considering equivalent (average) PWL (Cumulative as well as the mitigatory effect of potential barriers or other mitigation not included – simple noise propagation modelling only considering distance) (dBA)											
		5 m	10 m	20 m	50 m	100 m	150 m	200 m	300 m	500 m	750 m	1000 m	2000 m
Bulldozer CAT D5	107.4	82.4	76.4	70.4	62.4	56.4	52.9	50.4	46.9	42.4	38.9	36.4	30.4
Cement truck (with cement)	111.7	86.7	80.7	74.7	66.7	60.7	57.2	54.7	51.2	46.7	43.2	40.7	34.7
Compressor - Fuel Gas	96.4	71.4	65.4	59.4	51.4	45.4	41.9	39.4	35.9	31.4	27.9	25.4	19.4
Compressor - Gas, silenced	107.4	82.4	76.4	70.3	62.4	56.4	52.8	50.3	46.8	42.4	38.9	36.4	30.3
Compressor - Gas, unmitigated	113.3	88.4	82.4	76.3	68.4	62.4	58.8	56.3	52.8	48.4	44.9	42.4	36.3
Compressor building	92.8	67.9	61.8	55.8	47.9	41.8	38.3	35.8	32.3	27.9	24.3	21.8	15.8
Crane - Construction, typical	107.5	82.5	76.5	70.5	62.5	56.5	53.0	50.5	46.9	42.5	39.0	36.5	30.5
Dumper/Haul truck - Bell 25 ton (B25D)	108.4	83.5	77.5	71.4	63.5	57.5	53.9	51.4	47.9	43.5	40.0	37.5	31.4
Excavator - Cat 416D	103.9	78.9	72.9	66.8	58.9	52.9	49.3	46.8	43.3	38.9	35.4	32.9	26.8
Fans - Compressor cooling	95.4	70.4	64.4	58.4	50.4	44.4	40.9	38.4	34.8	30.4	26.9	24.4	18.4
Fans - Cooling, array	111.8	86.8	80.8	74.8	66.8	60.8	57.3	54.8	51.3	46.8	43.3	40.8	34.8
Fans - Water Cooling	100.4	75.4	69.4	63.4	55.4	49.4	45.9	43.4	39.9	35.4	31.9	29.4	23.4
FEL - Bell L1806C	102.7	77.7	71.7	65.7	57.7	51.7	48.2	45.7	42.1	37.7	34.2	31.7	25.7
General noise	108.2	83.3	77.2	71.2	63.3	57.2	53.7	51.2	47.7	43.3	39.7	37.2	31.2
General noise (area)	64.4	39.5	33.4	27.4	19.5	13.4	9.9	7.4	3.9	-0.5	-4.1	-6.6	-12.6
Generator - C2250 D5 (silenced)	71.4	46.5	40.4	34.4	26.5	20.4	16.9	14.4	10.9	6.5	2.9	0.4	-5.6
Grader - Operational Hitachi	108.9	83.9	77.9	71.9	63.9	57.9	54.4	51.9	48.4	43.9	40.4	37.9	31.9
Pile Driver - Impact	129.4	104.4	98.4	92.4	84.4	78.4	74.9	72.4	68.8	64.4	60.9	58.4	52.4
Pile Driver - Sonic	124.2	99.2	93.2	87.2	79.2	73.2	69.6	67.2	63.6	59.2	55.7	53.2	47.2
Pump - Condensate	103.5	78.5	72.5	66.5	58.5	52.5	49.0	46.5	43.0	38.5	35.0	32.5	26.5
Pump - Demineralized Water	89.5	64.5	58.5	52.5	44.5	38.5	35.0	32.5	29.0	24.5	21.0	18.5	12.5
Pumps (Cavity, slurry, VSD, etc)	89.5	64.5	58.5	52.5	44.5	38.5	35.0	32.5	28.9	24.5	21.0	18.5	12.5
Road Transport Reversing/Idling	108.2	83.3	77.2	71.2	63.3	57.2	53.7	51.2	47.7	43.3	39.7	37.2	31.2
Rock Breaker, CAT	120.7	95.7	89.7	83.7	75.7	69.7	66.2	63.7	60.2	55.7	52.2	49.7	43.7
Substation (one transformer)	85.2	60.3	54.2	48.2	40.3	34.2	30.7	28.2	24.7	20.3	16.7	14.2	8.2
Trenching Machine	115.6	90.6	84.6	78.6	70.6	64.6	61.1	58.6	55.1	50.6	47.1	44.6	38.6

Table 52: Acceptable Zone Sound Levels for Noise in Districts (SANS 10103:2008)

1	2	3	4	5	6	7
Type of district	Equivalent continuous rating level ($L_{Req,T}$) for noise dBA					
	Outdoors			Indoors, with open windows		
	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time $L_{Req,n}$	Day/night $L_{R,dn}$	Daytime $L_{Req,d}$	Night-time $L_{Req,n}$
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50



Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	43.2	41.4
$L_{Aeq,f}$ (dBA)	37.2	41.0
L_{A90} (dBA90)	27.4	38.7

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	59.2	44.6
$L_{Aeq,f}$ (dBA)	54.8	44.3
L_{A90} (dBA90)	29.6	43.4

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	41.6	36.5
$L_{Aeq,f}$ (dBA)	37.4	34.4
L_{A90} (dBA90)	30.4	28.5

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	64.0	43.7
$L_{Aeq,f}$ (dBA)	58.7	42.6
L_{A90} (dBA90)	29.0	40.1

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	68.0	51.5
$L_{Aeq,f}$ (dBA)	65.4	50.2
L_{A90} (dBA90)	35.4	45.7

Descriptor	Day
$L_{Aeq,i}$ (dBA)	42.0
$L_{Aeq,f}$ (dBA)	39.0
L_{A90} (dBA90)	30.7

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	42.8	38.9
$L_{Aeq,f}$ (dBA)	37.5	32.2
L_{A90} (dBA90)	27.2	25.8

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	36.1	39.8
$L_{Aeq,f}$ (dBA)	32.4	34.6
L_{A90} (dBA90)	24.9	31.3

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	74.9	72.6
$L_{Aeq,f}$ (dBA)	71.5	69.4
L_{A90} (dBA90)	33.9	36.1

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	59.2	44.6
$L_{Aeq,f}$ (dBA)	54.8	42.5
L_{A90} (dBA90)	29.6	43.4

Descriptor	Day
$L_{Aeq,i}$ (dBA)	38.5
$L_{Aeq,f}$ (dBA)	32.0
L_{A90} (dBA90)	24.7

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	34.4	35.7
$L_{Aeq,f}$ (dBA)	31.4	35.0
L_{A90} (dBA90)	24.8	31.1

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	42.9	42.0
$L_{Aeq,f}$ (dBA)	36.9	36.1
L_{A90} (dBA90)	25.3	22.7

Descriptor	Day
$L_{Aeq,i}$ (dBA)	50.0
$L_{Aeq,f}$ (dBA)	41.8
L_{A90} (dBA90)	29.0

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	50.6	34.8
$L_{Aeq,f}$ (dBA)	48.4	33.6
L_{A90} (dBA90)	27.8	31.1

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	48.0	46.1
$L_{Aeq,f}$ (dBA)	42.1	41.3
L_{A90} (dBA90)	28.8	33.4

Descriptor	Day	Night
$L_{Aeq,i}$ (dBA)	58.5	51.7
$L_{Aeq,f}$ (dBA)	54.5	50.5
L_{A90} (dBA90)	30.6	38.5

Figure 35: Summary of ambient sound levels collected in vicinity of MMSEZ Project – Including the Proposed Ferrochrome Plant

Figure 36: Aerial Image Indicating Areas with a "very high" Sensitivity to Noise as per Screening Tool

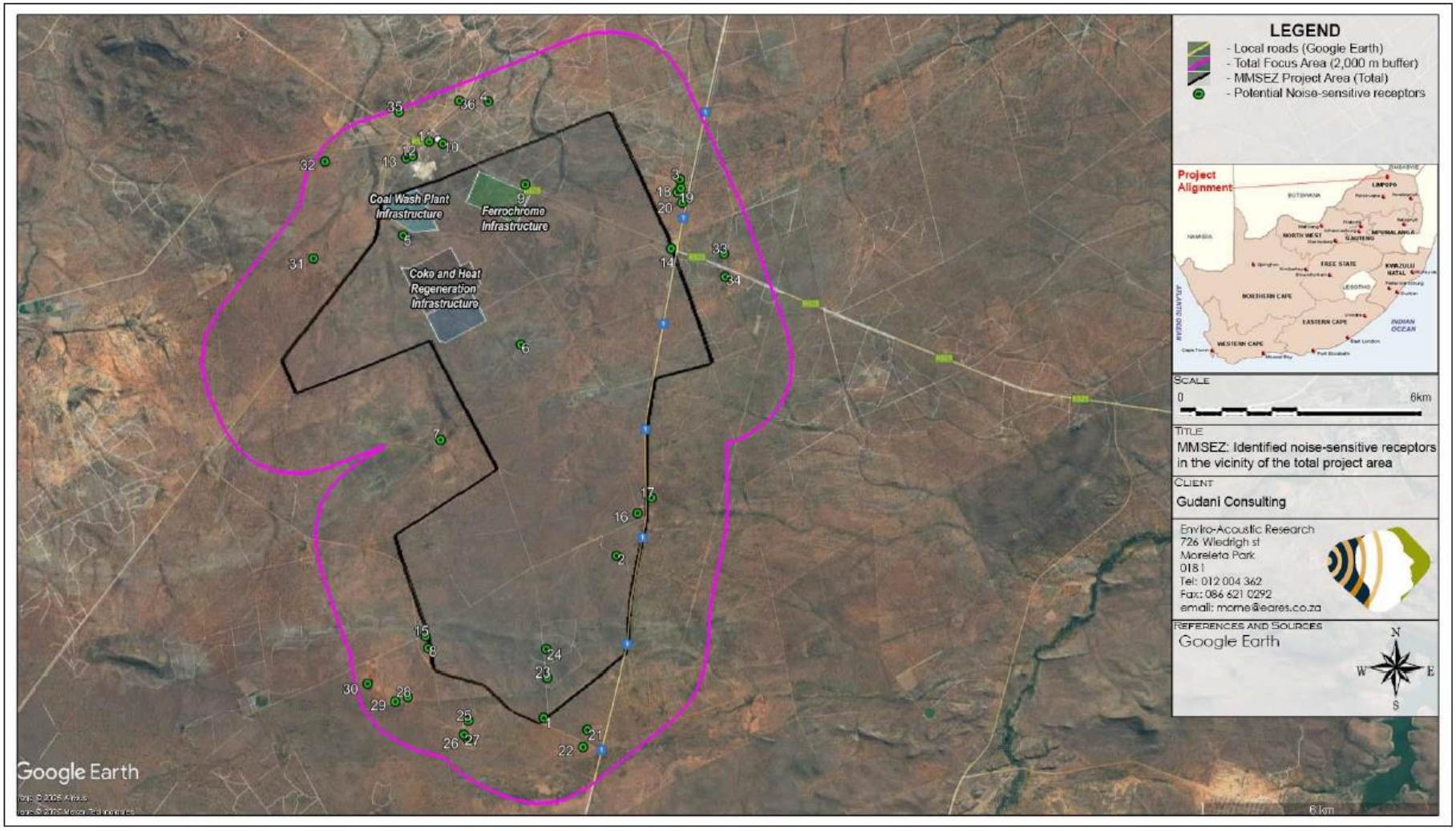


Figure 37: Aerial Image Indicating Potentially Noise-Sensitive Receptors Close to the Proposed Project Focus Area

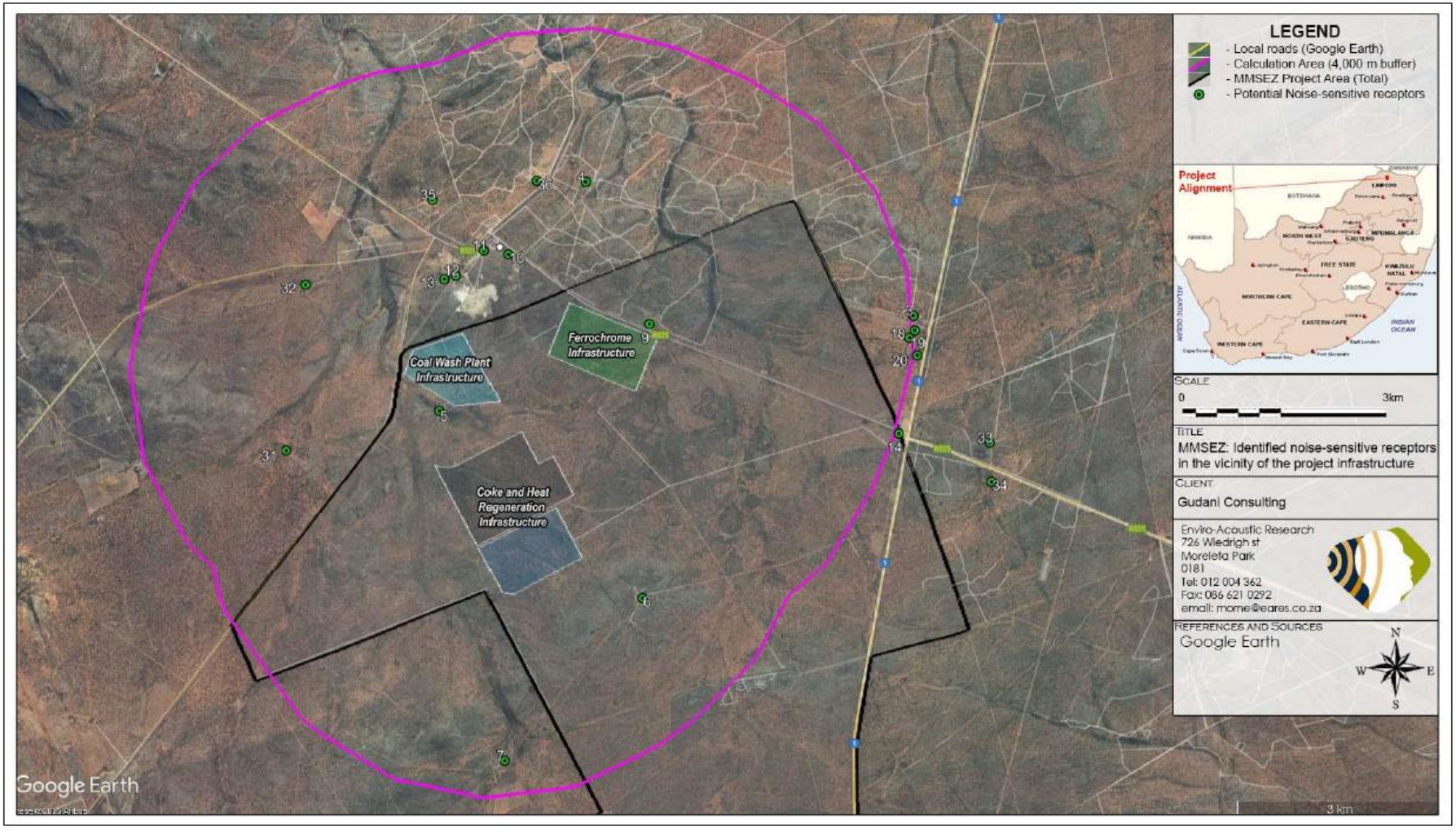


Figure 38: Aerial Image Indicating Potentially NSR close to the Proposed Project Infrastructure

8.8 Air Quality

8.8.1 Site Description and Terrain

Identified sensitive receptors in the study area include the small village of Mopane, approximately 2 km to the north-west of the Kinetic Project, as well as an individual homestead to the north of the R525 road, and two homesteads approximately 2 km to the southwest of the Kinetic Project. The closest sensitive receptors to the east of the Kinetic Project are homesteads and lodges close to the N1, approximately 4 km from the Kinetic Project (Figure 39).

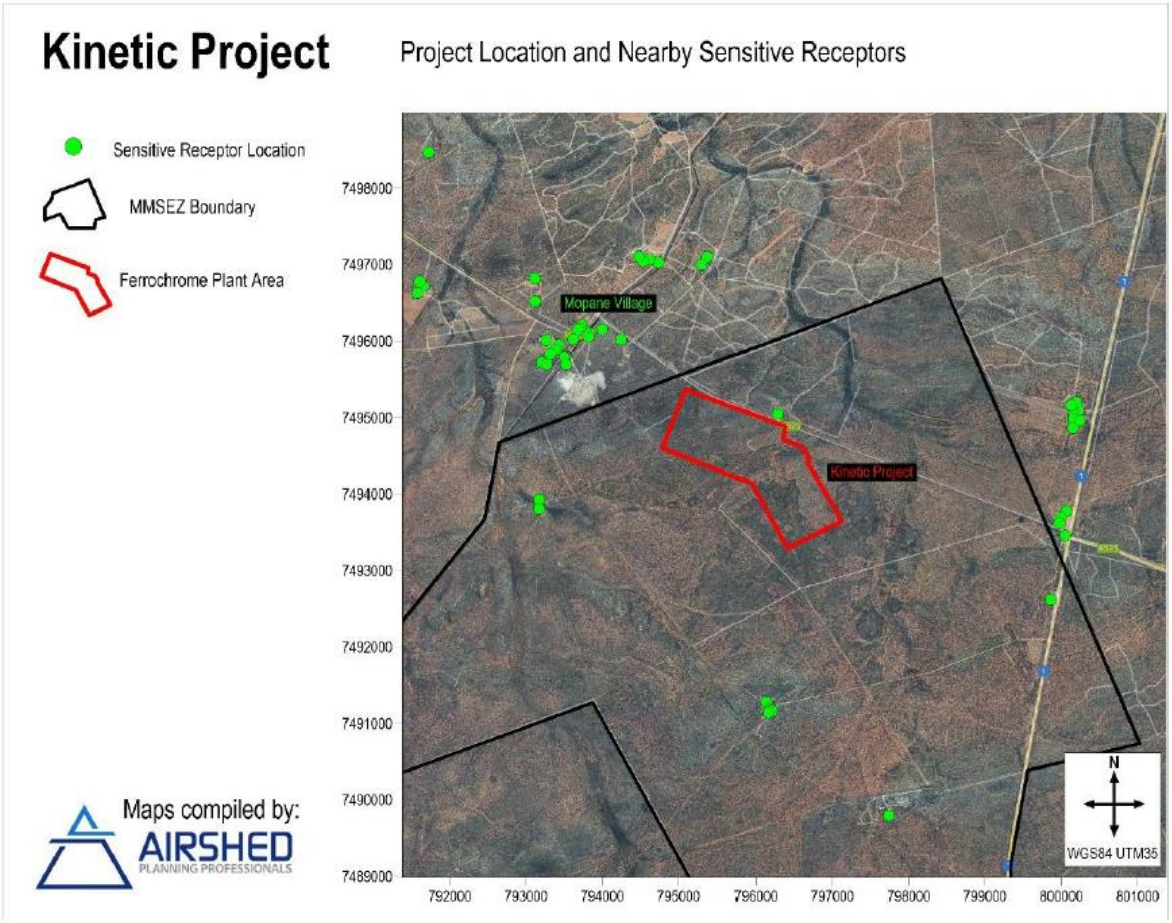


Figure 39: Location of Potentially Sensitive Receptors in Relation to the Kinetic Project

Readily available terrain data was obtained from the United States Geological Survey web site (https://earthexplorer.usgs.gov/). A study was made of Shuttle Radar Topography Mission 1 arc-sec data. The terrain for the study area is provided in Figure 40.

The project area is approximately 35 km to the north of the Soutpansberg mountains, and while the study area is fairly flat, ranging from 720m above mean sea level (mamsl) in the southeast to 650 mamsl in the northwest, there is a hill approximately 50m in height between the project area and the village of Mopane, therefore topography was included in the dispersion modelling simulations.

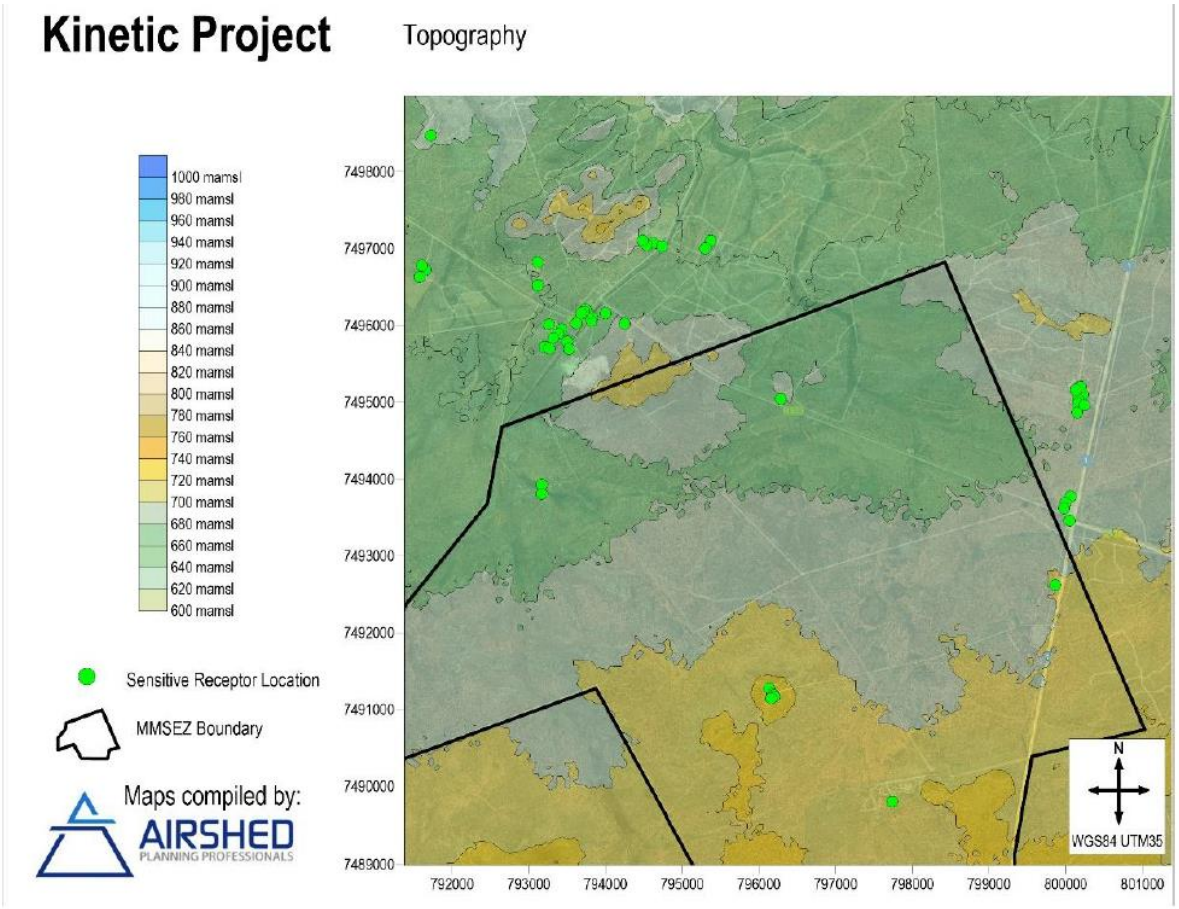


Figure 40: Terrain Elevation for the Study Area

8.8.2 Climate and Atmospheric Dispersion Potential

Meteorological mechanisms direct the dispersion, transformation, and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. This dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution due to plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. The pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Tiwary and Colls, 2010).

The spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). The atmospheric processes at macro- and meso-scales need therefore be considered to accurately parameterise the atmospheric dispersion potential of a particular area. A qualitative description

of the synoptic systems determining the macro-ventilation potential of the region may be provided based on the review of pertinent literature. These meso-scale systems may be investigated through the analysis of meteorological data observed for the region.

Meteorological information was sourced from modelled WRF[3] data for the site for the period 2022 to 2024.

8.8.3 Local Wind Field

The horizontal dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness (Tiwary and Colls, 2010).

The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period. The colours used in the wind roses below, reflect the different categories of wind speeds; the yellow area, for example, representing winds in between 5 and 6 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e., periods during which the wind speed was below 0.5 m/s are also indicated.

The period wind field and diurnal variability in the wind field are shown in Figure 41. Monthly variation in the wind field is shown in Figure 42.

The wind regime for the area is dominated by easterly flow fields. The east-north-easterly wind flow is more dominant during the day, with increased flow from the east-southeast during night-time conditions. Calm conditions occurred for less than 1% of the period summarised.

There is some seasonal variability to the wind field, with the highest wind speeds occurring in the spring months between August and November. The lowest wind speeds occur in autumn and early winter.

Dust mobilisation occurs only for wind velocities higher than a threshold value, and is not linearly dependent on the wind friction and velocity. The threshold friction velocity, defined as the minimum friction velocity required initiating particle motion, is dependent on the size of the erodible particles and the effect of the wind shear stress on the surface. The friction velocity for un-vegetated stockpiles usually given in the range of around 5.4 m/s (Shao, 2008), that means that at wind speeds above 5.4 m/s wind erosion could occur, whereas at wind speeds below 5.4 m/s wind erosion from open and exposed areas is unlikely. The average wind speed in the study area (4.25 m/s) is fairly high, and wind speeds above 5.4 m/s occur approximately 22% of the time (Figure 43). Significant fugitive dust emissions could results from raw material and slag stockpiles if these sources are not carefully managed.

[3] The Weather Research and Forecasting (WRF) Model is a next-generation mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications.

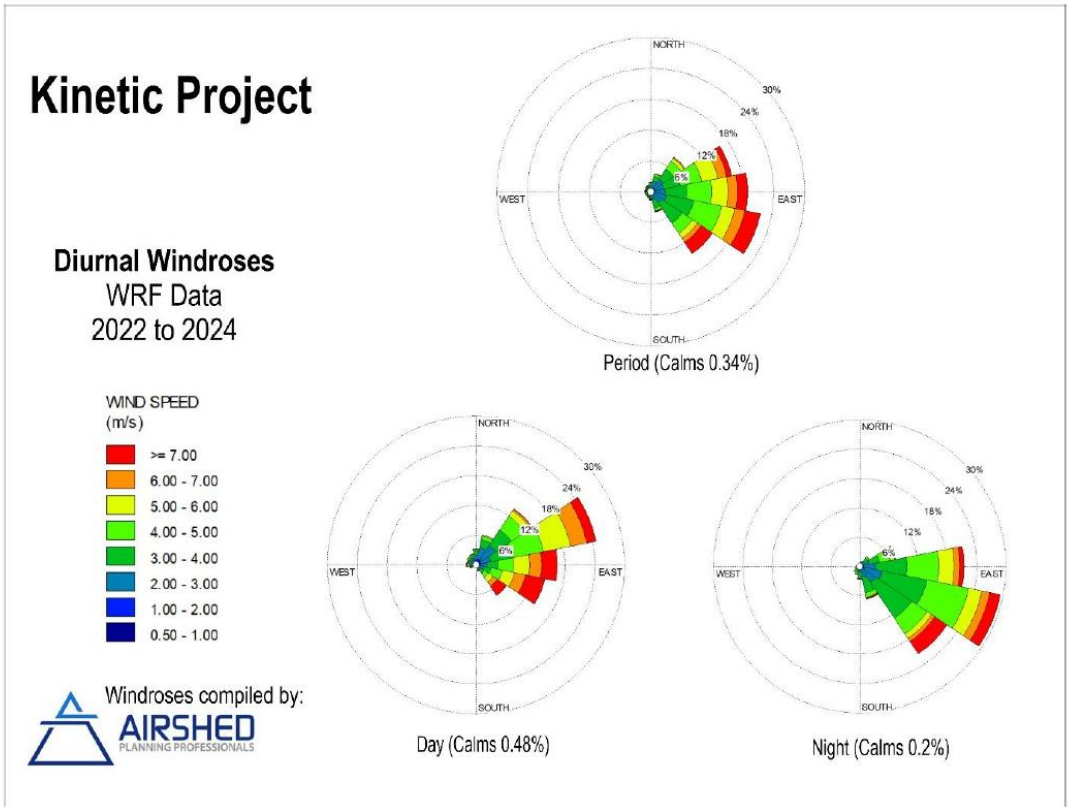


Figure 41: Period - Day and Night-Time Wind Roses (WRF data, 2022 to 2024)

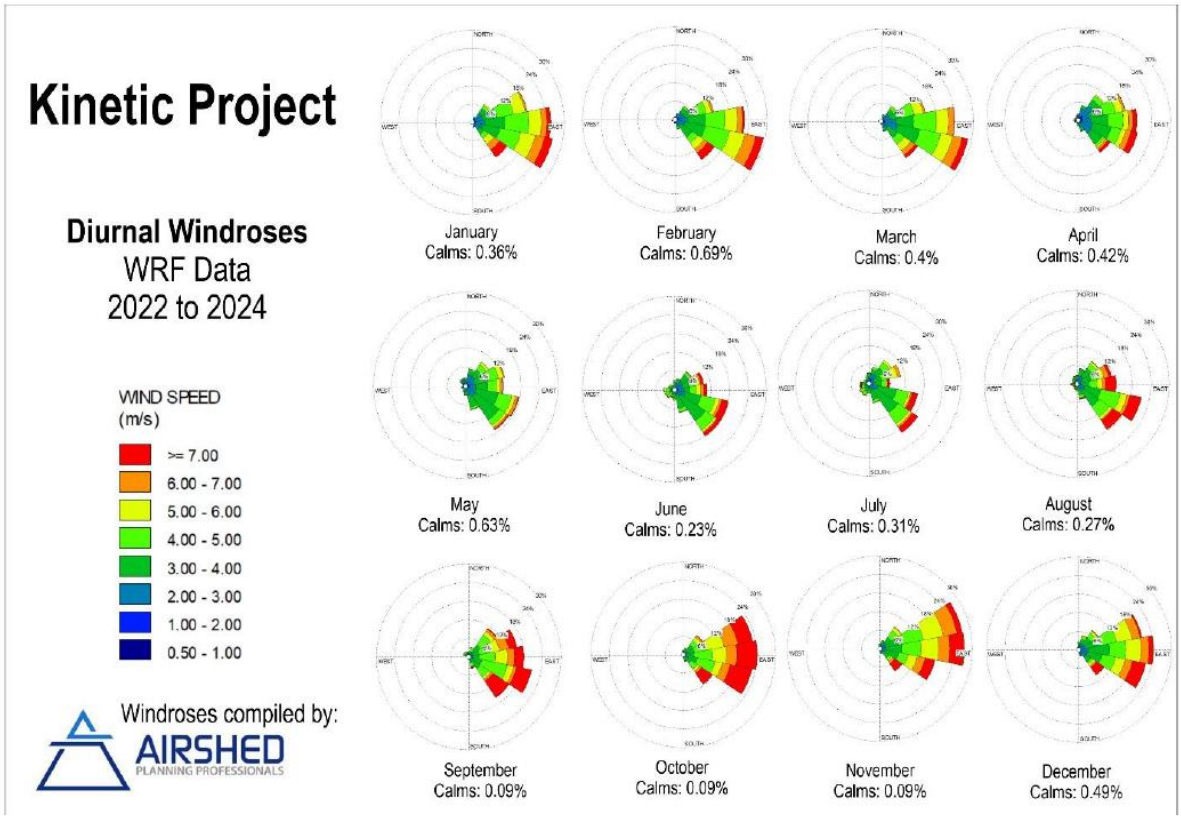


Figure 42: Monthly Wind Roses (WRF data, 2022 to 2024)

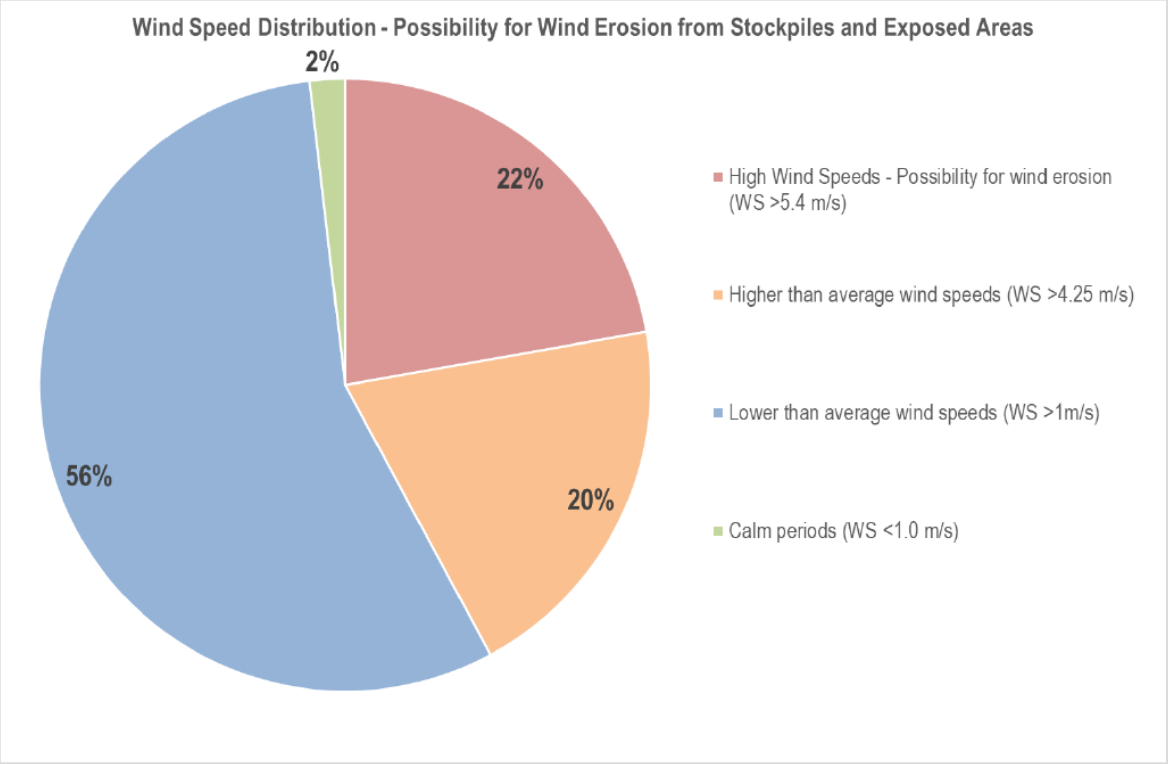


Figure 43: Wind Speed Frequency Distribution - WRF Data for the Study Area (January 2022 to December 2024)

8.8.4 Ambient Temperature and Precipitation of the Area

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the emission plume and the ambient air, the higher the plume can rise), and determining the development of the mixing and inversion layers.

Monthly mean, maximum and minimum temperatures are given in Table 53. Diurnal temperature variability is presented in Figure 3-4. Average monthly temperatures ranged between 16.6°C in June and 27.7°C in December. During the day, temperatures increase to reach maximum at about 15:00 in the late afternoon, with the highest temperatures, exceeding 40°C, occurring in September, October, December and March. Ambient air temperature decreases to reach a minimum at between 06:00, the lowest temperatures occur in July.

Table 53: Monthly Temperature Summary (WRF data, 2022 to 2024)

Monthly Minimum, Maximum and Average Temperatures (°C)												
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Minimum	13.6	12.9	12.4	9.9	7.5	5.6	2.7	6.7	5.7	8.5	10.8	13.2
Average	26.4	26.4	24.7	22.4	19.7	16.6	16.8	19.0	22.5	24.7	26.4	27.7
Maximum	37.3	39.7	40.2	36.8	33.9	33.0	31.6	36.3	40.5	40.7	39.6	41.5

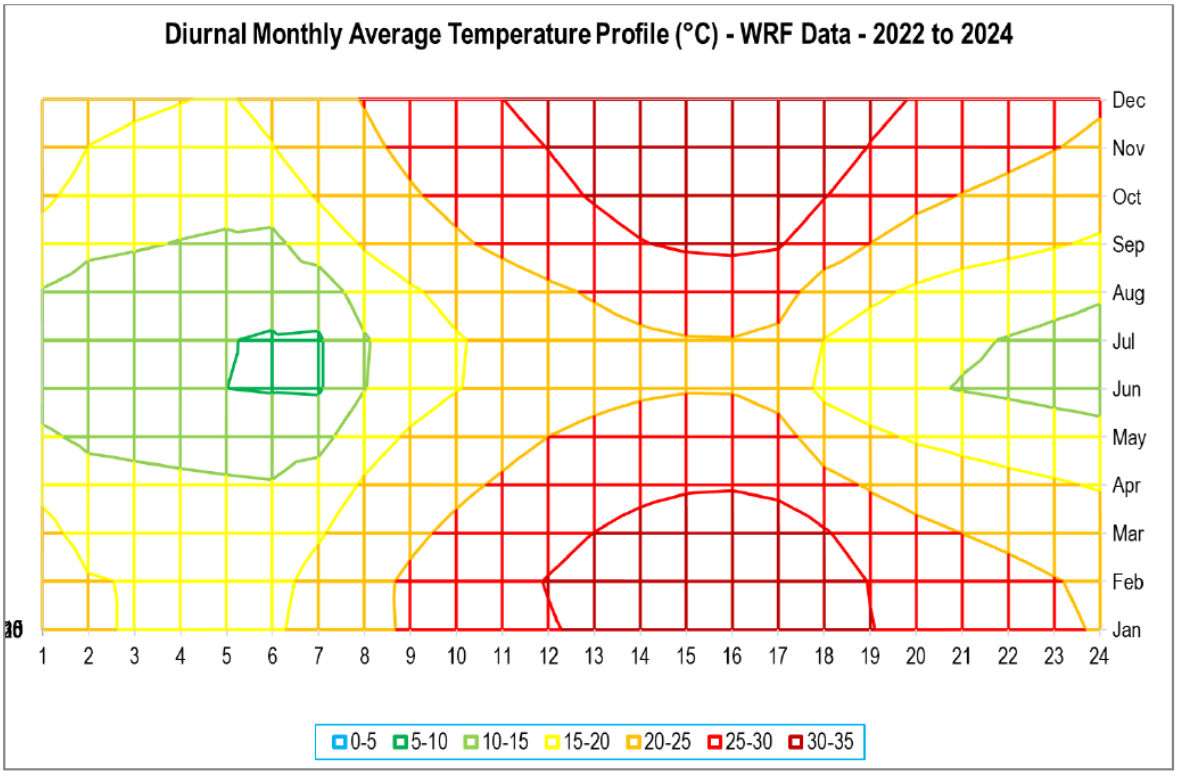
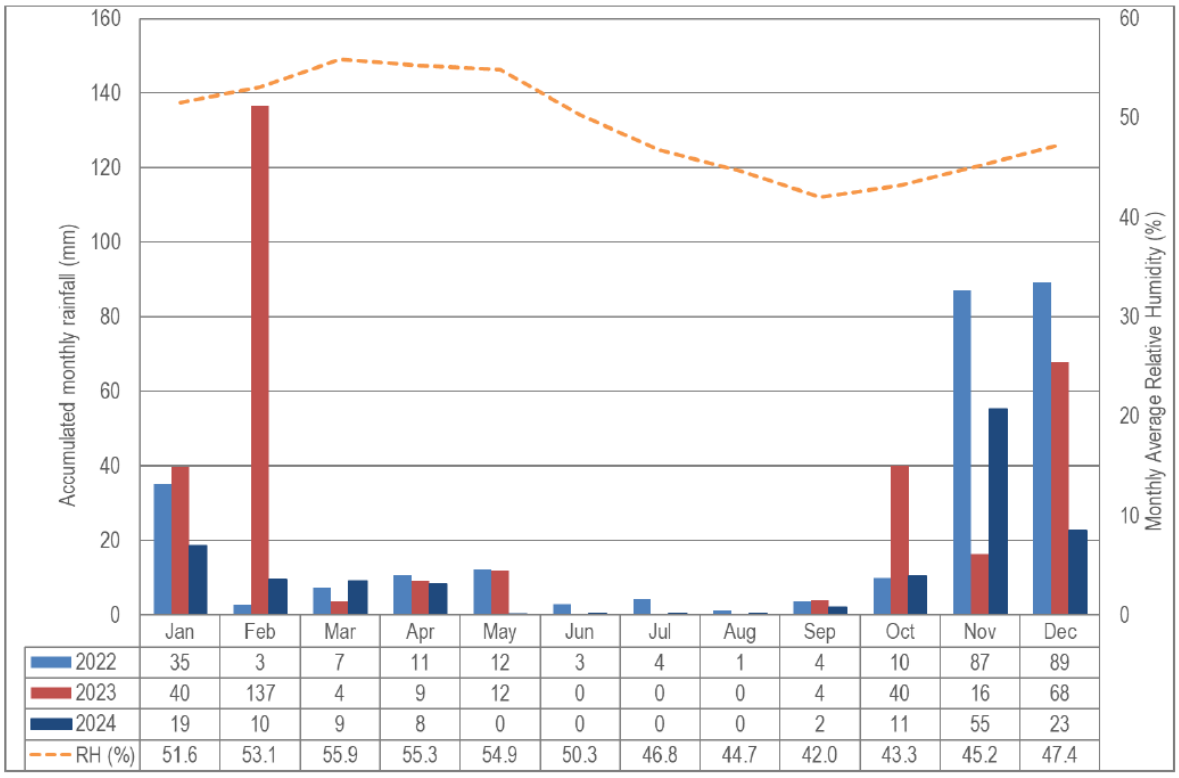


Figure 44: Diurnal Temperature Profile (WRF data, 2022 to 2024)

Precipitation is important to air pollution studies since it represents an effective removal mechanism for atmospheric pollutants and inhibits dust generation potentials. According to the rainfall data from the modelled WRF dataset, between 2022 and 2024 the total precipitation over the three years is 1 719 mm, ranging between 138 mm (2024) and 330 mm (2023). Precipitation occurs as showers and thunderstorms and falls mainly from October to April (about 88 days of measurable rain per year) with the maximum rainfall occurring in November and December, (although the maximum rainfall in 2024 occurred in February). The autumn and winter months are dry with the combined rainfall between May and September making up less than 6% of the annual total. The annual rainfall by month from 2022 to 2024 is given in Figure 45.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2022	35	3	7	11	12	3	4	1	4	10	87	89
2023	40	137	4	9	12	0	0	0	4	40	16	68
2024	19	10	9	8	0	0	0	0	2	11	55	23
RH (%)	51.6	53.1	55.9	55.3	54.9	50.3	46.8	44.7	42.0	43.3	45.2	47.4

Figure 45: Monthly Precipitation at the Study Area (WRF data, 2022-2024)

8.8.5 Atmospheric Stability and Mixing Depth

The new generation air dispersion models differ from the models traditionally used in several aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters: the boundary layer depth and the Monin-Obukhov length, rather than in terms of the single parameter Pasquill Class. The Monin-Obukhov length (LMo) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004).

The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and less dilution potential. During windy and/or cloudy conditions, the atmosphere is normally neutral. For low level releases, the highest ground level concentrations would occur during weak wind speeds and stable (night-time) atmospheric conditions. The atmospheric stability for the site is provided in Figure 46.

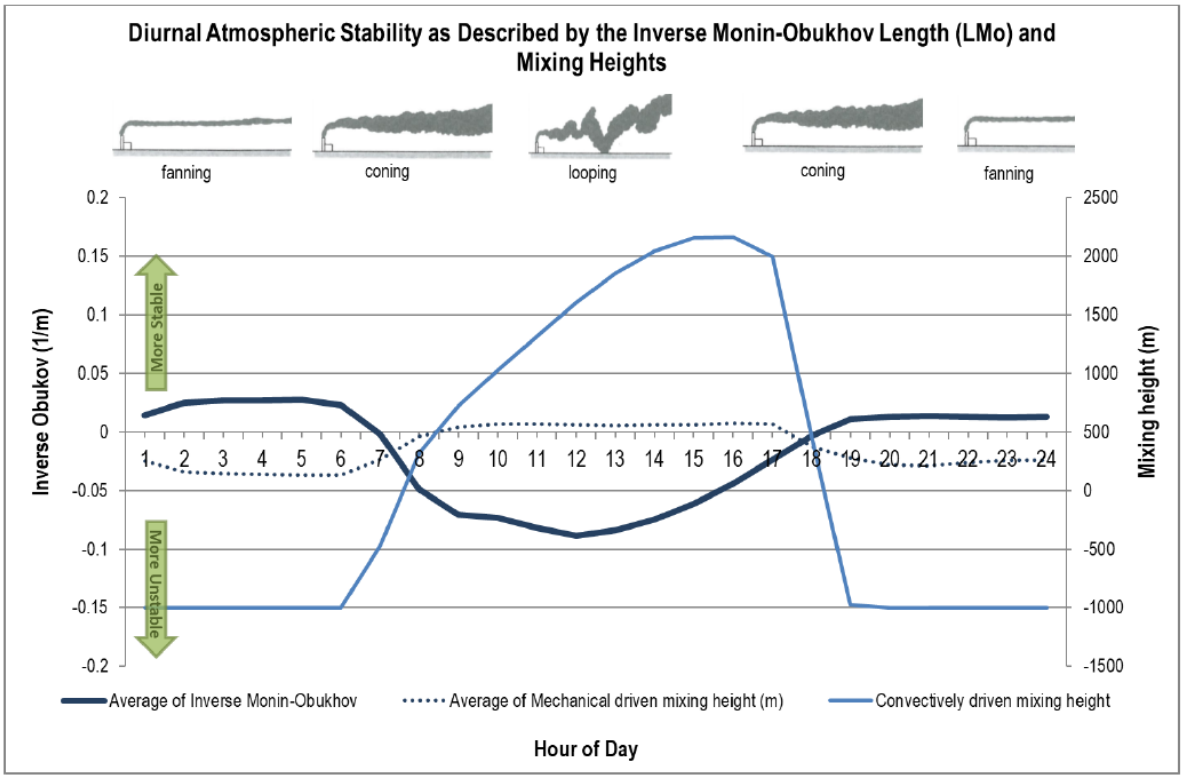


Figure 46: The Diurnal Atmospheric Stability for the Site - WRF data (2022 to 2024)

8.8.6 Baseline Ambient Air Quality

8.8.6.1 Existing Sources of Air Pollution in the Area

The main sources of existing air pollution in the study area and surrounds include the following:

- Mining activities, especially coal mines;
- Agricultural activities, both commercial and subsistence farming;
- Transportation Activities:
- Vehicle tailpipe emissions from public roads and during agricultural activities;
- Entrained dust emissions from public and farm roads;
- Commercial and recreational aircraft use.
- Household fuel burning;
- Biomass burning;
- Wind erosion from exposed soil surfaces.
- Landfills and wastewater treatment plants.

The types of emissions associated with each of these source groups is shown in Table 54.

Table 54: Summary of Air Pollutants Emitted from Various Sources in the Study Area

Sources	Particulate matter	Sulfur dioxide	Oxides of nitrogen	Carbon monoxide	Organic compounds	Heavy metals	Odorous compounds (e.g. hydrogen sulfide)
Mining operations	x	x	x	x		x	
Agricultural activities (excluding exhaust emissions)	x				x		x
Transport (motor vehicles, railway, and aircraft)	x	x	x	x	x	x	
Household fuel burning	x	x	x	x	x		
Biomass burning	x	x	x	x	x		
Wind erosion	x						
Landfills	x				x		x
Wastewater treatment plants					x		x

8.8.6.2 Measured Pre-Development Air Pollution

The South African Air Quality Information System (SAAQIS) aims to make information available to stakeholders, provide a common system for managing air quality in South Africa and provide uniformity in the way data; information and reporting are managed in SA. Providing near-real time ambient air quality data is one of the objectives of SAAQIS. The nearest air quality monitoring station to the study area with data reporting to SAAQIS is in Thohoyandou, approximately 50 km to the east-southeast of the project location. The data from this station for 2024 and 2025 were accessed as an indication of the air quality near the project site. It would appear that operation of this station only started in July 2024, with 44% data availability for the year 2024, but 99.9% availability between 23 July and 31 December 2024. Reference is therefore made for monitoring data from 27 July 2024 to 28 May 2025. Measured SO2, NO2 and CO concentrations at the Thohoyandou monitoring station were well below the NAAQS during the period 27 July 2024 to 28 May 2025.

Annual average PM_{10} and $PM_{2.5}$ concentrations for the period July 2024 to May 2025 were below the NAAQS limit values, while daily PM_{10} and $PM_{2.5}$ concentrations exceeded the allowed 4 exceedances of the NAAQS limit value. All of these exceedances occurred during August and September 2024, presumably due to either veld fires or wind erosion, as this is not only the dryest period in the study area, but also the time of the year with the highest wind speeds.

Table 55: Pollutant Concentrations Recorded at the Thohoyandou AQMS – 27 July 2024 to 28 May 2025

Parameters	Recorded Pollutant Concentration during the period 27 July 2024 to 28 May 2025 (µg/m³)				
	SO_2	NO_2	CO	PM_{10}	$PM_{2.5}$
Highest Hourly Concentration	57.1	83.6	1224.0		
Exceedances of Hourly NAAQS Limit	0				
Highest Daily Concentration	29.8			131.0	85.1
Exceedances of Daily NAAQS Limit	0			**21**	**18**
Annual Average Concentration	1.5	9.2	158.2	33.3	16.3

8.8.7 Emissions Inventory

Due to the absence of locally generated emission factors, use was made of the comprehensive set of emission factors published by the US Environmental Protection Agency (US-EPA) in its AP-42 document Compilation of Air Pollution Emission Factors as well as the Australian National Pollutant Inventory (NPI) emission estimation documents for the quantification of fugitive emission sources, such as vehicle entrainment on on-site roads and the access road, emissions generated from material handling operations, wind erosion from stockpiles and emissions from crushing.

8.8.7.1 Process Description

High-carbon ferrochromium alloy is produced through carbon reduction in a submerged arc furnace heated by electricity. Chromite ore serves as the raw material, silica stone acts as the slag-forming flux, and carbonaceous reducing agents (coke) are used. The production process features continuous smelting and intermittent tapping, adopting an electrothermal method.

Qualified coke, silica stone, and lumpy chromite ore are conveyed by belt-conveyors to the daily storage bins at the batching station. Facilities for pelletizing chromite fines are reserved. After batching, the materials are transported via belt-conveyors to the electric furnace bay and added to the storage hoppers. They are then fed into the furnace through feed pipes.

The taphole is opened by a taphole drill at intervals of 2.67 hours. Liquid ferrochromium alloy flows into the ladle, and furnace slag flows from the ladle into the slag pot. The ladle car and slag pot car are pulled out by an electric tapping car and enter the casting bay. The ladle is hoisted by a crane for slag skimming before casting. The cooled high-carbon ferrochromium alloy is processed into finished products of qualified particle size by a high-intensity crushing line in the finished product bay. Oversize materials are remelted in ingot molds. The slag pot is hoisted by a crane, and furnace slag flows into the dry slag pond through a dry slag chute. The cooled dry slag is sent to the dry slag storage area.

Two electric furnaces are installed in the electric furnace workshop. Each electric furnace is equipped with one set of flue gas purification system for electric furnaces (two sets in total). One set of dust collection system is set up at the tapping hole and top charging area of each electric furnace (two sets in total). Dust collection

facilities are installed for systems such as raw material supply and batching at the ground-level raw material yard.

The flue gas from the submerged arc furnace is cooled to 230°C by an air cooler. Next, it passes through a pre-cyclone dust collector and is filtered by a large negative-pressure bag dust collector. The flue gas after filtration meets the emission standards. Every two sets of dust collection systems share one exhaust stack for emission.
The flue gas at the tapping hole and the dust-laden gas during top-charging of the furnace are captured through their respective hoods. They are then guided via air ducts to a pulse bag dust collector for filtration. After that, the gas is discharged into the venting chimney by an induced draft fan.

The dust accumulated on the filter bags is blown off by low-pressure pulse gas and falls into the ash hopper. The dust is collected by a horizontal scraper conveyor and a bucket elevator and then sent to the ash storage silo. The dust collected from the dust collector is humidified before being transported out for disposal.

To prevent the filter bags from being damaged due to excessive fluctuations in flue gas temperature, a mixing air valve is installed on the inlet pipeline of the bag dust collector. The mixing air valve is interlocked with the temperature measuring points on the inlet pipeline of the bag dust collector. When the temperature is ≥ 250°C, the mixing air valve opens automatically; when the temperature is < 230°C, it closes automatically.

The dust-laden gas at various dust source points during the production process, like those from raw material processing equipment, is captured by installed capture hoods. It then enters dust collectors through dust removal pipelines for purification. The dust removal system for bulk materials and auxiliary raw materials typically consists of dust extraction hoods at unloading points such as transfer stations of belt conveyors and unloading trolleys, pipelines, regulating valves, fans, bag dust collectors, mechanical ash conveying devices, ash storage silos, chimneys, etc. The auxiliary support systems include instrument detection and electrical automation systems, compressed air systems, etc. Natural ventilation and necessary axial-flow mechanical exhaust systems are installed in each production workshop.

8.8.7.2 Point Sources

In the quantification of point source emissions, use was made of the design specifications for the plant and the Subcategory 4.9: Ferroalloy Production Minimum Emission Standards (MES), as published under Section 21 of the National Environmental Management: Air Quality Act (NEM:AQA).

The physical parameter for point sources at the Kinetic Project, together with estimated emissions (if all point sources were to operate at the Subcategory 4.9 MES), are shown in Table 56.

Table 56: Kinetic Project Point Source Parameters and Emissions

Point Source	Flow Rate (m^3/h)	Diameter (m)	Height (m)	Velocity (m/s)	Temperature (°C)	Emission Concentrations (mg/Nm^3)			Emissions Rate (g/s)		
						PM	SO_2	NO_x	PM	SO_2	NO_x
Dry material dust removal	60 000	1.32	20	13.5	25	50	500	400	0.8	7.5	6.0
Primary dust removal for submerged arc furnace	200 000	2.32	30	14.5	230	50	500	400	1.5	14.8	11.8
Raw material batching dust removal	50 000	1.22	20	13	30	50	500	400	0.6	6.1	4.9
Taphole fume extraction and charging dust removal	80 000	1.52	20	13.5	100	50	500	400	0.8	8.0	6.4
Taphole fume extraction and charging dust removal	80 000	1.52	20	13.5	100	50	500	400	0.8	8.0	6.4

8.8.7.3 Fugitive Sources

In addition to the point sources at the Kinetic Project, several fugitive emission sources are also expected to release pollutants to the atmosphere at or near ground level. These include transporting and handling of raw materials and ferrochromium alloy products, handling and deposition of slag, vehicle entrainment on on-site paved roads and the access road, crushing of ferrochromium alloy product and uncaptured secondary emissions from the furnaces, released during charging and tapping.

The emission factors, emission estimation techniques and parameters used in the estimation of emissions from the Kinetic Project operations are given in Table 57.

Table 57a: Emission Factors and Parameters Used in the Fugitive Emission Estimation

Activity	Emission Equation	Source	Information assumed/provided
Wind Erosion	$E_{TSP} = 0.4\ kg/ha/h$ $E_{PM10} = 0.2\ kg/ha/h$ $E_{PM2.5} = 0.02\ kg/ha/h$ Where, E = Default emission factor Fraction of $PM_{2.5}$ assumed to be 10% of PM_{10}	NPI Section: Mining	Wind erosion from raw material and slag stockpiles was only modelled for hours with wind speeds exceeding 5.4 m/s.
Furnace Fugitive Emissions	Furnace fugitive particulate emissions were estimated using the US EPA AP-42 Section 12.5 (Iron and Steel Production) emission factors for charging, tapping and slagging in electric arc furnaces (0.0215 kg/tonne ferroalloy produced) controlled by direct shell evacuation plus charging hood.	US EPA AP-42 Section 12.5 (Iron and Steel Production	Based on 125 329 t/a ferrochrome production. A control efficiency of 90% was applied to account for design fume extraction and the mitigating effect of the furnace building on particulate emissions inside the building.

Table 57b: Emission Factors and Parameters Used in the Fugitive Emission Estimation

Activity	Emission Equation	Source	Information assumed/provided
Materials handling	Loading stockpiles: $E_{TSP} = 0.004\ kg/t\ material$ loaded $E_{PM10} = 0.0017\ kg/t\ material$ loaded $E_{PM2.5} = 0.00017\ kg/t\ material$ loaded Unloading from stockpiles: $E_{TSP} = 0.03\ kg/t\ material$ handled $E_{PM10} = 0.013\ kg/t\ material$ handled $E_{PM2.5} = 0.0013\ kg/t\ material$ handled Conveying: $E_{TSP} = 0.005\ kg/t\ material$ handled $E_{PM10} = 0.002\ kg/t\ material$ handled $E_{PM2.5} = 0.0002\ kg/t\ material$ handled Front-End Loaders $E_{TSP} = 0.025\ kg/t\ material$ loaded $E_{PM10} = 0.012\ kg/t\ material$ loaded $E_{PM2.5} = 0.0012\ kg/t\ material$ loaded	NPI Section: Mining	The throughput of materials was given as follows: 125 329 t/a high-carbon ferrochrome 250 658 t/a chromite ore 62 664 t/a coke 21 807 t/a silica stone Hours of operation were assumed as 24 hrs per day, 7 days per week, 330 days per year.
Vehicle Entrainment on paved road surfaces	$E = 0.62\ (sL)^{0.91} \times (W)^{1.02}\ g/VKT$ Where; E = particulate emission factor in grams per vehicle km travelled (g/VKT) sL = silt loading on the road surface in g/m² W = average weight (tonnes) of the vehicles travelling the road	US-EPA AP42 Section 13.2.1	Estimated using raw material consumption and ferrochrome production rates, as given above. Distances travelled on site were estimated from site layout maps. In the absence of site-specific silt loading data, use was US EPA default mean silt loading of 9.7 g/m² for iron and steel production.
Vehicle entrainment on unpaved surfaces	$E = k\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b} \cdot 281.9$ Where, E = particulate emission factor in grams per vehicle km travelled (g/VKT) k = basic emission factor for particle size range and units of interest s = road surface silt content (%) W = average weight (tonnes) of the vehicles travelling the road The particle size multiplier (k) is given as 0.15 for $PM_{2.5}$ and 1.5 for PM_{10}, and as 4.9 for TSP The empirical constant (a) is given as 0.9 for $PM_{2.5}$ and PM_{10}, and 4.9 for TSP The empirical constant (b) is given as 0.45 for $PM_{2.5}$, PM_{10} and TSP	US-EPA AP42 Section 13.2.2	In the absence of site-specific silt data, use was made of the US EPA default mean silt content for iron and steel production of 6.0%. Emissions from all raw materials and ferrochrome product, with quantities transported as listed above, were estimated from the entrance to the MMSEZ (next to the N1) to the Kinetic Project site, following existing unpaved roads. Should shorter routes be established in the future, or roads in the MMSEZ paved, the emissions from vehicle entrainment on the access road will reduce. The capacity of the trucks to be used was assumed as 30 t.

Crushing and screening	Primary: $E_{TSP} = 0.01\ kg/t\ material\ processed$ $E_{PM10} = 0.004\ kg/t\ material\ processed$ $E_{PM2.5} = 0.0004\ kg/t\ material\ processed$ Where,	NPI Section: Mining	It was assumed that all ferrochrome produce would be crushed, emission estimation was based on 125 329 t/a ferrochrome production. A control efficiency of 90% was applied to account for the
	E = Default emission factor for high_moisture content material Fraction of $PM_{2.5}$ taken from US-EPA crushed stone emission factor ratio for tertiary crushing		mitigating effect of the furnace building on particulate emissions inside the building.

8.8.7.4 Summary of Atmospheric Emissions

Using the point emissions summarised in Table 56 and the fugitive emission estimation techniques described in Table 57, the emissions inventory for the Kinetic Project is summarised in Table 58. It should be noted that SO_2 and NO_2 emissions are quantified using the Subcategory 4.9 MES (as required by the Regulations Regarding Dispersion Modelling), however, given that the majority of point sources at the Kinetic Project serve as the point of release for dust and fume extraction, rather than releasing process or combustion emissions, it is likely that actual SO_2 and NO_2 emissions would be significantly lower than estimated, since there is expected to be very little SO_2 and NO_2 in the dust extraction emissions.

Table 58: Criteria Pollutant Emissions Inventory – Kinetic Project

Emission Source	Estimated Average Emissions Rate in g/s				
	TSP	PM_{10}	$PM_{2.5}$	SO_2	NO_2
Point Source Emissions	4.43	4.43	4.43	44.31	35.45
Fugitive Emissions from Materials Handling at the Raw Material Stockpile	0.435	0.192	0.019		
Fugitive Emissions from Materials Handling and Unloading Slag Stockpile	0.191	0.084	0.008		
Uncaptured Fugitive Process Emission at the Furnace Workshop	0.808	0.151	0.086		
Fugitive Emissions from Conveyors and Conveyor Transfer Points	0.0301	0.0141	0.0014		
Vehicle Entrainment on On-site Paved Roads	0.1046	0.0204	0.0047		
Vehicle Entrainment on Access Road	5.42	1.04	0.25		
Total	**11.42**	**5.93**	**4.80**	**44.31**	**35.45**

8.9 Climate Change

8.9.1 Physical Risks of Climate Change in the Region

The proposed project would be categorised in the industry category for both the global GHG inventory and for the national GHG inventory. According to the World Resources Institute – CAIT Climate Data Explorer2 (as accessed in June 2025) the 2022 global GHG emissions from the industry category were approximately 3 208.24 Mt CO2e; 6.4% of the total GHG emissions (including Land-Use Change and Forestry (LUCF)). The South African industry sector contributed 28.32 Mt CO2e, ~0.88% of the global emissions from the industry sector in 2022.

One of the impact requirements for a climate change assessment is an estimation of the Greenhouse Gas (GHG) emissions, direct and indirect (including upstream GHG emissions) that will be released into the atmosphere annually throughout the impact related to the activity.

8.9.1.1 Vulnerability

The risk profile was accessed for the Musina Local Municipality[4]. The Musina Local Municipality socio-economic vulnerability score[5] (out of 10) is 5.1 for 1996, reducing to 4.7 for 2011. The lower score in 2011 compared to 1996 indicates improvement of socio-economic factors. 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. The Musina Local Municipality for socio-economic vulnerability ranks 8th out of 22 in the province and 98th out of 213 in the country. The Musina Local Municipality economic vulnerability score[6] (out of 10) is 5.9 for 1996, increasing to 7.2 for 2011. The economic vulnerability ranks 14th out of 22 in the province and 173rd out of 213 in the country. The physical vulnerabilities[7] ranks 13th out of 22 in the province and 136th out of 213 in the country. The environmental vulnerability[8] ranks 20th out of 22 in the province and 195th out of 213 in the country.

8.9.1.2 Climate

Climate change metrics focus on temperature; the number of very hot days (where the maximum temperatures exceed 35°C); rainfall and extreme rainfall events (more than 20 mm of rain occurring within 24 hours). The baseline (1961 to 1990) annual averages for these metrics were accessed for the area near the project site from the South Africa 'Green Book'[9] (CSIR, 2019). The metrics include three percentiles[10] (10th, 50th, and 90th) as an indication of the variability within the measured data set.

Baseline annual average temperature was in the range 22.1°C (10th percentile) and 22.4°C (90th percentile) (Figure 47) with the number of very hot days varying between 48 (10th percentile) and 58 (90th percentile) days per year (Figure 48). The annual average rainfall range between the 10th and 90th percentiles is 292 mm and 344 mm (Figure 49). Extreme rainfall days varied between 1.3 (10th percentile) and 2.3 (90th percentile) days per year (Figure 50).

[4] https://riskprofiles.greenbook.co.za/

[5] Defined as the vulnerability of households based on household composition; education and health; access to basic services; safety and security.

[6] Defined as the susceptibility of the municipality to external shocks based on economic diversity; size of economy; labour force; gross domestic product (GDP) growth rate; and inequality.

[7] Defined by the physical fabric of connectedness of the settlements within the municipalities and structural robustness.

[8] This indicator represents the balance between preserving the natural environmental and the pressures of population growth, urbanisation, and economic development. The indicator is based on air quality, environmental governance and competition between ecology and the urban environment.

[9] https://greenbook.co.za/

[10] A percentile is a statistical measure to indicate the value below which a given percentage of observations in a group of observations falls. For example, the 90th percentile is the value below which 90% of the observations fall. The 10th percentile is the value below which 10% of the observations fall.

Recent change in climatic conditions near the project site were accessed from MeteoBlue[11] a weather forecasting platform developed at the University of Basel, Switzerland and based on models of National Oceanic and Atmospheric Administration (NOAA) or National Centres for Environmental Prediction (NCEP). The data sets also include historical climate data tracking changes in climate by referencing ERA5, the fifth generation ECMWF (European Centre for Medium-Range Weather Forecasts) atmospheric reanalysis of the global climate, for the period between 1979 to 2024, with a spatial resolution of 30 km. Based on a point selected over the project site, an increasing trend in the annual average temperatures have been observed from 20.5°C in 1979 to 22.5°C in 2024 (Figure 51 – top panel). The lower part the graph shows the so-called warming stripes. Each coloured stripe represents the average temperature for a year - blue for colder and red for warmer years. The change in rainfall over the same period (1979 – 2024) displays a slight decreasing trend from 398.5 mm in 1979 to 231.2 mm in 2024 (Figure 3-6), where the difference from long-term average for each year in the data set is visualised by the stripes in the lower panel of Figure 52 (brown stripes indicate lower than average rainfall and green stripes above average rainfall).

[11] https://www.meteoblue.com

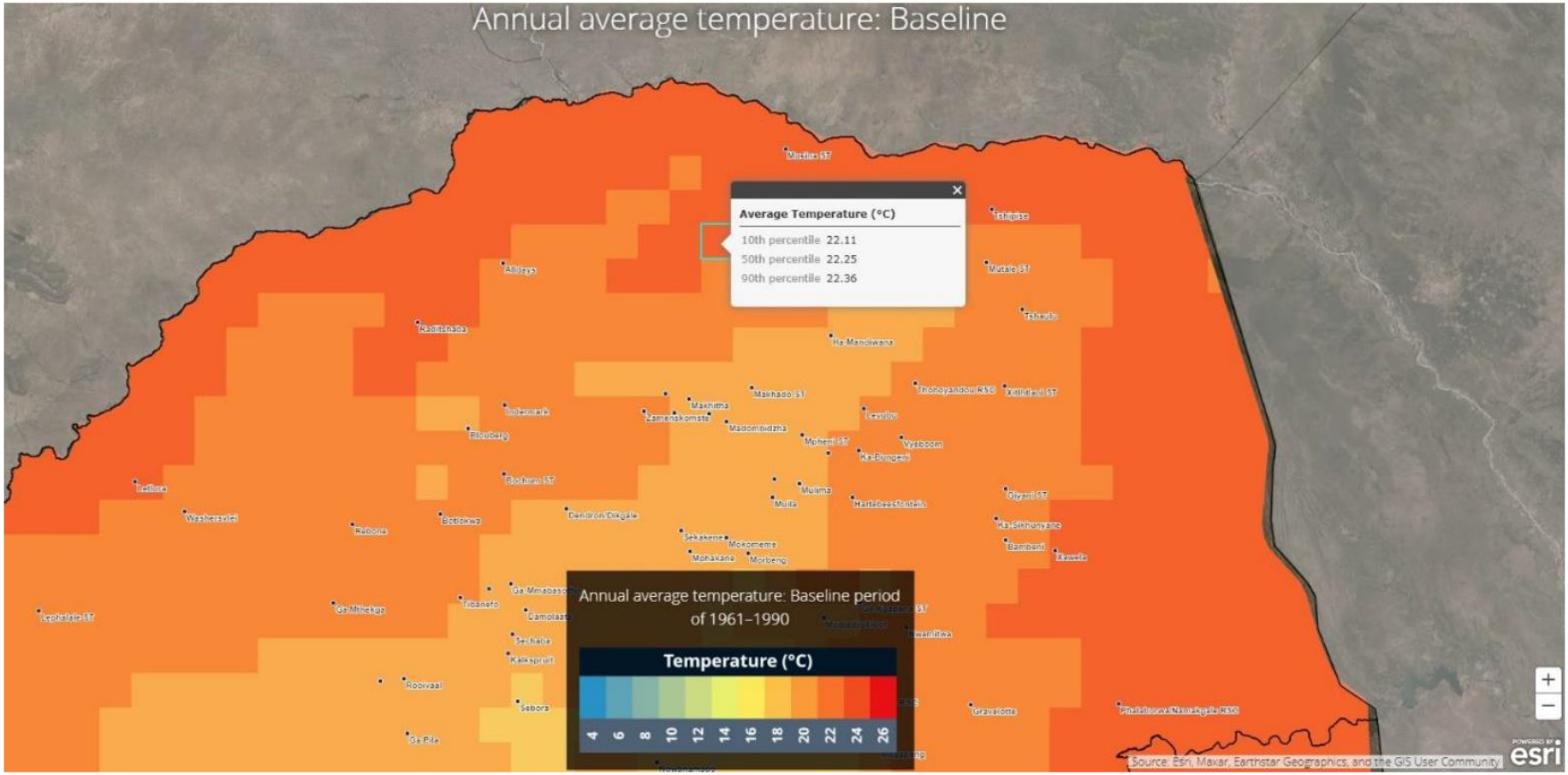


Figure 47: Baseline (1961 to 1990) Annual Average Temperature for the Project Area (CSIR, 2019)

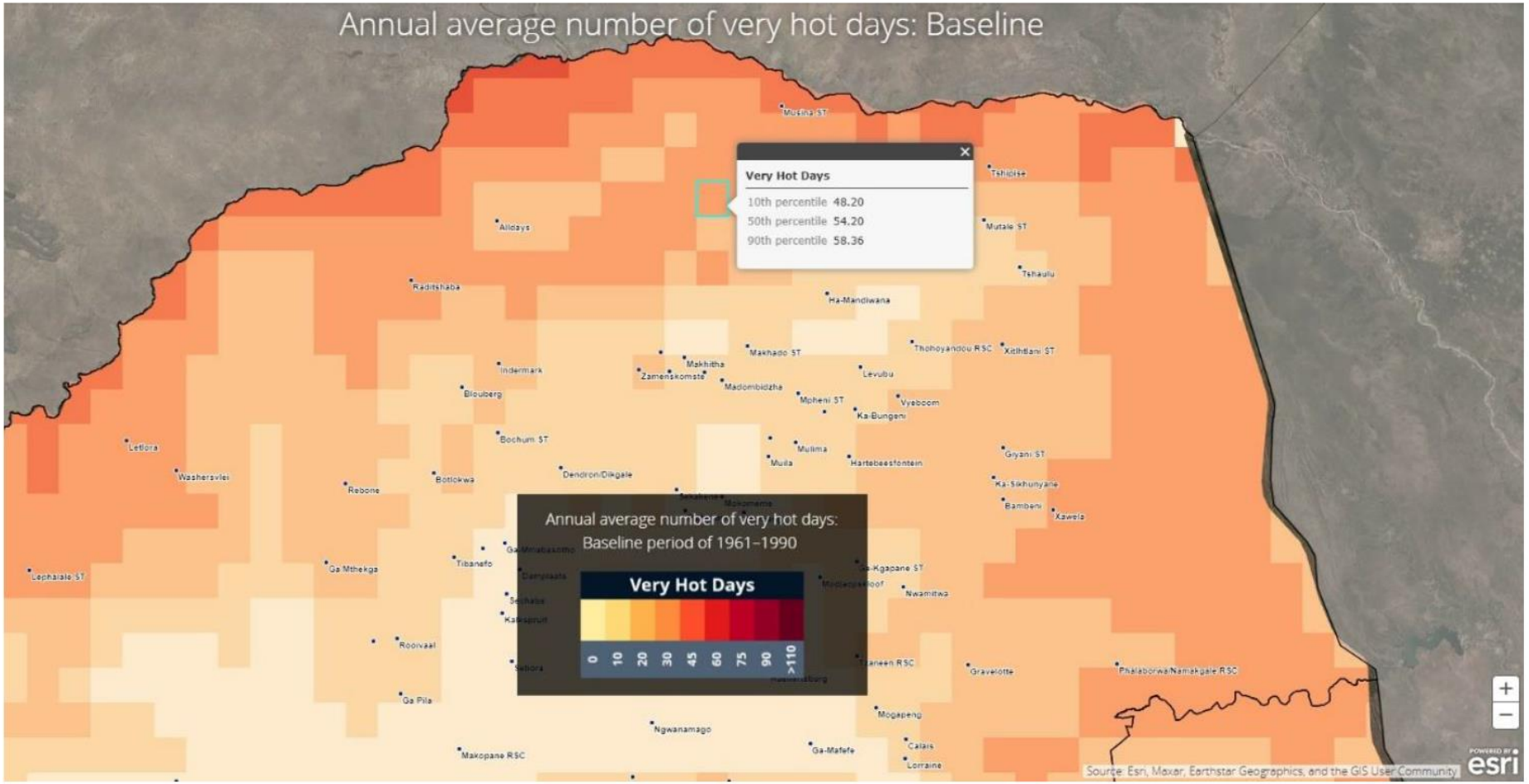


Figure 48: Baseline (1961 to 1990) Number of Very Hot Days (>35°C) Annually for the Project Area (CSIR, 2019)

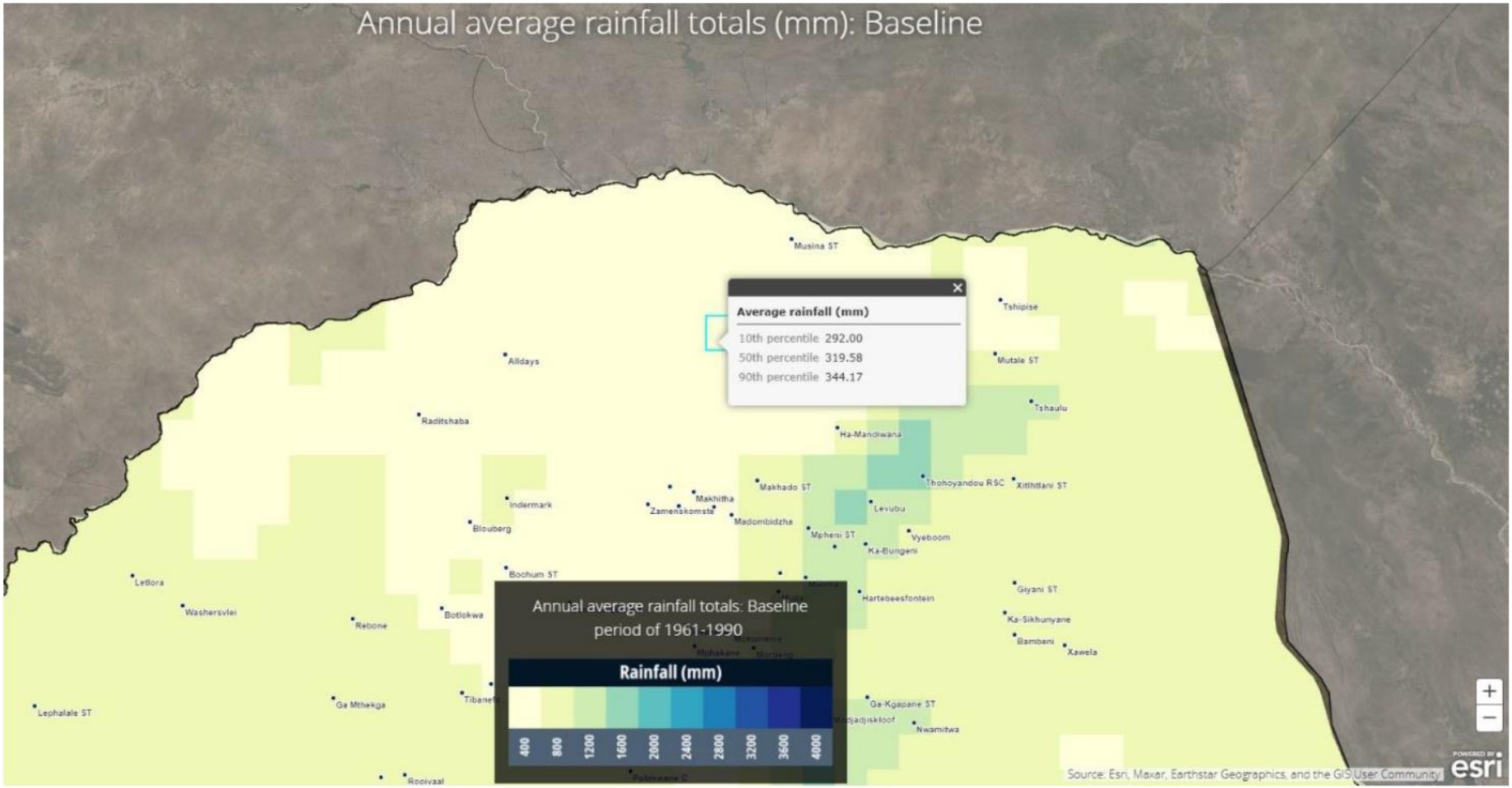


Figure 49: Baseline (1961 to 1990) Annual Average Rainfall for the Project Area (CSIR, 2019)

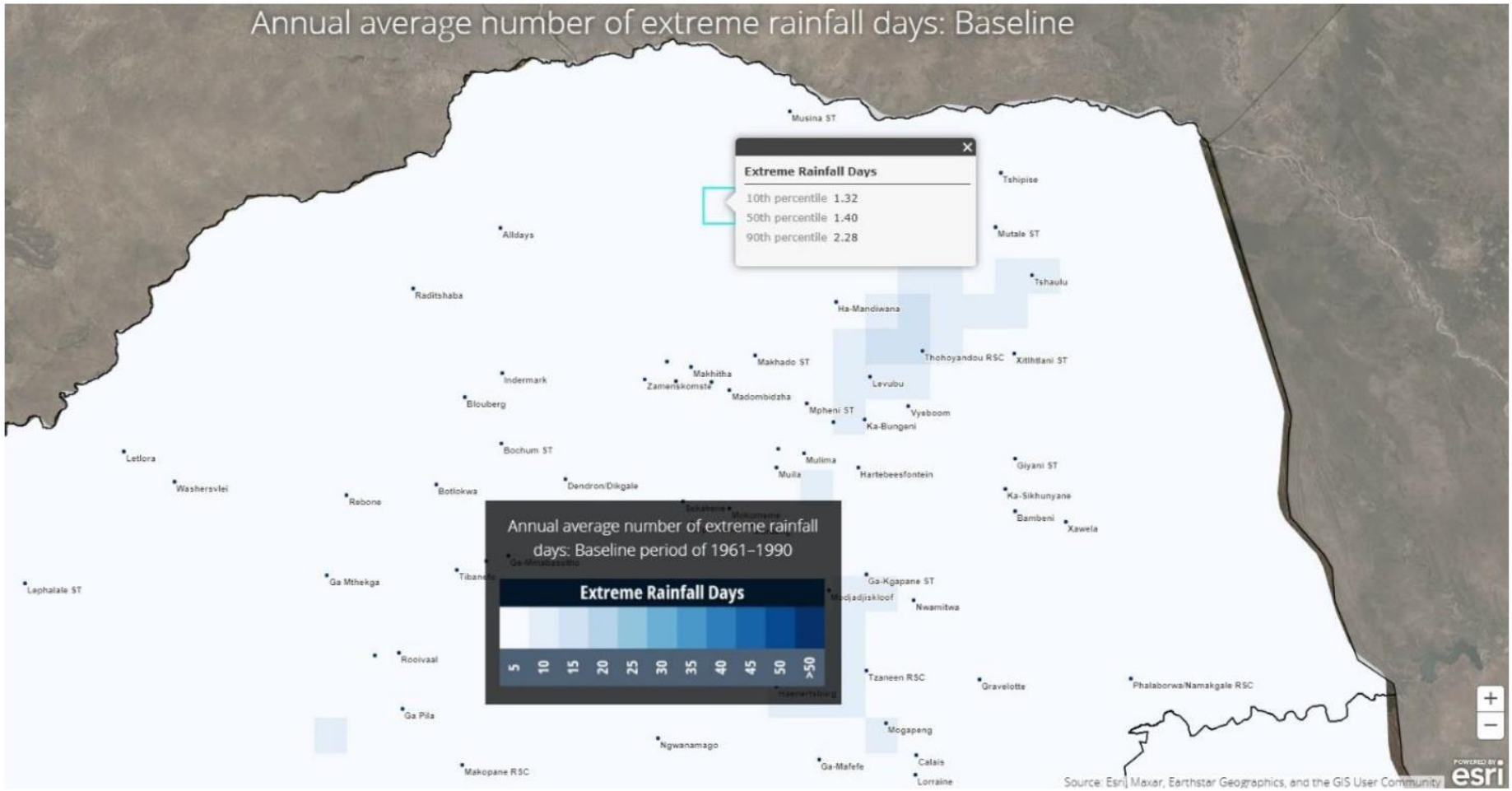


Figure 50: Baseline (1961 to 1990) Annual Average Number of Extreme Rainfall Days (>20 mm in <24 hours) for the Project Area (CSIR, 2019)

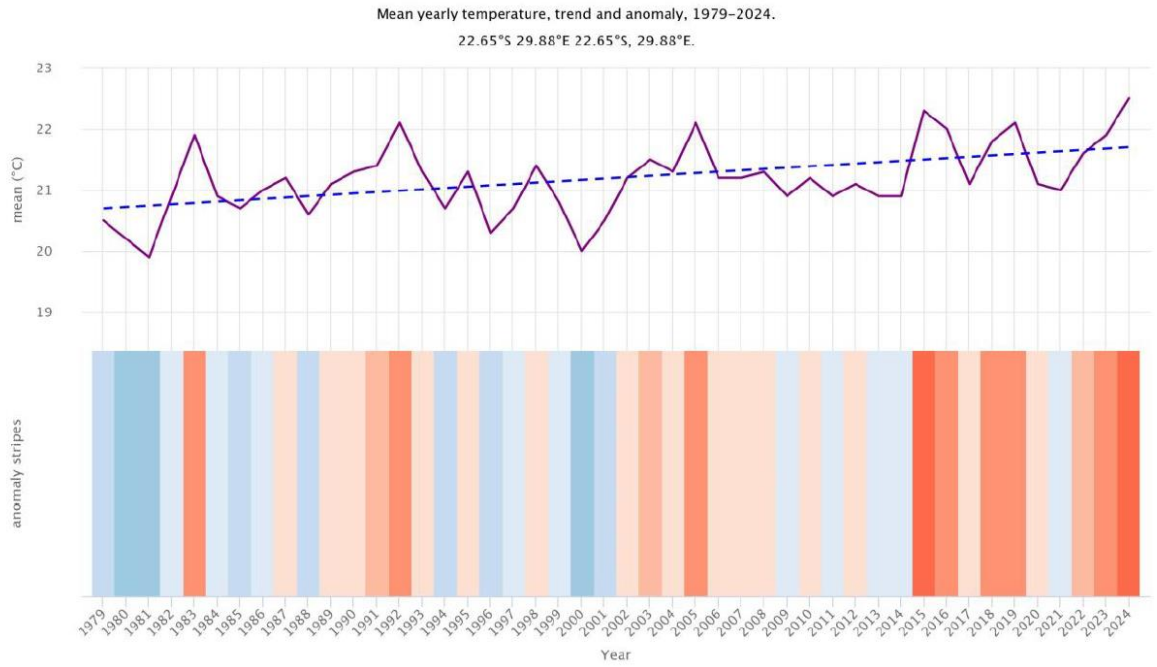


Figure 51: Annual Average Temperature (top panel) and Temperature Anomaly (lower panel) Between 1979 and 2024 (Meteoblue, 2025)

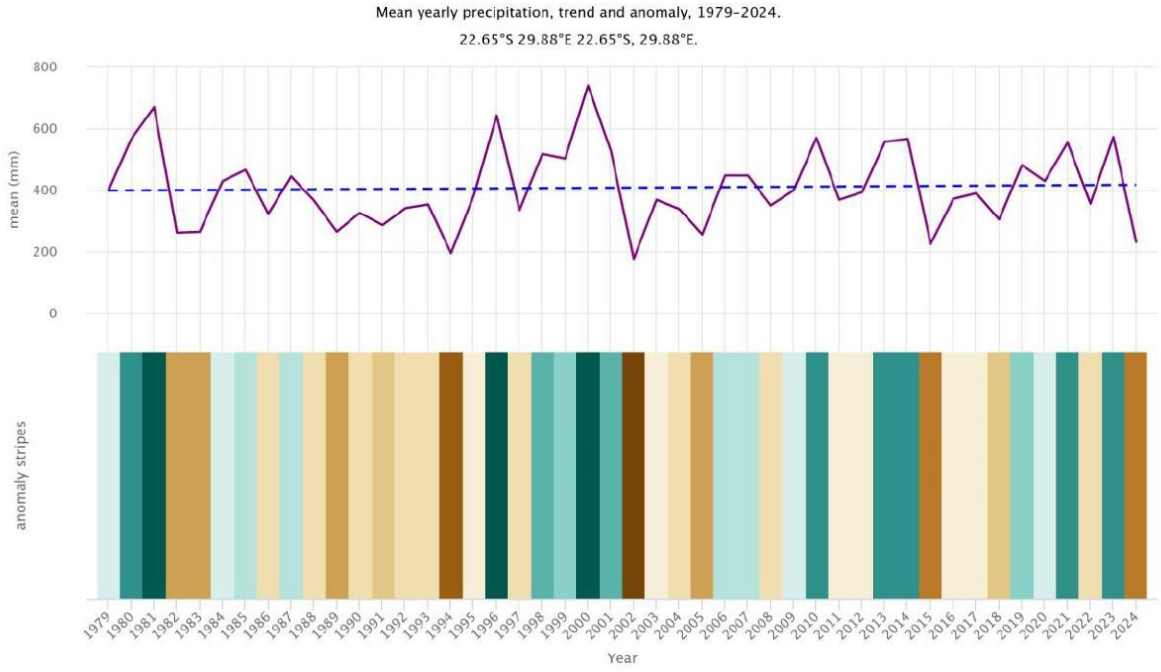


Figure 52: Annual Average Rainfall (top panel) and Rainfall Anomaly (lower panel) Between 1979 and 2024 (Meteoblue, 2025)

8.9.2 Impact of Climate Change

To understand the impact that climate change might have on the major resources of the Musina Local Municipality it is first necessary to provide an overview of the current situation, which has been provided for water, economy, and agriculture.

8.9.2.1 Water Resources and Supply

In addition to the hazards identified in the Green Book, Hofste, *et al.*, (2019) currently rate the project area as arid with extremely high-water stress (Figure 53) with a projection of near normal risk of water stress for the future (2050 based on a conservative low mitigation trajectory) (Figure 54).

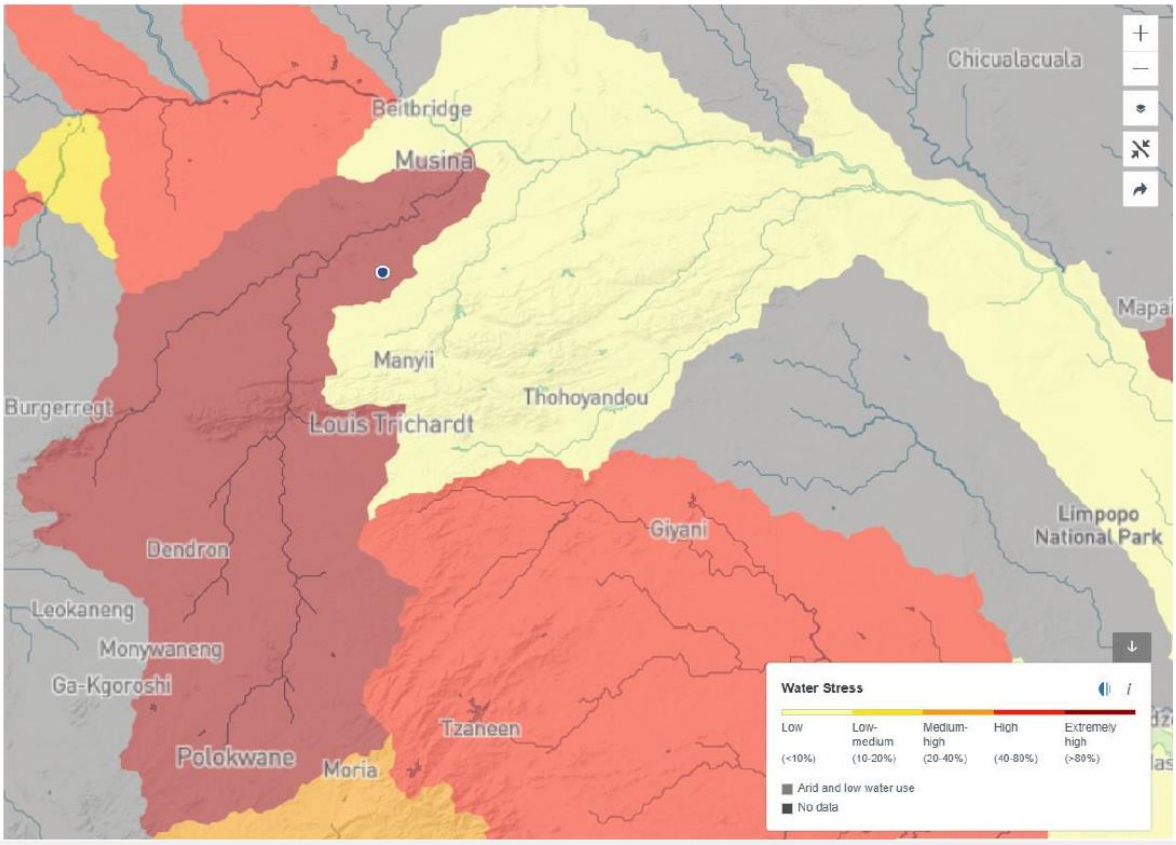


Figure 53: Current Water Stress for the Project Area (Hofste, et al., 2019) (blue dot indicates project location)

Figure 55 provides the current water supply vulnerability (i.e., demand versus supply) for the Musina Local Municipality based on the data compiled for the Department of Water and Sanitation (DWS) All Town's Study (Cole, Bailey, Cullis, & New, 2017). The current water demand for the municipality is 149 l/p/d (litres per person per day), and is within the supply of 283 l/p/d, with 50% of water sourced from surface water, and 50% sourced from groundwater.

Figure 56 shows the estimated current and future water supply vulnerability (i.e., the ratio of demand to supply) based on: 1) a local water supply perspective incorporating changes to population growth coupled with exposure to climate risk (based on impacts on local runoff), and 2) a regional water supply perspective (based on impacts of regional water supply assuming supply is part of the integrated regional and national bulk water supply network). The mean annual precipitation for the municipality is predicted to decrease by 2.8% for 2050 with a regional urban water supply increase of 29%.

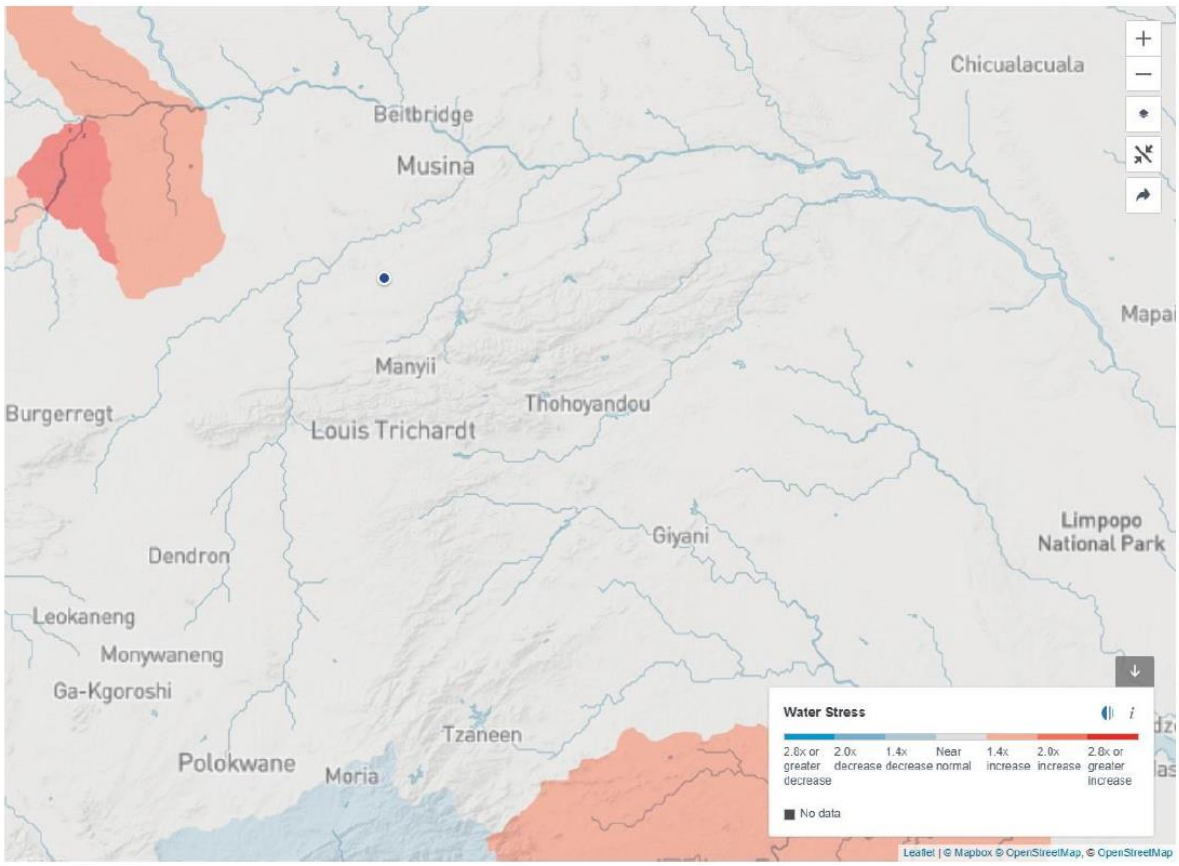


Figure 54: Projected (2050) Water Stress for the Project Area (Hofste, et al., 2019) (blue dot indicates project location)

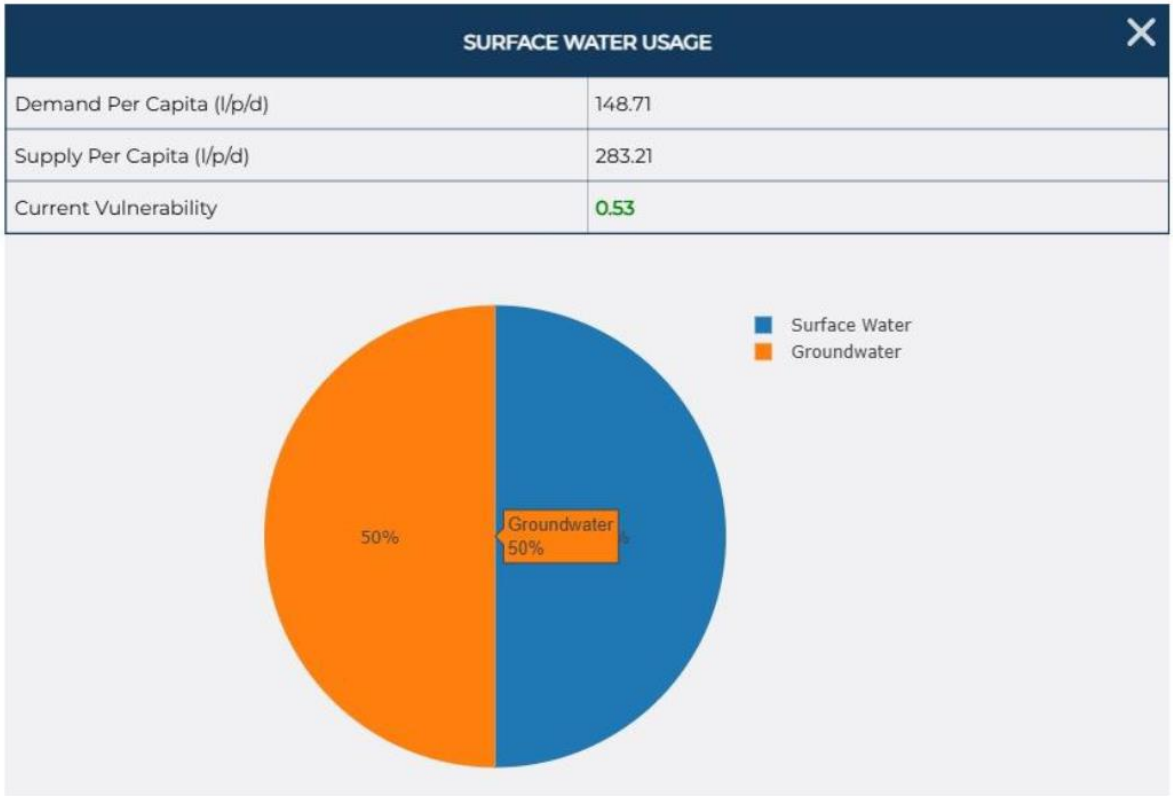
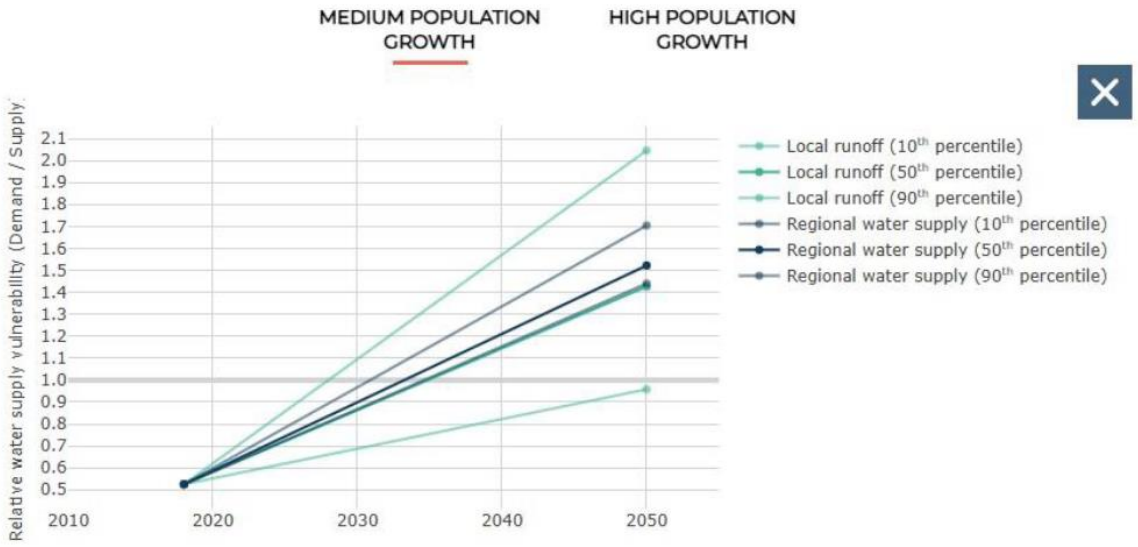


Figure 55: Current Water Availability for the Musina Local Municipality



VULNERABILITY CONTRIBUTION FACTORS		PERCENTAGE CHANGE
Mean annual precipitation	↓	-2.78%
Mean annual evaporation	↑	8.74%
Mean annual runoff	↑	43.63%
Regional urban water supply	↑	28.53%
Population growth	↑	200.84%

Figure 56: Estimated Current and Future (2050) Water Supply Vulnerability Based on Medium Population Growth for the Musina Local Municipality

The Musina Local Municipality is within the Limpopo Primary Catchment. Figure 57 depicts the current annual and monthly surface water runoff, precipitation and evaporation for the Limpopo Primary Catchment associated with the Musina Local Municipality. Precipitation and evaporation for the municipality is currently 426 mm/year and 1832 mm/year respectively. Figure 58 provides the projected monthly change for future (2050) evaporation, precipitation, and estimated runoff values.

The groundwater recharge potential map indicates the occurrence and distribution of groundwater resources across the municipality, showing distinctive recharge potential zones. The groundwater dependency map indicates where settlements get their main water supply from, be it groundwater, surface water or a combination of both sources. Settlements that rely on groundwater, either entirely or partially, are deemed groundwater dependent.

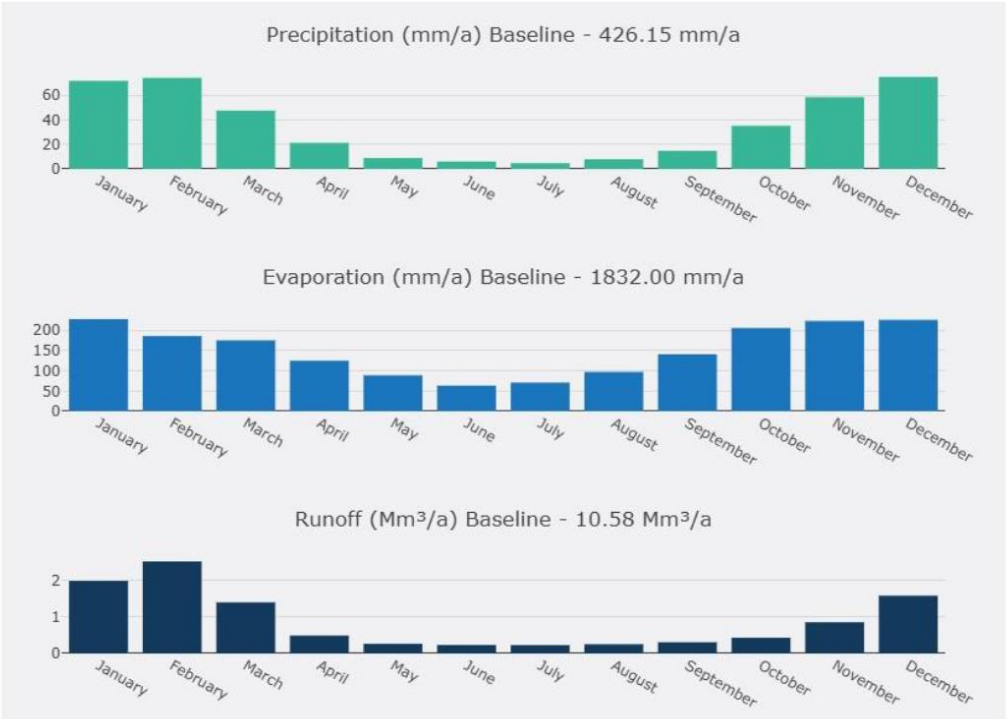


Figure 57: Current Annual and Monthly Surface Water Runoff, Precipitation and Evaporation for the Musina Municipality

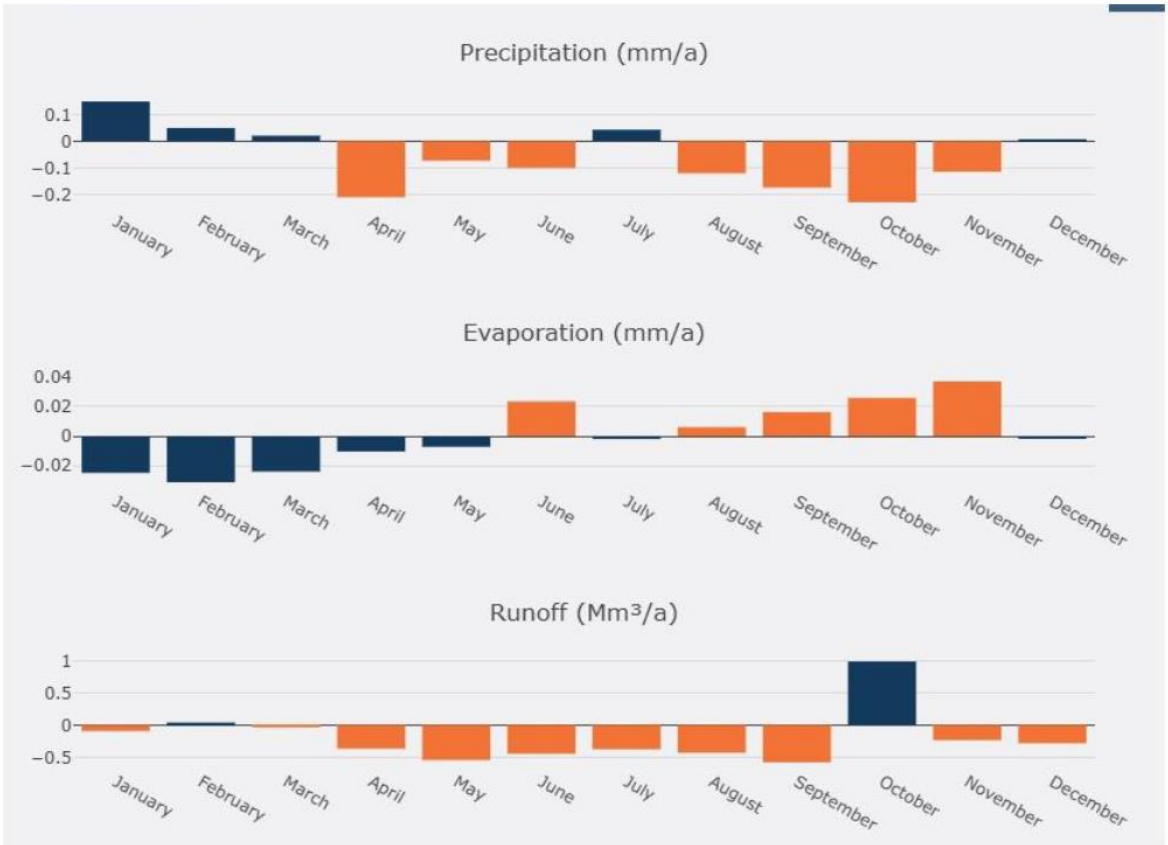


Figure 58: Projected Monthly Change to Future (2050) Evaporation, Precipitation, and Estimated Runoff Values

A groundwater depletion risk map was created to determine which of South Africa's groundwater dependent settlements may be most at risk to groundwater depletion based on decreasing groundwater aquifer recharge potential and significant increases in population growth pressure by 2050. The groundwater depletion risk map (Figure 59) is based on the settlement aquifer recharge potential of the 50th percentile RCP8.5 scenario, and the medium population growth scenario. There is a slight change to groundwater potential in the area.

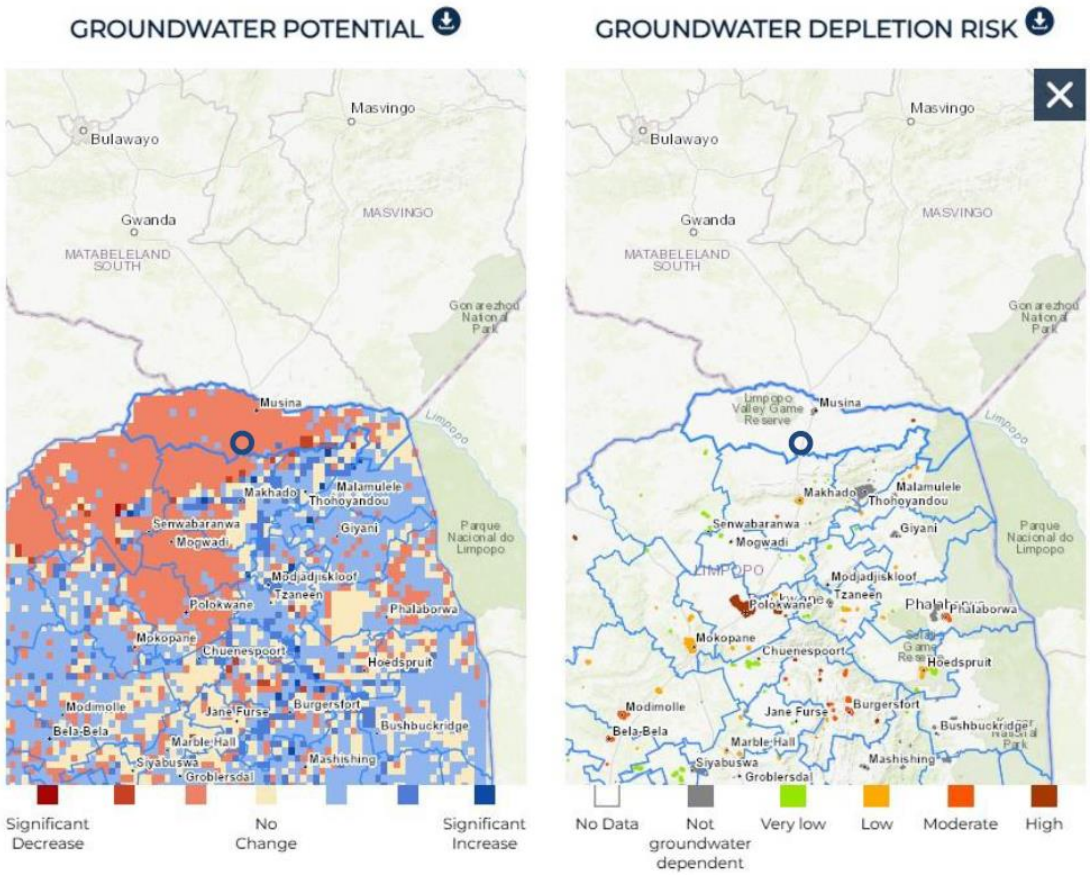


Figure 59: Groundwater Potential and Depletion for 2050 for the Musina Local Municipality (dark blue marker indicates location of the project)

8.9.2.2 Economy

Figure 60 shows the contribution that the different economic sectors make to the total Gross Value Added (GVA)14 of the Musina Local Municipality as well as its national GVA rank (total GVA contribution to the national GVA). The Musina Local Municipality ranks 85th in the national GVA rank.

Table 59 summarises the forecasted economic gains or losses for the Musina Local Municipality, under both the RCP4.5 and RCP8.5 scenarios, for each of the contributing economic sectors.

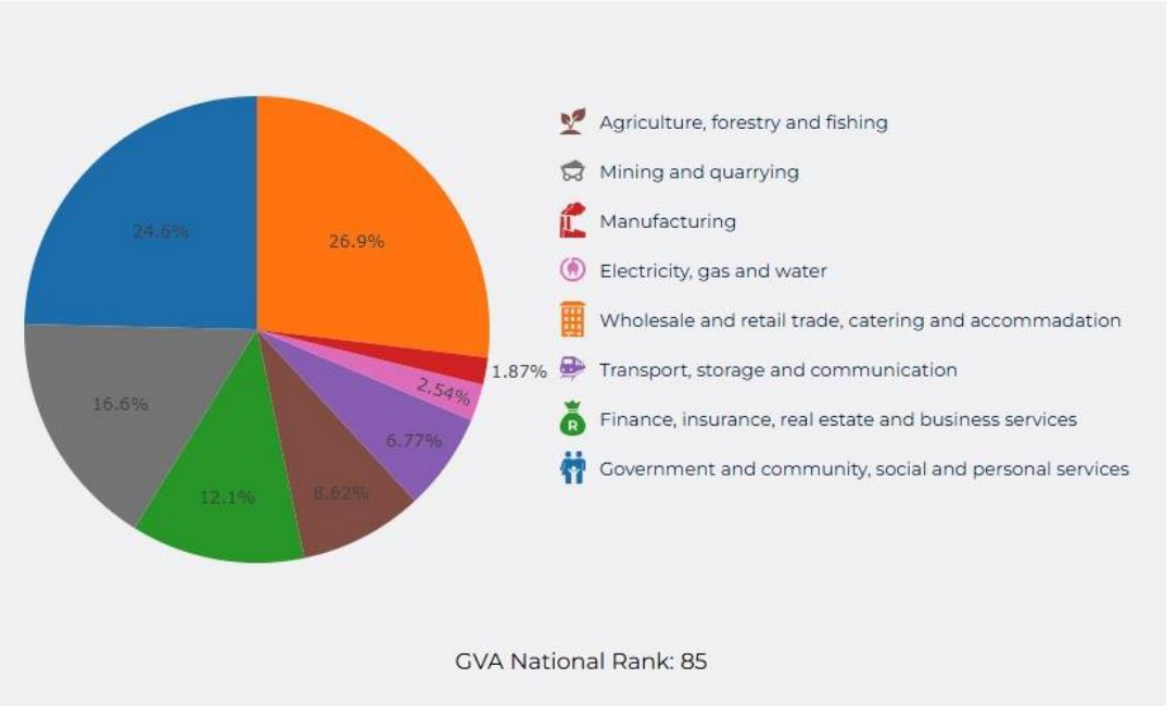


Figure 60: The Contribution that the Different Economic Sectors Make to the Total GVA of the Musina Local Municipality

Table 59: Forecasted Economic Gains or Losses for the RCP4.5 and RCP8.5 Scenarios

RCP 4.5 Impacts			RCP 8.5 Impacts	
Average	14.02% ▲		Average	10.02% ▲
Agriculture Sector	45.83% ▲		Agriculture Sector	34.42% ▲
Forestry Sector	43.55% ▲		Forestry Sector	32.72% ▲
Fishing Sector	0% -		Fishing Sector	0% -
Mining Sector	1.58% ▲		Mining Sector	-0.07% ▼
Manufacturing Sector	1.96% ▲		Manufacturing Sector	0.48% ▲
Electricity & Gas Sector	24.21% ▲		Electricity & Gas Sector	13.98% ▲
Water Sector	-13.17% ▼		Water Sector	-7.61% ▼
Service Sector	8.22% ▲		Service Sector	6.25% ▲

8.9.2.3 Agriculture

The main agricultural commodities for the Musina Local Municipality are citrus, subtropical fruit and cotton (Table 60). Agriculture, Forestry and Fishing (AFF) sector contributes 8.6% to Musina Local Municipality GVA production and 36.1% to Musina Local total employment. The total AFF GVA production of Musina Local Municipality

contributes 0.52% of the national AFF GVA ranking them as the 61st biggest contributor (Table 60).

The main agricultural commodities for 2050 for the Musina Local municipality are still citrus, subtropical and cotton (under an RCP8.5 low-mitigation scenario) (Table 61). For citrus, there will be increased irrigation requirements and an increase in temperature will benefit a more heat-tolerant disease vector towards the end of 2050. For subtropical, besides the increased irrigation requirements, the extreme temperatures will contribute to poor tree flowering, fruit set and decreases in production. Cotton production remains viable subject to water availability.

Table 60: Economic Contribution of Main Commodities for Musina Local Municipality

ECONOMIC CONTRIBUTION OF MAIN COMMODITIES

MAIN COMMODITIES		
CITRUS	SUBTROPICAL	COTTON
AFF contributes 8.62% to Musina GVA production	AFF contributes 36.14% to Musina total employment	The total AFF GVA production of Musina Municipality contributes 0.52% to the national AFF GVA, ranking them as the 61st biggest contributor

Table 61: Projected Economic Contribution of Main Commodities for Musina Local Municipality

ECONOMIC CONTRIBUTION OF MAIN COMMODITIES

MAIN COMMODITIES		
CITRUS	SUBTROPICAL	COTTON
CLIMATE IMPACT		
Change in climate expected: Hotter and drier but wetter towards end of century		
Increased evapotranspiration and irrigation requirements. An increase in temperature will benefit a more heat-tolerant disease vector.	Increased evaporation and irrigation requirements.Extreme temperatures contribute to poor tree flowering, fruit set and decreases in production.	Increased evapotranspiration and irrigation requirements. Cotton production remains viable subject to water availability.

8.10 Landuse

The northern and western parts of the Vhembe district are sparsely populated, whereas Thohoyandou, Makhado areas are of the most densely populated areas in the District. The nodes are well defined, with Makhado, Thohoyandou and Musina as the most important economical nodes.

The area north of the Soutpansberg mountain range is Mopani veld, and is only suitable for extensive cattle or game farming. There are a number of irrigation regions along the more important river systems with the Limpopo, Nwanedi and Nzhelele regions as examples. Various game farming which is linked to eco-tourism is situated north of the Soutpansberg area.

Musina-Makhado Special Economic Zone (MMSEZ)
Musina Makhado Special Economic Zone (MMSEZ) received Cabinet approval and subsequently gazetted in December 2017. The Musina Makhado Special Economic Zone State Owned Company (MMSEZ SOC) was established as a public entity in terms of the SEZ Act no. 16 of 2014, to develop, manage and operate the SEZ. The entity is a wholly owned subsidiary of the Limpopo Economic Development Agency (LEDA). The roll out of the Musina Makhado Special Economic Zone is in line with the National Development Plan and Limpopo Development Plan's goals to grow the economy and create jobs.

The MMSEZ is made up of two sites and hosted by two municipalities namely, Musina and Makhado located in the Vhembe district of the Limpopo Province. The first site is referred to as North Site (Antonvilla) approximately 3500 Hectares and it is situated between the Musina town and Limpopo riverbanks. This site is earmarked for the development of light and medium manufacturing industries, which includes logistics and agro-processing.

The second site is commonly referred to as South Site (Mopani) approximately 8000 Hectares and it is situated next to the Mopani railway station on the west side of the Baobab Toll Gate, at the border of both Musina and Makhado Municipalities. This site is earmarked for the development of the energy and metallurgical cluster and other associated heavy industries - of which 3862 Hectares have an environmental approval. The proposed ferrochrome smelter plant will be located on this South Site.

A large proportion of the land-use where the proposed ferrochrome/ferroalloys smelter will be located is subsistence cattle farming on land restitution farm land – with limited CPA households and eco-tourism practices and woodland. No active centre pivot irrigation systems over the applicable farms area were observed during the site investigations.

There are several gravel access roads within the farms and CPA communities and households. There is active and existing mining (Syferfontein Dolomite Mine) towards the northern-western boundaries of the proposed ferrochrome/ferroalloys smelter site. Mopane settlement is also located on the northern-western side of MMSEZ area.

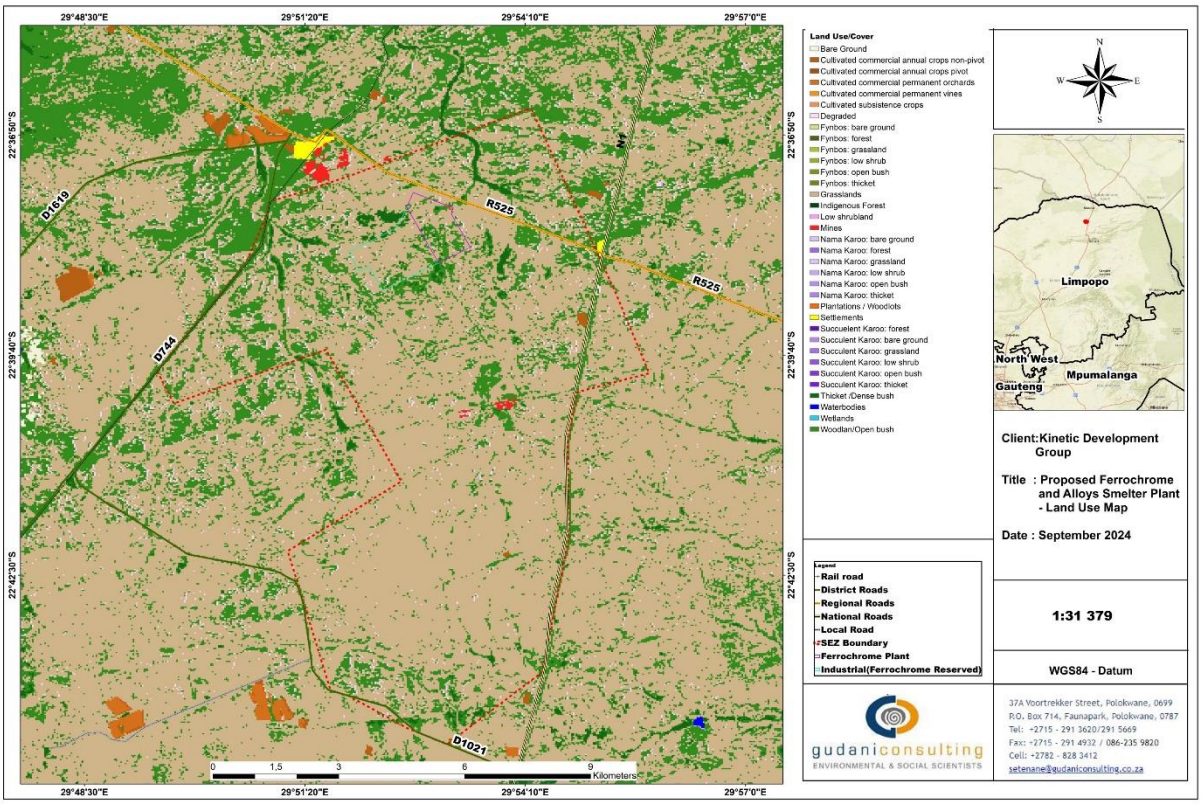


Figure 61: Landuse Map Around the MMSEZ Area and Project Site

8.11 Heritage Resources, Cultural and Archaeological Aspects

8.11.1 The Stone Age

The Stone Age is the period in human history when lithic (stone) material was mainly used to produce tools. In South Africa the Stone Age can be divided in basically into three periods. It is however important to note that dates are relative and only provide a broad framework for interpretation. A basic sequence for the South African Stone Age (Lombard et.al 2012) is as follows:

- Earlier Stone Age (ESA) up to 2 million – more than 200 000 years ago
- Middle Stone Age (MSA) less than 300 000 – 20 000 years ago
- Later Stone Age (LSA) 40 000 years ago – 2000 years ago

It should also be noted that these dates are not a neat fit because of variability and overlapping ages between sites (Lombard et.al 2012: 125).

No Stone Age sites (including rock art) are known to occur in the immediate study area. The closest known Stone Age sites are located at Kalkbank and Makgabeng south and south-west of the study area (Bergh 1999: 4), while known rock art (paintings) sites are located to the south of the study area and around Makhado & Schoemansdal (Bergh 1999: 5). Most of the Stone Age research in the region is focused in the Sashi-Limpopo about 70km West of the study areas (Vhufahashu Consultants 2021).

No Stone Age sites or material were identified in the study areas during the May 2025 assessment. During the 2021 assessment in the area an isolated single Stone Age

flake tool were recorded (Vhufahashu Consultants 2021: 28). If any Stone Age material are to be found in the area, then it would more than likely be single or small scatters of stone tools in an open-air surface context.

8.11.2 The Iron Age

The Iron Age is the name given to the period of human history when metal was mainly used to produce metal artifacts. In South Africa it can be divided in two separate phases (Bergh
1999: 96-98), namely:

- Early Iron Age (EIA) 200 – 1000 A.D
- Late Iron Age (LIA) 1000 – 1850 A.D.

Huffman (2007: xiii) however indicates that a Middle Iron Age should be included. His dates, which now seem to be widely accepted in archaeological circles, are:

- Early Iron Age (EIA) 250 – 900 A.D.
- Middle Iron Age (MIA) 900 – 1300 A.D.
- Late Iron Age (LIA) 1300 – 1840 A.D.

There are no known Iron Age sites (EIA or LIA) in the immediate study area, although a large number of EIA to LIA sites are known to exist in the larger geographical landscape in which the study area falls. This includes the sites of Klein Afrika & Happy Rest (EIA) located north & west of Louis Trichardt respectively, and the sites of Verulam, Verdun & Machemma (LIA) north of the study area (Bergh 1999: 6-7). Known Early Iron Age sites are found in the Nzhelele valley East of the study area (Prinsloo 1974).

Tom Huffman's research work shows that Iron Age sites, features or material could possibly be found in the area. This could include the so-called Silver Leaves facies of the Urewe Tradition dating to between AD280 and AD450 (Huffman 2007: 123); Mzonjani facies of the same tradition dating to between AD450 and AD750 (p.127); Icon facies of Urewe dating to between AD1300 and AD1500 (p.183); the Happy Rest facies of the Kalundu Tradition dating to between AD500 & AD750 (p.219); the Malapati facies of Kalundu dating to between AD750 & AD1030 (p.239); the Tavhatshena facies of Kalundu dating to between AD1450 & AD1600 (p.263); the Letaba facies of Kalundu dating to between AD1600 & AD1800 (p.267) and finally the Mutamba facies of the same tradition dating to between AD1250 and AD1450 (Huffman 2007: 271).

Again, no Iron Age sites, features or cultural material was identified during the May 2025 fieldwork, similar to the results of the earlier assessment by Vhufahashu Consultants in 2021.

8.11.3 The Historical Age

The historical age started with the first recorded oral histories in the area. It includes the moving into the area of people that were able to read and write. The first European group to pass close by the area were that of Coenraad de Buys in 1821 and 1825, followed by groups of Voortrekkers after 1844 (Bergh 1999: 12-14). Schoemansdal (originally Zoutpansbergdorp) was established in 1848, and finally

abandoned as a result of conflict with local groups in July 1867 (Bergh 1999: 131; 187). The town of Louis Trichardt was formally established in February 1899 (Bergh 1999: 147). During the Anglo-Boer war (1899-1902) there was a skirmish between British and Boer forces at Fort Edward near Louis Trichardt between 20 and 28 March 1902 (Bergh 1999: 54). The historical heritage of the area consists mostly of farmsteads, other farming-related features and grave sites.

Two sites (recorded previously in the area by Vhufahashu Consultants) were re-recorded in May 2025, but other than these no additional historical period sites were identified and recorded here.

The May 2025 field-based assessment for the Kinetic Development Group Limited (KDG) ferroalloys/ferrochrome smelter plant did not identify any Stone Age or Iron Age sites, features or remains, and no additional recent historical sites over and above the ones recorded in 2021. Two of the sites recorded in 2021 is located in the study & proposed development area (BG1 and Site 24).

Site BG1 contains a cluster of three graves belonging to the De Bruin family. These are located inside a fenced area, indicated by granite tombstones as grave dressings. The site is situated in proximity of an Adonsonia Digitata (Baobab) tree (Vhufahashu Consultants 2021: 29).

Plate 13: Site BG1 - GPS Coordinates: S22°37'38.00 E29°53'00.07

Graves and Grave Sites always carry a High Significance Rating from a Cultural Heritage perspective. As such, due care should be taken to not impact on them in any way through development actions. If possible, these sites should be avoided and protected in situ.

There are two Options (mitigation measures) available in mitigating the possible impacts on a Grave Site by any development. These are as follows:

Option 1
The 1st and preferred option, is always be to leave the site and graves on it intact. This will entail demarcating the site with a proper boundary fence and providing an

entrance gate for potential visitors (descendants/family members of the deceased). The site would also have to be clearly sign-posted as a Grave Site and will have to be cleaned and each grave marked, numbered and included in a Graves Register. A Graves Management Plan will have to be drafted and implemented as part of the Development. A 30m buffer zone (from the outside boundary fence of the site) will also have to be adhered to, with no development allowed in this exclusion zone.

Option 2
The 2nd Option available is the exhumation and relocation of the graves from the site. This entails the following:

a) Detailed social consultation/public participation in the form of Newspaper Advertisements and the erection of site notices. This is in order to try and trace any possible descendants of the deceased buried here and to obtain their consent for the exhumation and relocation work. These advertisements and notices need to be run for 60 days before permit applications to various government and local authorities can be undertaken. This includes SAHRA, Department of Health, COGTA, local Municipality/ies and the SAP.

b) Only once the permits have been issued, and all permissions (e.g., family consent) have been obtained, can the physical work be undertaken. A registered undertaker also needs to be contracted to be part of the process.

It needs to be noted that the costs involved with Option 2 can be high and that the time-delays can be quite long. However, with Option 1 the commitment to preserving the sites and the graves on them is ongoing and could lead to conflict with family members in terms of site visits/access and possible security issues.

Site 24 is an existing/operating hunting-camp (Vhufahashu Consultants 2021:28). The site and structures associated with it is not of historical heritage origin or significance (not older than 60 years of age) and no mitigation would be required from a cultural heritage point of view.

Plate 14: Site 24 - GPS Coordinates: S22°37’ 51.00 E29° 52’ 56.06

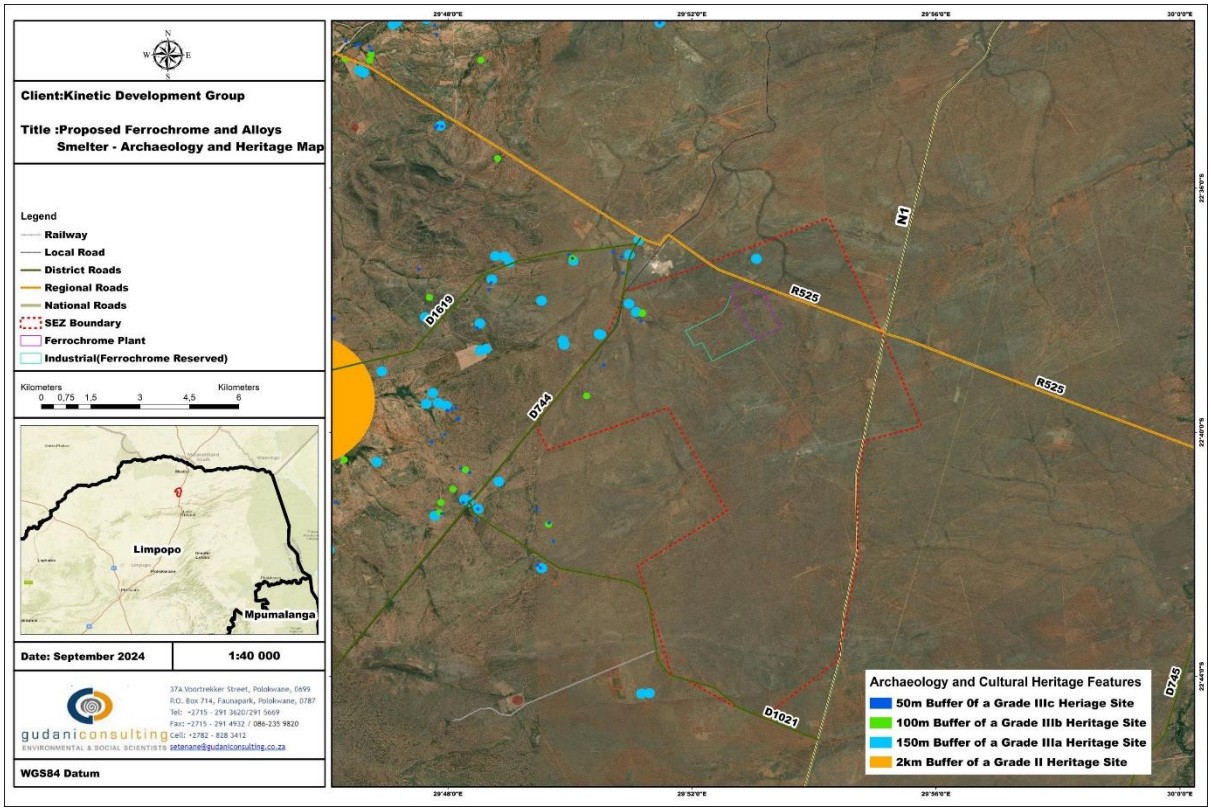


Figure 62: Other Known Heritage Sites Previously Recorded

8.11.4 Palaeontological Resources

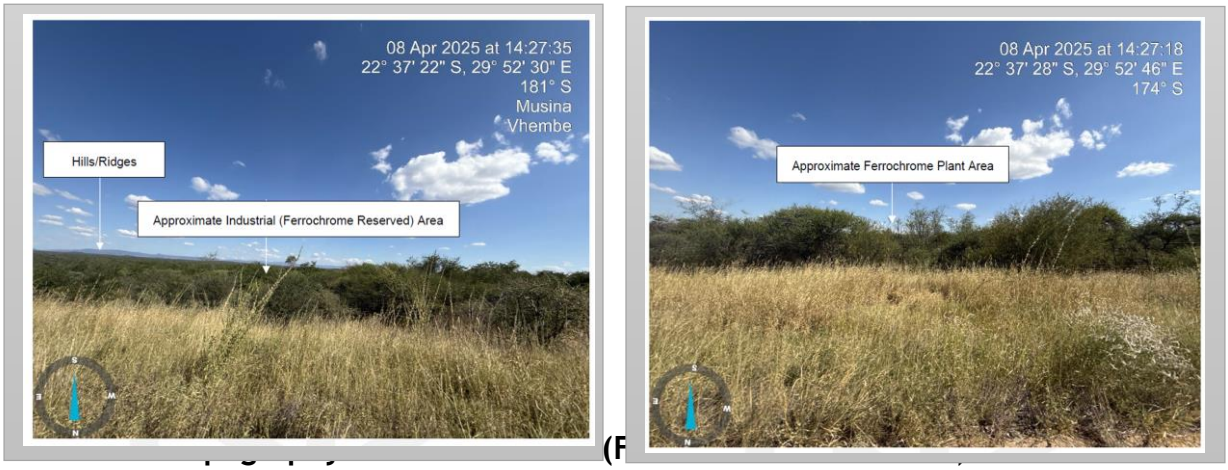
Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and do contain fossil plants of the early Permian Glossopteris flora. From the survey we are certain that there are no surface exposures of fossils because there are deep soils. They may occur below ground but from the onsite survey carried out there were NO fossils exposed. If fossils are present, then they are extremely rare and sporadic[12].

8.12 Visual Aspects

8.12.1 Topography

The total study area comprises of flat to undulating terrain, with hills and ridges located mainly across the southern and northern areas of the total study area. Surface elevations within the total study area varies between 528 meters above mean sea level (mamsl) and 927 mamsl, with an average slope degree of 2.11. The proposed Project activities are located on flat terrain, with an average slope degree of 0.78 degrees. Plate 15 shows the landscape features observed during the site visit.

[12] EIAR for Musina Makhado MMSEZ – South Site (Version 4) - 2021



(F

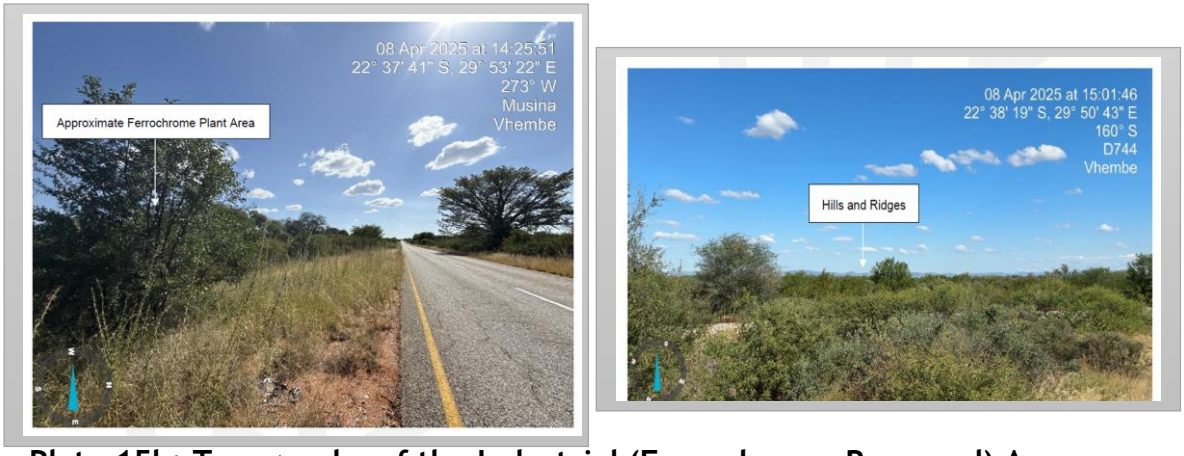


Plate 15b: Topography of the Industrial (Ferrochrome Reserved) Area

8.12.2 Vegetation

From the site visit, it was noted that the natural vegetation within the total study area is largely intact, with minimal transformation by human activity. Plate 16 shows the vegetation within the proposed Project site and total study area, observed during the site visit. Plate 17 shows the vegetation disturbed by human activity, such as road networks, railway lines, buildings and fences.

Plate 16: Vegetation of Ferrochrome Smelter Site

8.12.3 Landcover/Landuse

The landcover of the total study area as per the 2022 National Landcover Dataset, available from the Department of Forestry, Fisheries, and the Environment (DFFE). The figure indicates that the total study area comprises predominantly of open woodland, with areas of fallow land and old fields, commercial annual crops and natural grassland scattered within the total study area. Additional landcover and land-use types within the total study area include a formal residential area and mining activities located approximately 2 km north-west of the proposed Project, along with road and railway infrastructure. From a review of satellite imagery and from the site visit, the formal residential area was identified as the Mopane settlement, and the mining activities are associated with the existing Syferfontein Mine. Households and farmsteads, accommodation areas, recreational facilities and a school were also noted within the total study area during the site visit.

Plate 17: Vegetation Disturbed by Human Activities in the Study Area

Plate 18: Syferfontein Mining Area Located 2 km North-West of KDG Site

Plate 19: Existing Railway Line and the Mopane settlement

Plate 20: Some of the Households, Accommodation Areas, School and

Recreational Facilities

8.12.4 Visual Absorption Capacity (VAC)

VAC is the capacity of the landscape/receiving environment to absorb the potential visual impact of the proposed Project. The VAC is a function of the surrounding vegetation, topography and/or landcover. For instance, VAC will be high if the vegetation is tall, dense and continuous. Conversely, low growing, sparse and patchy vegetation will have a low VAC. Oberholzer (2005) categorises VAC as follows:

- High VAC - effective screening by the landscape/receiving environment.
- Moderate VAC - partial screening by the landscape/receiving environment.
- Low VAC - little screening by the landscape/receiving environment.

Based on the topography, vegetation and landcover characteristics of the total study area, the VAC of the total study area is categorised as moderate. This assessment stems from the ability of the surrounding vegetation and topography, specifically the hills and ridges, to partially screen and mitigate the visual impacts of the proposed ferrochrome project. Nevertheless, the mostly natural and undeveloped nature of the total study area lacks the capability to effectively absorb the potential landscape impacts from the proposed project; and taller infrastructure, specifically the exhaust stacks and related emissions, will still protrude above the tree line. Plate 21, captured during the site visit, shows the ability of the surrounding vegetation and topography to partially screen the existing activities within the total study area.

Plate 21: Partial Visual Screening by Vegetation

8.12.5 Visual Receptors

8.12.5.1 Potential Visual Receptors

Visual receptors refer to individuals, groups or communities who are subject to the visual influence of a particular project (Oberholzer, 2005). Visual receptors include, but are not limited to, residential areas, households, farmsteads, recreational facilities, tourists, users of the road networks and visitors of protected areas and conservation areas.

For the proposed ferrochrome smelter project, households and farmsteads, an intermediate school, users of the surrounding road networks, visitors to protected areas, users of accommodation areas and recreational facilities and tourists were noted within the total study area and are considered potential visual receptors due their potential to experience momentary or static views of the proposed Project.

Households and Farmsteads
Households and farmsteads were noted to be sparsely scattered within the total study area. The highest concentration of households and farmsteads occur within the Mopane settlement, located approximately 2 km north-west of the proposed Project, and within the agricultural area approximately 13 km north-west of the proposed Project. The closest household is located approximately 300 m of the proposed Project, north of the R525 main road. Residents within the households and farmsteads may experience static views of the proposed Project.

Schools
The Mopane Intermediate School is located approximately 2.6 km north-west of the proposed Project and may experience static views of the proposed Project.

Road Users
The identified road network within the total study area includes the N1 national route, which runs north to south and is located approximately 3 km east of the proposed Project. A main road, namely the R525, runs from west to east and is located approximately 200 m north of the proposed Project. Several secondary roads and streets are also located within the total study area and are mostly concentrated within the northern, southern and western regions. Users of the road network are expected to experience momentary views of the proposed Project.

Protected Areas
Two national protected areas were identified from the 2024 South African Protected Areas Database (SAPAD), namely the Avarel Private Nature Reserve located approximately 3 km north-east of the proposed Project, and the Baobab Private Nature Reserve located approximately 5 km north-west of the proposed Project.

Accommodation and Recreational Areas
Accommodation areas and recreational facilities are present within the total study area. These include, but are not limited to, lodges, guesthouses, game farms, game lodges, hunting safaris, farm shops and helicopter tours. The closest accommodation area, Maseri Cabins, is located approximately 3.2 km east of the proposed Project. Furthermore, the accommodation areas and recreational facilities are sparse within the eastern portion of the total study area, and more concentrated within the western portion of the total study area.

Tourists
Visitors to the identified protected areas, accommodation areas and recreational facilities are classified as tourists and may experience both momentary and static views of the proposed Project. Tourists may experience static views of the proposed Project from these areas if there is a direct line of sight between the visual receptor and the proposed Project, and especially if using optical instruments to view distant objects.

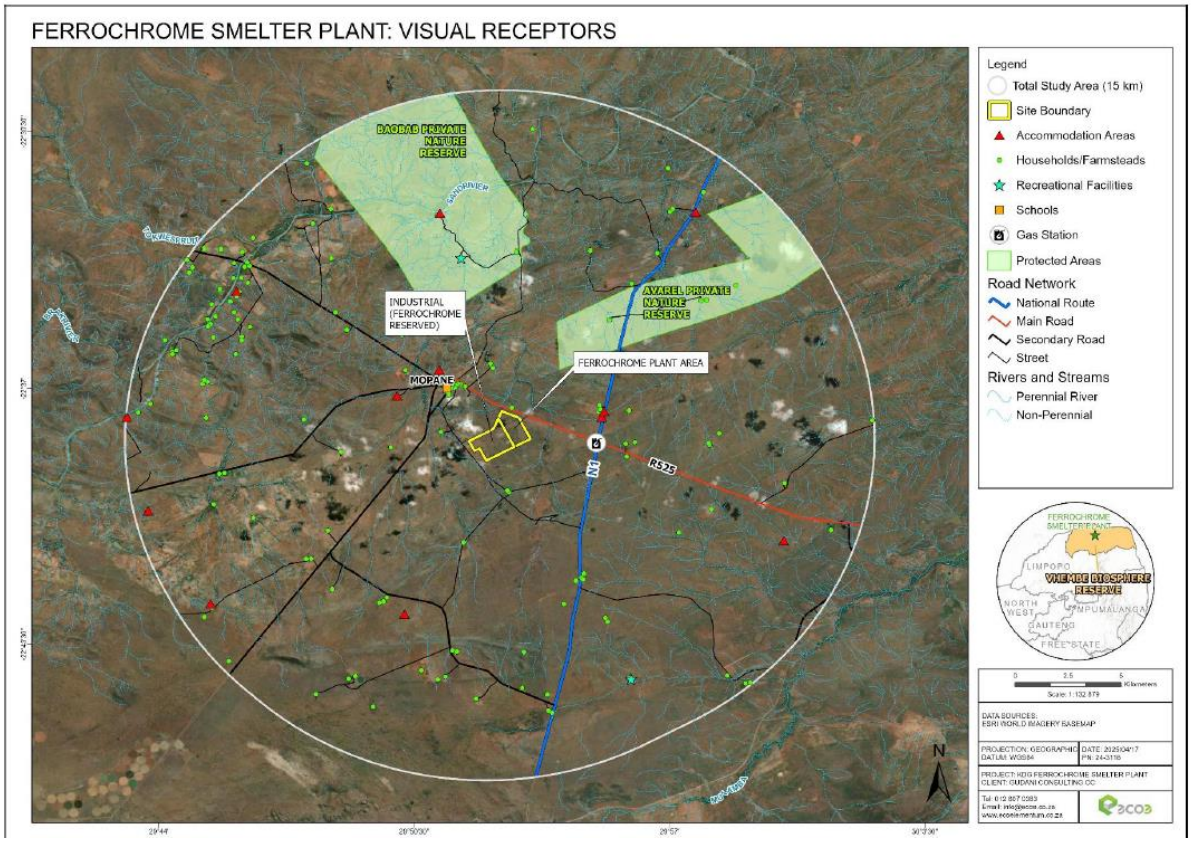


Figure 63: Identified Visual Receptors within the Total Study Area

8.12.5.2 Sensitivity of the Visual Receptors

The expected sensitivity of the identified visual receptors was as follows:

- High sensitivity – e.g. residential areas, nature reserves and scenic routes or trails.
- Moderate sensitivity – e.g. sporting or recreational areas, or places of work.
- Low sensitivity – e.g. industrial, mining, or degraded areas.

According to the abovementioned categories, the identified households and farmsteads, school, visitors to the protected areas and users of the accommodation areas are categorized as high sensitivity visual receptors and are expected to experience high levels of visual impacts from the proposed project. Users of the identified road network and recreational facilities are categorized as moderate sensitivity visual receptors as the views from these visual receptors will be sporadic and short.

Furthermore, the expected sensitivity of the identified visual receptors was considered in relation to existing visual disturbances within the total study area such as existing infrastructure, industrial activities and mining activities. From a desktop analysis of national databases and satellite imagery, and from the site visit, it was noted that the total study area is in a largely natural state with limited visual disturbances sparsely occurring within the total study area. Figure 64 shows the identified visual receptors in relation to the existing visual disturbances with the total study area. The figure indicates that an existing mine, namely the Syferfontein Mine, is located approximately 2 km north-west of the proposed Project, with the Mopane settlement and Mopane Intermediate School located within 350 m of the mine. Evidence of historical mining is also noted approximately 3.5 km south-east

of the proposed project. Regarding electrical infrastructure, a substation is located approximately 5 km east of the proposed project, with electrical overhead power lines occurring mainly along the surrounding road networks and traversing the Avarel Private Nature Reserve. A railway line is also located approximately 2.5 km west of the proposed Project, which runs in a north-east to south-west direction and between the Mopane settlement and Syferfontein Mine. Additionally, a telecommunication tower was observed within the area approximately 10 km south-east of the proposed Project, and road lights occur on the N1 national route. Plate 22 shows some of the existing visual disturbances within the study area as observed during the site visit.

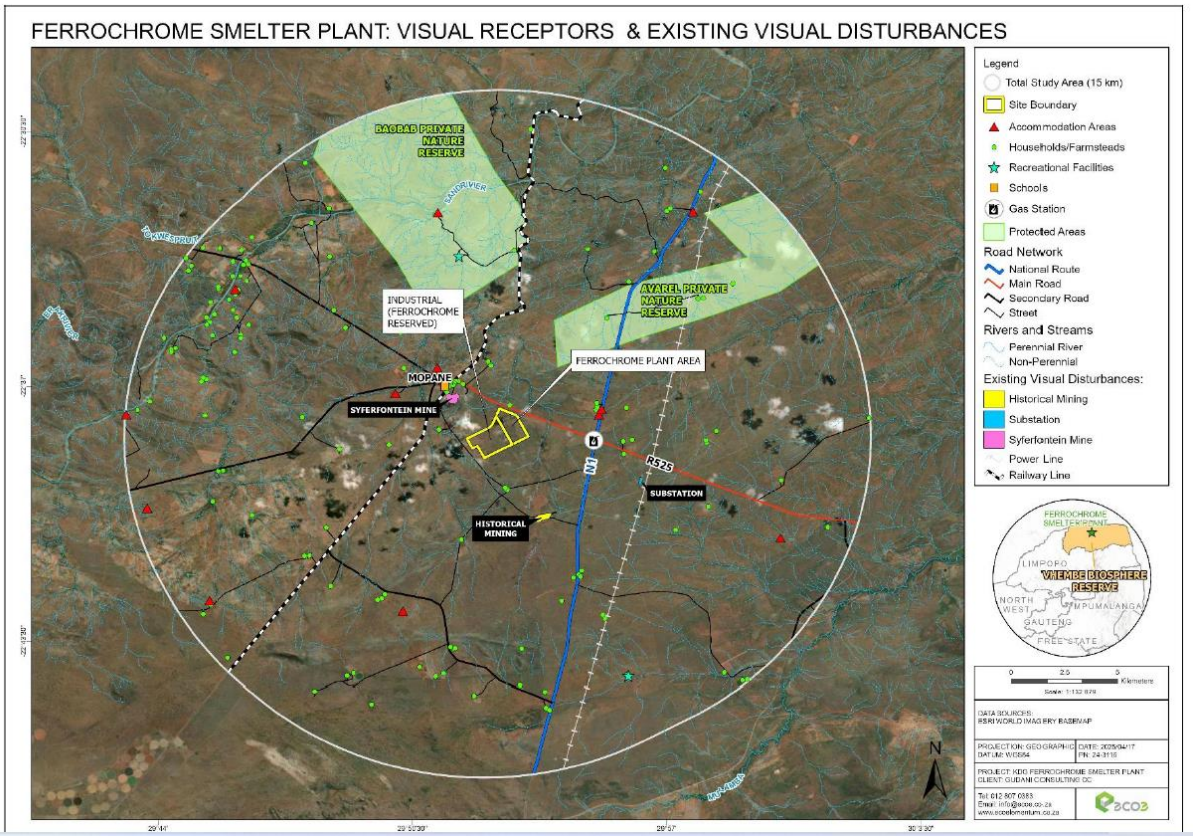


Figure 64: Identified Visual Receptors in Relation to Existing Visual Disturbances

Plate 22: Some of Existing Visual Disturbances in the Area

Overall, although the identified visual receptors are categorized as moderate to high sensitivity visual receptors, given the ability of the natural vegetation to partially screen the existing visual disturbances from the visual receptors, it is expected that the identified visual receptors will be moderately sensitive to the proposed Project. The visual sensitivity of the employees of the existing mining and industrial activities, along with the road network servicing these areas must also be considered. These receptors are categorized as low sensitivity visual receptors as their attention is focused on the mining or industrial activities and not on the surrounding landscape.

Regarding the impact of the proposed Project on the surrounding landscape, due to the scale of the proposed Project, the height of the proposed Project's infrastructure, as well as the largely natural state of the total study area and the presence of many accommodation areas and recreational facilities, it is anticipated that the way in which the landscape is perceived by the visual receptors will be negatively affected by the proposed Project. This is relevant especially since the proposed Project will be viewed by tourists or individuals who visit the area for its scenic value, and if the visual exposure analysis determines that the proposed Project will be visible from the surrounding protected areas, accommodation areas and recreational facilities.

Regarding the sensitivity of the visual receptors, it was noted from the satellite imagery and the site visit that the existing visual disturbances within the total study area are largely surrounded by existing natural vegetation which screen the visual disturbances from the surrounding visual receptors. Except for the taller infrastructure, such as overhead power lines and road lights, that protrude above the tree line and remain visible to the visual receptors. Furthermore, majority of the identified visual receptors visited during the site visit are interspersed and surrounded by the existing natural vegetation which assists in partially screening the surrounding visual disturbances from the identified visual receptors. The N1 national route, R525 main road and all secondary roads within the total study area were also traversed during the site visit. A moderate number of motorists were observed on the N1 national route, and a low number of motorists were observed on the R525 main road and secondary roads.

8.12.6 Sense of Place

The concept of "a Sense of Place" does not equate simply to the creation of picturesque landscapes or aesthetically pleasing buildings but recognising the importance of a sense of belonging. Embracing uniqueness, as opposed to standardization, attains quality of place. In terms of the natural environment, it requires the identification, a response to and the emphasis of the distinguishing features and characteristics of landscapes. Different natural landscapes suggest different responses.

From the baseline description of the affected environment, the total study area has a unique sense of place originating from the largely natural state of the area, limited visual disturbances, abundant natural vegetation and unique topographic landscape comprising of flat to undulating terrain, with hills and ridges located mainly across the southern and northern areas of the total study area.

The total study areas sense of place further interlinks with the level of visual intrusion expected from the proposed ferrochrome smelter project. Visual intrusion refers to the level of compatibility of the proposed Project with the particular qualities of the area, which is related to the idea of context and maintaining integrity of the landscape (Oberholzer, 2005). Visual intrusion is categorized by Oberholzer, 2005 as follows:

- High visual intrusion – results in a noticeable change or is discordant with the surroundings.
- Moderate visual intrusion – partially fits into the surroundings, but clearly noticeable.
- Low visual intrusion – minimal change or blends in well with the surroundings.

Considering the total study areas current sense of place, the proposed project is expected to create a high level of visual intrusion where the proposed project is expected result in noticeable changes and is discordant with the surroundings.

8.13 Community Public Health

The driving concept behind the community health impact assessment (cHIA) is that individual and community health is not simply determined by health services or biological factors (e.g., age). It is also shaped by wider social, economic and environmental influences and factors. These health determinants are the factors that lead to health outcomes and include:

- Physical environment factors (e.g., air quality, water quality, hazards);
- Built environment factors (e.g., buildings, public spaces, roads, bike lanes);
- Livelihood factors (e.g., income, employment);
- Social and community factors (e.g., social support, family structure, access to services); and
- Lifestyle factors (e.g., diet, exercise, alcohol and tobacco use).

On the other hand, there are health-related outcomes. These health outcomes refer to the health status of both individuals and groups within a population or community and can include both positive and negative outcomes. The health determinants—as impacted by an activity—contribute to health outcomes in various ways, either directly or indirectly. Health outcomes can include things like morbidity rates (injuries), mortalities, asthma, diabetes, cardiovascular disease, and other diseases. Both determinants of health as well as health outcomes will be assessed in this Report. This Report does however use a broader definition of health outcomes that includes the behaviours and contributing factors that contribute to an individual or community's health status. For example, while physical activity is not exactly a health outcome, it does have a notable effect on health outcomes and is therefore considered a health-related outcome.

Figure 65 illustrates the general relationship between an activity, the impacts activities can have on health determinants, and the resulting influences and changes to health-related outcomes. These determinants of health encompass all 12 EHAs.

The entire community living in Mopane is likely to be affected by the proposed operations of the proposed ferrochrome smelter and MMSEZ including people living on farms to, in and surrounding the proposed project area. In addition to visiting the

local health facilities, informal discussions were conducted in the immediate and wider proposed Project site. The informal discussions were held with randomly selected individuals at the following communities:

- Maaname;
- Manyii;
- Tshikuwi
- Mopane; and
- Mudimeli.

Although women generally considered to be the gatekeepers to family health and usually have a good understanding of critical issues that influence health at the community and household level, it was decided to include both men and women during these informal discussions. This allows for a high-level understanding of the health challenges, from both a biophysical and social health perspective. Discussions were conducted in English, with simultaneous translation into the local language spoken (TshiVenda) in the community.

Figure 65: Activity Impacts, Health Determinants and Health-Related Outcomes

8.13.1 Environmental Health Areas (EHAs) Framework

Potential community health impacts were identified on the basis of: (i) the available health data from the literature review; (ii) the information generated through stakeholder consultation; (iii) the knowledge of the Project context and developments; (iv) input from other specialist studies that inform the elements of the EIA; and (v) experience of previous cHIAs in similar settings.

The identified potential impacts were then categorised in terms of 12 Environmental Health Areas (EHAs) – a set of health-related factors and considerations defined by IFC methodology. These are summarised in the table 63 below. The set of EHAs provides a linkage between Project-related activities and potential positive or negative community-level impacts and incorporates a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of a cHIA focusing primarily on disease-specific considerations – as is frequently done in many biomedical analyses of potential Project-related public health impacts. The EHA framework is based on an analysis performed and published by the World Bank.

Table 63: Environmental Health Areas

Environmental Health Areas (EHAs)	
1.	Vector-related diseases – Mosquito, fly, tick and lice-related diseases (e.g., malaria, dengue, yellow fever, lymphatic filariasis, rift valley fever, etc.).
2.	Acute respiratory infections and respiratory effects from housing – Transmission of communicable diseases (e.g., acute respiratory infections, pneumonia, tuberculosis, meningitis, plague, leprosy, etc.) and respiratory infections.
3.	Veterinary medicine and zoonotic issues – Diseases affecting animals (e.g., bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g., rabies, brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.).
4.	Sexually-transmitted infections, including Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome (HIV/AIDS) – Sexually-transmitted infections such as syphilis, gonorrhoea, chlamydia, hepatitis B and, most importantly, HIV/AIDS. Linkages of TB will be discussed where relevant under HIV, but often linked to EHA1.
5.	Soil-, water- and waste-related diseases – Diseases that are transmitted directly or indirectly through contaminated water, soil or non-hazardous waste (e.g., diarrheal diseases, schistosomiasis, hepatitis A and E, poliomyelitis, soil-transmitted helminthiases, etc.).
6.	Food- and nutrition-related issues – Adverse health effects such as malnutrition, anaemia or micronutrient deficiencies due to e.g., changes in agricultural and subsistence practices, or food inflation; gastroenteritis, food-borne trematodiases, etc. This will also consider feeding behaviours and practices.
7.	Accidents/injuries – Road traffic or work-related accidents and injuries (home and Project related); drowning.
8.	Exposure to potentially hazardous materials, noise and malodours – This considers the environmental health determinants linked to the Project and related activities. Noise, water and air pollution (indoor and outdoor) as well as visual impacts will be considered in this biophysical category. It can also include exposure to heavy metals and hazardous chemical substances and other compounds, solvents or spills and releases from road traffic and exposure to mal-odours. There is a significant overlap in the environmental impact assessment in this section. Ionizing radiation also falls into this category.
9.	Social determinants of health – Including psychosocial stress (due to e.g., resettlement, overcrowding, political or economic crisis), mental health, depression, gender issues, domestic violence, suicide, ethnic conflicts, security concerns, substance misuse (drug, alcohol, smoking), family planning, health seeking behaviours, etc. There is a significant overlap in the Social Impact Assessment (SIA) in this section.
10.	Cultural health practices – Role of traditional medical providers, indigenous medicines, and unique cultural health practices.
11.	Health systems issues – Physical health infrastructure (e.g., capacity, equipment, staffing levels and competencies, future development plans); program management delivery systems (e.g., malaria-, TB-, HIV/AIDS-initiatives, maternal and child health, etc.).
12.	Non-communicable diseases – cardiovascular diseases, cancer, diabetes, obesity, etc.

8.13.2 Health Opportunities and Risks Associated with SEZ

The nature of SEZs can hold unique health risks for both workers and communities. These zones tend to be located outside of capital regions, and, as such, infrastructure, services and knowledge, and attitudes and practices around health are generally less developed than in urban settings (ADB, 2018). In addition, the Musina-Makhado SEZ is strategically placed to take advantage of cross-border collaboration, and subsequently, transient migrant populations are to be expected. This may place added pressure on existing health as well as social infrastructure. The proposed SEZ is expected to be a culturally diverse location, and, in taking into consideration all of the above, the proposed SEZ Project may also hold risks to local communities and workers if left unidentified and unmanaged.

In a well-functioning SEZ, health opportunities can stem from:

- Meeting of basic essential needs (clean water, shelter, sanitation, security, and food safety are accessible);
- Proper zoning of residential and commercial, recreation, and industrial areas;
- The capacity of the emergency preparedness and response sector to respond to both industrial and community incidents;
- Industrial traffic having designated routes and road infrastructure in good, safe condition;
- Strategic resettlement of households, when required, with infrastructure complete and in excellent condition;
- Separate and safe industrial and public waste management;
- Safe worker behaviour on- and off-site;
- Peaceful cohabitation of workers and community members;
- Strategic location and good condition of worker accommodations; and
- Protection of cultural and spiritual sites.

In a poorly functioning SEZ, health risks can stem from:

- Mixing of residential and industrial uses of land (the lack of appropriate buffer zones);
- Environmental issues such as airborne emissions, water pollution, noise, light, and vibration;
- Inadequate health services for mobile and migrant workers and community members;
- Inability of emergency preparedness and response sector to respond appropriately to industrial and community incidents;
- Conflicts between local residents and projects;
- Lack of cohesion between community members and workers;
- Resettlement that happens multiple times and infrastructure that remains unfinished;
- Worker accommodation that is in poor condition;
- Non-existent waste management strategies;
- Disorganized and chaotic traffic;
- Workers not being equipped with safe working conditions or provided the basics to be safe on- and off-site;
- Poor coping and personal health practices, such as alcohol and drug abuse;
- Human trafficking;
- Impoverishment; and
- Lack of basic needs being met including access to safe water, sanitation, shelter, security, and safe food.

8.13.3 Sustainable Development

MMSEZ is committed to environmentally sustainable growth and regional integration. Infrastructure development cannot be sustainable if human health is damaged. Conversely, development that includes health gains is likely to be more sustainable. MMSEZ is also committed to supporting the SDGs.

Figure 66: Sustainable Development Goals

8.13.4 Baseline Health Profile: Vhembe District

Vhembe District is located in the Northern part of Limpopo Province South Africa boarded by Capricorn District in the South-West and Mopani in the East. Vhembe District shares land port boarders with Zimbabwe and Botswana on the North-West through Limpopo River and Mozambique South-East through the Kruger National Park. Vhembe District is comprised of four (4) Municipalities as District Municipality: i.e. Collins Chabane, Makhado, Musina, and Thulamela. The district has a population of 1 367 186, with a population density of 53.4 people per km^2 and falls in socio-economic Quintile 2, among the poorer districts, and has an estimated medical scheme coverage of 7.2%. Vhembe is one of the 11 National Health Insurance (NHI) pilot districts.

The Vhembe District has 6 District Hospitals, 1 specialized, 1 regional Hospital, 115 fixed Primary Health Care facilities, 8 Community Health Centres and 18 mobile clinics. District hospitals provides secondary level of care whiles specialized hospital provides mental health services and regional hospital acts as a referral facility for the district hospitals. Fixed Primary Health Care facilities, Community Health Centres (CHC) render comprehensive health services whereas mobile clinics render Primary health care in areas more than 5 kilometres away from the clinic.

Makhado Sub-District in Makhado Municipality situated on the western side of Vhembe District boarded by Capricorn on the south-east with an estimated population of 458778. The sub district has 36 fixed PHC clinics, 3 District Hospitals and 2 CHC and 5 mobile clinics.

The Musina Sub-District in Musina Local Municipality is situated on the north boarded by Capricorn District on the North-west side of Vhembe District 'sharing borders with Zimbabwe on the North and Botswana on the West with an estimated population of 120452. Although the population appears to be little compared with other sub districts there is high rate of external and internal migrants utilizing Primary health care services. Musina sub district is comprised of 1 district hospital, 10 fixed PHC clinics, 2 mobile clinics and Port health clinic in Beit bridge boarder post. Half of the area of Musina Municipality is visited by mobile clinics with estimated visiting points. Musina sub-district has fewer health facilities as compared to the rest of the sub-district. This has a negative impact on health service delivery with regard to accessibility of health service by the community.

8.13.5 Baseline Health Status in the Primary Zone: MMSEZ

The following section describes the baseline health status in the proposed Project area with reference to the EHAs.

8.13.5.1 Vector-Bourne Diseases: EHA#1

Vector-borne diseases are illnesses caused by pathogens and parasites in human populations. Distribution of these diseases is determined by a complex dynamic of environmental and social factors. Vector-related diseases may be present in the community, resulting from unmanaged water bodies and vectors drawn to waste, such as rats and mice.

While vector-borne diseases are not common in the study area, illegal dumping of waste and the influx of people coupled with poor environmental management may lead to establishment of vector breeding sites in the study area, a situation that may lead to emergence and increase in the prevalence of vector-borne diseases, e.g. toxoplasmosis.
Uncollected refuse was seen in the streets of Musina town, which can have negative health impacts on the communities of concern, including but not limited to diarrhoea, eye and skin infections. Makhado is comparatively cleaner than Musina.

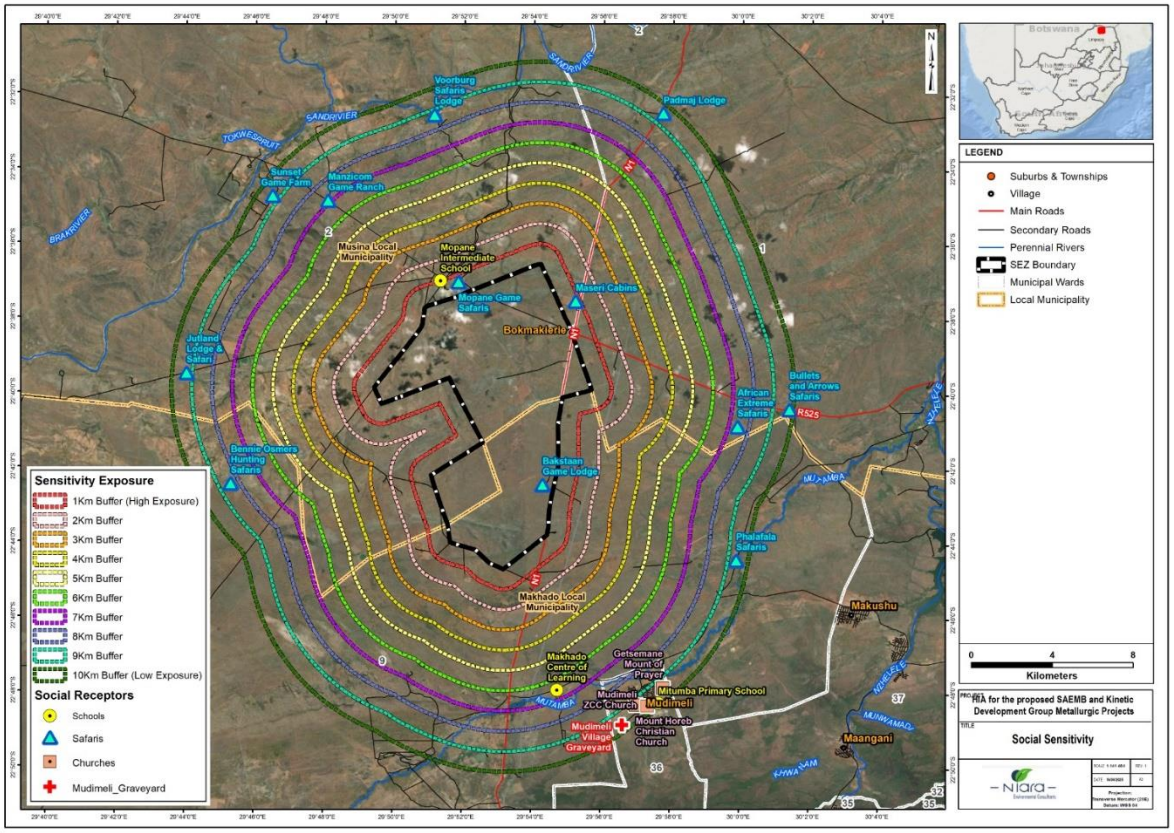


Figure 67: Social Sensitivity Plan

8.13.5.2 Acute Respiratory Infections and Respiratory Effects from Housing: EHA#2

There is positive correlation between poorer housing and an increased death rate among children (Phillips, 1990).

To have "healthy housing" it is necessary that the following elements are adequately addressed: shelter, water supply, sanitation, solid waste, wastewater, overcrowding, indoor air pollution, food safety, vectors of disease, as well as aspects related to transport, and shopping facilities (WHO 1997). Coughs in children were identified as a common health problem in the surveyed communities.

Based on the key informant interview it was clear that most households live in a brick structure or traditional structures on individual properties (with more than one house on the respective property) or one house on a separate stand/property. According to data derived from 2011 census there is not an extreme need for housing throughout the province as 88.7% of people in Limpopo reside in formal housing (Stats SA, 2011). It was confirmed during the field visit that much of the population within the project area has some kind of formal residence. Houses were traditional brick or mud structures either with a thatch or corrugated iron roof.

8.13.5.3 Veterinary Medicine and Zoonotic Issues: EHA#3

This EHA refers to diseases affecting animals (e.g. bovine tuberculosis, swinepox, avian influenza) or that can be transmitted from animal to human (e.g. rabies,

brucellosis, Rift Valley fever, Lassa fever, leptospirosis, etc.). A zoonotic disease is a disease that can be passed between animals and humans. Zoonotic diseases can be caused by viruses, bacteria, parasites, and fungi. These infectious diseases of animals have different modes of transmission. In direct zoonosis the disease is directly transmitted from animals to humans through media such as air (influenza) or through bites and saliva (Rabies). In contrast, transmission can also occur via an intermediate species (referred to as a vector), which carry the disease pathogen without getting infected.

No zoonotic issues were identified during interviews. It is however, important to remain cognizant that an increase in domestic animals may increase the risk for zoonotic diseases. The Kinetic Group would have to implement mitigation measures if these arose due to the project.

8.13.5.4 Sexually Transmitted Infections – Including HIV/AIDS: EHA#4

There was, generally, good knowledge about HIV and how it is contracted. Mudimeli Clinic, which was the one healthcare facility visited, has the ability to diagnose HIV and stock ARVs.

Condoms are readily available within the communities. They are available for free at health facilities and they are also available in public toilets, shops, 'spazas', schools and shebeens. There is little stigma associated with buying condoms, although some women stated that they sometimes feel shy to take free condoms from public places and that it was the responsibility of the men to acquire condoms.

There are regular HIV awareness campaigns within the communities. It was observed that there is good knowledge of HIV transmission and prevention measures. Most members of the communities also have a good attitude towards people with HIV, none of the respondents voiced discriminatory attitudes towards HIV positive people. Information collected during focus group discussions shows that a large proportion of respondents know the two main ways to prevent HIV, namely condom use and having one uninfected sexual partner.

8.13.5.5 Soil, Water and Waste Related Diseases: EHA#5

The two main sources of water in the area are the Limpopo River (and the alluvial aquifer under the riverbed) and the Nzhelele Dam. The Nzhelele Dam is situated on the Nzhelele River, approximately 50 km north- east of Makhado. The Sand River a perennial stream that is often dry in the winter and flows to the west, 10 km north of the SEZ site. The Mutamba/ Nzhelele Rivers with perennial flow in a south-east direction, 20 km east of the SEZ site.

Adequate provision of water and sanitation services is a critical public health infrastructure. Safe drinking water and adequate sanitation is a necessity for good health, as households without safe water and proper sanitation systems are more vulnerable to water borne diseases. Government water schemes provide most households within the local study area with piped water; however, a considerable number of households still depend on groundwater resources for domestic and agricultural use.

The availability of sanitation facilities not only improves the dignity of people, but also promotes their health. Areas without proper sanitation systems give rise to water-borne diseases like cholera and diarrhoea. The field visit indicated that the majority of households do not have access to adequate sanitation services. Some residents of the surveyed communities construct their own pit latrines, often of poor standard. The majority of the respondents used pit latrines and Ventilated Improved Pit-latrine (VIP) toilets in their own yards/ homes.

8.13.5.6 Food and Nutrition Related Issues: EHA#6

This category includes health outcomes and determinants related to food security, dietary choices, and the consumption of subsistence foods. The key health outcomes considered are nutrient levels, malnutrition or improvements in nutrient intake, and the subsequent increases or decreases in related diseases. The key determinants include diet composition, food security, and the consumption of subsistence foods.

Food security means having enough food to fully meet basic needs at all times. According to the Food and Agricultural Organization of the United Nations, "Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2001). At present, there are no known acute shortages of major dietary components (e.g., proteins, carbohydrates, grains, fruits, or vegetables) in any of the potentially affected communities. Food security is an important consideration in understanding potential health impact of development Projects. This EHA is affected by influx of people resulting in increased demand for food.

MMSEZ projects (including the proposed ferrochrome smelter) can increase the range, quality and amount of food available, leading to improved nutrition and positive health and well-being impacts. However, projects can also reduce access to traditional food sources by, for example, using agricultural land for other purposes or increasing the demand, and therefore prices, of locally grown food. There may also be risks associated with increased availability and affordability of manufactured food products that are high in fat, salt and sugar. Obesity and micronutrient deficiencies can co-occur when calorie intake is high and the food eaten is low in essential vitamins and minerals.

Maize meal, porridge or mieliepap ('pap') was listed the most prominent staple food eaten in the affected communities with all respondents mentioning this food as their staple diet. Beans, cabbage, potatoes, wild spinach, pumpkin, rice, samp, chicken and tinned fish were also listed as commonly consumed foods.

There were no reported deaths by malnutrition or other nutritional disorders in the surveyed communities or the neighbouring settlements.

8.13.5.7 Accidents and Injuries: EHA#7

This category contains health outcomes and determinants related to accidents and injuries. The key outcomes considered are increases and decreases in intentional

and unintentional injuries with fatal and nonfatal results. The key determinants in this category include items such as the presence of law enforcement, traffic patterns, alcohol involvement, distance to emergency services, and the presence of prevention programs.

8.13.5.8 Exposure to Potentially Hazardous Materials, Noise and Malodours: EHA#8

During the field visit, it was apparent that numerous households still use wood and coal (open fire) for cooking and heating that may cause a risk from indoor air pollution and associated respiratory health concerns in the surveyed communities. As waste removal from households also seems to be a challenge, many households burn waste that can emit harmful by products especially with plastics.

The figure below illustrates refuse which according to respondents had been sitting there for over two days. “The municipality is always on strike and they leave the dirt here for us” said one of the respondents. Just on the outskirts of the surveyed communities are illegal and uncontrolled dump sites which can contaminate water supplies and present unhygienic conditions –please refer to.

Wind erosion is a major cause of both loss and dispersion of pollutants from the proposed project site. Such dust dispersion is not only a nuisance but also a potential health hazard to inhabitants in close proximity and can also cause soil and water pollution. The main pollutant of concern during the project will be particulate matter including PM_{10} and $PM_{2.5}$.

Dust generation in the project area is principally a result of traffic of vehicles on unpaved roads in the area. It was also observed that some residents of the surveyed communities sweep their yards with grass/ straw brooms. This is done with no dust suppression and generates a lot of dust.

Both general and hazardous waste will be generated on the proposed MMSEZ Project sites. These wastes will need to be handled, separated, stored and disposed of according to their classification.

8.13.5.9 Social Determinants of Health: EHA#9

The social determinants of health refer to the conditions in which people are born, grow, live, work and age. These circumstances are shaped by the distribution of money, power, access, and resources at global, national, state, regional, and local levels. The social determinants of health are mostly responsible for health inequities –the unfair and avoidable differences in health status seen within and between countries. This category reviews outcomes and determinants related to mental health, maternal and child health, substance use, social exclusion, psychosocial distress, historical trauma, family dynamics, economic status, educational status, social support systems, and employment status.

Mental health, or behavioural health, is considered a critical component of overall health and is linked to physical health and well-being for persons of all ages. Mental health includes reactions to stress and depression and problems with emotions. Substance misuse such as alcohol, tobacco or other drugs is not only an important health determinant but also closely linked to mental health (Prince et al., 2007).

These practices are also associated with crime, prostitution and domestic violence. It was observed that several men on Mopane members of their communities drink a lot of alcohol, especially during the weekends and at the end of the month when individuals have received their wages, salaries or social grants. The key health personnel validated this by asserting that alcohol and drug abuse was a definite contributor of disease.

The respective local municipalities are faced with developmental challenges coupled with socio-economic problems such as unemployment, job creation, education, HIV prevalence, basic service delivery, inequality, poverty, economic growth, sectorial dependency and economic distribution.

8.13.5.10 Cultural Health Practices: EHA#10

Culture and traditional values play a very important role in the local communities. Most black African people place a large emphasis on traditional values and practices and this relates to health care and health-seeking behaviour. The community members' beliefs in their health as influenced by spiritual powers is an interesting notion of physical health and illness quite different from the western perception hereof. It cannot be exclusively said how the respondents perceive physical and spiritual purposes of using the plants (i.e. whether physical illness is seen as physical irrespective of its cause).

Although one may be aware that medical pluralism, combining both biomedical and traditional medicine, is practiced in many South African households, respondents in the surveyed communities did not want to comment much on personally using the services of sangomas[13].

In healthcare literature, religion and spirituality are most of the time used interchangeably, although they have quite different meanings (Miller & Thorensen, 2003). Spirituality is defined in individual terms, characterized by experiences involving meaning, connectedness, and transcendence, whereas religion is defined in communal terms, characterized by institutionalized practices and beliefs, membership and modes of organization (Pesut, Fowler, Taylor, Reimer-Kirkham & Sawatzky, 2008; Miller & Thorensen, 2003). Thus, whereas spirituality is understood at the level of the individual, religion is more of a social phenomenon, and as such is included in the more overarching concept of spirituality.

The difficulty in conceptualizing spirituality/religion comes from the multi-dimensionality of these concepts (Miller & Thorensen, 2003) and extends to the problem of how exactly spirituality/religion influence health. This, in turn, emphasizes the fact that there are multiple interpretations of how spirituality/religion influences health and a number of pathways through which this happens. Four most prominent such pathways have been proposed: health behaviours (through prescribing a certain diet and/or discouraging the abuse of alcoholic beverages, smoking, etc., religion can protect and promote a healthy lifestyle), social support (people can experience social contact with co-religionists

[13] Although sangoma is a Zulu term that is colloquially used to commonly describe all types of Southern African traditional healers, there are differences between practices: an inyanga is concerned mainly with medicines made from plants and animals, while a sangoma relies primarily on divination for healing purposes and might also be considered a type of fortune teller

and have a web of social relations that can help and protect whenever the case), psychological states (religious people can experience a better mental health, more positive psychological states, more optimism and faith, which in turn can lead to a better physical state due to less stress) and 'psi' influences (supernatural laws that govern 'energies' not currently comprehended by science but possibly understandable at some point by science). It is because spirituality/religion influence health through these pathways, they act in an indirect way on health (Oman & Thorensen, 2002).

8.13.5.11 Health System Issues: EHA#11

This category considers health outcomes and determinants related to healthcare access and healthcare infrastructure. Important outcomes include the increase or decrease in the number of medical evacuations, clinics or hospital visit trends, health expenditures, and medication usage. Health determinants may include distance to health facilities, mobile clinics, the presence of community health workers, and the frequency of physician visits to the area/ clinics.

The health care infrastructure in the district and municipal area is relatively well served. The infrastructure was observed as sound. All respondents were happy with the quality of services they receive from the surveyed communities Clinic. There were no complaints of a lack of skilled staff to support the daily functioning of the facilities; the operating times of the facilities; long queues or overcrowding.

Key health personnel mentioned a shortage of staff, in the form of both professional nurses as well as doctors. This creates service delivery challenges and often results in long waits for patients, and places increased stress on the current medical staff. Staff shortages were also reported at the clinic level and this associated with equipment, consumables and limited documentation storage/filing methods, mean that these services do not function optimally.

8.13.5.12 Non-Communicable Disease (NCD): EHA#12

This category includes health outcomes and determinants related to chronic disease. Important outcomes include increases or decreases in mortality and morbidity rates of cancer, cardiovascular and cerebrovascular diseases, diabetes, respiratory diseases, and mental health disorders. Many NCDs can be prevented by reducing common risk factors such as tobacco use, harmful alcohol use, physical inactivity and eating unhealthy diets. Key determinants for chronic diseases may include smoking rates, rates of alcohol and drug abuse, physical activity levels, presence of recreation centres, as well as cancer screening rates.

The term NCDs refers to a group of conditions that are not mainly caused by an acute infection, result in long-term health consequences and often create a need for long-term treatment and care. These conditions include cancers, cardiovascular disease, diabetes and chronic lung illnesses. Many other important conditions are also considered NCDs, including injuries and mental health disorders.

The chief chronic conditions observed in the surveyed communities include chronic diseases such as hypertension, diabetes and stroke. Several respondents in the surveyed communities reported that hypertension and diabetes are very common in their community.

8.13.5.13 Anticipated Health Impacts – Ferrochrome Smelter

Ferrochrome (FeCr) is an iron-chromium alloy which is used to make stainless steel. Soil, sediment, water and air can all become contaminated with chromium through industrial activities. Dust from industry operations such as mining and smelting settles out of the air, polluting soils and surface water. Most soluble chromium eventually settles onto sediment. Contamination of soil, surface and groundwater can also occur through release of industrial wastewater and leaching of soluble Cr compounds from wastes such as waste rock, dust and slag piles. Ferrochrome production creates air pollution, dust, slag (waste produced during ferrochrome separation from other ore elements) and process water. These waste materials have the potential to be contaminated with chromium and other heavy metals and chemicals of concern.

Ferrochrome production emits air pollutants such as nitrogen oxides, carbon oxides and sulphur oxides (NOx, COx, SOx) and particulate dusts that contain heavy metals such as chromium, zinc, lead, nickel and cadmium. During the high temperature smelting of chromite ore, some Cr-III is converted to toxic Cr-VI, contaminating the dust.

Inhalation: High concentrations of dusts or fumes may cause irritation. Repeated or prolonged exposure to various chromium compounds has been reported to result in ulceration and perforation of the nasal septum, irritation of the throat and lower respiratory tract, less commonly in gastrointestinal disturbances, blood changes, pulmonary sensitization, pulmonary pneumoconiosis or fibrosis, and rarely liver effects.

Skin Contact: Contact with dusts or powder may cause irritation. Repeated or prolonged exposure to various chromium compounds has been reported to cause various types of dermatitis, including eczema, “chrome holes”, sensitization, and, in contact with damaged skin, kidney damage. These effects have not been reported from exposure to the metal per se.

Eye Contact: Contact with dusts or powders may cause irritation. Repeated or prolonged exposure to some chromium compounds may cause conjunctivitis and lacrimation[14]. These effects have not been reported from exposure to the metal per se.

Ingestion: Chromium metal is poorly absorbed by the intestinal tract. Absorption of sufficient amounts of some chromium compounds may result in dizziness, intense thirst, abdominal pain, vomiting, shock, oliguria[15] or anuria[16], and uraemia[17], which may be fatal.

[14] Shedding tears, or shedding more tears than is normal.
[15] Oliguria refers to low urine output.
[16] Anuria is defined as absence of any urine output.
[17] Uraemia is a clinical syndrome marked by elevated concentrations of urea in the blood and associated with fluid, electrolyte, and hormone imbalances and metabolic abnormalities, which develop in parallel with deterioration of renal function

8.14 Socio-Economic Environment

The proposed ferrochrome/ferroalloys smelter site is located 30 km south-west of Musina Town and 35 km north of Makhado Town in Vhembe District, Limpopo Province. It is located close to the N1 national route from Makhado to Musina, along road 525 to Mopane settlement.

8.14.1 Rationale for SEZ and MMSEZ

With an eye to international trends, the South African government has adopted the SEZ policy to accelerate the country's industrialisation, regional and economic development. The dti states that the SEZ programme is a critical tool for the attraction of FDI, creation of decent jobs, establishment of new industrial centres, the development and improvement of existing infrastructure.

Specifically, the South African government's objectives in establishing SEZs are five-fold:

- Promotion of targeted industrial capabilities within the framework of the IPAP and the NDP,
- Promotion of beneficiation and value-addition to the country's minerals and other natural resources,
- Development of the world-class infrastructure required to support the development of the targeted
- industrial activities,
- Attraction of foreign and domestic direct investment,
- Acceleration of economic growth and the creation of much needed jobs in previously marginalised regions of the country.

The Musina-Makhado site offers the best geographic location and largest economic benefits for the establishment of the special economic zone (SEZ) than any other potential sites in Limpopo Province such as Polokwane, Tubatse, Tzaneen and Lephalale.

The Musina-Makhado SEZ site is approximately 51.6 km from Beit Bridge border post which is South Africa's primary gateway into the SADC region and the African Continental Free Trade Area (ACFTA) markets. South Africa is both a member of SADC and the African Union (AU) which are both multilateral institutions created to advance peace and security, economic cooperation, trade integration and development in Africa.

The country can potentially harness the geographic proximity of the Musina-Makhado SEZ to the Beit Bridge border post together with its Dar-es Salaam rail and road corridor linkages to substantially increase steel and agro-processed products exports to the SADC and ACFTA markets. Currently, a wide range of South African manufactured products including vehicles, processed food, chemicals and capital equipment are exported to the SADC and ACFTA markets via the Beit Bridge border post.

The proximity of the Musina-Makhado SEZ to the border post of Beit Bridge offers economic opportunities for a number of trade, logistic and border related services

and facilities such as bonded warehouse, vehicle distribution centres, holding depots, container yards and truck shops. In addition, the Musina-Makhado SEZ can be used as an inland intermodal terminal directly connected by both the N1 north-south corridor and Johannesburg-Beit Bridge railway for the trans-shipment of sea cargo to inland destinations and manufactured goods to SADC markets. Vehicles manufactured in Durban, East London and Port Elizabeth can be railed to the Musina-Makhado SEZ for storage before being transported to SADC and ACFTA markets.

The establishment of SEZ in the Musina- Makhado area also provides an opportunity to enhance agro-processing activities in the Vhembe District Municipality as well as accelerating agro-industrial development of Limpopo Province as a whole.

Agricultural Business Chamber South Africa's statistics indicate that the Limpopo Province accounts for a large portion (75% of mangoes, 65% of papayas, 60% of litchis, 60% of avocados and 60% of tomatoes) of South Africa's agricultural production. The bulk of the province's vegetables, fruits and nuts are produced in the Makhado and Thohoyandou areas which are within 30kms - 50kms radius from the Musina- Makhado SEZ site. This provides an opportunity to food manufacturers to process fruits, nuts, and vegetables produced in the district into fruit juices, canned fruits and vegetables in the Musina- Makhado SEZ and sell to both domestic, regional and international markets.

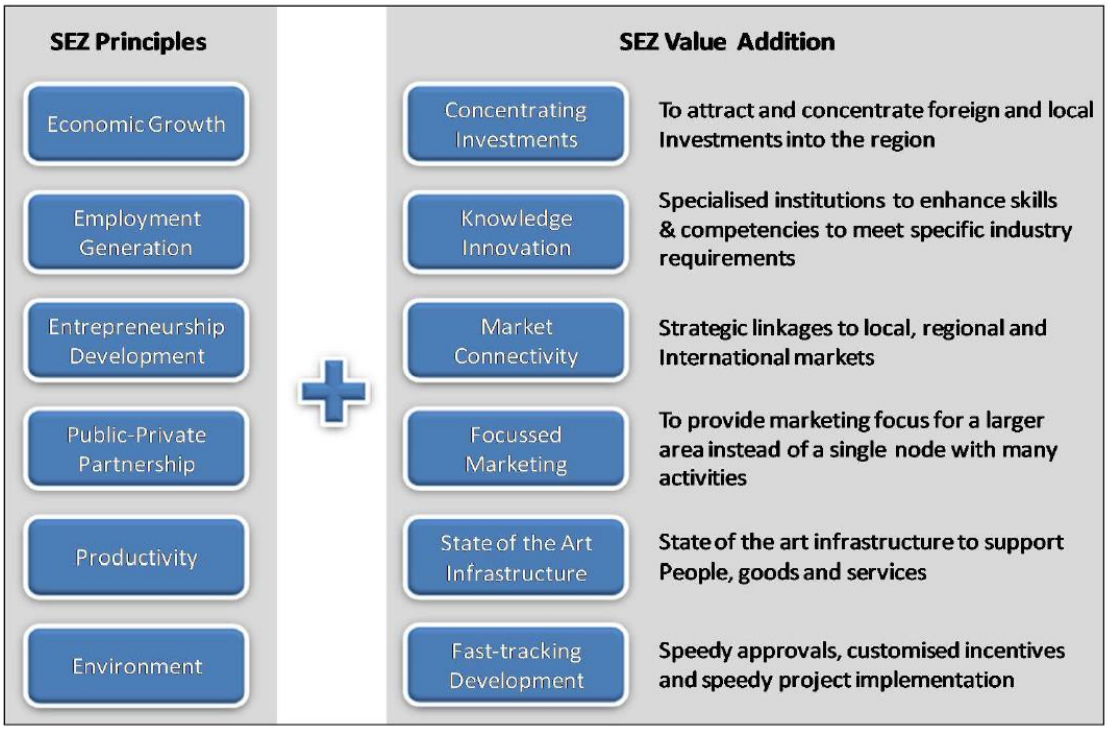


Figure 68: Economic Value Addition by Special Economic Zones

South Africa is a leading player in the international ferro alloys industry. Historical factors including an abundance of chrome deposits and relatively low cost electricity that have contributed to this dominant position. A number of recent developments are potentially threatening this position. These include the stagnating global demand for steel which in turn depress the demand for ferrochrome in China, logistics constraints at South Africa's ports, electricity supply shortages, high

electricity tariffs. These factors have all collectively eroded the competitiveness of the local ferro-alloys industry.

However, the fundamentals for being a successful ferro alloy producer are still largely in place for South African producers. South Africa's chrome reserves are expected to last for the next 200 years at current production rates. While electricity tariffs in South Africa have gone up considerably since, they are relatively cheaper when compared with other ferrochrome producing economies and gives the country's ferrochrome producers a pricing advantage over competing products in international ferrochrome markets. Therefore, the South African ferro alloy industry will remain competitive and is well placed for continued growth in line with the international growth in ferro alloy demand in the medium to long term. This when taken together with the government focus on beneficiation of minerals and imposition of an export tax on raw chromite mean that industry should emerge leaner, more efficient and ready to respond to any future demand.

A study that was done by Demacon (2019), a consulting company, estimated that the development of the R255 billion Musina- Makhado SEZ will generate approximately 21 000 jobs in the first 5 years of its operation. This will increase to 51 000 jobs in the tenth year of the SEZ's operation thereby giving rise to a larger impact on Vhembe District Municipality, Limpopo and South African economies.

The proposed ferrochrome smelter will have an initial capital investment of R1.23 billion and employ 235 people for Phase 1. This will ramp-up to R1880 people at full capacity and R10.2 billion capital investment – see Table 16.

8.14.2 Administrative Settings

The Vhembe District Municipality (Venda: Masipala wa Tshiṱiriki tsha Vhembe; Tsonga: Masipala wa Xifundza xa Vhembe) is one of the 5 districts of the Limpopo province of South Africa. VDM comprise of the following local municipalities: (Musina, Thulamela, Makhado, and Collins Chabane). It is the northernmost district of the country and shares its northern border with the Beitbridge District in Zimbabwe and on the east with the Gaza Province in Mozambique. The seat is Thohoyandou, the capital of the former Venda Bantustan. According to the 2011 census, the majority of the municipality's 800,000 inhabitants spoke TshiVenda as their mother language, while 400,000 spoke Xitsonga as their home language. However, the Tsonga people form the majority south of the Levubu River, while the Venda are the minority south of Levubu at 15%. The Sepedi speakers number 27,000. The district code is DC34. The Limpopo River valley forms the border between the district and its international neighbours. The municipal area is 25 597 km^2 in extent and covers a geographical area that is predominantly rural. The main economic sectors of Vhembe District are mining, community services and finance.

The Vhembe region became the Vhembe Biosphere Reserve in 2009, which was officially declared a biosphere reserve in 2011. The reserve includes the Blouberg Range, the Kruger National Park, the Philip Herd Nature Reserve, the Nwanedi Nature Reserve, the Makgabeng Plateau, the Makuleke Wetlands, the Mapungubwe Cultural Landscape and the Soutpansberg.

The Vhembe District Municipality has a low economically active population of about 24%, with an employed economically active of 61.7%. Notable is the integration of skills profile that holds 26.2% of skilled occupations. The district also holds 40.2% of Semi-skilled occupations and 33.6% low-skilled occupations. All these have contributed to the high unemployment levels in the Vhembe District. The concern is that instead of the unemployment decreasing, it is increasing.

Vhembe District is predominantly comprised of a young population with 74.99% of the population being at 35 years of age and below. Much of the population are at a good age to be trained and acquire the skills necessary for the development of the economy. The Vhembe district municipality is characterised and or dominated by mining, finance, trade, community services and with agriculture, construction, electricity and transport form the other parts of the economics activities.

The Musina area has been identified as being a rural service point by the NSDF, whilst the Makhado area has been identified as an urban growth point. The role of the Makhado area is to be an urban-rural anchor providing essential social economic services to surrounding rural communities.

The Musina and Louis Trichard towns have been identified as provincial growth points by the local and provincial spatial development frameworks. The N1 highway is considered the primary corridor for both host municipalities and aligns to future investment expectations related to logistics and industrial development.

8.14.3 Settlements

The area surrounding the smelter is characterised by Mopane community, farm homesteads and Mulambwane CPA farms. Other communities in the region include: Maaname, Manyii, Tshikuwi, and Mudimeli.

8.14.4 Demographics

8.14.4.1 Population

The Vhembe District has a total population of 1 402 779 people, increasing from 1 294 722 in 2011. According to Community Survey, in 2016 most of these people resided in Thulamela (497 237), followed by Makhado (416 728), Collins Chabane (347 974) and Musina (32 009). Thulamela LM is the most populated municipality in the district, while Musina LM is the least populous municipality in the district. the district population grew by 0.9% in 2019 as compared to 0.6 in 2006. The population growth rate of the district is comparable to that of the province, but lower than the national figure of 1.5%.

8.14.4.2 Gender, Age and Race

About 54% of the population are females. The median age is 21 with 51% of the population being between 18 and 64. The highest segment are those who are below the age of 18 with 46% being under 19. These are significantly higher than the South Africa average. Males above these ages are significantly underrepresented relative to the South Africa average, assumingly because of the migrant labour system. Women between the ages 45 and 59, as well as above 75 are above the South African average. 11 99% of the population are Black Africans and about 1% are whites, with very few coloureds (2 689) and Indians/Asians.

8.14.4.3 Household Dynamics

There are 387 089 households in Vhembe as compared to 382 357 households 2016. about one-quarter of the provincial total (1 628 479) and about less than 10% (17 041 912) of the national figure. In 2016, a majority of the households (130 321) were in Thulamela LM, followed by Makhado LM (116 371), Collins Chabane LM (91 936) and Musina LM (43 730). About 2.8% of these households live in informal dwellings (shacks) and 78% live in a formal house.

Child Headed There are 7 470 child headed households in the district which is about one quarter of the provincial total and less than 10% of the total number of child-headed households in the country. About 51% of these households are headed by women. In terms of women headed households, the District has a total of 194 980 female headed households, as compared to 187 378 male headed households. Collins Thulamela has highest number of female-headed households (65 728), followed by, Makhado (56 984), Collins Chabane (53 302) and Musina (18 966).

8.14.4.4 Health Profile

According to the Department of Health, the three highest causes of death for children under the age of 5 in Vhembe are: Diarrhoea (21%), lower respiratory infections (13.5%) and pre-term birth complications (9. 2%). The top two causes of death for young women and men between the ages 15-24 are accidental threats to breathing at 13 14.2% and road injuries at 13.3%. In the age group 25 to 64, the top causes of death for males and females are TB, HIV/AIDS and lower respiratory infections. With regard to HIV, there are 64 372 people infected with HIV in Vhembe, this constitutes 19,5% and 1.53% of people infected with HIV in Limpopo and South Africa, respectively. The HIV/AIDS infected population represented 4.61% of the district total population in 2016. Amongst the HIV infected people, 2 451 are infected with TB. In addition, the top 3 causes of death affecting women in the childbearing age group are: indirect maternal (27.5%), other maternal (21.2%) and hypertension in pregnancy (20.2%)

8.14.5 Poverty Dimensions

8.14.5.1 Distribution

In 2019, there were 788 514 people living in poverty, using the upper poverty line definition, across Vhembe District Municipality in comparison to 801 524 in 2009. Inequality in 2019, the Gini coefficient in Vhembe District Municipality was at 0.57, which represents a marginal increase from 2009 to 2019. the District has the lowest when compared to other districts in the province.

8.14.5.2 Employment

The number of formally employed people in Vhembe counted 202 000 in 2018, which is about 67.20% of total employment in the district, while the number of people employed in the informal sector counted 98 800 or 32.80% of the total employment. Informal employment in Vhembe increased from 62 100 in 2008 to an estimated 98 800 in 2018.

8.14.6 Educational and Skills Profile

Within Vhembe District Municipality, the number of people without any schooling decreased from 167 166 (2009) to 92 469 (2019), while in the same period the number of people within the 'matric only' category, increased from 75 567 to 174 521. The number of people with 'matric and a certificate/diploma' increased from 25 736 to 55 648 in the same period, while number of people with a 'matric and a Bachelor's' degree increasing from 2 669 to 26 563. Overall improvement in the level of education is visible with an increase in the number of people with 'matric' or higher education.

According to the District Integrated Development Plan (IDP), there are 27 circuit offices and 938 public schools (many of these schools are concentrated in Thulamela and Makhado). In addition, there are 132 Adult Basic Education & Training (ABET) centres 1 University, 9 TVET colleges (number inclusive of satellite campuses) and 413 Early Childhood Development centres.

8.14.7 Structure of the Economy

With a GDP of R 63.4 billion in 2018 (up from R 27.8 billion in 2008), Vhembe District contributed 17.71% to the Limpopo Province GDP of R 358 billion in 2018, increasing in the share of the Limpopo from 17.09% in 2008. The District contributed 1.30% to the GDP of South Africa which had a total GDP of R 4.87 trillion in 2018. In 2019, the community services sector was the largest accounting for 33% of the total gross value added (GVA) of the district economy. The sector that contributes the second most to the GVA is finance sector at 18%, followed by the trade (18%) and trade (17%). The sectors that contribute the least to the economy are agriculture and manufacturing with a contribution of 3% each of the total GVA.

The primary sector in the district consists of two broad economic sectors, namely; mining and the agriculture. Between 2008 and 2018, agricultural sector experienced the highest positive growth with an average growth rate of 20.8%, while the mining sector reached its highest point of growth of 4.9% in 2010. The agricultural sector experienced the lowest growth for the period during 2016 at -7.4%, while the mining sector reaching its lowest point of growth in 2009 at -18.8%.

The secondary sector in Vhembe consists of three broad economic sectors, namely; manufacturing, electricity and construction.

8.14.8 Access to Services

8.14.8.1 Water

Almost 9% of households use underground water from boreholes and 91% surface water in the district. About 40% of households have water inside the yard, which is the highest level of water service standard. About 6.36% of households are using water from rain-water tanks, river, springs, and wells. In terms of access to safe and healthy drinking water in the district, about 4.05% households in Thulamela LM have no access to water, followed by in Makhado LM at 1.38%, Musina LM at 55% and Collins Chabane LM at 0.40%. The highest number of households without access to safe and health drinking water is in Thulamela LM. A majority of household, approximately 78.1% are supplied with water from municipality, with 33% of the households with piped water inside the yard.

8.14.8.2 Sanitation

2.74% of the household in the district use flush toilet connected to a septic tank or conservancy tank, 15.97% is a public sewerage system and 5.96% have no sanitation facilities (without toilet). About 13% of the households in urban areas have flush toilets connected to sewerage system compared to 2% in traditional. This shows that there are still households in urban areas without flush toilets in the district.

8.14.8.3 Electricity

In terms of electricity, 93.74% of households in the district have access to electricity and 3% has no access to electricity as reflected in the figure below. This demonstrates that Eskom, Musina and Makhado local municipalities as electricity providers are doing well in terms ensuring that everyone has access to electricity. Collins Chabane local municipality has highest number of households without access to electricity at 1.23% compared to other municipalities

8.14.8.4 Roads

The total length of Vhembe district surfaced road is 1368.44 km, however there is still 2482.39 kilometres backlog (gravel road) in the district.

9.0 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE

9.1 Environmental Features

In terms of the Department of Environmental Affairs and Tourism (DEAT) guidelines for Integrated Environmental Management (IEM), sensitive landscapes are a broad term applying to: Nature conservation or ecologically sensitive areas – indigenous plant communities (particularly rare communities or forests), wetlands, rivers, river banks, lakes, islands, lagoon, estuaries, reefs, inter-tidal zones, beaches and habitats of rare animal species; Unstable physical environments, such as unstable soil and geo-technically unstable areas Important nature reserves – river systems, groundwater systems, high potential agricultural land; Sites of special scientific interest Sites of social significance or interest – including sites of archaeological, historic, cultural spiritual or religious importance and burial sites and; Green belts or public open space in municipal areas.

As a desktop exercise, sensitive areas were identified using the information from the Screening Tool compiled in 2024 (www.dffe.gov.za) and the overall sensitivities for the environmental themes are provided in Table 64.

Table 64: Summary of Environmental Sensitivities - 2024 Screening for Proposed Ferrochrome Smelter Project

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		x		
Animal Species Theme			x	
Aquatic Biodiversity Theme	x			
Archaeological and Cultural Heritage Theme		x		
Civil Aviation Theme		X		
Defence Theme			X	
Palaeontology Theme	x			
Plant Species Theme				X
Terrestrial Biodiversity Theme	x			

The above was expanded on and fine-tuned (for the proposed ferrochrome smelter project) in the 2025 specialist assessments conducted and the following sensitive areas were identified as discussed below.

9.1.1 Air Quality Receptors

Identified sensitive receptors in the study area include the small village of Mopane, approximately 2 km to the north-west of the Kinetic Project, as well as an individual homestead to the north of the R525 road, and two homesteads approximately 2 km to the southwest of the Kinetic Project. The closest sensitive receptors to the east of the Kinetic Project are homesteads and lodges close to the N1, approximately 4 km from the Kinetic Project (Figure 39).

9.1.2 Heritage Resource Sensitivity

Heritage resources with a low to high sensitivity were identified on site and are described in Section 8.11.

9.1.3 Terrestrial Ecological Resource Sensitivity

The Sensitivity of the identified Vegetation units are described in Section 8.4, please also refer to Figure 16 to 18.

9.1.4 Noise Receptors

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool. Potential noise-sensitive areas with a "very high" sensitivity are indicated on Figure 36 and Section 8.7.5.

9.1.5 Agricultural Resource Sensitivity

The agricultural sensitivity of the agricultural impact footprint was evaluated by means of an intensive baseline field investigation, consisting of a detailed soil, land capability and land use assessment. See Table 21a, Figure 10 and Section 8.2.2.4.

9.1.6 Geohydrological Sensitivity

The primary anticipated effect on the groundwater system is the dewatering of the surrounding aquifer, which may result in a lowering of the local water table – See Figure 69.

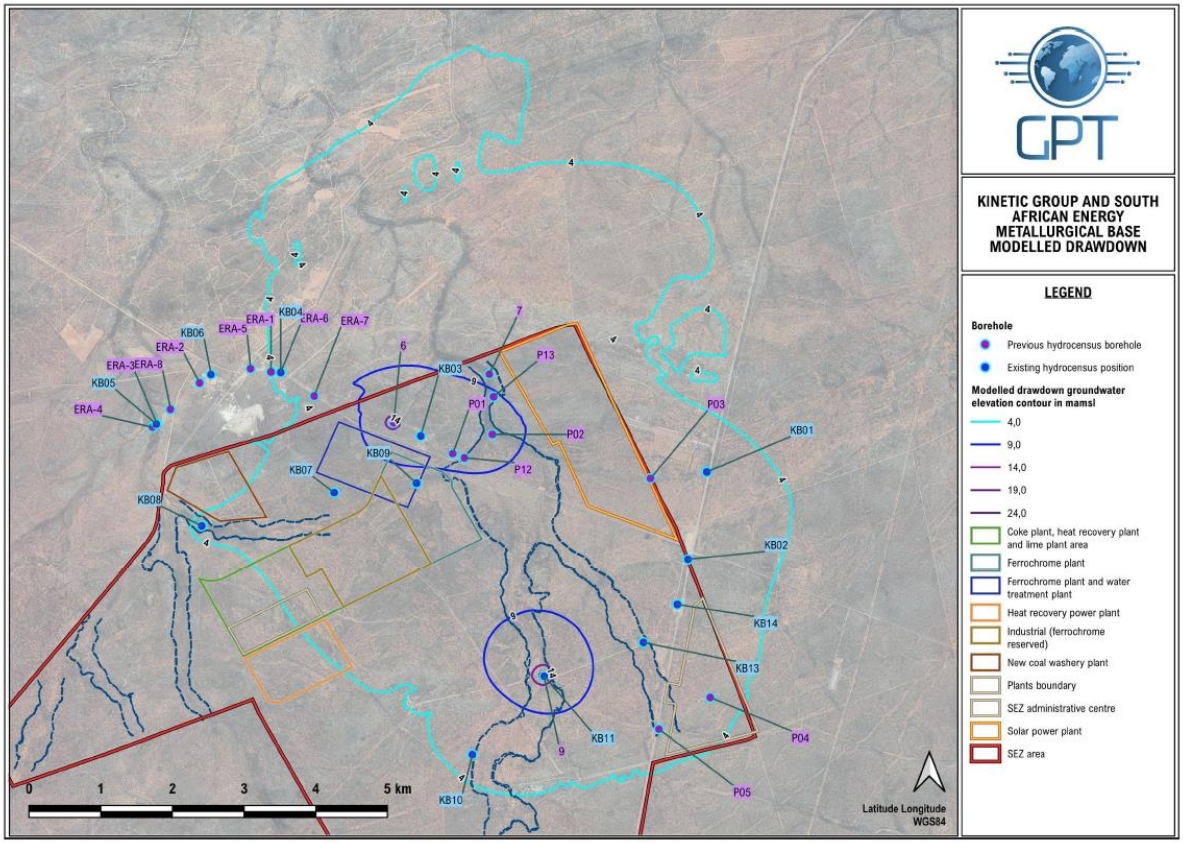


Figure 69: Modelled Borehole Drawdown

Aquifer vulnerability assessment indicates the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. Stated in another way, it is a measure of the degree of insulation that the natural and manmade factors provide to keep contamination away from groundwater – See Section 8.6.7.1:

- Vulnerability is high if natural factors provide little protection to shield groundwater from contaminating activities at the land surface.
- Vulnerability is low if natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation.

9.1.7 Terrestrial Biodiversity

All the sites – including the proposed ferrochrome smelter - fall within Ecological Support Area 1 (ESA 1) – See Figure 16 below. ESA1 areas are natural, near natural or degraded areas supporting CBA's by maintaining ecological processes (LEDET 2013) – See Section 8.4.1.3.

9.1.8 Visual Receptors

See Section 8.12.5.2. The expected sensitivity of the identified visual receptors was as follows:

- High sensitivity – e.g. residential areas, nature reserves and scenic routes or trails.
- Moderate sensitivity – e.g. sporting or recreational areas, or places of work.
- Low sensitivity – e.g. industrial, mining, or degraded areas.

9.2 Infrastructure on Site

Main facilities for the proposed ferrochrome smelter include:

▪ High-carbon ferrochrome production workshop ▪ Chromium furnace baking workshop (reserved) ▪ Raw materials, batching and feeding system ▪ Charcoal dry ▪ 132KV (power supply) substation and the capacitor compensation ▪ Device ▪ machine repair shop ▪ Electrode shell production workshop ▪ Raw material storage yard, spare parts warehouse, finished product warehouse, etc ▪ slag disposal area	▪ Furnace gas purification and dust removal system ▪ Dust removal system in the production area ▪ Compressed air preparation ▪ Raw materials into the factory, finished products factory ▪ loadometer duty room ▪ Fire protection, safety, environmental protection and other basic facilities ▪ General map of transport and roads, walls, gates ▪ Factory area office building ▪ Laboratory room
▪ Power supply and distribution, electrical control, automation ▪ instruments, telecommunications facilities ▪ Whole-plant control system ▪ Industrial TV monitoring system	▪ Water source is connected to the production plant purification ▪ water supply system ▪ Net ring water system ▪ Turbring water system ▪ Production and living water supply and drainage system ▪ Whole-plant fire protection system ▪ Ventilation and air-conditioning system

10.0 IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCES AND EXTENT

10.1 Impacts Identified

The impacts identified, together with the significance, probability and duration and the extent to which they can be mitigated are indicated in Table 65.

Identified impact and associated activities (E: Extend, D: Duration, I: Intensity, P: Probability, WF: Weighing Factor, SWOM: Significance without Mitigation, ME: Mitigation efficiency, SWM: Significance with Mitigation, O: Operational, C: Construction, Cl: Closure, Decom: Decommissioning

Table 65: Identified Impact and Associated Activities

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
Geology	Ferrochrome Smelter Site	Sterilization of the mineral orebody over the ferrochrome smelter site	C, O	2	4	3	4	2	26	Low to Medium	0.6	15.6	Low
Topography	Ferrochrome Smelter and Associated Infrastructure	During the construction and operational phases, the topography will be altered to develop the ferrochrome smelter.	C, O	2	4	3	5	5	70	Medium-High	0,8	56	Medium
Topography	Ferrochrome Smelter and Associated Infrastructure	During closure the pre-development topography will be recreated as far as possible.	Cl, Post Cl	2	4	3	3	5	60	Medium-High	0,6	36	Low-Medium
Air Quality	General Vehicle use	Increase in noxious vehicle exhaust fumes	C, O	2	4	3	4	3	39	Low-Medium	0,8	31.2	Low-Medium
Air Quality	Increase in Light Commercial Vehicles (LCV)	Increase in Fugitive dust	Cl/Rehab	2	2	4	4	4	48	Medium	0,8	38.4	Low-Medium
Air Quality	Excavation works	Increase in Fugitive dust	C Cl/Rehab	2	2	3	5	4	48	Medium	0,8	38.4	Low-Medium
Air Quality	Ferrochrome Smelting Activities	Elevated PM_{10} and $PM_{2.5}$ concentrations	O	2	4	5	5	5	80	High	0,2	16	Low
Air Quality	Ferrochrome Smelting Activities	Elevated NO_2 and SO_2 concentrations	O	2	4	3	1	3	30	Low-Medium	0,4	12	Low
Air Quality	Ferrochrome Smelting Activities	Elevated Dust Fallout	O	1	4	1	2	2	16	Low	0,4	6.4	Low

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
Soil, Land Use and Land Capability	Ferrochrome Smelter Footprint - complete stripping of all productive soil horizons (A and B) and stockpiling thereof and replacement during the construction, operations and decommissioning phase.	Complete cease of arable and grazing land capability at ferrochrome smelter footprint until site is rehabilitated and topsoil replaced and the footprint re-vegetated or reintroduced to arable and grazing.	C, O, Decom	2	4	5	5	5	80	High	0,6	48	Medium
Soil, Land Use and Land Capability	Ferrochrome Smelter Footprint - complete stripping of all productive soil horizons (A and B) and stockpiling thereof and replacement during the construction, operations and decommissioning phase.	Degradation of soil potential and quality during stripping and stockpiling due to complete disturbance of the original natural soil horizon sequence (mixing A and B-horizons), which negatively impact on the original effective soil depth, soil fertility and water holding capacity.	C, O, Decom	2	4	5	5	5	80	High	0,4	32	Low-Medium
Ecological Biodiversity	Ferrochrome Smelter Development and Activities	Development related activities will lead to damage or degradation of habitats and vegetation communities and overall loss of biodiversity and ecosystem function within the clearance area. As a result of the construction and operational activities degradation or compression may occur if heavy vehicles are not kept to the demarcated roads and/or development footprint.	C, O	3	4	5	5	4	68	Medium-High	0,8	54,4	Medium
Ecological Biodiversity	Ferrochrome Smelter Development and Activities	Construction, human and vehicle movement and introduction of foreign material e.g., soils may lead to the	C, O	3	4	3	4	4	56	Medium	0,4	22,4	Low-Medium

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
		introduction of alien invader species, impacting on the floral characteristics of the project site and adjacent natural areas.											
Ecological Biodiversity	Ferrochrome Smelter Development and Activities	Development related activities may lead to the loss of species of conservation concern. Some SCC were found to occur on the project footprint or are likely to occur on the project footprint.	C, O	3	4	5	5	4	68	Medium-High	0,8	54,4	Medium
Ecological Biodiversity	Ferrochrome Smelter Development and Activities	The continuous human activity over a longer-term period may further impact on the faunal communities within the area. Associated noise, waste, the smell of humans and physical infiltration into remaining natural areas are problematic and may lead to ever declining populations (where the disturbance of habitat has caused habitat remaining to become unfavourable).	C, O	3	4	5	4	4	64	Medium-High	0,8	51,2	Medium
Ecological Biodiversity	Ferrochrome Smelter Development and Activities	The results may be positive if rehabilitation has been done correctly and the site may be rehabilitated back to a natural landscape. Rehabilitation could be ineffective if measures are not appropriately complied to or rehabilitation is not planned well in advance. Without the necessary mitigation measures, rehabilitation will be unsuccessful and the environment will not be self-sustaining. Without mitigation the alien invasive species will increase and result in a degraded veld condition making the property less viable for post-closure land use activities such as wilderness, grazing and agriculture.	Cl, Decom	2	4	3	2	3	33	Low-Medium	0,6	19,8	Low

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
Heritage / Archaeological	Ferrochrome Smelter Development and Activities	The impact of any construction and smelter operations or related development actions on the existing homesteads and structures if they cannot be preserved in situ and needs to be demolished as a result.	C, O	2	3	3	2	4	40	Medium	0,8	32	Low-Medium
Noise	Ferrochrome Smelter: The construction process will consist of the following principal activities: • Site survey and preparation; • Development of internal access roads and security fencing; • Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure. Operational activities include: raw material handling, furnaces, bag-house and scrubbers, slag and metal handling, and auxiliary equipment.	Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 45 (average impulse-weighted equivalent value) and 50 dBA (arithmetic fast-weighted average) (see section 8.7.3). With ambient sound level measurement indicating the potential that existing levels within the IFC recommended noise limits for residential use, daytime construction activities should not change the existing ambient sound levels with more than 3 dB.	C, O	2	4	3	3	3	36	Low to Medium	0.6	21.6	Low to Medium
		Considering the ambient sound level measurements collected in the area, night-time sound levels could range between 43 (average impulse-weighted equivalent value) and 50 dBA (arithmetic fast-weighted average). With ambient sound level measurement indicating that existing levels are within the IFC recommended noise limits for night-time residential use, night-time construction activities should not change the existing ambient sound levels with more than 3 dB.	C, O	2	4	5	5	4	64	Medium to High	0.8	51.2	Medium
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Creation of a number of jobs for locals Positive.	C	2	1	5	5	5	65	Medium-High			Positive

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Influx of job-seekers to site.	C	2	1	5	4	4	48	Medium	0,4	28.8	Low to Medium
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Training of local people. Positive.	C	2	1	3	5	1	11	Low			Positive
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Traffic congestion.	C	2	1	5	5	5	65	Medium-High	0,2	13	Low
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Creation of local procurement opportunities. Positive.	C	2	1	3	5	5	55	Medium			Positive
Socio-Economic	Construction activities associated with the ferrochrome smelter project	Site disturbance by local business forums.	C	1	1	5	4	5	55	Medium	0,2	11	Low
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Employment creation and retention. Positive.	O	2	4	3	4	5	65	Medium - High			Positive
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Contribution to Local Economy. Positive.	O	2	4	3	4	4	52	Medium			Positive
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Regional economic development. Positive.	O	2	4	3	3	4	48	Medium			Positive
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Community development. Positive.	O	2	4	3	3	4	48	Medium			Positive

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Skills transfer and development. Positive.	O	2	4	3	3	4	48	Medium			Positive
Socio-Economic	Operational activities associated with the ferrochrome smelter project	Health and safety risks. Positive.	O	2	1	5	3	4	44	Medium	0,4	17,6	Low
Socio-Economic	Closure and Decommissioning activities associated with the ferrochrome smelter project	Loss of employment. Reduced local and regional activity. Reduced community development investments.	Cl, Decom	2	5	5	3	4	60	Medium-High	0,8	48	Medium
Surface Water	Ferrochrome Smelter Removal of vegetation and exposure of soils Construction and use of hydrocarbon storage facilities Movement of heavy machinery and vehicles during the construction phase Runoff from the area, stockpiles, and haul roads.	Surface water quality - Sedimentation and pollution of surface water resources resulting in the deterioration of water quality.	C, O, Cl	3	4	5	5	4	68	Medium-High	0,8	54,4	Medium
Surface Water	Ferrochrome Smelter Implementation of surface water runoff management mechanisms during construction Movement of heavy machinery and vehicles during the construction phase	Surface water quantity - changes in the runoff flow velocity and volume increasing erosion and sedimentation	C, O, Cl	3	4	3	5	3	45	Medium	0,8	36	Low-Medium

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
	Development and operation of surface infrastructure												
Surface Water	Ferrochrome Smelter Implementation of surface water runoff management mechanisms during construction	Surface water quantity - Reduction of Catchment Yield as dirty water runoff within the smelter will be contained in the PCD/Slag Area.	C, O	3	4	5	5	4	68	Medium-High	0,8	54,4	Medium
Aquatic Ecology	Ferrochrome Smelter Activities in and around sensitive areas	Loss of biodiversity and ecological function. Impacts to ecological corridor functioning due to prolonged activity in proximity to watercourses.	C, O	3	3	1	1	4	32	Low-Medium	0,4	12,8	Low
Aquatic Ecology	Ferrochrome Smelter Implementation of surface water runoff management mechanisms during construction Movement of heavy machinery and vehicles during the construction phase.	Alteration of drainage patterns leading to decrease and changes in water quantity and availability.	C, O	2	4	1	1	4	32	Low-Medium	0,2	6,4	Low
Aquatic Ecology	Ferrochrome Smelter Implementation of surface water runoff management mechanisms during construction and operations	Surface water quantity reducing the capacity available to sustain aquatic diversity.	C, O	3	4	1	1	4	36	Low-Medium	0,4	14,4	Low
Aquatic Ecology	Ferrochrome Smelter Loosening of soil during rehabilitation processes Movement of heavy machinery and vehicles compacting	Decommissioning impacts resulting in impacts to biodiversity and ecological function within buffer zones or regulated zones.	Cl, Decom	2	1	1	2	5	30	Low-Medium	0,4	12	Low

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
	soils during demolition of infrastructure and rehabilitation processes												
Aquatic Ecology	Ferrochrome Smelter Removal of storm water management mechanisms	Alteration of drainage patterns after or during removal of the infrastructure, leading to decrease and changes in water quantity and availability.	Cl, Decom	2	1	1	1	4	20	Low-Medium	0,2	4	Low
Aquatic Ecology	Ferrochrome Smelter Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	Deterioration of water quality in the surrounding and downstream water resources due to polluted water runoff, affecting aquatic communities during decommissioning and removal of infrastructure.	Cl, Decom	2	1	1	1	4	20	Low-Medium	0,2	4	Low
Wetland Ecosystem	Ferrochrome Smelter: Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil	Flow alterations due to erosion and sedimentation. Pollution of watercourses	C	3	2	4	4	5	65	Medium-High	0,8	52	Medium

Aspect	Activity	Impact	Phase	E	D	I	P	WF	SWOM		ME	SWM	
	during rehabilitation processes.												
Wetland Ecosystem	Ferrochrome Smelter: Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	Flow alterations due to erosion and sedimentation. Pollution of watercourses	O	4	4	5	4	5	85	High	0,8	68	Medium-High
Groundwater	Ferrochrome Smelter Activities	Drawdown: lowering of the water table.	O	2	4	4	5	4	60	Medium-High	0,8	51,2	Medium
Groundwater	Ferrochrome Smelter Activities	Spread of pollution.	Post Cl	2	4	4	5	5	75	Medium-High	0,4	30	Low-Medium
Visual	Ferrochrome Smelter Activities	Potential visual impact on the viewpoints that had a visual exposure rating for the construction phase	C	1	2	3	4	5	50	Medium	0,4	20	Low to Medium
Visual	Ferrochrome Smelter Activities	Potential permanent visual impact on the viewpoints that had a visual exposure rating.	O, Cl, Post Cl.	2	4	3	4	5	65	Medium-High	0,6	39	Medium
Climate Change	Ferrochrome Smelter Activities	GHG Emmissions and Carbon Footprint	C,O	3	4	5	5	5	85	High	0,8	68	Medium to high

11.0 METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

The criteria for the description and assessment of environmental impacts were drawn from the EIA Guidelines (DEAT, 1998) and as amended from time to time (DEAT, 2002).

The level of detail as depicted in the EIA Guidelines (DEAT, Environmental Impact Assessment Guidelines., 1998) (DEAT, Impact Significance, Integrated Environmental Management, Information series 5., 2002)) was fine-tuned by assigning specific values to each impact. In order to establish a coherent framework within which all impacts could be objectively assessed, it was necessary to establish a rating system, which was applied consistently to all the criteria. For such purposes each aspect was assigned a value, ranging from one (1) to five (5), depending on its definition. This assessment is a relative evaluation within the context of all the activities and the other impacts within the framework of the project.

11.1 Impact Measurement Criteria and Rating

The criteria and explanation followed to measure each impact is outlined below:

NATURE: The character of the impact			
EXTENT	**DURATION**	**PROBABILITY**	**MAGNITUDE**
Area	Time Frame	Likelihood	Intensity of impact to destroy or alter socio-economic and biophysical environment.
SIGNIFICANCE: Implication of the impact both with or without mitigation			
TYPE: Description as to whether the impact is negative or positive or neutral.			
MITIGATION: Possible impact management, minimization and mitigation of the identified impacts.			
NO GO OPTION: Evaluation of the no-go-option			

Table 66a: Impact Assessment Criteria

EXTENT	
Classification of the physical and spatial scale of the impact	
Footprint	The impacted area extends only as far as the activity, such as footprint occurring within the total site area.
Site	The impact could affect the whole, or a significant portion of the site.
Regional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
National	The impact could have an effect that expands throughout the country (South Africa).
International	Where the impact has international ramifications that extend beyond the boundaries of South Africa.

DURATION	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
Short term	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase (0 – 1) years
Short to Medium term	The impact will be relevant through to the end of a construction phase (1 - 5 years).
Medium term	The impact will last up to the end of the development phases (6 – 10 years), where after it will be entirely negated.
Long term	The impact will continue or last for the entire operational lifetime i.e. 11 - 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
Permanent	This is the only class of impact, which will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient.
INTENSITY	
The intensity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
Low	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
Medium	The affected environment is altered, but functions and processes continue, albeit in a modified way.
High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
PROBABILITY	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
Improbable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
Possible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chances of this impact occurring is defined as 25 %.
Likely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chances of this impact occurring is defined as 50 %.
Highly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chances of this impact occurring is defined as 75 %.
Definite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100 %.

11.1.1 Nature of Impact

Nature of impact describes the character of the impact in terms of the effect on the relevant environmental, social and economic aspect.

11.1.2 Impact Significance and Mitigation

Significance measures the foreseeable significance of the impacts of the smelter activity both with and without mitigation measures.

The impacts that are generated by the development can be minimised if measures are implemented in order to reduce the impacts. The mitigation measures ensure that the development considers the environment and the predicted impacts in order to minimise impacts and achieve sustainable development.

11.1.3 Determination of Significance-Without Mitigation

Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Where the impact is positive, significance is noted as "positive". Significance is rated on the following scale:

Table 66b: Significance-Without Mitigation

NO SIGNIFICANCE	The impact is not substantial and does not require any mitigation action.
LOW	The impact is of little importance, but may require limited mitigation.
MEDIUM	The impact is of importance and is therefore considered to have a negative impact. Mitigation is required to reduce the negative impacts to acceptable levels.
HIGH	The impact is of major importance. Failure to mitigate, with the objective of reducing the impact to acceptable levels, could render the entire development option or entire project proposal unacceptable. Mitigation is therefore essential.

11.1.4 Determination of Significance-With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. Significance with mitigation is rated on the following scale:

Table 66c: Significance- With Mitigation

NO SIGNIFICANCE	The impact will be mitigated to the point where it is regarded as insubstantial.
LOW	The impact will be mitigated to the point where it is of limited importance.
LOW TO MEDIUM	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels.
MEDIUM	Notwithstanding the successful implementation of the mitigation measures, to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
MEDIUM TO HIGH	The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.

HIGH	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance, after mitigation could render the entire development option or entire project proposal unacceptable.

11.1.5 Assessment Weighting

Each aspect within an impact description was assigned a series of quantitative criteria. Such criteria are likely to differ during the different stages of the project's life cycle. In order to establish a defined base upon which it becomes feasible to make an informed decision, it was necessary to weigh and rank all the criteria.

11.1.6 Ranking Weighting and Scaling

For each impact under scrutiny, a scaled weighting factor is attached to each respective impact (refer Table 66d). The purpose of assigning weights serves to highlight those aspects considered the most critical to the various stakeholders and ensure that each specialist's element of bias is taken into account. The weighting factor also provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspect criteria.

Simply, such a weighting factor is indicative of the importance of the impact in terms of the potential effect that it could have on the surrounding environment. Therefore, the aspects considered to have a relatively high value will score a relatively higher weighting than that which is of lower importance.

The significance on the aspects of the environment is classified as:

Table 66d: Description of Assessment Parameters with its Respective Weighting

Significance Rating (SR) =	(Extent + Intensity + Duration + Probability) x WF

EXTENT		**DURATION**		**INTENSITY**		**PROBABILITY**		**WEIGHTING FACTOR (WF)**		**SIGNIFICANCE RATING (SR)**	
Footprint	1	Short term	1	Low	1	Improbable	1	Low	1	Low	0-19
Site	2	Short to Medium	2			Possible	2	Low to Medium	2	Low to Medium	20-39
Regional	3	Medium term	3	Medium	3	Likely	3	Medium	3	Medium	40-59
National	4	Long term	4			Highly Likely	4	Medium to High	4	Medium to High	60-79
Internatio nal	5	Permanent	5	High	5	Definite	5	High	5	High	80-100

MITIGATION EFFICIENCY (ME)		**SIGNIFICANCE FOLLOWING MITIGATION (SFM)**	
High	0.2	Low	0 - 19
Medium to High	0.4	Low to Medium	20 - 39
Medium	0.6	Medium	40 - 59
Low to Medium	0.8	Medium to High	60 - 79
Low	1.0	High	80 - 100

11.1.7 Identifying the Potential Impacts Without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 1:
Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

11.1.8 Identifying the Potential Impacts With Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it was necessary to re-evaluate the impact.

11.1.9 Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation efficiency (ME) rating (refer to Table 66d). The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact.

Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 2:
Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency
or WM = WOM x ME

11.1.10 Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations taken into account.

11.1.11 Status of Impact

Status of impact describes whether the impact is positive (beneficial) on the affected environment (social and bio-physical) or negative (detrimental) or neutral.

The degree of confidence in the predictions, based on the availability of information and specialist knowledge.

Other aspects to take into consideration in the specialist studies are:

- Impacts should be described both before and after the proposed mitigation and management measures have been implemented.
- All impacts should be evaluated for the full-lifecycle of the proposed development, including construction, operation and decommissioning.
- The impact evaluation should take into consideration the cumulative effects associated with this and other facilities which are either developed or in the process of being developed in the region.

- The specialist studies must attempt to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are to be used as a measure of the level of impact.

12.0 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY AND THE ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

The site for the proposed ferrochrome/ferroalloys smelter project operations are within the already approved MMSEZ industrial area by LDEDET and Limpopo Government. The direct surface owners of the applicable farms – Mulambwane CPA have no objection to the proposed MMSEZ development. The No-Go option is the only other alternative identified during the scoping phase, which has been discussed in detail as part of the EIA/EMP phase.

Table 67: Advantages and Disadvantages of the Ferrochrome Smelter Project vs the No-Go option

Advantages	Disadvantages
Ferrochrome Smelter Project	
South Africa is a developing country with extremely high levels of poverty and crime rate. The concept of Special Economic Zone (SEZ) – including the proposed ferrochrome smelter - is intended to accelerate economic growth, development and job creation in Limpopo through: Promoting industrialisation; Facilitating increased trade and investment, Supporting the development of sustainable enterprises; and Ensuring infrastructure development – within the framework of sound environmental assessment and management of impact to achieve sustainable development.	The impact on the natural environment as determined by the specialists as described in this report.
No Go option	
Surface environmental impacts will not occur.	Existing high levels of poverty, lack of employment and low standard of living in the area and surrounding communities will persist.

13.0 POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

The summary of issues raised by interested and affected parties and responses thereto is attached in Appendix 5 with the Public Participation Report. The said summary will be updated after the EIA/EMP phase consultation and submitted to LDEDET.

Impact mitigation and management measures to be implemented are outlined in Part B of this report.

14.0 OUTCOME OF SITE SELECTION MATRIX AND FINAL SITE LAYOUT PLAN

The site for the proposed ferrochrome/ferroalloys smelter project operations are within the already approved MMSEZ industrial area by LDEDET and Limpopo Government. The direct surface owners of the applicable farms – Mulambwane CPA have no objection to the proposed MMSEZ development. The No-Go option is the only other alternative identified during the scoping phase, which has been discussed in detail as part of the EIA/EMP phase.

The final site layout plan is attached in Appendix 4.

15.0 MOTIVATION WHERE NO ALTERNATIVES WERE CONSIDERED

The Musina-Makhado site offers the best geographic location and largest economic benefits for the establishment of the special economic zone (SEZ) than any other potential sites in Limpopo Province such as Polokwane, Tubatse, Tzaneen and Lephalale. The Musina-Makhado SEZ site is approximately 51.6 km from Beit Bridge border post which is South Africa's primary gateway into the SADC region and the African Continental Free Trade Area (ACFTA) markets. South Africa is both a member of SADC and the African Union (AU) which are both multilateral institutions created to advance peace and security, economic cooperation, trade integration and development in Africa.

The site for the proposed ferrochrome/ferroalloys smelter project operations are within the already approved MMSEZ industrial area by LDEDET and Limpopo Government. The direct surface owners of the applicable farms – Mulambwane CPA have no objection to the proposed MMSEZ development. The No-Go option is the only other alternative identified during the scoping phase, which has been discussed in detail as part of the EIA/EMP phase.

16.0 STATEMENT MOTIVATING THE PREFERRED SITE

With an eye to international trends, the South African government has adopted the SEZ policy to accelerate the country's industrialisation, regional and economic development. The dti states that the SEZ programme is a critical tool for the attraction of FDI, creation of decent jobs, establishment of new industrial centres, the development and improvement of existing infrastructure. Specifically, the South African government's objectives in establishing SEZs are five-fold:

- Promotion of targeted industrial capabilities within the framework of the IPAP and the NDP,
- Promotion of beneficiation and value-addition to the country's minerals and other natural resources,
- Development of the world-class infrastructure required to support the development of the targeted
- industrial activities,
- Attraction of foreign and domestic direct investment,
- Acceleration of economic growth and the creation of much needed jobs in previously marginalised regions of the country.

The development of the R255 billion Musina- Makhado SEZ will generate approximately 21 000 jobs in the first 5 years of its operation. This will increase to 51 000 jobs in the tenth year of the SEZ's operation thereby giving rise to a larger impact on Vhembe District Municipality, Limpopo and South African economies. The proposed ferrochrome smelter will have an initial capital investment of R1.23 billion and employ 235 people. Ramp-up to full production within 5 years will increase the labour force to 1880 people employed with a capital investment of R10.2 billion. There is there direct economic and social benefit for both Musina and Makhado Local Municipalities and the region at large.

The proximity of the Musina-Makhado SEZ to the border post of Beit Bridge offers economic opportunities for a number of trade, logistic and border related services

The proposed ferrochrome smelter project will have medium to high negative impacts on the surrounding environmental aspects – mainly vegetation and biodiversity, groundwater, surface water, air quality, noise and visual aspects. Mitigation measures as outlined in Part B of this report will minimize and manage the said impacts.

17.0 DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE

17.1 Topography

17.1.1 Methodology Used

Contour mapping was used to map out the contour lines and topography of the area – including the valleys and hills, and the steepness or gentleness of slopes. The contour interval of a contour map is the difference in elevation between successive contour lines.

17.1.2 Description of Issues and Risks

The ferrochrome infrastructure, slag area, temporary raw material stockpiles and topsoil storage will alter the existing topographic configuration of the flat to undulating surface on which the proposed ferrochrome smelter will be developed. operations are located.

Construction Phase

The construction excavations, earthworks and infrastructure development for ferrochrome smelter will result in the physical change of the landform on the site. The said earthworks and smelter infrastructure, material stockpiles will be confined to the designated ferrochrome smelter area ONLY. Some of the over-burden material will be used to cover the side slopes of the disturbed smelter site, and revegetated to bring them to as close as possible to the surrounding vegetation cover and minimize visual impact.

There is an existing mining operation (Syferfontein Mine) with opencast pits, plant infrastructure, access and haul roads, waste rock dumps (WRD), and topsoil stockpiles. Therefore, the topography of the area is already altered to some extent.

Figure 70: Existing Adjacent Opencast Mining Operations

Primary access to the proposed ferroalloy/ferrochrome smelter and MMSEZ South site is currently via the N1 main road from Makhado to Musina, which is situated along the east of the site and allows north-south traffic movement. The secondary access to the site was identified as the R525, which is situated along the northern

part of the site and allows east-west traffic movement and connectivity to the N1. Due to the prescripts of the SEZ guidelines, security and access control facilities will need to be provided at all access points to the MMSEZ South site – including the proposed smelter. The access and haul roads will not alter the road or horizontal configuration. The road base and foundation will be aligned with the existing ground level.

Operational Phase:
The proposed ferrochrome infrastructure, terrain and including the raw material stockpiles, will be visible from the N1 and R525 road and up to 10 km away. The topographic configuration around the ferrochrome smelter will be altered and create a long term elevated infrastructure above ground level. The impact is of medium to high negative significance to the physical environment as far as topography is concerned.

Ferrochrome slag, a byproduct of ferrochrome production, is finding increasing use in various applications, particularly in the construction and road-building industries. It's being utilized as a sustainable alternative to natural aggregates, in cement and concrete production, and even in specialized applications like refractory materials. Kinetic Development Group will explore these options to minimize the slag stockpile.

Drainage and storm water management structures will also be constructed to ensure and maintain the existing natural flow of surface water.

Decommissioning and Closure Phase:
All raw material and slag stockpiles will be removed and sold to the secondary markets. The impact will be reduced from medium-high to low negative significance.

The smelter infrastructure not usable for secondary use by the secondary industries, community or land surface owners will be demolished and removed. The impact will be reduced from medium-high to low negative significance.

17.1.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**1**	Low	**3**	Short-Term	**2**	Definite	**5**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**55**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
55				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium-ve**			**44**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	

Ferrochrome Smelter Footprint	2	Medium	3	Long Term	4	Definite	5
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium-High -ve**			**70**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
70				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**56**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	2	Medium	3	Long-Term	4	Likely	3
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium-High -ve**			**60**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
60				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low – Medium -ve**			**36**
NO-Go OPTION:							
The existing Mulambwane CPA farm area is currently used for grazing and limited subsistence agricultural and crop farming land use. It is flat terrain that undulates towards the draining channels. The existing status quo and landuse will remain should the ferrochrome smelter project not proceed.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	2	Low	1	Medium-Term	4	Possible	3
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low – Medium -ve**			**30**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
30				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**18**
CUMMULATIVE IMPACTS:							
As development and other commercial/industrial activities in the MMSEZ area come to effect, the topography of a wider area will be affected by surface infrastructure development (flattening of area) and the artificial “hills” as a result of possible soil stockpiles, raw material and product stockpiles, waste dumps and access roads.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	3	Medium	3	Long-Term	4	Highly Likely	4
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium-High -ve**			**70**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
70				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**56**

17.2 Soil, Landuse and Land Capability Assessment

17.2.1 Methodology Used

The Protocol requires an initial, high-level verification of the accuracy of the sensitivity categories as rated by the Screening Tool. The Protocol state that prior to commencing with a specialist assessment, the current use of the land and the potential environmental sensitivity of the site under consideration as identified by the Screening Tool, must be confirmed by undertaking a site **sensitivity verification** as follows:

- The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist. The site sensitivity verification must be undertaken through the use of:
  - a desk top analysis, using satellite imagery;
  - a preliminary on-site inspection; and
  - any other available and relevant information.

- The outcome of the site sensitivity verification must be recorded in the form of a report that:
  - confirms or disputes the current use of the land and the environmental sensitivity as identified by the Screening Tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;
  - contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and
  - is submitted together with the relevant assessment report prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

Geographic Information System (GIS) software from Esri (Environmental Systems Research Institute) called ArcGIS-ArcMap was used to store and process field data and generate spatial data for map compilations.

Field observation points were generated at a density of 150 x 150 m across the proposed infrastructure footprints. The coordinates of the observation points were calculated and loaded on a Geographic Positioning System (GPS) to accurately locate the position of the observation points in the field. The study area and field observation points were superimposed on Google Earth satellite imagery for the compilation of large-scale field maps.

The soils within the development site were investigated by means of auger observations at a density of 150 x 150 m and randomly within homogeneous sections as deemed necessary. Auger holes were made to a maximum depth of 1.5m or to refusal. The soils were described and classified according to the South African Taxonomic Soil Classification System (Soil Classification Working Group, 2nd edition 1991).

Wetland and riparian zones were delineated according to the practical field procedure for the identification and delineation of wetlands and riparian areas

(Department of Water Affair and Forestry, 2005). Four indicators were used in the study to delineate wetland and riparian zones, namely:

- Terrain unit;
- Soil form;
- Soil wetness; and
- Wetland and riparian vegetation.

The detailed soil map, indicating dominant soil forms and associated properties, serves as basis of the derived agricultural sensitivity map. The soil forms are grouped in land capability classes based on soil properties, topography and climate. The land capability layer is then refined by incorporating current land use practices in order to produce a final agricultural sensitivity map.

17.2.2 Description of Issues and Risks

The proposed development will withdraw 300 ha for the ferrochrome smelter and a possible further 980.1 ha of the 4 affected farms if the proposed other industrial developments on the mentioned farms are fenced off and agriculture (cattle farming) can continue undisturbed on the surrounding areas. The productive land on the 4 farms will decrease with 1280.1 ha. If the structure footprints are not fenced off, it will result in additional areas that become unavailable for cattle farming and the area of land that become unproductive will increase further.

Table 68: Loss in Livestock Yields Due to the Development

Farms	Portion	Production unit	Area withdrawn due to development (ha)	Current grazing load	Reduction in large stock units due to development	Reduction in offspring at 85% weaning rate per annum
Van der Bijl 528MS	Rem.Ext.	Cattle	459.4	50 ha/lsu	9	8
Dreyer 526MS	Rem.Ext.	Cattle	586.7	19 ha/lsu	31	26
Antrobus 566MS	Rem.Ext.	Cattle	200.6	16 ha/lsu	12	10
Steeenbok 565MS	Rem.Ext.	Cattle	33.4	27 ha/lsu	1	1
			1280.1		**53**	**45**

One main activity that will be responsible for the impact on soils, land use and agricultural production is the development and construction of the proposed ferrochrome smelter and associated infrastructure over 300 ha.

The ferrochrome smelter infrastructure will affect the soil productive ability and agricultural production in the following way:

- The footprints of roads, parking areas, buildings (workshops, offices, ablutions etc.) and smelter plants will be covered completely with concrete, tar or pavers. The soil surface will thus be covered completely and it will cause the productive ability of the soils to cease completely and any agricultural production will thus also cease completely for the entire lifespan of the structure, until it is demolished and the footprint is rehabilitated.

The following impact on soil and land capability are envisaged. The said impacts will be of high negative significance on the ferrochrome smelter site:

- The ferrochrome smelter footprint will cover the soil surface and cause a complete cease of agricultural production and food supply.
- The topsoil will be disturbed and will probably be used to crated embankments.
- The remaining soil horizons will be compacted severely prior to placement of the liner/concrete flooring.
- The topsoil and overburden stockpiles will cover the soil surface and cause a complete cease of agricultural production and food supply.
- The upper natural soil horizons will be compacted severely by the weight of the topsoil and overburden material.
- All vegetation and animal life at the footprint will be destroyed. All natural soil processes and microbial activities will cease to a large extent or completely.
- The base material that covers the soil surface will cause a complete cease of agricultural production and food supply.
- The natural soil horizons underneath the base material will be compacted during construction of the base layer and during operation thereafter.

Construction and Operations Phase:
In general, the soils around the proposed smelter site vary in depth from a few centimetres (0-20cm – shallow) (western side) to depths of between 50-100cm – moderately deep).

Soils and soft overburden will be stripped prior to excavation and earthworks for the proposed ferrochrome smelter and associated infrastructure and stored separately for subsequent and progressive rehabilitation. Disturbance caused by smelter infrastructure development will result in higher permeability within the smelter footprint, allowing for greater flow of groundwater into and through disturbed surfaces.

There is possible contamination of soil due to fuel, lubricants and other chemical spills (accidental) from the various vehicles and machinery used for smelter activities. Erosion is also likely due to runoff from storm water, because soil would have been disturbed.

All surfaces where the smelter infrastructure will be constructed, will disturb the soil, and similarly the soil will be stripped and stored. The soil beneath the access road base will be mixed with gravel, and compacted. Movement of vehicles on the roads will result in compaction of soil structure. The following activities will impact on soil during operational phases:

- The stripping of all utilisable soil (top 100mm to 500mm depending on activity);
- The preparation (levelling and compaction) of lay-down areas, foundations, and pad footprint areas for stockpiling of utilisable soil removed from the footprint of the planned stockpile area, the construction of the storm water control facility(s) inclusive of berms and trenches to divert clean water around the smelter workings;
- The clearing, stripping and stockpiling from the construction of all access and haulage roads, smelter infrastructure, water supply, and electrical power supply servitudes (linear infrastructure);
- The use of heavy machinery over unprotected soils;
- The creation of dust and loss of materials to wind and water erosion (loss of resource), and

- The possible contamination of the soils by chemical and hydrocarbons spills (dust and dirty water runoff).
- The sterilisation of the soil resource under which the smelter footprint. This will be an on-going loss for the duration of the operation;
- The creation of dust and the possible loss (erosion) of utilisable soil down-wind and/or downstream, and the siltation of the local streams and waterways;
- The compaction of the in-situ and stored soils and the potential loss of utilisable materials from the system;
- The contamination of the in-situ and stored soils by dirty water run-off and or spillage of hydrocarbons, lubricants and other chemicals from vehicle and machinery or from dust from the process of smelter and hauling of raw material and chrome ore;
- Contamination of soils through the use of dirty water for road wetting (dust suppression) and irrigation of the stockpile vegetation.

Soils will only be stripped where practicably possible. Stripping of soil for use in rehabilitation will reduce the duration of the impact. Soil is a vital resource for the successful rehabilitation of the smelter area, therefore, the conservation of soils will be managed carefully. Soil stockpiles will be constructed and maintained to preserve the viability and fertility of the soil – however these two characteristics will be reduced overtime. The impact will therefore be of moderate to high negative significance.

The impact will be high negative significance and permanent for the soil beneath the access roads base. The impact is negative on the bio-physical environment and soil aspects. With the daily smelter activities – including vehicular movements, there is a possibility of fuel and oil spillages. Strict management procedures will be put in place to control such accidental spillages.

The in situ availability of the smelter footprint soils and their current potential to sustain vegetation and human land use will be lost for a long duration. The frequency of the activity, frequency of the impact and duration of the impact will all be definite and of long term duration.

Decommissioning and Closure Phase:
All soil stripped and stockpiled separately for rehabilitation purposes will be used for such purpose. The rehabilitated surfaces will be re-vegetated to minimize and prevent soil erosion. Contaminated soil will be bio-remediated to make it re-usable as a medium of plant growth. The long length of time for topsoil storage will impact on the physical and chemical characteristics of the stockpiled soil.

The ferrochrome smelter infrastructure will be demolished and removed from site. The overall impact will therefore remain medium to high negative on soil over the smelter area.

The surface owners – Mulambwane CPA – supports the proposed ferrochrome smelter project. There are no plans to use the proposed site for crop production. There is adequate surrounding area available for grazing purposes.

17.2.3 Significance Assessment

CONSTRUCTION PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	High	**5**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**		**5**
SIGNIFICANCE RATING (WOM):				**High -ve**		**80**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
80				**0.8**		
SIGNIFICANCE RATING WITH MITIGATION:				**Medium to High -ve**		**64**
OPERATIONAL PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**		**5**
SIGNIFICANCE RATING (WOM):				**High - ve**		**80**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
80				**0.8**		
SIGNIFICANCE RATING WITH MITIGATION:				**Medium to High -ve**		**64**
DECOMMISSIONING PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Long-Term	**3**	Definite	**5**
WEIGHTING FACTOR:				**High**		**5**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**		**65**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
65				**0.4**		
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**		**39**
NO-Go OPTION:						
The existing Mulambwane CPA farm area is currently used for grazing and limited subsistence agricultural and crop farming land use. The existing status quo, soil conditions, agricultural potential and landuse will remain should the ferrochrome smelter project not proceed.						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**1**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**		**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**		**24**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
24				**0.6**		
SIGNIFICANCE RATING WITH MITIGATION:				**Low -ve**		**14.4**
CUMMULATIVE IMPACTS:						

Highly productive soils will be occupied by the ferrochrome smelter and associated infrastructure and then often poorly rehabilitated, which causes a permanent loss of high potential and highly productive soils. This is a serious, negative, accumulating impact on our national soil resource which reduces food production annually. The same will apply should the other proposed industrial activities within the MMSEZ come into effect.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**2**	High	**5**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**75**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
75				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**45**

17.3 Ecology and Biodiversity

17.3.1 Methodology Used

Literature Review and Databases:
For background information, the relevant maps, aerial photographs, and other information on the natural environment of the area concerned were obtained through literature studies and databases.

Field Studies: Vegetation, Flora and Fauna Surveys
The field survey 1-3 and 12 – 13 April 2025, to assess vegetation, flora and habitat suitability and presence of fauna.

A Google Earth image was used to stratify and map different units representing differences in cover and vegetation. At several sampling plots and transects within each mapping unit a description of the dominant and characteristic plant species found was made. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded resulted in a list of the plant species present, including trees, shrubs, grasses and forbs. A comprehensive species list was therefore derived for the site, but it is realised that some species could have been missed. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina et al. 2000, Brown et al. 2013) and are considered an efficient method of describing vegetation and capturing species information. Within each mapping unit noted were made of relevant habitat features, with emphasis on topography and some soil properties Additional notes were made of any other features that might have had an ecological influence, e.g. previous utilization and disturbance.

The distributional ranges and habitat preferences of fauna species were determined by using scientific literature, field guides, atlases and other data bases. Within a particular Biome and/or Vegetation Type the local occurrences of fauna are closely dependent on broadly defined habitat types. These habitat types are defined by topography and vegetation cover:

- Terrestrial fauna that prefers grassland, the herbaceous layer in bushveld, old fields or agricultural fields,
- Arboreal, that is tree-living fauna,
- Rupicolous, that is rock-dwelling fauna and
- Wetland-associated fauna.

17.3.2 Description of Issues and Risks

In terms of terrestrial ecology, the following points are emphasized:

- Messina Mopane Bushveld, located in Limpopo Province stretching over a very large area from the north of the Soutpansberg to the Limpopo River is a homogeneous bushveld type, totally dominated by *Colophospermum mopane*, and with a relatively low plant species richness, as is confirmed by the Screening Tool results for this study site, as well as by the field study.
- The proposed ferrochrome smelter site site covers about 300 hectares, a very small fraction of the 23000 km^2 that Mopaneveld covers in in South Africa (Du Plessis 2001). A total of 550000 km^2 of this vegetation type occurs over eight southern African countries (Siebert et al. 2003). It is acknowledged that great biological and ecological variation occur the extent of Mopaneveld.
- The vegetation on the proposed site is primary mopane bushveld, with little signs of disturbance, but with signs of some overutilization over many years, resulting in considerable densification of the woody layer and the associated exclusion of many other species by the very dense *Colophospermum mopane*. This also contributes to relatively low grazing capacity, and the scarcity and even absence of medium to large herbivore populations. Although there is adequate habitat for many smaller fauna species, they are secretive and confined to very specific habitat sites and are not easily observed.
- The field survey revealed five plant communities *Colophospermum mopane Dense Bushveld, Colophospermum mopane Open Bushveld, Colophospermum mopane* Plains Bushveld , Ridge Bushveld and Drainage Lines. The construction phase of the proposed development will have Medium-High significance, without mitigation, on the vegetation and flora of these plant communities. Proposed mitigation measures may reduce the significance to Medium. Mitigation during the operational phase my reduce the impact significance to Low-Medium.
- The drainage lines are very shallow, almost not observable and the vegetation is continuous with the adjacent terrestrial vegetation, without a definite riparian area. It is therefore suggested that the drainage lines do not need to be excluded from the adjacent development, as it will not influence drainage significantly.
- An aspect that may need attention is the protection of the protected trees on the sire, particularly *Adansonia digitata* (baobab) but also *Sclerocarya birrea* (marula) and *Boscia albitrunca*. A permit is needed to cut or remove protected trees. Young individuals of baobab and marula may be successfully transplanted, but not *Boscia albitrunca*.
- It is suggested to protect these trees as far as possible (particularly in the southern part of the site, where several individuals occur). If not possible, apply for permits to remove or transplant. Develop a nursery to cultivate protected trees to plant at suitable habitats in Mopaneveld.
- Larger fauna and birds will generally move away, so there will be little, or no fauna left on the site during the construction and operational phases. The significance of the impacts on fauna is generally Medium to Low-Medium as they will ether move away, or killed in the case of smaller fauna species, e.g. snakes, lizards or mice etc.

Flora:

Any clearing of vegetation on areas to be developed for the ferrochrome smelter surface infrastructure will result in a negative impact on flora.

The impact is of medium to high negative significance since clearing of vegetation will take place mainly ONLY on the approximately 300 hectares for ferrochrome smelter footprint and site area. Clearing of vegetation will be confined ONLY to the area necessary for smelter infrastructure development. No unnecessary clearing of vegetation or veld burning will take place on the ferrochrome smelter site.

Movement of construction and smelter vehicles and people will impact on habitat through pollution by littering, noise, fuel, oils, hydraulic fluids, chemicals, etc.

Disturbance of the soil will transform the vegetation in the smelter area and create conditions favourable for the establishment of populations of alien and invader plant species as well as common weeds. Proliferation of alien plant species may alter plant community structure. Failure to implement a comprehensive alien weed control plan will lead to an increase in alien vegetation encroachment.

With the development of any infrastructure the fragmentation of natural habitats can occur with the negative effect that the flow of ecosystem services (seed dispersal, pollination, exchanging of genes from one area to the next, etc.) may be interrupted having a negative long-term effect on isolated fragments.

Fauna:
The specific ferrochrome smelter area will be fenced-off to ensure restricted access to livestock and wild animals and for safety reasons for persons. There will however be sufficient surrounding land available for grazing.

The status of the impact is regarded as **medium negative** significance. No evidence of larger wildlife (e.g. kudus, antelopes, elephants, zebras, springboks etc.) was encountered during the various field investigations conducted on the proposed ferrochrome smelter area for the purposes of this report. Only domestic livestock was observed – cattle, sheep, and goats.

Micro-habitats will be destroyed on areas excavated for surface infrastructure, and access roads. However, in this case, a significant area of the surrounding habitat is left intact which provides sufficient habitat for the fauna to migrate to during and after the smelter operational phase.

Construction Phase
- Most of the impacts on plant species will occur during the construction phase when removal of plant communities will take place on site.
- Vegetation clearance will likely destroy habitats and lead to possible invasive and/or exotic species establishing in the area and edge-effects occurring surrounding the development. Bare areas may become vulnerable to Alien and Invasive species, and these may compete with indigenous species, likely leading to the migration of sensitive species from the site to a more favourable habitat.
- The onset of construction activities will result in impacts to the natural environment due to increased movement, traffic and large machinery to the area. Heavy machinery and vehicles may result in compaction of the soil and destruction of vegetation habitat which in turn will also impact on the animals that use the area as habitat.

- This activity could fragment ranges that certain animals may need to sustain adequate foraging area and breeding grounds. This is relevant since the current habitat has value as foraging grounds and corridors for movement between other natural areas.
- Possible impacts on Species of Conservation Concern (SCC) associated with the area. Endemic and/or vulnerable species could possibly occur within the area of construction and would then be destroyed without proper knowledge and/or mitigation measures.

Operational Phase

- The continuous human activity over a longer-term period may further impact on the faunal communities within the area. Associated noise, waste, the smell of humans, physical penetration into sensitive zones and natural areas are problematic and may lead to ever declining populations (where the disturbance of habitat has caused habitat remaining to become unfavourable).
- Invasive plant species may increase during the operational phase of the project. This will mostly take place in the remaining natural areas. Removal of these species is an ongoing process and if not managed regularly could result in severe changes and competition in plant communities.
- Flora could be damaged by staff and contractors if they are allowed to access certain natural areas that should be indicated as no-go zones.
- Possible impacts on Species of Conservation Concern (SCC) if encountered by employees and/or contractors.
- Impacts to the wildlife as operations commence, restricting access to the natural areas and specialized niches.

Decommissioning and Closure Phase:

- Once the operation has been decommissioned, final steps in the rehabilitation process will take place. It is, however, possible that the rehabilitation plans are not feasible or only implemented and planned at a late stage, hindering successful rehabilitation.
- Decommissioning and rehabilitation will have similar impacts as the construction phase, but thereafter positive impacts as the natural environment starts to recover, restoring balance.

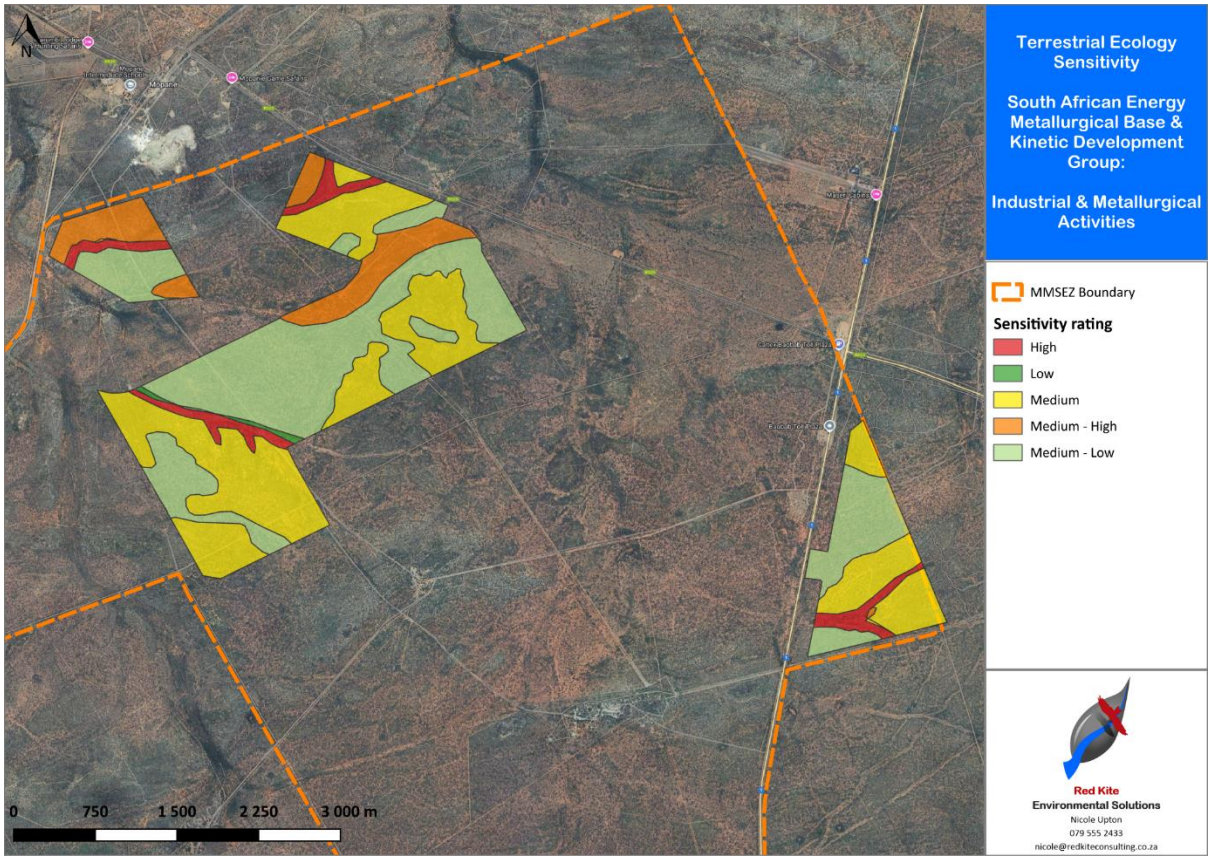


Figure 71: Terrestrial Ecology Sensitivity Map

17.3.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	High	**5**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**64**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
64				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**51.5**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**68**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
68				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**54.4**
DECOMMISSIONING PHASE:							

EXTENT		INTENSITY		DURATION		PROBABILITY	
Ferrochrome Smelter Footprint	2	Medium	3	Medium - Term	3	Definite	5
WEIGHTING FACTOR:				Medium to High			4
SIGNIFICANCE RATING (WOM):				Medium -ve			52
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				ME			
52				0.6			
SIGNIFICANCE RATING WITH MITIGATION:				Low to Medium -ve			31.2
NO-Go OPTION:							
The vegetation on the proposed site is primary mopane bushveld, with little signs of disturbance, but with signs of some overutilization over many years, resulting in considerable densification of the woody layer and the associated exclusion of many other species by the very dense *Colophospermum mopane*. This also contributes to relatively low grazing capacity, and the scarcity and even absence of medium to large herbivore populations. Although there is adequate habitat for many smaller fauna species, they are secretive and confined to very specific habitat sites and are not easily observed. The status-quo will persist should the proposed ferrochrome smelter project not proceed.							
EXTENT		INTENSITY		DURATION		PROBABILITY	
Ferrochrome Smelter Footprint	2	Medium	3	Medium-Term	3	Likely	3
WEIGHTING FACTOR:				Medium			3
SIGNIFICANCE RATING (WOM):				Low to Medium -ve			33
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				ME			
33				0.6			
SIGNIFICANCE RATING WITH MITIGATION:				Low -ve			19.8
CUMMULATIVE IMPACTS:							
The terrestrial flora and fauna, whether domestic or game, are integrally linked and the destruction or removal of the one will have a negative impact on the other. The vegetation provides food and protection to the fauna, while the fauna contributes to the pollination and dispersal of the vegetation. Any loss of natural vegetation will have a domino/ knock on effect, with the fragmentation of other larger natural vegetation areas. The genetic composition of the remaining species may also change due to the loss of meta-populations or the isolation of populations resulting in inbreeding.							
EXTENT		INTENSITY		DURATION		PROBABILITY	
Ferrochrome Smelter Footprint and Region	3	High	5	Long-Term	4	Definite	5
WEIGHTING FACTOR:				Medium to High			4
SIGNIFICANCE RATING (WOM):				Medium to High -ve			68
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				ME			
68				0.8			
SIGNIFICANCE RATING WITH MITIGATION:				Medium -ve			54.4

17.4 Surface Water and Wetlands Assessment

17.4.1 Methodology Used

The study includes an assessment used to generate the baseline information. The baseline information gathered include:

- Location detail including:
  - Identify the climate for the area;
  - Identify the topography of the site and the area surrounding the site; and
  - Identify the Ecoregion and characteristics.
- Surface water details including:
  - Determine whether the site overlaps with Freshwater Ecosystem Priority Areas (FEPA);
  - Determine whether the site overlaps with Strategic Water Source Areas (SWSA);
  - Identify the catchment, classification, ecological state and importance of the resource;
  - Identify affected surface water resources and surrounding drainage systems;
  - Create a baseline water quality objective; and
  - Identify potential surrounding surface water uses and users.

With the baseline in place, an impact assessment is undertaken, utilising rating criteria to assess the impacts of the proposed project on the surface water system, as well as providing proposed mitigation measures to avoid or minimise these potential impacts.

The overall purpose of the Surface Water Assessment is to evaluate the potential impacts that the proposed infrastructure, or activities might have on the surface water quality and quantity within the project area. The impactable water resources, with their accompanying catchments, and sub-catchment areas will be noted as well as setting forth information on which measures, and legislation will be applicable to the said property.

The study included a desktop study which provided the majority of the surface water and climate baseline information, water quality data comparison, a site survey to assess the condition of the watercourses and associated riparian vegetation on site and the application of rating criteria to assess the impacts of the proposed project on the surface water system. A field survey was conducted supplementary to the desktop analysis and served as a fatal flaw analysis to determine whether there are any major ecological concerns with regard to the proposed project. Field surveys were undertaken during May 2025.

17.4.2 Description of Issues and Risks

The project area is located in the A71 tertiary catchment within the Limpopo Water Management Area (WMA) North, specifically in the A71K quaternary catchment. The major river in catchment A71K is the Sand River. The Sand River flows from south to north and drains into the Limpopo River at the South African and Zimbabwe border, 7 Km east of Musina. The site drains through two non-perennial unnamed tributaries of the Sand River on the north-eastern and north-western sections of the site. These drainage lines converge north of Mopane before the confluence with the Sand River further north.

No significant watercourses, riparian areas or wetlands are located within 100 m of the project footprint, based on the study. Impacted drainage lines are non-perennial

and are expected to be of medium sensitivity. Therefore, in terms of surface water features, the entire project footprint and 100 m project area buffer is expected to be of medium sensitivity.

There are no wetlands within 500m of the project footprint, which is supported by the 1:50000 ortho-maps, as well as the NFEPA database.

The drainage lines found on site are all non-perennial, and are expected to only containing water during and shortly after heavy rain events. Due to the limited rainfall and high evaporation in the area, riparian and wetland areas will be unlikely. Drainage lines are expected to only have denser vegetation consistent with the surrounding areas

There was no surface flow within the project area at the time of this study and therefore no surface water samples were taken and analysed to form a baseline. As with the classification and reserve determination, quality objectives are yet to be set for the catchment by DWS.

Construction Phase:
The following construction activities could impact detrimentally on the water quality of surface and groundwater resources during the construction phase for the proposed ferrochrome smelter:

- Spilling and leakages of lubricants, chemicals and fuels used during construction;
- Transportation of material to site and the storage of material on site;
- Vegetation clearance to construct smelter infrastructure;
- Construction of haul and access roads; and
- Dust fallout as a result of construction activities

The above-mentioned impacts associated with the construction phase can be adequately managed through the implementation of a construction Environmental Management Plan/Programme (EMP). The following impacts are site specific impacts associated with the construction phase:

- Destruction or degradation of drainage areas and consequent aquatic biodiversity and integrity.
- Decrease in catchment yield and water supply to downstream water users due to altering/diversion of the flow of the non-perennial tributary.
- Erosion of exposed topsoil by construction activities may increase suspended solids and cause siltation of watercourses.
- Surface water resource and environmental contamination as a result of leakage of hydraulic fluid, fuel and oil from vehicles used in construction.
- Groundwater resource and environmental contamination as a result of leakage of hydraulic fluid, fuel and oil from vehicles used in construction.

The impacts have a significance of which is deemed to be **medium to high negative**, given the long-term duration, regional extent and high intensity.

Operational Phase:
The following potentially negative impacts on the surface water associated with the operational phase have been identified:

- Possible increase in the regional demand for water from the Nzhelele Dam.

- Potential contaminated storm water run-off from the slag storage stockyard.
- Potential contaminated runoff from the raw stock piles.
- Impact on the aquatic biodiversity and ecology of the river system.

A monitoring program for surface and groundwater quality and levels will be established around the proposed ferrochrome smelter site. A water use or water wastage minimization plan will be implemented. It will include:

- Monitoring surface and groundwater quality and water levels;
- Surface water controls installed and maintained;
- Monitoring the water quality in the surrounding water resources;
- Implementing a water use or water wastage minimization plan.

Water Resources

Proposed ferrochrome smelter infrastructure development requires large earth moving and operational activities to take place resulting in the removal of the vegetation cover. With the vegetation cover removed increased risk for erosion is likely to occur contributing towards sediment load transported to the receiving water environment.

Water Quality

Several activities during the operational phase could contribute towards water quality deterioration. These impacts stem from contaminated runoff from the ferrochrome smelter footprint – including raw materials and slag stockyard. In the event that pollution control facilities fail to contain poor quality water, spillages to the environment will cause negative impacts on the water quality and aquatic ecology of the area. The impact will be significant and long-term and will extend beyond the boundaries of the project area. With the implementation of mitigation measures the impact could be rated low to moderate.

Storm Water Impacts

The management of storm water runoff is required to avoid spillage of contaminated water, reuse and recycling water and storm water wherever possible, treatment of water for reuse or discharge, and as a last resort, discharging storm water in compliance with Department of Water and Sanitation limits. The smelter development and hardened surfaces on the site will lead to an increase in runoff. Some of this runoff may be contaminated with oils or grease, or chemicals used on the ferrochrome smelter site.

Decommissioning and Closure Phase:

Drainage characteristics over the proposed ferrochrome smelter site will be altered permanently due to the surface infrastructure to be constructed over the smelter site area. These will however not alter the overall catchment drainage patterns. Once rehabilitated, surface erosion and sediment transfer from the smelter site will be significantly reduced and revert to existing erosion or sediment transfer patterns to pre-smelter conditions. Impacts on the surrounding regional rivers will therefore discontinue.

The entire smelter site is on flat to undulating ground, and will have a significant area disturbed that will require to be scarified and re-vegetated to prevent soil erosion.

Indirect on-going impacts associated with an above ground raw material and slag stockpile area on the aquatic ecological environment include the impacts of dust blown from the stockpiles increasing sediment levels of aquatic systems, resulting in loss of habitat due to smothering, increased turbidity, decreased photosynthesis and physiological stress on organisms. The impact at the site would have a low intensity and long-term duration. Accordingly, a low to medium negative significance impact on surface water is anticipated.

17.4.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	High	**5**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High ve**			**68**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
68				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**54.4**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**68**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
68				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**54.4**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	Medium	**3**	Long - Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**45**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
45				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**36**
NO-Go OPTION:							
If the ferrochrome smelter project does not proceed, the existing impacts from agriculture, surrounding mining operation (including the existing Syferfontein Mine) and farming homesteads will continue on the surface water resources of the area.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	

Ferrochrome Smelter Footprint/Region	**3**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**30**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
30				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**24**
CUMMULATIVE IMPACTS:							
In addition to the existing mining operations and agricultural activities, the ferrochrome smelter project will also use water for its operations. However, the smelter will rely on underground water for such operational activities. There will be no surface water extraction that may impact on the catchment yield. Additional alternative sources of water will have to be explored for the larger MMSEZ concept. With surface water assessments the impacts are not specific to the site, instead take into account all downstream surface water resources. Containment of dirty water within the smelter footprint will ensure that the impact is reduced.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	High	**5**	Long - Term	4	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High**			**68**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
68				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**54.4**

17.5 Groundwater Assessment

17.5.1 Methodology Used

Existing data and previous reports (both geological, geotechnical and hydrogeological) were gathered, collated, and assessed to provide input for the numerical flow and transport model. This comprehensive review ensured that relevant historical and current information was integrated into the model for accuracy and reliability.

A hydrocensus and site visit investigation was conducted to collect data from the study area and surrounding environments and to facilitate site familiarization. This investigation included a comprehensive census of boreholes, with water level measurements and the sampling of six boreholes. Samples were submitted to a SANAS accredited laboratory for full SANS241:2015 analysis excluding certain microbiological analysis. Additionally, other groundwater-related information was investigated to provide a thorough understanding of the local hydrogeological conditions.

Modelling was performed as a representation of a groundwater flow system and/or geochemical system that attempts to mimic the natural processes. It is therefore a simplified version of the natural system, compiled with geological, hydrogeological, hydrological and meteorological data, which utilises governing equations to incorporate all this data and simulates the hydraulic properties or geochemical properties of the system.

These models were utilised to provide a quantitative understanding of a groundwater system in terms of existing conditions as well as induced stresses, which inherently aids in the identification of cost-effective and efficient solutions to groundwater contamination and management challenges.

Numerical groundwater modelling is the most reliable method of anticipating and quantifying the potential impacts on the groundwater regime. The finite difference numerical model was created using the Groundwater Modelling System (GMS) Version 10.8 graphical user interface for the well-established Modflow and MT3DMS numerical codes.

17.5.2 Description of Issues and Risks

According to the 1:500 000 General Hydrogeological Map the rocks underlying the site typically act as secondary aquifers (intergranular and fractured rock aquifers). However, the multi-layered weathering system present on these rocks could prove to have up to two aquifer systems present in the form of a shallow, saprolitic aquifer with a weathered, intergranular soft rock base associated with the contact of fresh bedrock and the weathering zone; and an intergranular and fractured bedrock aquifer.
The main source of recharge into the shallow aquifer is rainfall that infiltrates the aquifer through the unsaturated (vadose) zone. Vertical movement of water is faster than lateral movement in this system as water moves predominantly under the influence of gravity. The predominant groundwater flow direction is westwards. The water levels ranged between 17.34 mbgl and 33.42 mbgl with an average of 25.95 mbgl.

The groundwater quality at the site exceeds several guideline limits for drinking, domestic and industrial applications. The water is can therefore generally be classified as having poor-quality and can be considered brackish, with elevated concentrations of dissolved salts.

Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a “Sole Aquifer System”, based on the fact that the local population is dependent on groundwater.

The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as medium at 34%.

Construction and Operational Phases:

Water Quantity

The primary anticipated effect on the groundwater system is the dewatering of the surrounding aquifer, which may result in a lowering of the local water table. The construction and operational phases were both assumed to have a similar impact on groundwater quantity, primarily due to the relatively low yield of the production boreholes in comparison to the estimated water demand during operation. It is assumed that groundwater abstraction will occur continuously from the construction phase through to the operational phase, at rates recommended by Matukane and Associates (PTY) Ltd – approximately 18 l/s maximum.

The model was used to simulate drawdown from the existing groundwater levels at the site. The spatial extent of the predicted drawdown is illustrated in Figure 72, while Table 69 presents the corresponding declines in water levels at affected boreholes. Alternative sources of water supply are being explored including Nzhelele Dam, and/or development of a dam in Musina and transfer to MMSEZ Southern Site through pipeline.

The highest drawdown, exceeding 9 metres, is expected to remain confined within the site boundaries. Beyond the site, a broader area of influence is anticipated, extending northward, where water levels are projected to decline by approximately 4 to 9 metres. A number of boreholes that is used for domestic and livestock watering purposes will be affected.

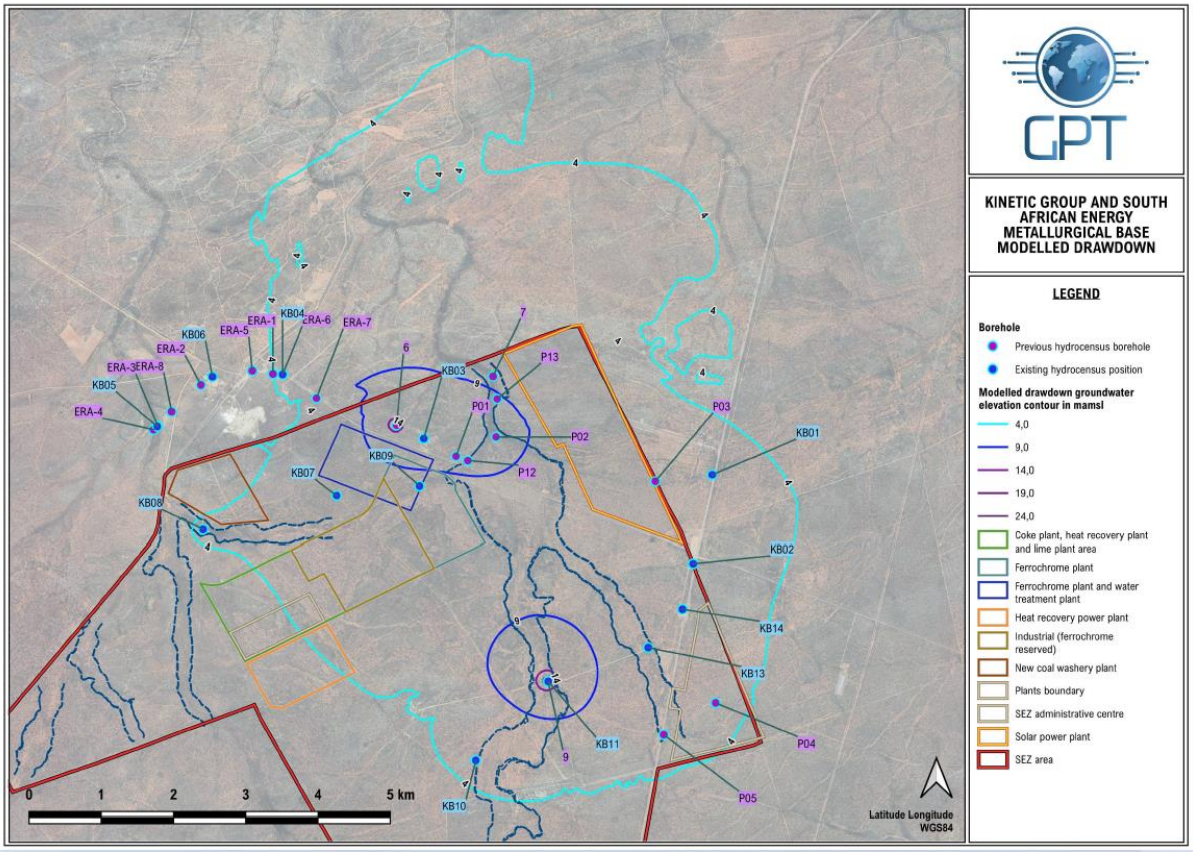


Figure 72: Modelled Borehole Drawdown

Table 69: Predicted Drawdown at Affected Boreholes

BH	Drawdown (m)
Mopane Game Safaris	6.4
ERA-1	4
KB04	4.4
ERA-7	7
KB03	10.6
KB07	6
KB09	8.4
7	8.6
P13	9.3
P02	12.6
P01	9.5
P12	9.4
P03	6
KB01	5
KB02	5.9
KB14	6.1
KB13	6.9
P04	4.9
P05	5.5
KB10	4.8

Water Quality

Groundwater quality is typically a primary consideration in hydrogeological assessments. However, as detailed in the Conceptual Site Model (CSM), the risk of contamination to the aquifer at this site is considered negligible due to the presence of a thick vadose zone, low recharge potential, and engineered control measures such as hardstanding areas and wastewater management systems. As such, no significant impact on the underlying aquifer is anticipated under normal operating conditions.

Nevertheless, it remains essential to maintain stringent preventative measures during both the construction and operational phases. While the risk of contaminant migration to groundwater is low, accidental spills, leaks, or poor handling of raw materials and waste must be prevented. All dirty water and process-related waste must be captured and in a dedicated wastewater management system, and regular inspections should be conducted to detect and rectify any potential leaks or containment failures.

Once operations commence, a waste classification study should be conducted to re-evaluate the potential risks associated with contaminant impacts. This assessment should include an estimation of waste volumes, potential leachate generation, and leaching characteristics to ensure that appropriate management and mitigation measures are in place.

Decommissioning Phase:

When abstraction activities from the boreholes cease, the estimated recovery period for groundwater levels to return to baseline conditions is approximately 34 years, based on a worst-case scenario. This recovery timeframe is influenced by several factors, with rainfall and natural recharge being the most significant.

During the decommissioning phase, all infrastructure, including hardstanding's, process areas, stockpile zones, and associated wastewater management systems, must be properly dismantled, cleaned, and managed to prevent any potential contamination of soil and groundwater. Residual materials, waste, and chemicals must be safely removed or disposed of in accordance with environmental regulations, and the site should be rehabilitated to ensure long-term protection of water quality.

17.5.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	Medium	**3**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**60**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
60				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**48**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**68**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
68				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**54.4**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**56**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
56				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**44.8**
NO-Go OPTION:							
If the ferrochrome smelter project does not proceed, the existing impacts from agriculture, surrounding mining operation (including the existing Syferfontein							

Mine) and farming homesteads will continue on the groundwater water resources of the area.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Site	**2**	Medium	**3**	Long-Term	**3**	Definite	**5**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium**			**39**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
39				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**31.2**
CUMMULATIVE IMPACTS:							
In addition to the existing mining operations and agricultural activities, the ferrochrome smelter project will also use water for its operations. However, the smelter will rely on underground water for such operational activities. There will be no surface water extraction that may impact on the catchment yield. Additional alternative sources of water will have to be explored for the larger MMSEZ concept. Containment of dirty water within the smelter footprint will ensure that the impact is reduced.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	High	**5**	Long-Term	**5**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High**			**72**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
72				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**57.6**

17.6 Air Quality Assessment

17.6.1 Methodology Used

In the evaluation of air emissions and ambient air quality impacts reference is made to National Ambient Air Quality Standards (NAAQS). These standards apply only to a number of common air pollutants, collectively known as criteria pollutants. Criteria pollutants include SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$, benzene, ozone and lead. Particulates, SO_2 and NO_2 represent the main pollutants of concern in the assessment of operations from the project. For the current assessment, the impacts were assessed against published NAAQS and National Dust Control Regulations (NDCR).

The baseline study encompassed the analysis of air quality sensitive receptors, atmospheric dispersion potential and ambient air quality within the study area. Air quality sensitive receptors were identified from available satellite imagery. The dispersion potential was assessed by means of modelled Weather Research and Forecasting (WRF) model meteorological data for the period 2022 to 2024.

No on-site ambient air quality and dust fallout monitoring is currently conducted. A qualitative description of existing sources of ambient air pollution is therefore

provided, and reference made to publicly available ambient air quality monitoring data from the Thohoyandou monitoring station.

The establishment of a comprehensive emissions inventory forms the basis for the assessment of the impacts of the project's emissions on the receiving environment. The establishment of an emissions inventory comprises the identification of sources of emission, and the quantification of each source's contribution to ambient air pollution concentrations.

The main source of process emissions at the Kinetic Project will be the electric arc furnaces. Emissions from the furnaces are captured, treated and released to the atmosphere through an elevated stack. Sources of fugitive emissions, but which have dedicated extraction points include dust removal from dry material handling, dust removal from raw material batching and taphole fume extraction and charging dust removal. Other sources of fugitive emissions, mostly particulate emissions, include transporting and handling of raw materials and ferrochromium alloy products, handling and deposition of slag and crushing of ferrochromium alloy product.

In the quantification of point source emissions, which include emissions from the furnaces and the dedicated dust extraction points, use was made of the design specifications for the plant and the Subcategory 4.9: Ferroalloy Production Minimum Emission Standards, as published under Section 21 of the National Environmental Management: Air Quality Act (NEM:AQA).

Due to the absence of locally generated emission factors, use was made of the comprehensive set of emission factors published by the US Environmental Protection Agency (US-EPA) in its AP-42 document Compilation of Air Pollution Emission. The US-EPA AP-42 emission factors are of the most widely used in the field of air pollution.

This study was considered to meet the requirements of a Level 2 assessment, and the US EPA AERMOD model was selected on the basis that this Gaussian plume model is well suited to simulate dispersion where transport distances are likely to be less than 50 km:

- Level 1: where worst-case air quality impacts are assessed using simpler screening models;
- Level 2: for assessment of air quality impacts as part of license application or amendment processes, where impacts are the greatest within a few kilometres downwind (less than 50 km);
- Level 3: requires more sophisticated dispersion models (and corresponding input data, resources and model operator expertise) in situations.

Identified sensitive receptors in the study area include the small village of Mopane, approximately 2 km to the north-west of the Kinetic Project, as well as an individual homestead to the north of the R525 road, and two homesteads approximately 2 km to the southwest of the Kinetic Project. The closest sensitive receptors to the east of the Kinetic Project are homesteads and lodges close to the N1, approximately 4 km from the Kinetic Project – See Figure 39. All identified sensitive receptors were modelled as discreet receptors.

17.6.2 Description of Issues and Risks

Dispersion modelling was undertaken to determine 99th percentile hourly, 99th percentile daily, and annual average ground level concentrations (GLCs). Averaging periods were selected to facilitate the comparison of predicted pollutant concentrations to relevant ambient air quality and inhalation health criteria.

Pollutants with the potential to result in human health impacts which are assessed in this study include PM_{10}, $PM_{2.5}$, NO_2 and SO_2. Ground level concentration or dustfall isopleths presented in this section depict interpolated values from the concentrations simulated by AERMOD for each of the receptor grid points specified. Simulated daily (Figure 73) and annual (Figure 74) PM10 concentrations as well as simulated daily (Figure 75) and annual (Figure 76) PM2.5 concentrations are in compliance with NAAQS for all areas outside the Kinetic Project boundary, including at all identified sensitive receptor locations.

If all point sources were to be operated at the Subcategory 4.9 MES, simulated hourly NO_2 (Figure 77) and SO_2 (Figure 79) concentrations, as well as daily SO_2 concentrations (Figure 80), may exceed the NAAQS limits outside the boundary of the Kinetic Project, but are in compliance with the NAAQS at all identified sensitive receptors, and for all areas outside the MMSEZ. However, given the nature of the majority of point sources at the Kinetic Project, which serve as dust and fume extraction, rather than the point of release of process or combustion emissions, it is unlikely that actual NO_2 and SO_2 emissions from point sources at the Kinetic Project would be as high as the Subcategory 4.9 MES allows, and ground-level impacts of these pollutants are expected to be significantly lower than those simulated.

Annual average NO_2 (Figure 81) and SO_2 (Figure 82) concentrations, even with all point sources operating at the Subcategory 4.9 MES, are below the NAAQS for these pollutants for all areas outside the Kinetic Project boundary, including at all identified sensitive receptor locations.

Simulated dust fallout rates are expected to be well below the NDCR residential and non-residential limit for all areas outside the project boundary (Figure 81).

Making conservative assumptions the baseline dust concentrations are generally moderate with the 24 hour TSP (total suspended particles) average over the entire area of about 100 mg/m^2/day. The typical ambient dust levels around rural areas ranges between 50 – 100 mg/m^2/day TSP depending on daily wind speed and direction, and movement of vehicles. It is estimated that the said vehicle movements increase the dust levels to approximately 100 - 200 mg/m^2/day during day time on unpaved roads. Occasional blasting from the adjacent opencast mine may also increase the dust levels. This is, however, well within the maximum allowable guidelines set by SANS 1929:2005 for both residential and industrial areas, which are as follows:

Residential = D < 600 mg/m^2/day – over 30 day average
Industrial = 600 < D < 1200 mg/m^2/day - over 30 day average

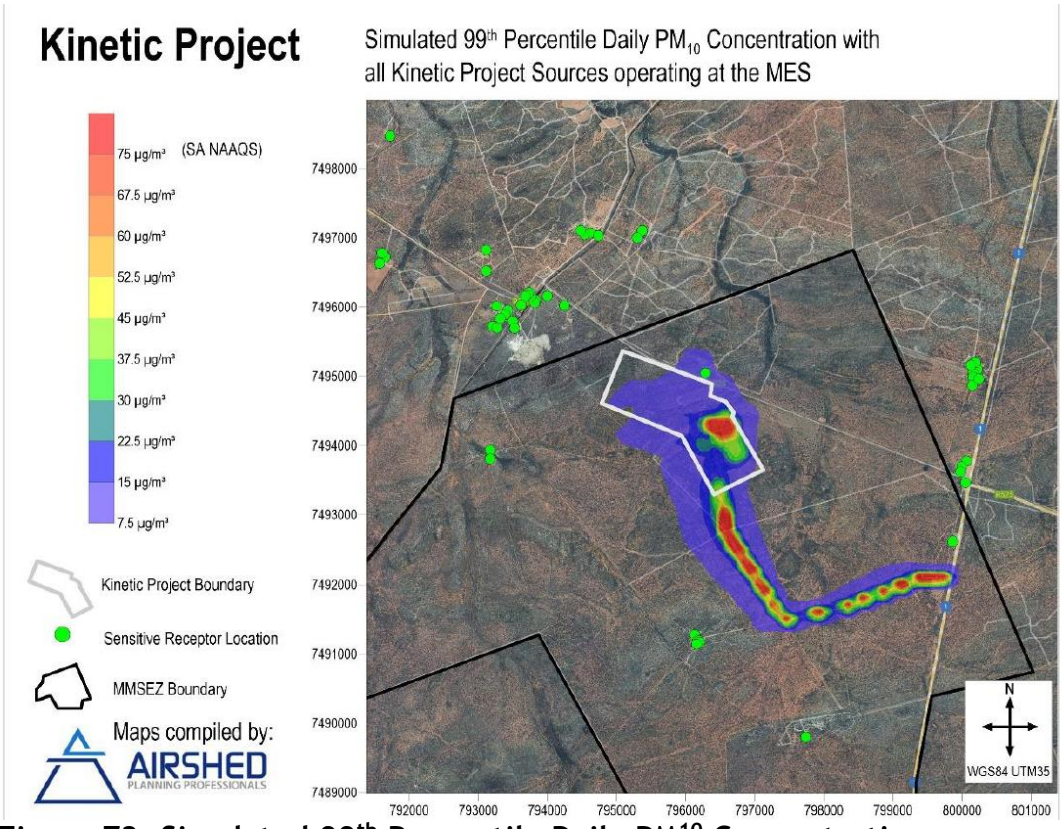


Figure 73: Simulated 99th Percentile Daily PM10 Concentration

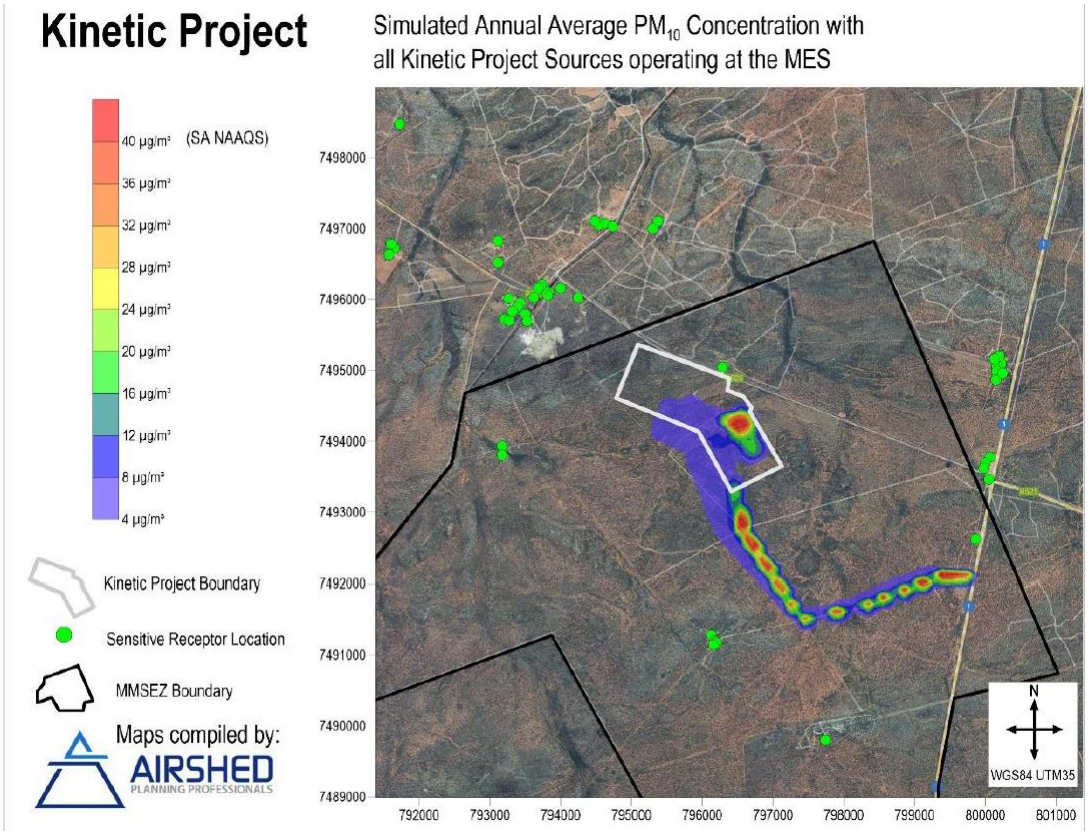


Figure 74: Simulated Annual Average PM_{10} Concentration

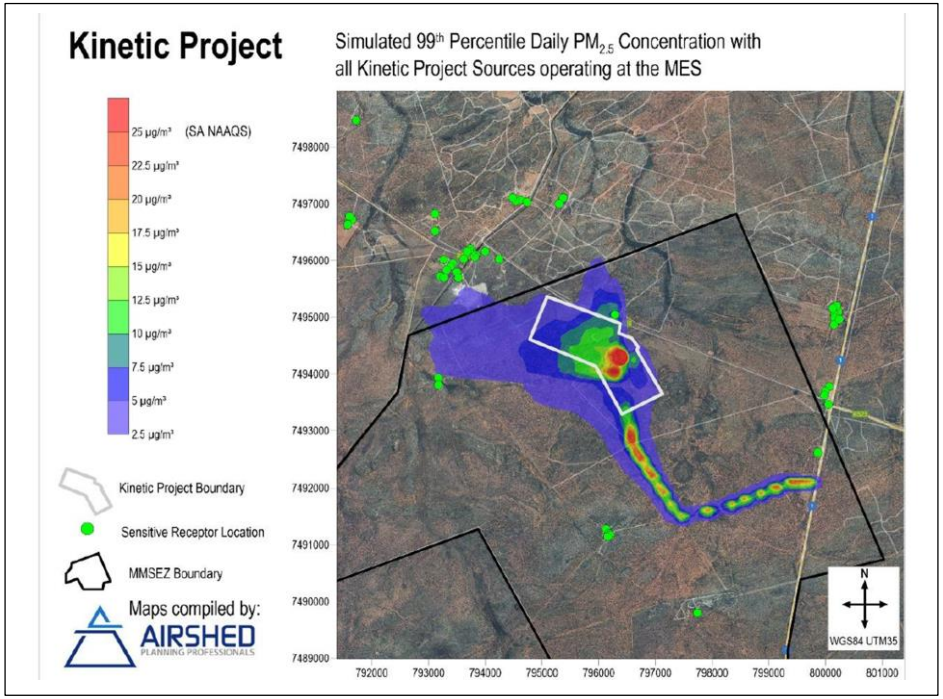


Figure 75: Simulated 99th Percentile Daily $PM_{2.5}$ Concentration

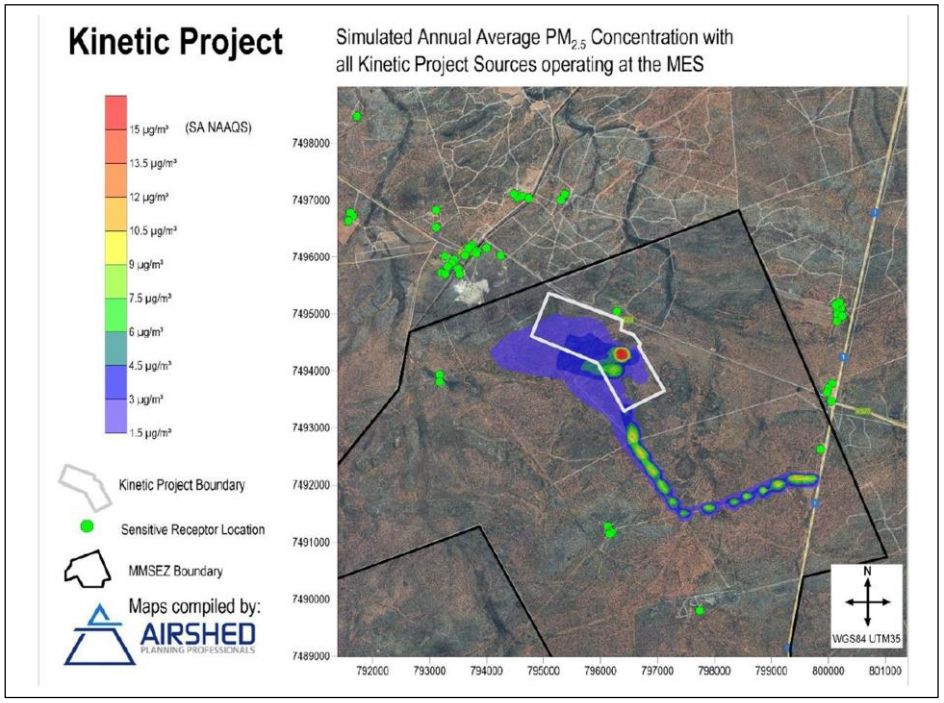


Figure 76: Simulated Annual Average $PM_{2.5}$ Concentration

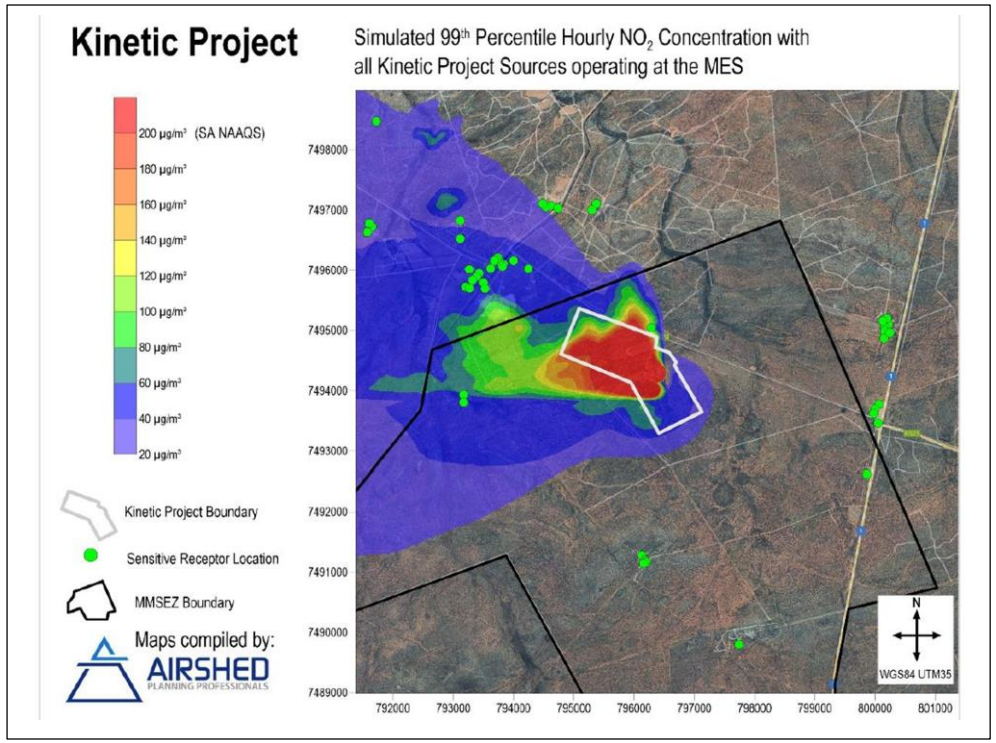


Figure 77: Simulated 99th Percentile Hourly NO_2 Concentration

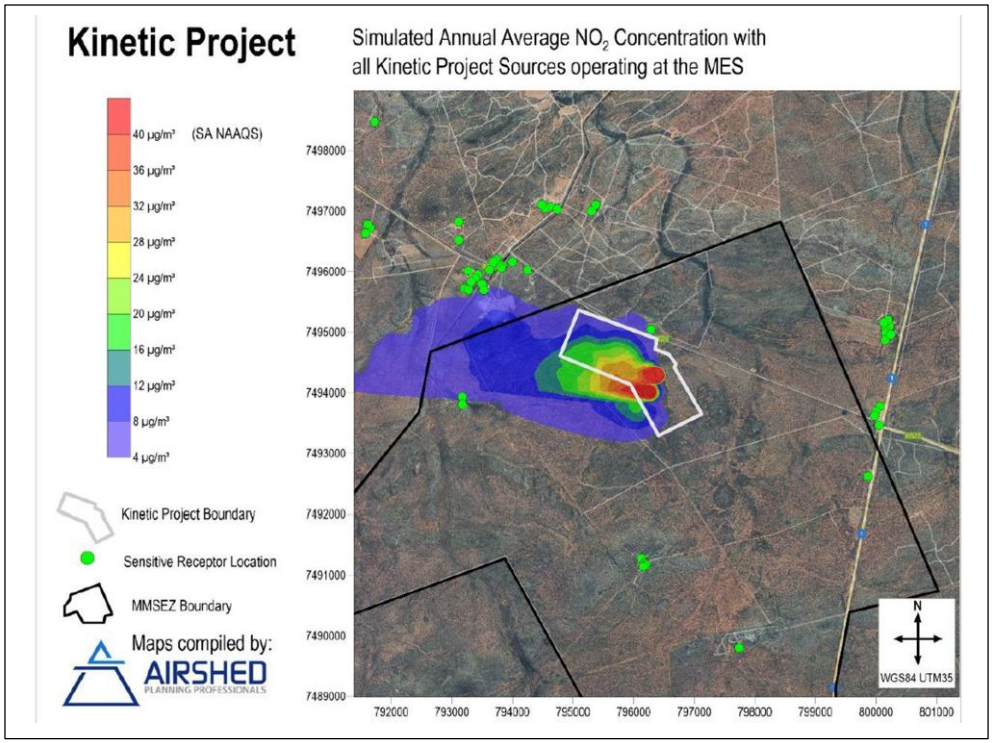


Figure 78: Simulated Annual Average NO_2 Concentration

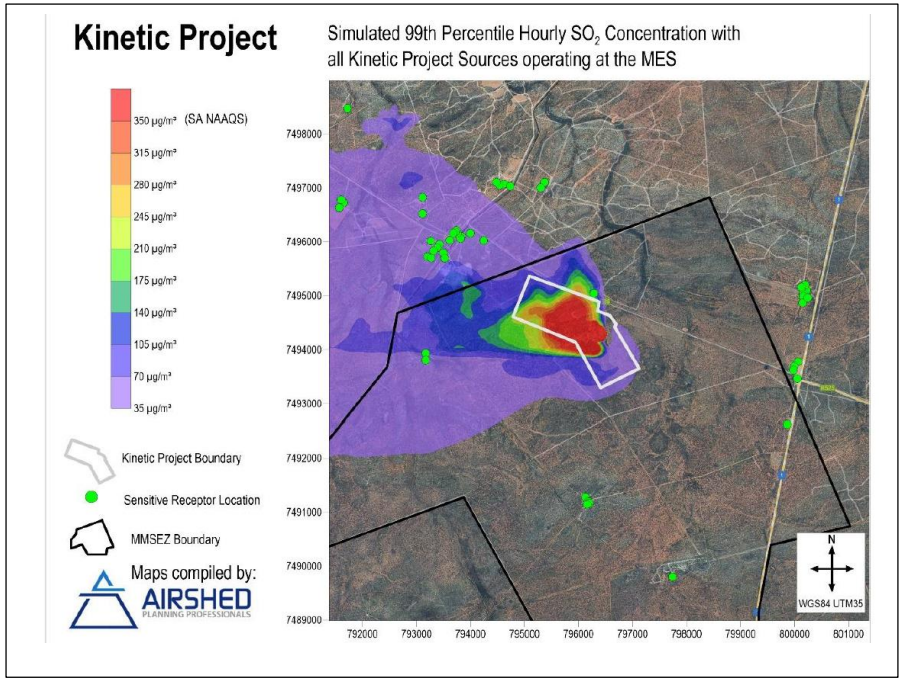


Figure 79: Simulated 99th Percentile Hourly SO_2 Concentration

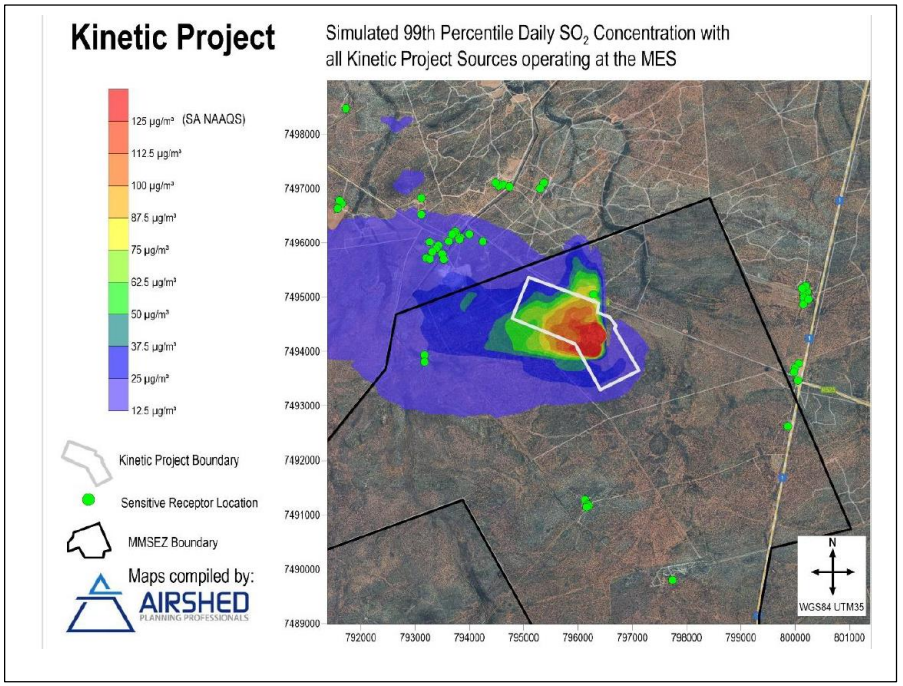


Figure 80: Simulated 99th Percentile Daily SO_2 Concentration

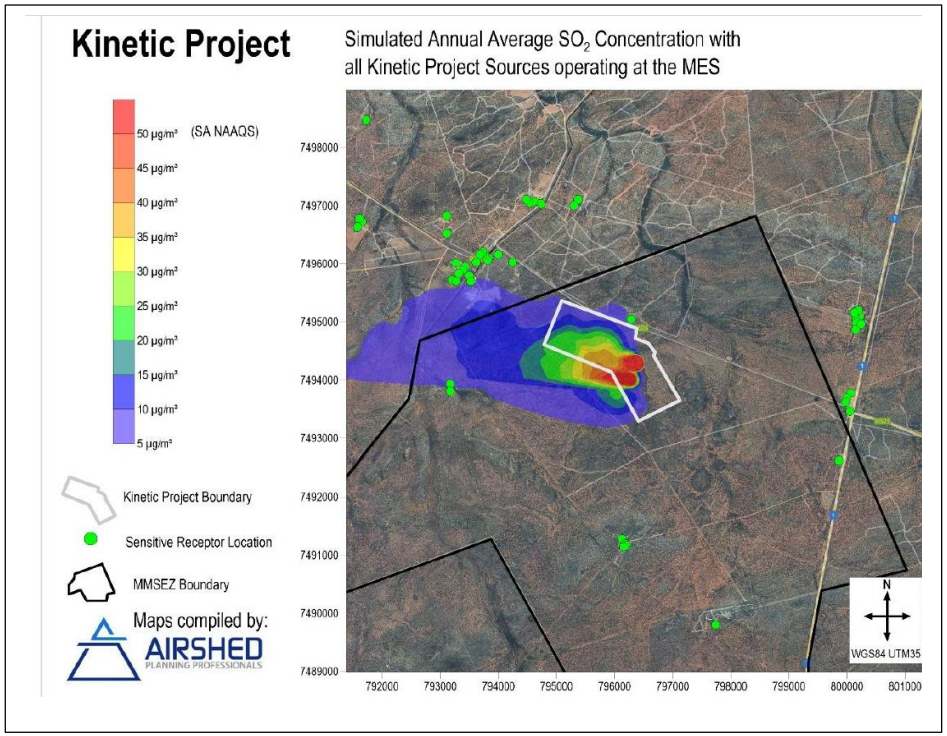


Figure 81: Simulated Annual Average SO_2 Concentration

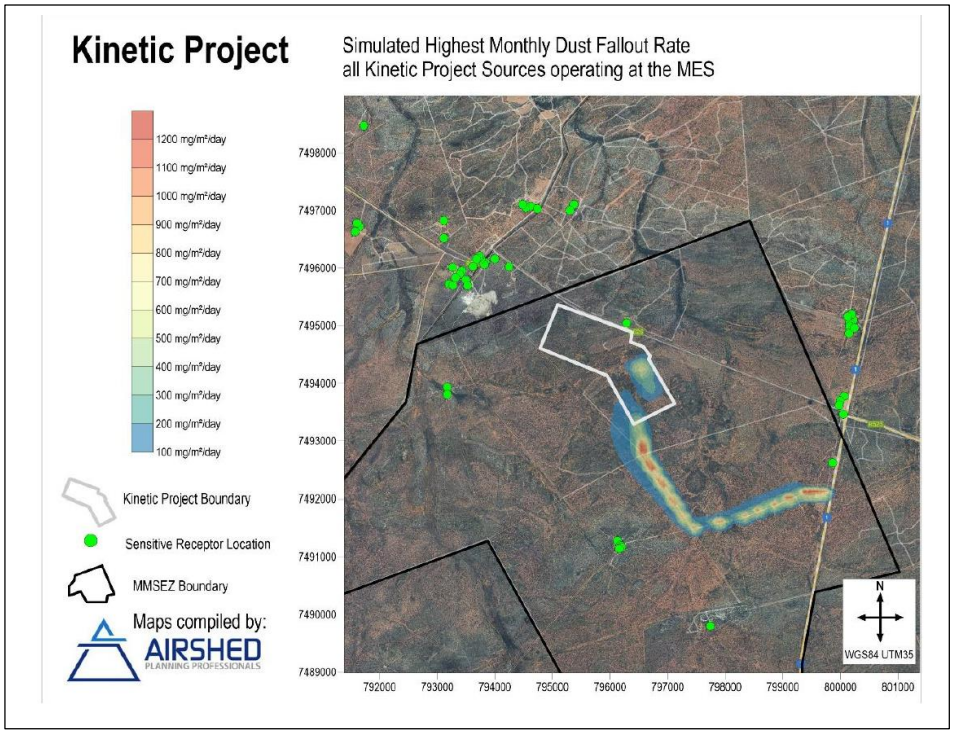


Figure 82: Simulated Highest Monthly Dust Fallout Rate

17.6.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**1**	Medium	**3**	Medium - Term	**2**	Definite	**5**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**33**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
33				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**19.8**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**High -ve**			**80**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
20				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**48**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Medium-Term	**3**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**36**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
36				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**21.6**
NO-Go OPTION:							
The current ambient dust levels around the area of between 100 – 200 mg/m^2/day TSP depending on daily wind speed and direction, movement of vehicles, farming and mining activities will remain.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**33**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
33				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**19.8**
CUMMULATIVE IMPACTS:							
The proposed ferrochrome smelter will add to pollutants with the potential to result in human health impacts - including PM_{10}, PM2.5, NO_2 and SO_2. However,							

PM_{10} concentrations as well as simulated daily and annual $PM_{2.5}$ concentrations are in compliance with NAAQS for all areas outside the Kinetic Project boundary, including at all identified sensitive receptor locations. The nature of the majority of point sources at the Kinetic Project, which serve as dust and fume extraction, rather than the point of release of process or combustion emissions, it is unlikely that actual NO_2 and SO_2 emissions from point sources at the Kinetic Project would be as high as the Subcategory 4.9 MES allows, and ground-level impacts of these pollutants are expected to be significantly lower than those simulated. The possible development of other potential industrial and commercial activities within the MMSEZ are likely to add to the above air quality impacts.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**2**	High	**5**	Long - Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**High -ve**			**80**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
80				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**48**

17.7 Noise

17.7.1 Methodology Used

Ambient sound levels were previously measured during 4 – 5 July 2013, 23 – 25 January 2018 as well as 7 – 8 March 2019, with the measurements including long-term semi-continuous as well as a number of short-term readings. These measurements which were done for the larger MMSEZ project, with the sound levels summarized in Figure 35. These measurements resulted in more than 500 daytime as well as 288 night-time measurements.

Considering the ambient sound levels measured onsite, as well as the developmental character of the area, the acceptable zone rating level would be typical of a **rural area** (35 dBA at night and 45 dBA during the day) as defined in SANS 10103:2008 for most of the area. Rating levels will be higher in an area up to 500m from the N1, mainly due to traffic noises from the national road. The rating levels would also be higher in the town of Mopane, due to the activities of the existing Syferfontein Dolomite quarry.

The project site was assessed in terms of the Noise Sensitivity Theme using the online Environmental Screening Tool. Potential noise-sensitive areas with a “very high” sensitivity were obtained from the online screening tool using the Utilities Infrastructure => Electricity => Generation => Renewable => Wind category, with the potential noise-sensitive areas illustrated on Figure 36.

The Noise Specialist Study has been undertaken in accordance with the requirements of GNR320 as part of the EIA.

An assessment of the site was done using available aerial images (GoogleEarth®) to identify potential dwellings that could be considered to be noise-sensitive receptors (NSR), supported by information gained during site visits in 4 – 5 July 2013, 23 – 25 January 2018 as well as 7 – 8 March 2019.

17.7.2 Description of Issues and Risks

Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person[18]. One can generalise by saying that sound becomes unwanted when it:

- Hinders speech communication;
- Impedes the thinking process;
- Interferes with concentration;
- Obstructs activities (work, leisure and sleeping); and
- Presents a health risk due to hearing damage.

However, it is important to remember that whether a given sound is "noise" depends on the listener or hearer. The driver playing loud rock music on their car radio hears only music, but the person in the traffic behind them hears nothing but noise.

Response to noise is unfortunately not an empirical absolute, as it is seen as a multi-faceted psychological concept, including behavioural and evaluative aspects. For instance, in some cases, annoyance is seen as an outcome of disturbances, and in other cases it is seen as an indication of the degree of helplessness with respect to the noise source.

Noise does not need to be loud to be considered “disturbing”. One can refer to a dripping tap in the quiet of the night, or the irritating “thump-thump” of the music from a neighbouring house at night when one would prefer to sleep.
Severity of the annoyance depends on factors such as:

- Background sound levels and the background sound levels the receptor is used to;
- The manner in which the receptor can control the noise (helplessness);
- The time, unpredictability, frequency distribution, duration, and intensity of the noise;
- The physiological state of the receptor; and
- The attitude of the receptor about the emitter (noise source).

SANS 10103:2008 also provides a guideline for estimating community response to an increase in the general ambient noise level caused by an intruding noise. If Δ is the increase in sound level, the following criteria are of relevance:

- Δ ≤ 3 dBA: An increase of 3 dBA or less will not cause any response from a community. It should be noted that for a person with average hearing acuity

[18] World Health Organization, 1999; Noise quest, 2010; Journal of Acoustical Society of America, 2009

an increase of less than 3 dBA in the general ambient noise level would not be noticeable.

- $3 < \Delta \leq 5$ dBA: An increase of between 3 dBA and 5 dBA will elicit 'little' community response with 'sporadic complaints'. People will just be able to notice a change in the sound character in the area.
- $5 < \Delta \leq 15$ dBA: An increase of between 5 dBA and 15 dBA will elicit a 'medium' community response with 'widespread complaints'. In addition, an increase of 10 dBA is subjectively perceived as a doubling in the loudness of a noise. For an increase of more than 15 dBA the community reaction will be 'strong' with 'threats of community action'.

Construction Phase:

A conceptual construction scenario will be investigated, considering the noise-generating activities as depicted in Figure 83. Only the daytime scenario will be investigated, as night-time construction activities are unlikely to take place. The potential noise contours for the conceptual operational scenario are illustrated in:

- Figure 84, with the noise levels (as well as the potential significance of the noise impact) at the identified NSR; and
- Figure 85, with the noise levels (as well as the potential significance of the noise impact) at the identified NSR. It is assumed that night-time activities will be similar and at the same intensity as daytime activities, though, it is likely that, if night-time activities take place, it will be less than typical daytime activities.

Operational Phase:

The scenario considered the conceptual noise-generating activities depicted in Figure 86. The potential noise contours for the conceptual operational scenario are illustrated in:

- Figure 87 from 45 dBA upwards for the conceptual daytime operational activities. The noise levels (as well as the potential significance of the noise impact) at the identified NSR.
- Figure 88 from 35 dBA upwards for the conceptual night-time operational activities. The noise levels (as well as the potential significance of the noise impact) at the identified NSR for a worst-case scenario (assuming all noise sources are active). It is possible to reduce noise levels further with the recommended mitigation measures.

Decommissioning and Closure Phase:

The potential for a noise impact to occur during the decommissioning and closure phase will be much lower than that of the operational phases and noise from these phases will not be investigated further.

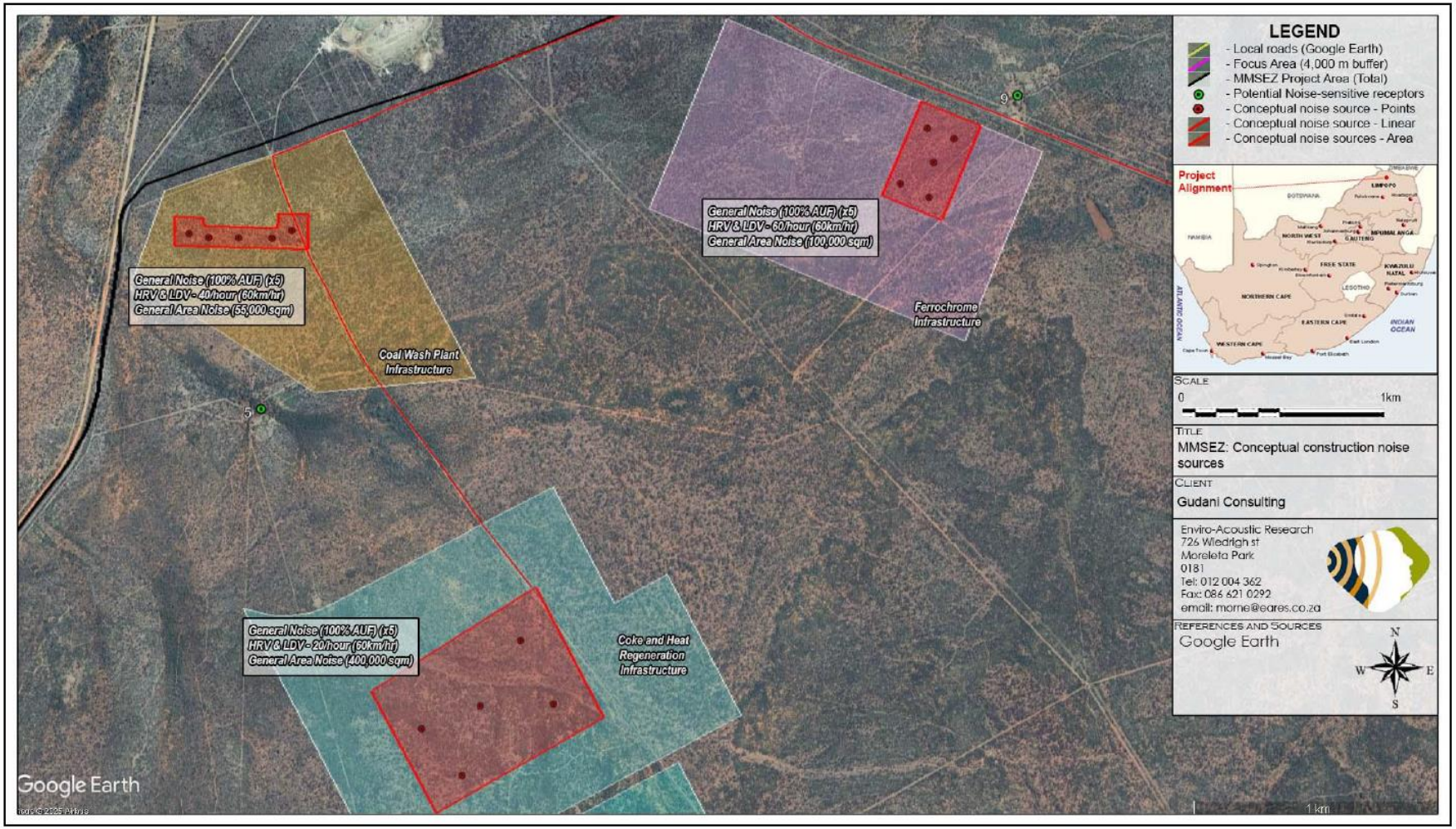


Figure 83: Conceptual Construction Noise Sources

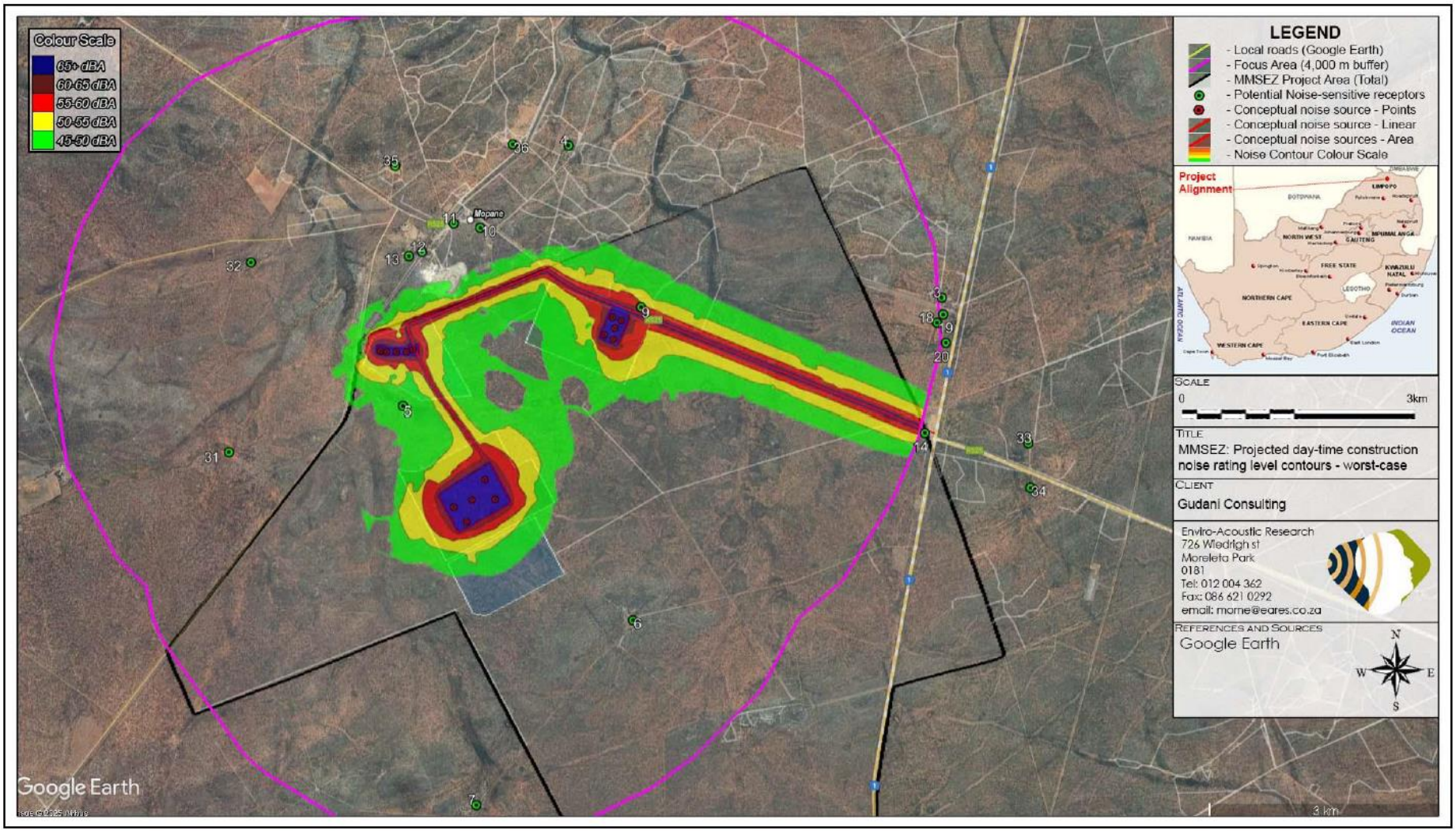


Figure 84: Projected Conceptual Daytime Construction Noise Level Contours

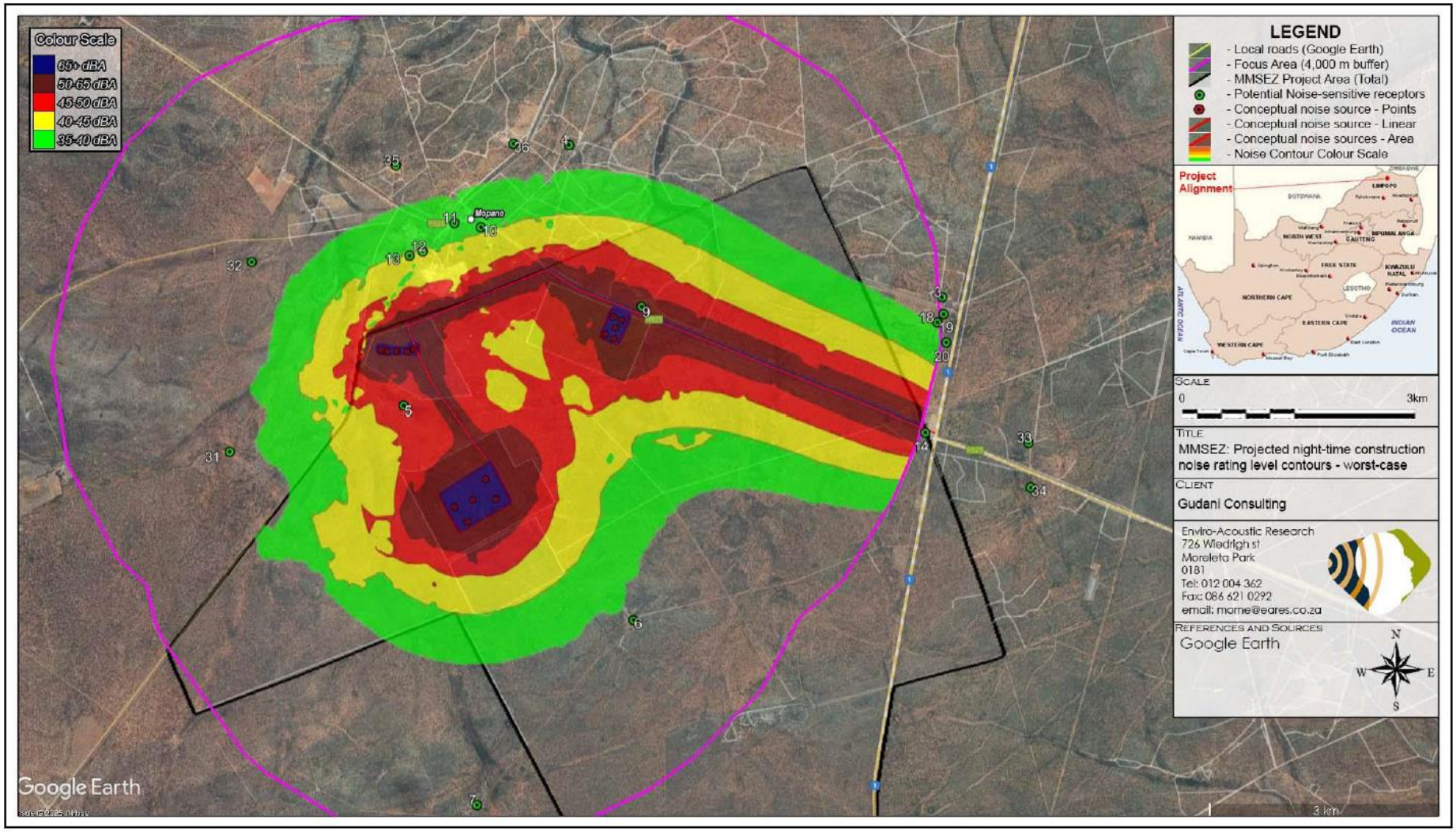


Figure 85: Projected Conceptual Night-Time Construction Noise Level Contours

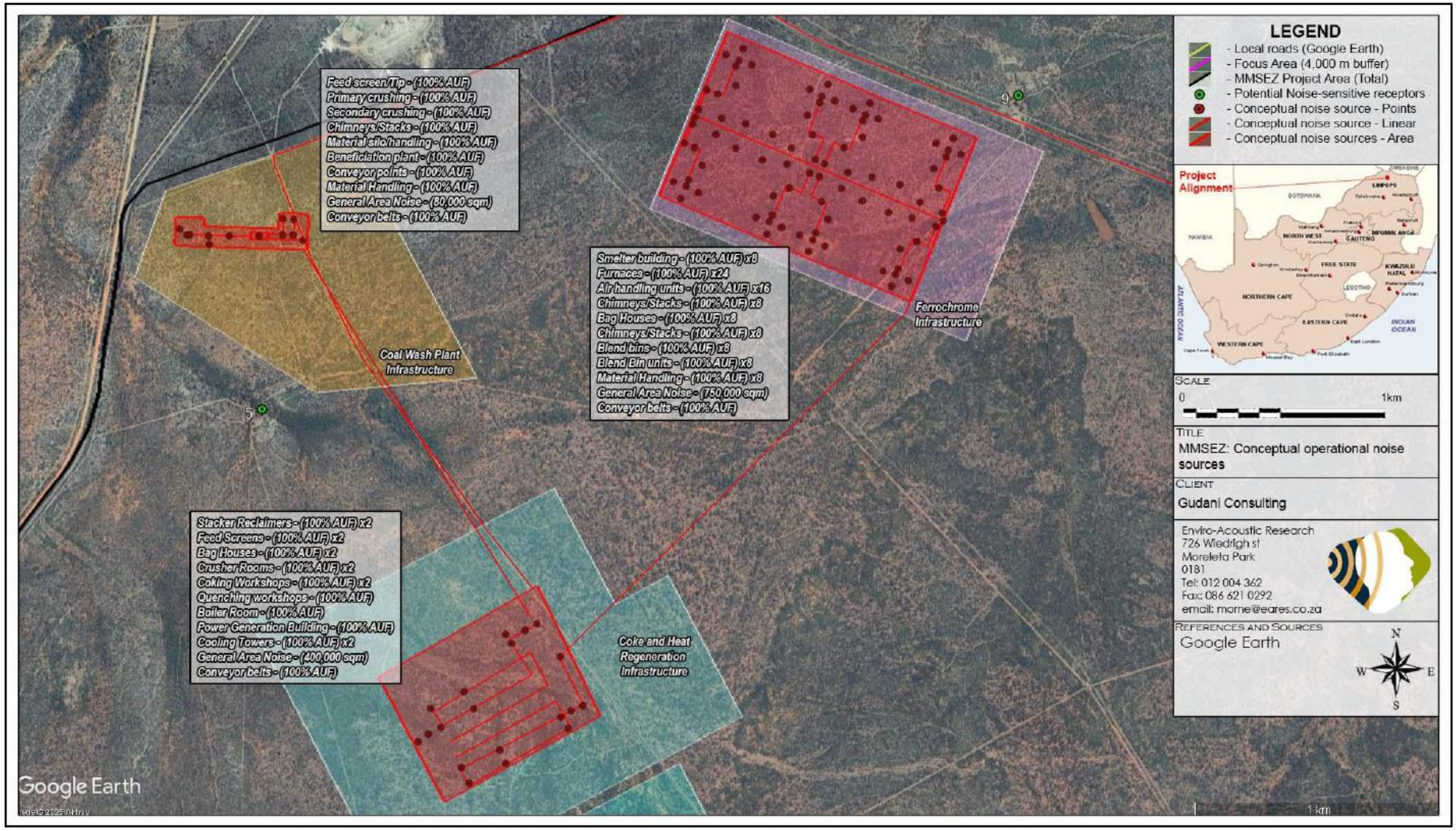


Figure 86: Conceptual Operational Noise Sources

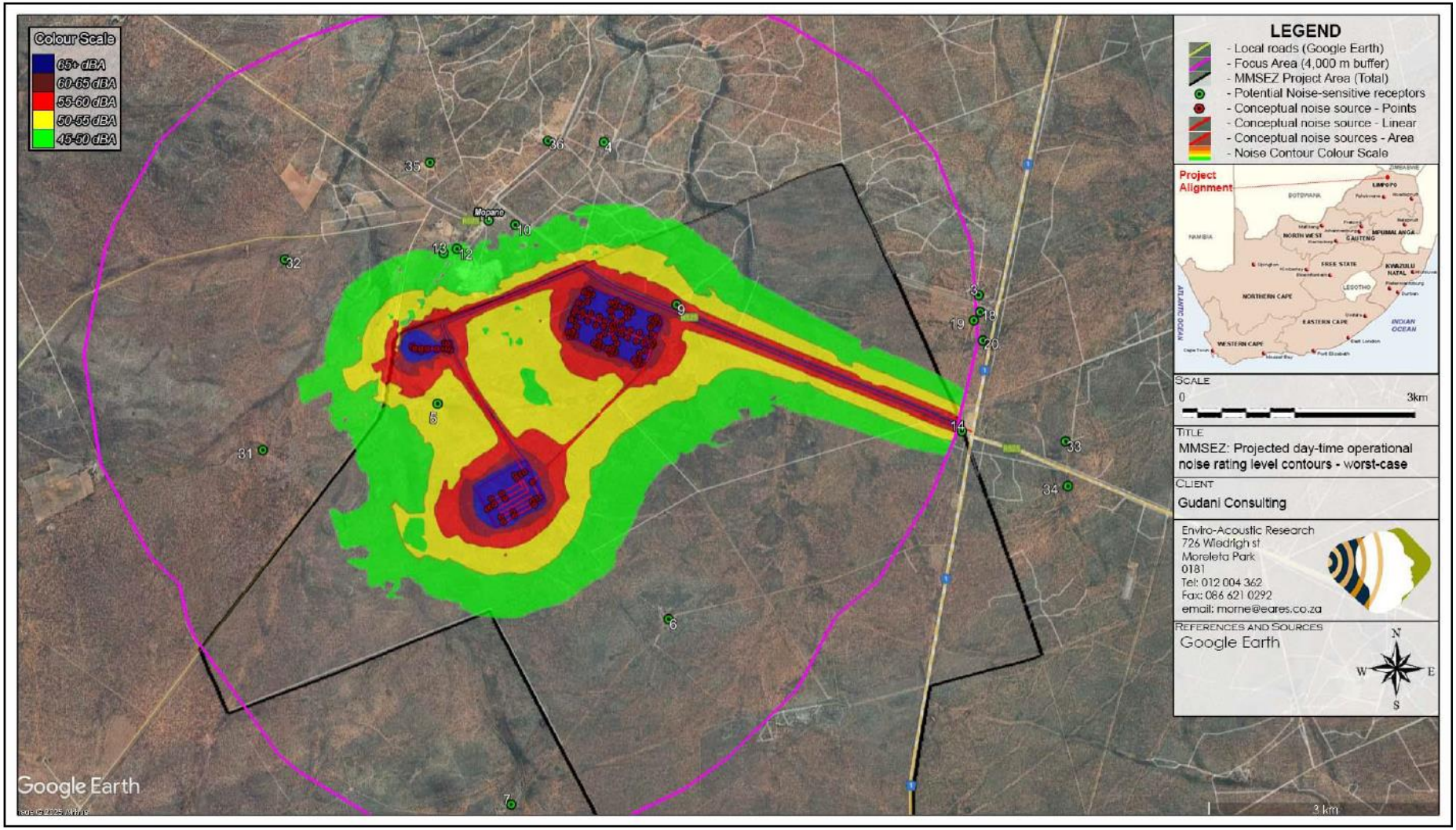


Figure 87: Projected Conceptual Daytime Operational Noise Level Contours

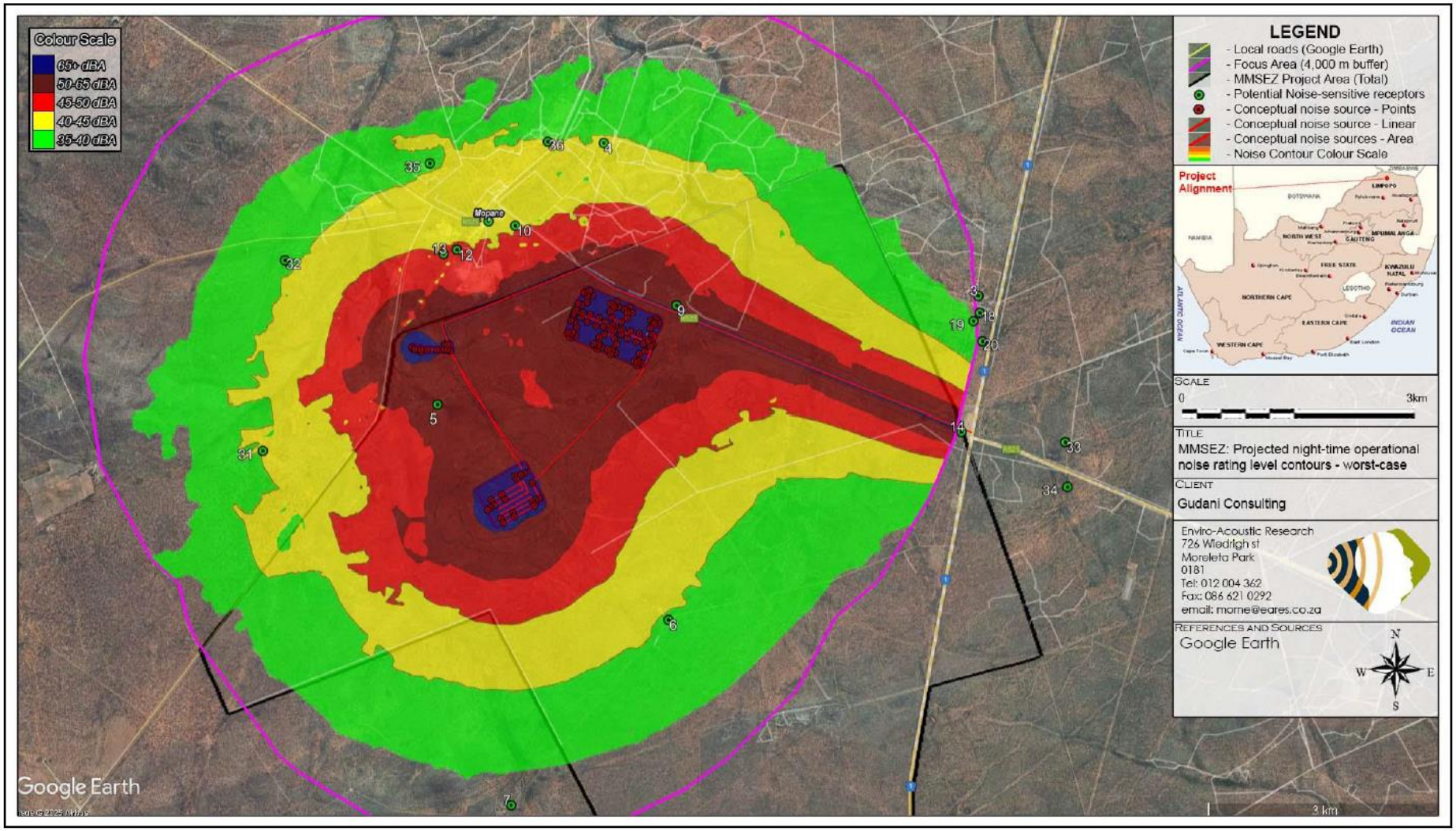


Figure 88: Projected Conceptual Night-time Operational Noise Rating Level Contours

17.7.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Medium-Term	**3**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**36**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
36				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**28.8**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High - ve**			**64**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
64				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**51.2**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**27**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
27				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**21.6**
NO-Go OPTION:							
If the proposed ferrochrome smelter development and operations does not proceed, the existing noise generated from N1 highway and R525 road and surrounding mining and farming activities will remain.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Long-Term	4	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**30**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
30				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low -ve**			**18**
CUMMULATIVE IMPACTS:							

The proposed ferrochrome smelter will add to the existing noise levels in the area. In addition any other industrial and commercial development within the MMSEZ area will also increase the noise levels.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**2**	High	**5**	Long - Term	4	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**60**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
60				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**36**

17.8 Climate Change

17.8.1 Methodology Used

The assessment has been undertaken in accordance with the principles of:

- ISO 14064-1:2006 Greenhouse gases – Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
- Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (GHG Protocol) (World Business Council for Sustainable Development and World Resources Institute, 2015).
- IPCC Fifth Assessment Report (2014).

These guidelines are considered representative of good practice GHG accounting internationally and are applicable to the project.

The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (WRI & WBCSD, 2004), provides two approaches. This includes the assessment of GHGs based on: (1) the organisational boundaries and (2) operational boundaries. For the calculation of GHG footprint for the project, the operational boundary approach was selected.

The following GHG emissions have been considered:

- Process emissions during project operational activities (scope 1);
- Fuel consumption during project operational activities (scope 1); and,
- Electricity consumption during project operational activities (scope 2)

Scope 1:

Direct GHG emissions occur from sources that are owned or controlled by the company, for example, emissions from combustion in owned or controlled vehicles, etc.; and/or emissions from chemical production in owned or controlled process equipment.

Scope2:
Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

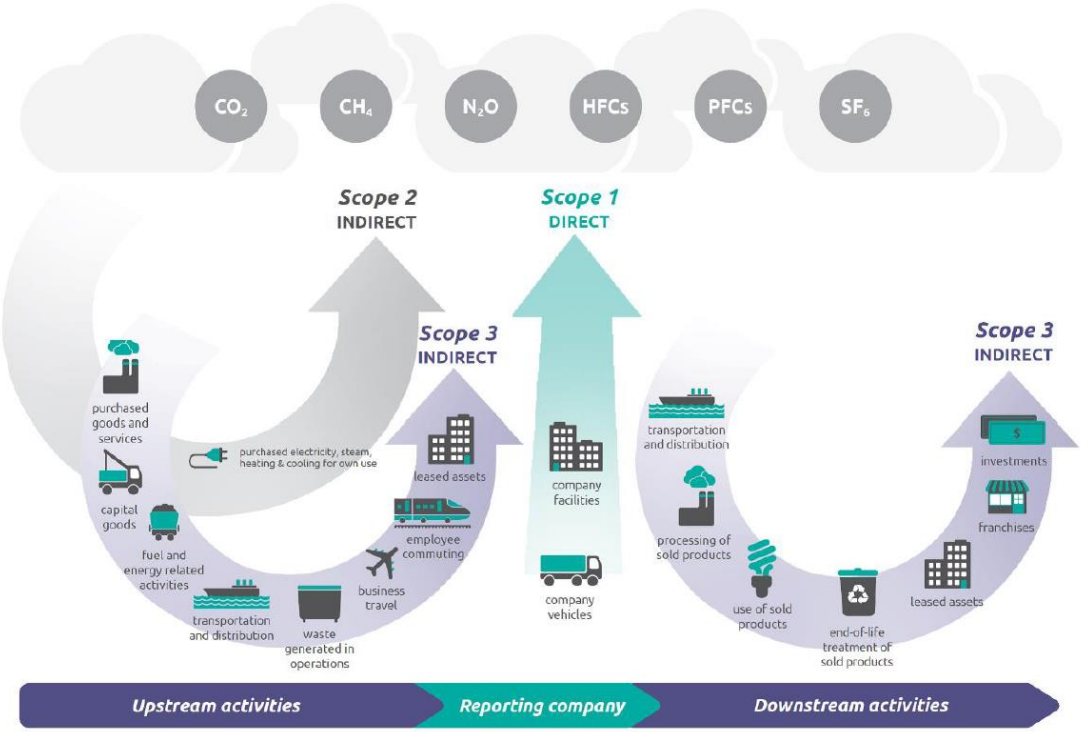


Figure 89: Overview of Scopes and Emissions

17.8.2 Description of Issues and Risks

The GHGs considered in this assessment and the corresponding global warming potential (GWP) for each GHG are listed in Table 70. GWP is a metric used to quantify and communicate the relative contributions of different substances to climate change over a given time horizon. GWP accounts for the radiative efficiencies of various gases and their lifetimes in the atmosphere, allowing for the impacts of individual gases on global climate change to be compared relative to those for the reference gas carbon dioxide. The GWPs from the IPCC Third Assessment report were used in this assessment. These are reflective of radiative forcing over a 100-year time horizon. There are more recent GWP values available (i.e. the IPCC Sixth Assessment report). However, the recent Methodological Guidelines for Quantification of Greenhouse Gas Emissions (DFFE, 2022) published by the Department of Forestry, Fisheries and Environment stipulate the older GWP values (from the Third Assessment report) to be used.

17.8.2.1 Sources of Data

The input data and assumptions used in estimating GHG emissions for the operational phase of the project is provided in Table 71. The diesel used for on-site mobile equipment was calculated based on the distance the trucks would travel (Table 72) assuming a capacity of 30 tonnes and a fuel consumption of 40 litres per 100 km.

Table 70: Greenhouse Gasses and 100-year Global Warming Potentials

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	23
Nitrous oxide (N_2O)	296

Table 71: Greenhouse Gas Assessment Source Data and Assumptions for the Operational Phase

Operation	Value	Unit
Operation Period	20	years
Scope 1		
High-carbon ferrochromium	125 329	t/year
Chromite ore	250 658	t/year
Reducing agent (coke and semi-coke)	63 416	t/year
Silica stone	21 807	t/year
Diesel used (mobile combustion - vehicles)	3 165	litres/year
Scope 2		
Electricity consumed by operations	438 000 000	kWh

Table 72: Calculated Distances Travelled for Onsite Vehicles

Material	Description	Quantity Moved (tpa)	Truck capacity (t)	Trips	Route distance (m)	Total distance (m/yr)
Electrode paste	Electrode paste and refractory materials are transported from the comprehensive warehouse to the main workshop	5 100	30	170	1 000	340 000
High-carbon ferrochromium	High-carbon ferrochromium is transported from the main workshop to the finished product warehouse.	125 000	30	4 167	200	1 666 667
Steel bars	Steel bars, etc., are transported from the comprehensive warehouse to the electrode shell processing and machine repair workshop.	680	30	23	300	13 600
Electrode shells	Electrode shells are transported from the electrode shell processing and machine repair workshop to the main workshop.	310	30	10	300	6 200
Slag to waste site	Slag transported from the furnace workshop to the slag disposal site.	147 136	30	4 905	600	5 885 450

17.8.2.2 Emission Factors and Emissions

The emission factors used for the assessment is provided in Table 73 and were mainly sourced from the:

- South African Methodological Guidelines for Quantification of Greenhouse Gas Emissions gazetted by the Department of Forestry, Fisheries and Environment, No. 47257(2598) (DFFE, 2022b).
- South Africa's 2022 Grid Emission Factors Report gazetted by the Department of Forestry, Fisheries and Environment, No. 51495(5498) (DEFRA, 2024).

Table 73: Emission Factors Used in the Assessment

Emission factors	Value	Unit	Source	Reference
Scope 1 - Direct Emissions				
Process related activities				
Ferrochromium	1.3	t CO_2e per tonne product	(DFFE, 2022)	Table C.1
Fuel related activities				
Diesel – mobile combustion	74 638	kg CO_2 per TJ	(DFFE, 2022)	Table A.3 (country specific)
Diesel – mobile combustion	3.9	kg CH_4 per TJ	(DFFE, 2022)	Table A.2 (IPCC, 2006)
Diesel – mobile combustion	3.9	kg N_2O per TJ	(DFFE, 2022)	Table A.2 (IPCC, 2006)
Scope 2 - Indirect Emissions				
Electricity				
Electricity (national)	0.93	t CO_2e per MWh	(DFFE, 2024)	

The estimated GHG emissions due to project operations is provided in Table 74 below.

Table 74: Estimated GHG Emissions for the Operational Phase of the Project

Source	Input				
	Value	Units	Scope 1	Scope 2	Total
Operation					
Fuel and Energy related activities					
Ferrochromium production	125 329	t/year	162 928		162 928
Diesel (mobile combustion)	3 165	litres/year	9		9
Electricity usage					
Electricity from national grid	438 000 000	kWh		407 778	407 778
Total t CO_2e per year			*162 936*	*407 778*	*570 714*
Total t CO_2e for operating period			*3 258 725*	*8 155 560*	*11 414 285*

The GHG emissions provided as a percentage per scope for project operations is provided in Figure 90.

Scope 1 and Scope 2 emissions for the project operations is 11 414 285 tCO_2e over the 20-year life of the project (~570 714 tCO_2e per annum) and making up 71% and 29% of the total GHG emissions for the project respectively.

For comparison, international reporting considers a small facility as producing 10 000 tCO_2e per annum, medium at 25 000 tCO_2e per annum and large at 100 000 tCO_2e per annum (for Scope 1 and 2 emissions). This project would thus be considered a large facility.

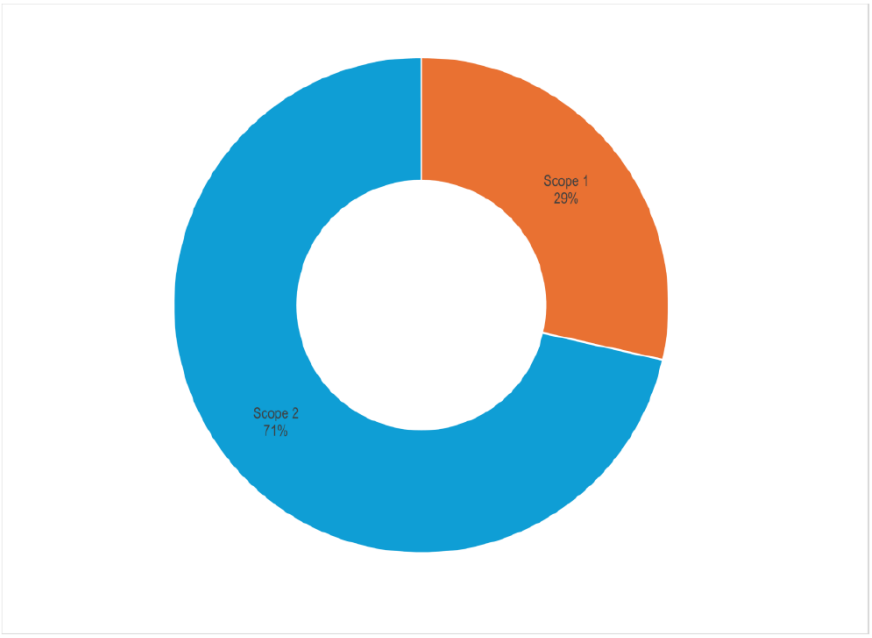


Figure 90: Percentage GHG emissions per Scope for Project Operation Activities

17.8.2.3 The Proposed Ferrochrome Smelter GHG Impact

According to the updated first NDC (Section 2.3), the South African remaining carbon budget is in the range of 398 – 510 Mt CO_2e for 2025 and 350 – 420 Mt CO_2e by 2030. Using the lower end of the range for 2030, the project activities would contribute approximately 0.16% of the remaining carbon budget per year and represent a contribution of 0.13% (operation) to the 2022 National GHG inventory total.

Most of the South African GHG policy is in early phases of implementation where GHG emissions have been reported to DFFE since 31 March 2018 and the Carbon Tax Act came into effect on the 23 May 2019. The project will be required to align GHG reporting with national policy. An annual Carbon Tax environmental levy account will need to be submitted in July of each year after operations commence.

17.8.2.4 Physical Risks of Climate Change of the Project's Operations

With the increase in temperature, there is the likelihood of an increase in discomfort and possibility of heat related illness (such as heat exhaustion, heat cramps, and heat stroke). Both these have the potential to negatively affect employee performance and productivity along with process efficiency.

From a process point of view, elevated ambient temperatures (up to 45°C) may slightly increase evaporative fuel losses from vehicles and increase temperature related wear on equipment. Similarly, there will be increased water use for drinking water and dust emission abatement on roads.

17.8.2.5 Physical Transitional Risks and Opportunities of Climate Change on the Project

The Taskforce for Climate-related Financial Disclosures (TCFD) advocates the disclosure of the financial risks associated with climate change impacts on organisations (TCFD, 2020). These include physical risks resulting in large-scale

financial losses caused by storms, droughts, wildfires, and other extreme events. The Taskforce also advocates the quantification of transitional risks associated with the adjustment to low carbon economies, such as the rapid loss in the value of assets due to policy changes or consumer preference; and financial risks to the economy through elevated credit spreads, greater precautionary saving and rapid pricing readjustment (TCFD, 2020). Along with risks, the Taskforce encourages organisations to identify possible opportunities that could build resilience in economies shifting due to climate change.

17.8.2.6 Potential Impact Description and Significance

Gaseous pollutants released from the combustion of fuel is the main source of GHGs from the project. The release of GHG includes mainly CO_2, CH_4 and N_2O. GHGs are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour H_2O, CO_2, N_2O, CH_4 and O_3 are the primary GHG in the Earth's atmosphere. The effect of climate change is related to changing atmospheric GHG concentrations, increased temperatures, changing weather patterns and sea level rise (indirect negative impact).

When evaluating significance, all new GHG emissions contribute to a negative environmental impact; however, some projects could replace existing development or baseline activity that has a higher GHG profile. Therefore, the significance of a project's emissions should be based on its net impact over its lifetime, which may be positive, negative or negligible. To meet the South African (SA) NDC targets and interim budgets, action is required to reduce GHG emissions from all sectors, including projects in the built and natural environment. The proposed project must therefore consider whether and how the project will contribute to or jeopardise the achievement of these targets. Such an assessment would however require a much broader evaluation of the project against all current energy mix and their resources practiced in South Africa. In the absence of such a comprehensive assessment, the current assessment will rely on using thresholds to define the significance of the GHG impact.

The proposed intensity rating for annual emissions is as follows:

25 000 tCO_2e:	**Very Low** (i.e., threshold used by EBRD, IFC and Equator Principals)
25 000 – 100 000 tCO_2e:	**Low** (i.e., DFFE PPP requirement threshold is 100 000 tCO_2e)
100 000 – 500 000 tCO_2e:	**Medium** (i.e., DFFE PPP to 0.1% of the total gross SA GHG emissions)
500 000 – 5 000 000 tCO_2e:	**High** (i.e., 0.1% to 1.0% of the total gross SA GHG emissions)
>5 000 000 tCO_2e	**Very High** (i.e., more than 1.0% of the total gross SA GHG emissions

The GHG emissions for project operations (570 714 tCO_2e) per annum for Scope 1 and Scope 2 are 0.13% of the total gross SA GHG emissions. The impact significance

is therefore considered to be high. The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.

17.8.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	Medium	**3**	Medium-Term	**3**	Definite	**5**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**42**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
42				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**33.6**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				Medium to High			**85**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
85				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium to High -ve**			**68**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint/Region	**3**	Medium	**3**	Medium-Term	**3**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**39**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
39				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**31.2**
NO-Go OPTION:							
Should the ferrochrome smelter project not proceed, the existing potential risks in climate change patterns will remain – including the potential increase in temperature and changes in weather patterns.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Medium-Term	**3**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**36**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
36				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**28.8**

CUMMULATIVE IMPACTS:							
The GHG emissions for project operations (570 714 tCO2e) per annum for Scope 1 and Scope 2 are 0.13% of the total gross SA GHG emissions. The impact significance is therefore considered to be high. The project will be required to report CO2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan. The possible additional industries within the MMSEZ zone will also increase and add to the GHG emissions.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	High	**5**	Long Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**High - ve**			**80**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
80				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium to High -ve**			**64**

17.9 Heritage and Archaeological Assessment

17.9.1 Methodology Used

A review of available literature was undertaken in order to place the development area in an archaeological and historical context. The sources utilized in this regard are indicated in the bibliography. These include Bergh (1999), Huffman (2007) & Lombard et.al (2012).

The field assessment component of the study was conducted between the 12th and 14th of May 2025 according to generally accepted HIA practices and aimed at locating all possible objects, sites, and features of heritage significance in the area of the proposed development. The location/position of all sites, features and objects is determined by means of a Global Positioning System (GPS) where possible, while detail photographs are also taken where needed.

17.9.2 Description of Issues and Risks

No Stone Age sites (including rock art) are known to occur in the immediate study area. The closest known Stone Age sites are located at Kalkbank and Makgabeng south and south-west of the study area (Bergh 1999: 4), while known rock art (paintings) sites are located to the south of the study area and around Makhado & Schoemansdal (Bergh 1999: 5). Most of the Stone Age research in the region is focused in the Sashi-Limpopo about 70km West of the study areas (Vhufahashu Consultants 2021).

No Stone Age sites or material were identified in the study areas during the May 2025 assessment. During the 2021 assessment in the area an isolated single Stone Age flake tool were recorded (Vhufahashu Consultants 2021: 28). If any Stone Age material are to be found in the area, then it would more than likely be single or small scatters of stone tools in an open-air surface context.

There are no known Iron Age sites (EIA or LIA) in the immediate study area, although a large number of EIA to LIA sites are known to exist in the larger geographical landscape in which the study area falls. This includes the sites of Klein Afrika & Happy Rest (EIA) located north & west of Louis Trichardt respectively, and the sites of Verulam, Verdun & Machemma (LIA) north of the study area (Bergh 1999: 6-7). Known Early Iron Age sites are found in the Nzhelele valley East of the study area (Prinsloo 1974).

The historical heritage of the area consists mostly of farmsteads, other farming-related features and grave sites. Two sites (recorded previously in the area by Vhufahashu Consultants) were re-recorded in May 2025, but other than these no additional historical period sites were identified and recorded here.

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the development can be excavated / recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

Construction and Operational Phase:
The status of the impact is considered as low negative significance since no cultural and heritage resources have been encountered within the proposed ferrochrome Smelter footprint and site.

The cultural and historic remains are area specific and very important to the cultural and values of the area. In the unlikely event that some resources are encountered during operations of the smelter activities, the impact will become of moderate negative significance since the earth moving equipment will destroy such resources to the detriment of the local people or inhabitants - especially the descendants of the people living in and around the project area - Mopane.

Decommissioning and Closure Phase:
Proposed ferrochrome smelter and its activities will form part of the history of the local area. Some smelter infrastructure may be preserved as local heritage resources during decommissioning – subject to consultation with local authorities and health/safety requirements.

17.9.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**2**	Short-Term	**2**	Possible	**2**
WEIGHTING FACTOR:				**Low to Medium**			**2**
SIGNIFICANCE RATING (WOM):				**Low -ve**			**16**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
16				**0.4**			

SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**6.4**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Long Term	**4**	Possible	**2**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**33**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
33				**0.4**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low -ve**			**13.2**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**1**	Low	**1**	Medium-Term	**3**	Possible	**2**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**21**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
21				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low -ve**			**12.6**
NO-Go OPTION:							
The MMSEZ area is not pristine piece of land any longer as communities (Mopane and Mulambwane CPA) and other adjacent businesses have lived in this area for a prolonged period of time. The identified heritage resources will remain intact and preserved by the families and the hunting camp owners.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**1**	Low	**1**	Medium-Term	**3**	Possible	**2**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low-ve**			**21**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
21				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**12.6**
CUMMULATIVE IMPACTS:							
Any smelter infrastructure preserved after closure will form part of the history of the local area. With possible development of other industries within the MMSEZ, the history of Mopane area will change. Developments for other possible industries may identify other heritage resources within the MMSEZ footprint through their respective EIA/EMP processes.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	Low	**3**	Long - Term	**4**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**39**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							

WOM	**ME**		
39	**0.6**		
SIGNIFICANCE RATING WITH MITIGATION:		**Low to Medium -ve**	**23.4**

17.10 Visual Aspects

17.10.1 Methodology Used

The following methodology was applied to assess and quantify the potential visual impacts that may be associated with the proposed Project.

Visual receptors surrounding the proposed Project were identified using Google Earth™ imagery and available national databases. Visual receptors include, but are not limited to, residential areas, households, farmsteads, recreational facilities, tourist areas, road networks, protected areas and conservation areas and may experience visual impacts from the proposed Project.

Viewshed and viewing distance was modelled using Geographic Information System (GIS) analysis, utilizing ArcGIS Pro 3.0.3 and Spatial Analyst Extension. The key inputs into the GIS analysis included the point locations and the aboveground heights of the proposed Project infrastructure, as well as an elevation model of the surrounding area. The point locations for the plant area was determined by equally subdividing the site boundaries into 5 rows and 5 columns and thereafter creating point features at the centroids of each resulting grid block. Additional point features were then created at 100 m intervals along the site boundaries, also representing the plant area. Regarding the exhaust stacks, two point features were created at the centroid of each site boundary. The respective aboveground heights of the infrastructure were then assigned to the point features which formed part of the visual analysis.

The viewshed and viewing distance was then determined for up to 15 km from the proposed Project. In order to determine the decreasing visual impact of the proposed Project, concentric radii zones from the proposed Project were superimposed on the viewshed to determine the level of visual exposure. The closest zone to the proposed Project designates the area of most significant impact, and the furthest zone from the proposed Project indicates the area of least impact. The visual ratings of the zones have been defined as follows:

- < 1 km (very high).
- 1 - 2 km (high).
- 2 - 5 km (moderate).
- - 10 km (low).
- 10 - 15 km (very low).

A quantitative visual exposure analysis was conducted, which included the following parameters:

- Terrain slope
- Slope aspect
- Landforms
- Slop position
- Relative evelation
- Terrain ruggedness
- Visual adsorption capacity

- Overall visual impact.

The significance of the potential visual impacts was rated based on the result of the abovementioned overall visual impact, according to an impact and aspects rating methodology formalized by the specialist. Cumulative visual impacts of the proposed Project in conjunction with other existing developments.

Feasible mitigation measures were recommended based on the impact ratings and specialist knowledge, whereafter a reasoned opinion, from a visual perspective, is provided as to the acceptability of the proposed Project based on the results.

A site visit was conducted on the 08th of April 2025. The site visit was conducted during clear weather conditions to allow the specialist to easily identify key landscape features. The main objectives of the site visit were to familiarise the specialist with the proposed Project site and its surroundings, as well as to verify the desktop findings.

17.10.2 Description of Issues and Risks

17.10.2.1 Terrain Slope

Figure 91 indicates the slope angles of the total study area. The results indicate that the proposed Project will be built on flat terrain, with an average slope of 0.78 degrees. The steeper slope angles occurring within the southern and northern regions of the total study area will assist in screening the proposed Project from the areas beyond these slopes. Furthermore, due to the proposed project position on a flat surface, it is expected that the proposed Project will be less visible to surrounding areas than if it were built on steeper slopes.

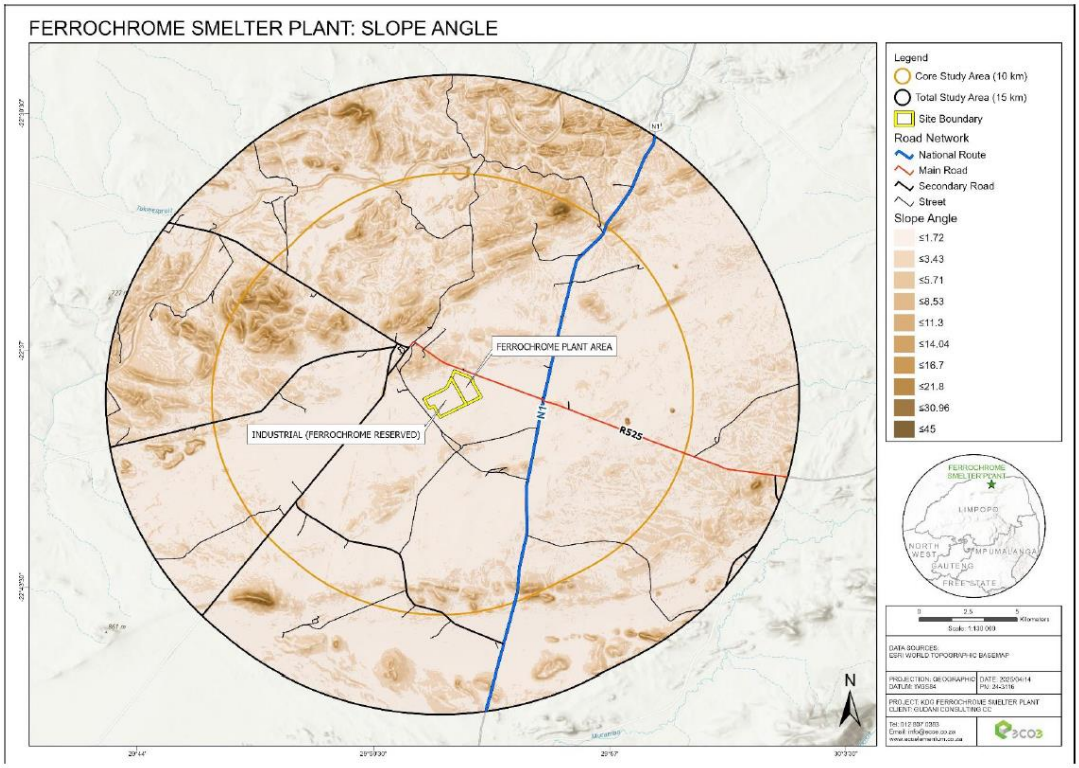


Figure 91: Terrain Slope of the Total Study Area

17.10.2.2 Slope Aspect

Figure 92 shows the slope aspect of the total study area. The figure shows that the proposed Project infrastructure is located mainly on north and north-east facing slopes. Infrastructure on north facing slopes are generally less visible from areas in the south. Therefore, the proposed Project is expected to be less likely visible from the areas within the southern region of the total study area. However, the taller infrastructure, specifically the exhaust stacks and related emissions, are expected to still be visible from the southern regions.

17.10.2.3 Terrain Ruggedness

The results of the terrain ruggedness indicated that the total study area has an overall low level of ruggedness which will decrease the areas VAC characteristics. However, the hills and ridges within the northern region of the total study area offer a rugged terrain which will increase the areas VAC characteristics and assist in screening the proposed Project from visual receptors located beyond the rugged terrain. Figure 93 shows the terrain ruggedness within 15 km of the proposed Project area.

17.10.2.4 Relative Elevation

The relative elevation results show that the proposed Project occurs on low lying terrain relative to the surrounding areas elevation. Therefore, the proposed Project is expected to be less visible to surrounding areas than if it were built on much higher lying terrain. The higher lying areas within the total study area will assist in screening the proposed Project from visual receptors located beyond these high lying areas. However, should a visual receptor be located on a high lying area, the receptor may be susceptible to visual exposure. Figure 94 shows the relative elevation within the total study area.

17.10.2.5 Landforms

Figure 95 indicates the landforms within the total study area. The landform results show that the proposed Project infrastructure is situated on plains. The surrounding areas of upper slopes, mid slope ridges, small hills and high ridges are located within the total study area and these landform types may provide visual screening to the areas behind these landforms.

17.10.2.6 Slope Position

The results of the slope position (Figure 96) show that the proposed Project lies within a valley/cliff base, which to an extent will assist in concealing the proposed Project from the surrounding areas. The surrounding areas of mid slopes, upper slopes and ridges may further assist in screening the proposed Project from visual receptors. However, the proposed Project is more likely to be visible should a visual receptor be located on these high lying areas.

17.10.2.7 Landcover VAC

Figure 97 indicates the potential VAC of the total study area calculated using the surrounding landcover. The results show that the mining areas, residential areas, fallow land and old fields, and commercial annual crops create higher VAC levels relative to the remaining landcover types. However, these landcover types are

sparse within the total study area and are expected not to effectively absorb visual impacts. Furthermore, the areas of natural grassland are expected to create the lowest VAC level and occurs sporadically within the total study area. The remaining areas within the total study area, comprising of open woodland, creates a moderate VAC level and will provide some screening of the proposed Project from the surrounding areas. On average, the results indicate that the total study area has a moderate level of VAC therefore, partial screening of the proposed Project by the landscape/receiving environment is expected.

17.10.2.8 Veiwshed and Visibility Count

Figure 98 shows the expected viewshed of the proposed Project. The viewshed results indicate that the proposed Project will be visible from approximately 26% of the total study area. Majority of the viewshed is concentrated within the core study area, and within the northern and south-western regions beyond the core study area. The remaining areas beyond the core study area are largely screened from the proposed Project by the surrounding topography. Within the core study area, the viewshed is concentrated within the eastern, western and southern regions.

For the visibility count analysis, the proposed Project was allocated 150 observer points, which represents the location and aboveground heights of the proposed Project infrastructure. The visibility count analysis calculates the number of observer points that may be visible from any point within the viewshed. Figure 98 indicates that the highest number of observer points will be visible from majority of the viewshed within the core study area and from the areas approximately 14 km north and more than 10 km south-west of the proposed Project. Lower numbers of observer points are expected to be visible from the remaining areas covered by the viewshed.

17.10.2.9 Viewshed Visibility Count Distance Ranking

The results of the viewshed visibility count were further ranked based on the distance from the proposed Project. The closest zone to the proposed Project designates the area of most significant impact from a visual point of view, and the furthest zone indicates the area of least impact. The visibility ratings of the zones have been defined in Table 75. It is important to note that although the ratings of the visibility zones have been defined by the distance from the proposed Project, the visual model also incorporates the results of the visibility count. Therefore, where the visibility zone is defined as very high, but the visibility count is low, the overall visibility impact can be low and vice versa.

Table 75: Visibility Rating

DISTANCE	VISIBILITY RATING
0 – 1 km	Very High
1 – 2 km	High
2 – 5 km	Medium
5 – 10 km	Low
10 – 15 km	Very Low

Figure 99 indicates that the visibility impact level of the proposed Project will be very high from majority of the areas within 1 km of the proposed Project. Within 1

to 2 km of the proposed Project, very low to high visibility impact levels are expected from the areas north-east of the proposed Project, with medium to high visibility impact levels occurring within the remaining areas of this visibility zone. Furthermore, medium visibility impact levels are expected from the areas 2 to 5 km east and west of the proposed Project, and from the areas approximately 3 km north-west and 5 km north-east of the proposed Project. The remaining areas covered by the viewshed are expected to experience very low to low visibility impacts.

17.10.2.10 Visual Exposure Ranking

Through various raster calculations, the viewshed visibility count and distance ranking were then combined with the slope angle, slope aspect, slope position, ruggedness, relative elevation, landforms and landcover VAC to obtain a quantitative visual exposure ranking of the viewshed. Table 76 indicates the visual exposure rankings and Figure 100 shows the visual exposure results.

Table 76: Visual Exposure Ranking

VISUAL EXPOSURE RANKING	
1 – 2	Very Low
3 – 4	Low
5 – 6	Medium
7 – 8	High
9 – 10	Very High

Figure 100 indicates that medium to very high visual exposure levels are expected from the areas approximately 8.5 km to 9.5 km north-east of the proposed Project. Furthermore, medium to high visual exposure levels are expected from the areas approximately 300 m and 3 km north-west of the Ferrochrome Plant Area, and from the areas approximately 7.7 km to 10 km north-west and 12 km south-west of the Industrial (Ferrochrome Reserved) Area. Medium visual exposure levels are expected from the areas approximately 300 m north, 750 m south, 1.2 km west, 6.8 km north-west and 11.6 km south-west of the Industrial (Ferrochrome Reserved) Area; and from the areas approximately 4 km north-east, 13.5 km north-west and 9.5 km south of the Ferrochrome Plant Area. The remaining areas within the viewshed are expected to experience very low to low levels of visual exposure from the proposed Project.

17.10.2.11 Sources of Data

Each identified visual receptor was overlaid on the visual exposure ranking to determine the level of visual impact potentially experienced by the identified visual receptor (Figure 111). It is important to note that the GIS tools used to quantify the overall visual exposure levels, only incorporates the variables as described in this report. Factors such as real time and micro scale vegetation are not considered, thus the actual level of visual exposure may be lower or higher depending on the updated land use in the vicinity or current vegetation growth/height on a micro and macro scale. The results are by no means a rating of visual quality; it is rather used to determine the likelihood of the proposed Project being visible from the visual receptors.

Figure 111 indicates that 18% of the identified point location visual receptors (i.e. the accommodation areas, households and farmsteads, recreational facilities, gas station and school) fall within the viewshed and are all expected to experience very low to low levels of visual exposure from the proposed Project. Furthermore, the results indicate that the Mopane settlement will be completely screened from the proposed Project by the surrounding topography.

Regarding the users of the road network within the total study area, the results show that the proposed Project will be visually exposed to minimal portions of the road network. Where visual exposure is expected, these levels are very low; except for a 600 m portion of the R525 main road, approximately 300 m north of the proposed Project, where high visual exposure levels are expected. Furthermore, the results indicate that the proposed Project will be visible from approximately 7 km of the N1 national route, from approximately 4 km north-east to 6 km south-east of the Ferrochrome Plant Area; and from approximately 8 km of the R525 main road, from approximately 1 km north-west to 6 km east of the Ferrochrome Plant Area. The remaining length of these roads are expected to be topographically screened from the proposed Project.

Furthermore, the visual exposure results indicate that majority of the two national protected areas will be topographically screened from the proposed Project. Where visual exposure levels are expected, the visual exposure levels are low to very low, except for a minimal portion of the Baobab Private Nature Reserve, approximately 13.6 km north-west of the Ferrochrome Plant Area, where medium visual exposure levels are expected.

Overall, the results indicate that majority of the visual receptors will be topographically screened from the proposed Project. Where visual exposure is expected from the visual receptors, the level of visual exposure is expected to be low to very low. Except for a portion of the R525 main road and a portion of the Baobab Private Nature Reserve which are expected to experience high and medium visual exposure levels respectively, from the proposed Project. The expected low levels of visual exposure are mainly due to the areas moderate VAC level and the location of the affected visual receptors and proposed Project on flat terrain and not high lying areas.

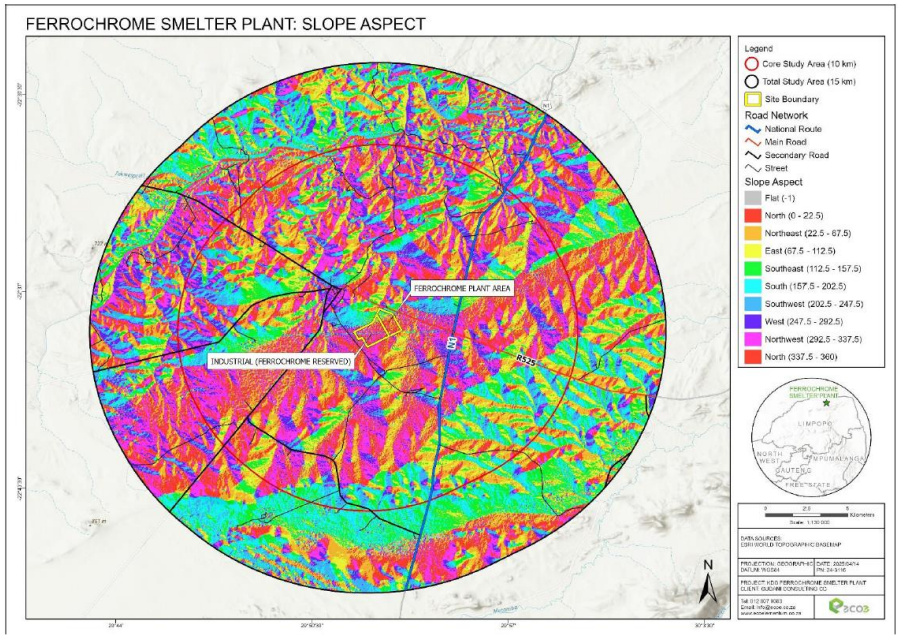


Figure 92: Slope Aspect of the Total Study Area

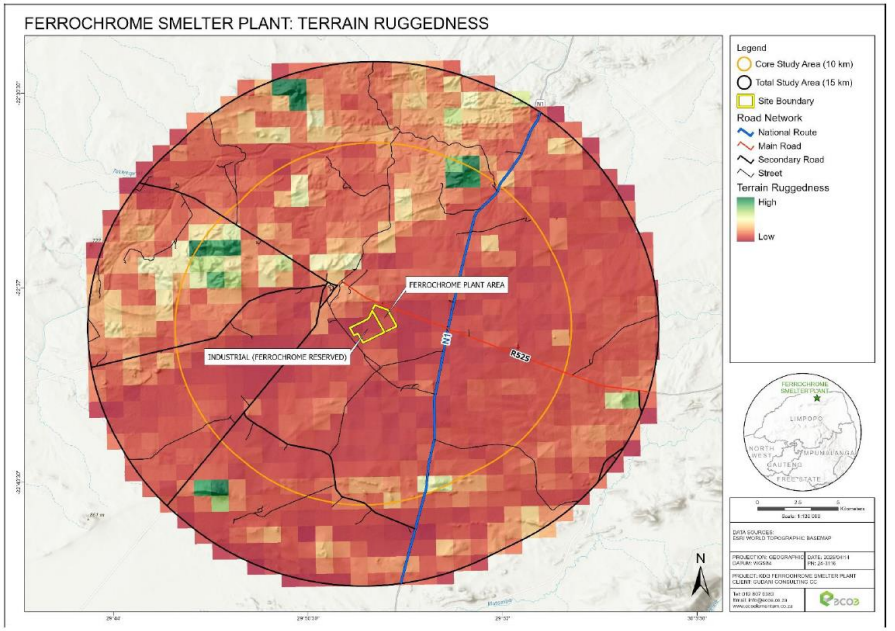


Figure 93: Terrain Ruggedness

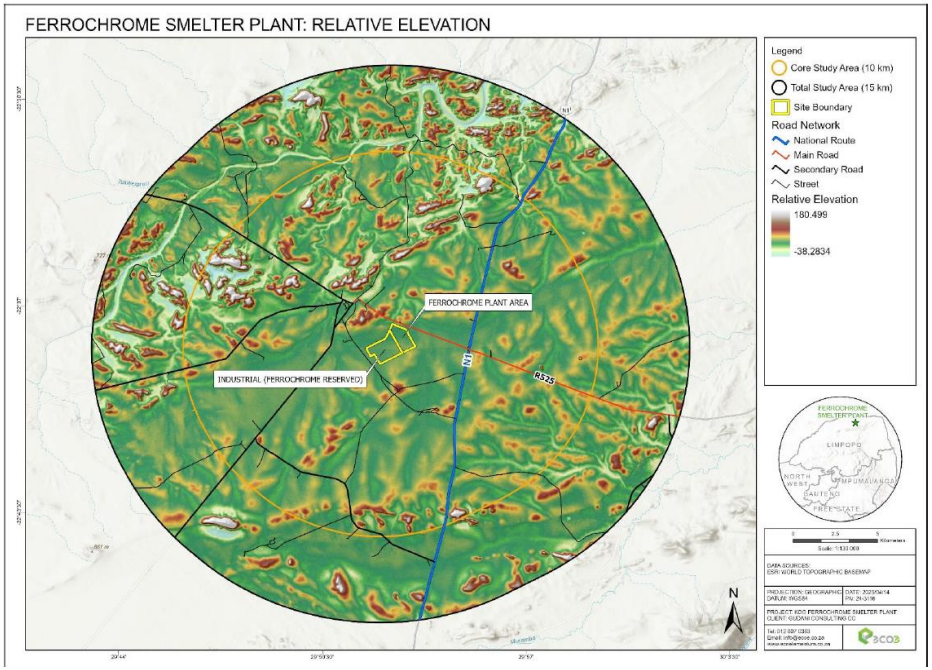


Figure 94: Relative Elevation

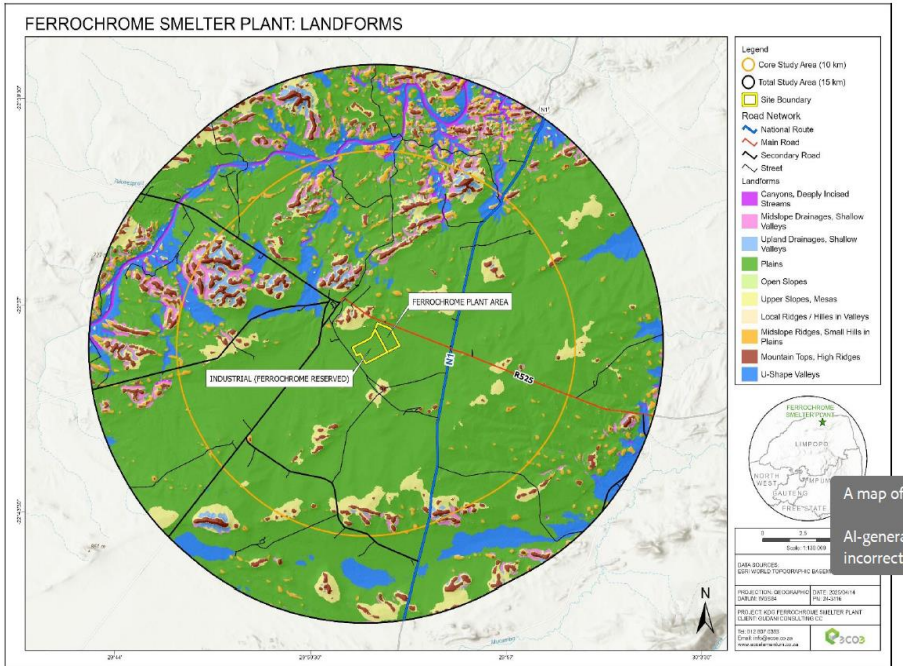


Figure 95: Landforms within the Study Area

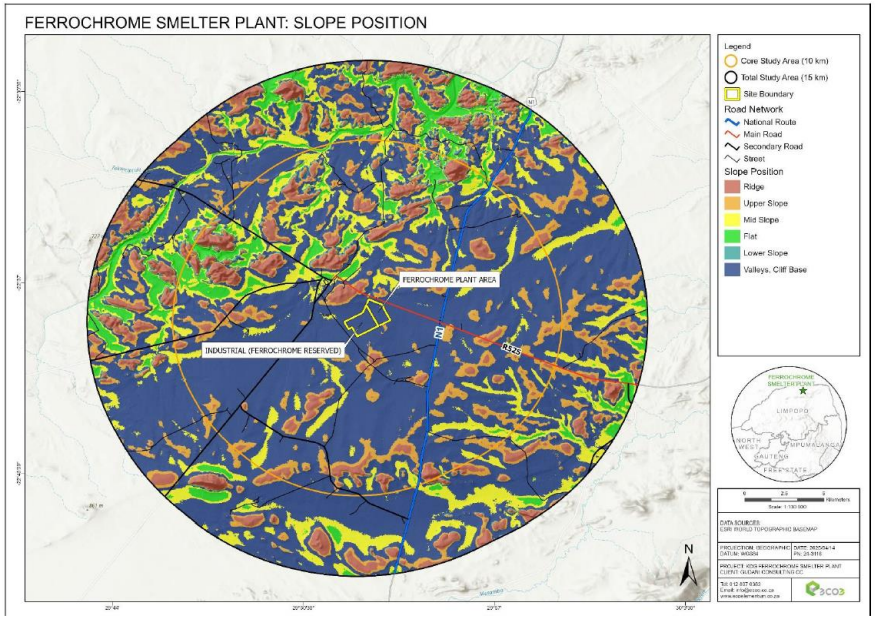


Figure 96: Slope Positions

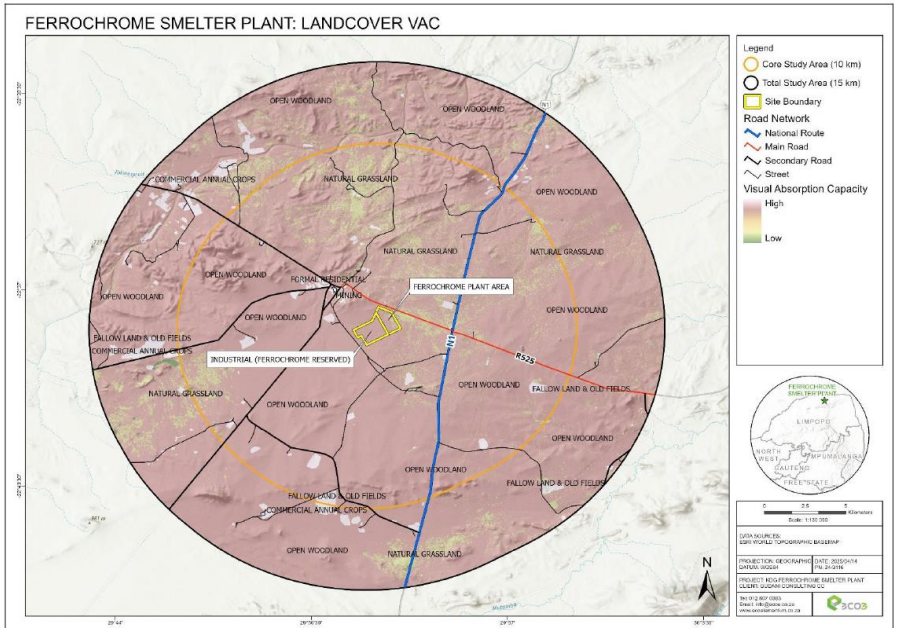


Figure 97: Potential Visual Absorption Capacity

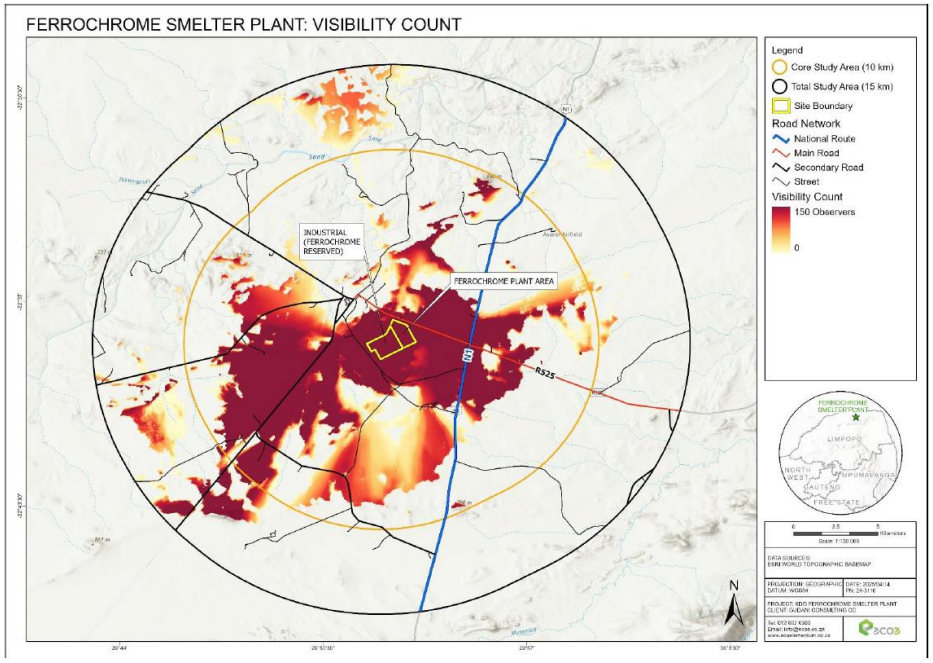


Figure 98: Viewshed Visibility Count

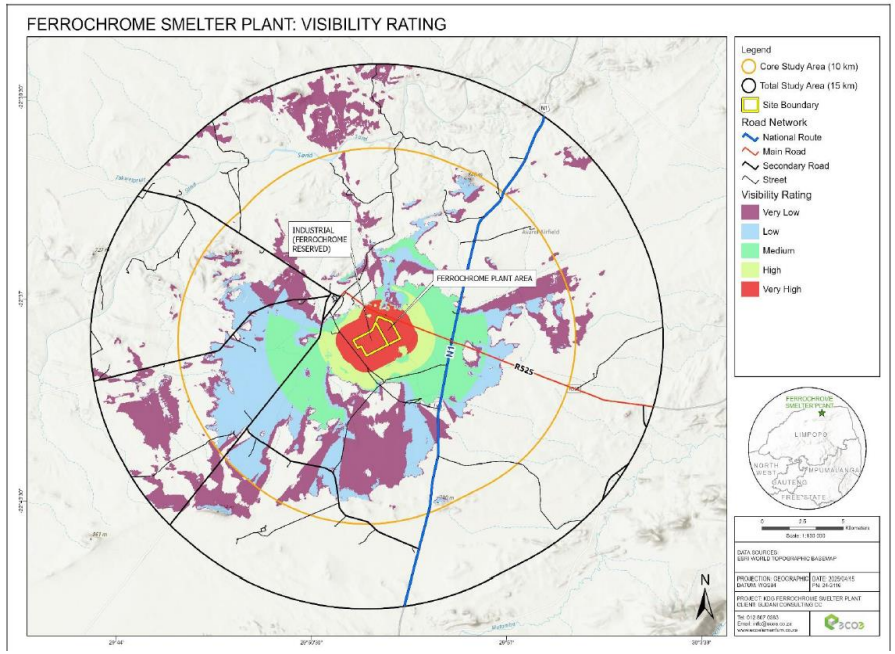


Figure 99: Visibility Count Distance Rank

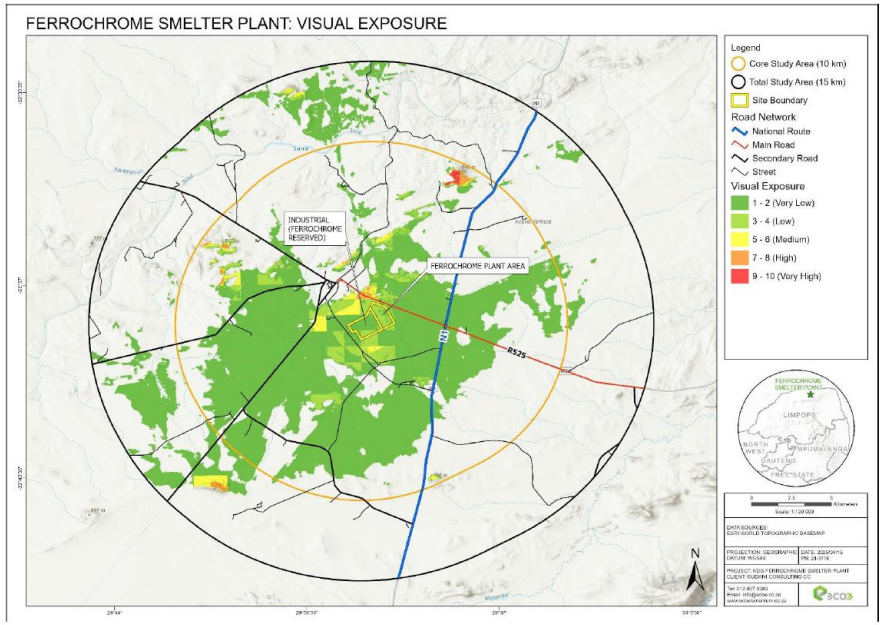


Figure 100: Visual Exposure Ranking

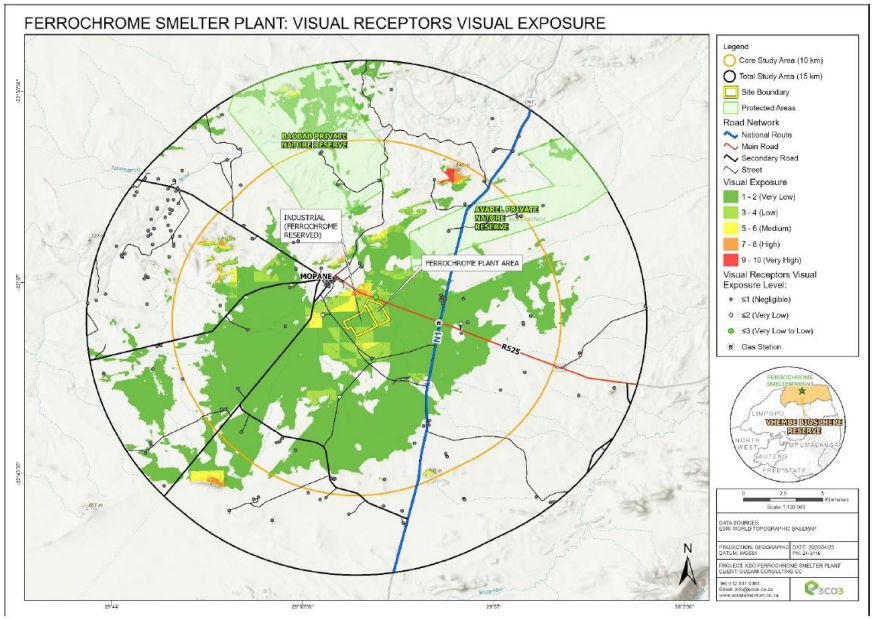


Figure 111: Visual Exposure and Visual Receptors

Construction Phase:
Visual impacts of medium negative significance are expected during the construction phase of the proposed Project due to the site clearance and project establishment activities. Following the successful implementation of the recommended mitigation measures, the significance of these impacts can be lowered however, will remain of medium negative significance. The medium negative significance is mainly a result of the expected alteration to the total study areas unique sense of place and landscape character. The remaining impacts within the construction phase, relating to construction waste generation and night lighting, are of low to medium negative significance. The significance of the impact relating to construction waste generation can be reduced to a low negative significance following the implementation of the recommended mitigation measures however, the impacts will remain of relevance. Regarding the visual impact from night lighting, the significance of the impact can be reduced post-mitigation, however, will remain of low to medium negative significance due to the introduction of night lighting within a largely undeveloped area.

Operational Phase:
During the operational phase, impacts of high negative significance are expected on the total study areas unique sense of place and landscape character. With the proper implementation of the recommended mitigation measures, the significance of these impacts can be reduced to a medium to high negative significance. Although the total study area has a moderate level of VAC created by the natural vegetation and topography, impacts of medium to high negative significance are expected post-mitigation due to the proposed Projects location within a mostly natural and undeveloped area. Furthermore, the taller infrastructure associated with the proposed Project, specifically the exhaust stacks and related emissions, will still protrude above the tree line thereby leading to a change in the total study areas unique sense of place and landscape character, and potentially affect tourism within the total study area and larger Vhembe Biosphere Reserve.

Regarding the visual impact on the identified visual receptors within the total study area, medium to high negative significance impacts are expected before the implementation of the recommended mitigation measures. The significance of these impacts can be reduced to a medium negative significance post-mitigation. The lower significance rating is attributed to the results of the viewshed and visual exposure analysis where it was determined that majority of the visual receptors are expected to experience low to very low visual exposure levels. The significance rating of this impact post-mitigation also considered the nature and sensitivity of the visual receptors (such as the accommodation areas and tourist routes) thereby lending to a medium negative significance post-mitigation.

The impacts relating to night lighting, and increased human activity, operational vehicles and heavy machinery during the operational phase are of low to medium negative significance. The significance of these impacts can be reduced following the implementation of the recommended mitigation measures, however, will remain of low to medium negative significance due to the alteration of the total study areas unique sense of place and landscape character.

Lastly, low to medium negative significance impacts are expected from operational waste generation during this phase. The significance of the impact can be reduced to a low negative significance following the implementation of the recommended mitigation measures however, the impacts will remain of relevance.

Decommissioning and Post-Closure Phase:
The visual impacts expected during the decommissioning phase are of low to medium negative significance. The significance of the impacts can be reduced to a low negative significance following the implementation of the recommended mitigation measures. Low significance impacts are expected during this phase mainly due to the time of exposure to these activities being temporary.

The impacts relating to the revegetation and rehabilitation of all disturbed areas within the proposed Project during the decommissioning and post-closure phases are expected to be of medium positive significance. Impacts of positive significance are anticipated due to the removal of infrastructure and the revegetation/rehabilitation of the proposed Project footprint to the resemble the pre-construction landscape.

17.10.3 Significance Assessment

CONSTRUCTION PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	Medium	**3**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**56**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
56				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**33.6**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	Medium	**3**	Long Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**Medium to High -ve**			**70**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
70				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**56**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	Medium	**3**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Medium -ve**			**42**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			

42				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:					**Low to Medium -ve**		**33.5**
NO-Go OPTION:							
If the proposed Project does not proceed, no additional/new visual impact would occur that would have been associated with the proposed Project. The potential impacts expected from the development of the MMSEZ will however still occur.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:					**Medium**		**3**
SIGNIFICANCE RATING (WOM):					**Low to Medium -ve**		**24**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
24				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:					**Low -ve**		**14.4**
CUMMULATIVE IMPACTS:							
Overall, the proposed Project in conjunction with the phased development of the MMSEZ, is expected to create negative cumulative visual impacts on the surrounding visual receptors and landscape by introducing large scale industrial activities in a largely natural and undeveloped landscape. Cumulative effects can also arise from the inter-visibility (visibility) of a range of developments and/or the combined effects of individual components of the proposed development occurring in different locations or over a period of time. The separate effects of such individual components or developments may not be significant, but together they may create an unacceptable degree of adverse effects on visual receptors within their combined visual envelopes							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	Medium	**4**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:					**High**		**5**
SIGNIFICANCE RATING (WOM):					**Medium to High -ve**		**70**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
70				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:					**Medium -ve**		**56**

17.11 Community Public Health

17.11.1 Methodology Used

It is important that a distinction is made between cHIA and Health Risk Assessment (HRA). HRA is concerned with the identification of hazards and risks to the workforce which relate to occupational health and safety and engineering design. Generally, HRA is "within the fence" while cHIA is "outside the fence" but there are distinct overlaps with cHIA often taking a central position as workplace activities can affect community health and existing community health needs or disease burdens can affect workplace health. cHIA is used to evaluate the public health consequences of proposed decisions in non-health sectors, while HRA is about "quantitative, analytic

process to estimate the nature and risk of adverse human health effects associated with exposure to specific chemical contaminants or other hazards in the environment, now or in the future.

The set of EHAs provides a linkage between project-related activities and potential positive or negative community-level impacts and incorporate a variety of biomedical and key social determinants of health. In this integrated analysis, cross-cutting environmental and social conditions that contain significant health components are identified instead of a cHIA focusing primarily on disease-specific considerations – as is frequently done in many biomedical analyses of potential project-related public health impacts. The EHA framework is based on an analysis performed and published by the World Bank.

To identify and quantify potential health impacts an accurate population profile is required and it is important to distinguish between differences in exposure and susceptibility. Thus, besides a demographic profile of the at-risk population and the identification of the most vulnerable groups, it is crucial to understand how the development, construction and operational activities are likely to impact at both a household and community level. Impacts caused by resettlement, shifts in the social structures or influx triggered increases in population density are considered within the overall assessment. The key aspects when considering the potential influence of the project to the Potentially Affected Communities (PACs) is the exposure pathway of the potential health determinant.

The driving concept behind cHIA is that individual and community health is not simply determined by health services or biological factors (e.g., age). It is also shaped by wider social, economic and environmental influences and factors. These health determinants are the factors that lead to health outcomes and include:

- Physical environment factors (e.g., air quality, water quality, hazards);
- Built environment factors (e.g., buildings, public spaces, roads, bike lanes);
- Livelihood factors (e.g., income, employment);
- Social and community factors (e.g., social support, family structure, access to services); and
- Lifestyle factors (e.g., diet, exercise, alcohol and tobacco use).

A standardised approach was considered for the cHIA to ensure that evidence-based recommendations supported the impact assessment. To ensure compliance with the IFC performance standards, and especially PS4, the methodology outlined in the Good Practice Note for cHIA from the IFC, was adopted (IFC, 2009).

The framework that is commonly used for a cHIA follows a 6-step process (IFC, 2009):

- Screening (preliminary evaluation to determine the necessity of a cHIA);
- Scoping (identifying the range of potential Project-related health impacts and defining the terms of reference for the cHIA, based on published literature, local data and broad stakeholder consultation and how these may be influenced by the Project);
- Risk assessment (qualitative and quantitative appraisal of the potential health impacts in relation to defined communities and the Project development, including stakeholder participation);
- Appraisal and mitigation (development of a CHMP) based on the findings of the risk assessment);

- Implementation and monitoring (realisation of the CHMP including monitoring activities that allow for adaptation); and
- Evaluation and verification of performance and effectiveness (key step to analyse the cHIA process as a whole).

The data collection activities of the cHIA included a desktop literature review, participatory data collection (stakeholder input – informal, site visits, exposure analysis, randomly selected discussions) and direct observation.

A site visit was undertaken in April 2025. The field visits provided an opportunity to visualise and assess the prevailing situation in the communities and their relation to the proposed ferrochrome Project and additional industrial hazardous waste dump near the Mopane community. This was important to understand the potential areas of influence of the Project and also the general living conditions in the communities living in close vicinity to the proposed ferrochrome Project site.

17.11.2 Description of Issues and Risks

The ultimate goal of a cHIA is to identify whether there are potential health impacts and communicate these impacts to decision makers during the planning and permitting process. The potential impacts during the construction phase will be similar with a lower significance than the busier long-term operational phase. Health impacts include:

- Changes in health outcomes or determinants, not general changes in environmental conditions;
- Specific health outcomes or determinants, not general statements about health status; and
- Quantifiable, whenever possible.

All communities have existing health problems and health assets. Similarly, all development projects have the potential to generate positive and negative health and well-being impacts. It is within this wider context that the community health impacts of industrial projects – including smelter - should be considered. Both positive and negative impacts occur because a project has the potential to change the economic, social, sanitary and natural environments within which communities live and work. Good design and management can help to maximise the positive health and safety impacts and avoid or minimise the negative ones. A health impact is a positive or negative change in a specific health outcome or health determinant.

17.11.2.1 Vector Related Diseases – EHA#1

During active operational periods, the proposed ferrochrome smelter Project may create new breeding sites for key mosquito vectors which would significantly increase the vector-borne disease risk. In addition, existing water bodies, such as surface-water environmental-control dams or new reservoirs, may become magnets for local community members and increase the risks of injury, including accidental drowning. In addition, water storage facilities require careful environmental engineering (for example, shoreline slopes and vegetation control) to prevent development of vector breeding sites. During construction and operations phases, tires, drums, and other containers may become significant breeding sites for mosquitoes.

17.11.2.2 Acute Respiratory Infections and Respiratory Effects from Housing – EHA#2

Diseases that may be intensified due to heavy industrial activities include: conjunctivitis, respiratory tract diseases, vector borne diseases such as schistosomiasis and STDs such as HIV/AIDS. Acute conjunctivitis is attributed to high dust particles, smoke or chemical content in the air. With steel plants, dust and other chemicals are regularly dispersed in the air, which could lead to acute conjunctivitis. Similarly, respiratory tract diseases such as tuberculosis (TB) and silicosis may spread more quickly in these areas. Sneezing or coughing, the most common means of producing airborne TB bacilli, is common among industrial workers as they are exposed to dust and chemicals in the air created by certain industrial activities.

17.11.2.3 Sexually Transmitted Diseases – EHA#4

HIV/AIDS and STI are existing public health challenges both nationally and within the immediate proposed Project area. The HIV prevalence in the proposed ferrochrome smelter Project area is a public health concern. STIs, if present and untreated, have been found to increase the risk of transmission of HIV, if one partner is infected. HIV's link with TB and its importance has been discussed above.

Influx and/or movement of labour into the proposed Project area will pose an increased risk for STIs. There will be more disposable income, either as a direct or indirect consequence of the project. Although there will not be any accommodation on site as it is planned to use local labour, commercial sex workers are still likely to establish in the surveyed communities and other nearby towns, where newly employed men from the local community may be vulnerable to opportunistic sexual liaisons. The likely effect of the project employing a number of relatively well-paid employees may also increase the risk for transactional sex. Economic upliftment and settlement in the project area may also lead to lifestyle changes, which may also play a role in casual sexual engagement.

The improved economic status of the area and the influx of new people, living away from their families, can also lead to an increased risk of sexually transmitted infections such as HIV/AIDS, gonorrhoea and chlamydia. Major outbreaks of infectious diseases can have a devastating effect not only on communities, but on the viability of a heavy industrial activity project such as the proposed Project.

17.11.2.4 Soil, Water and Waste Related Diseases – EHA#5

The additional waste generated from the industry to be disposed of at the local Makhado – and/or Musina municipality's landfill will increase the depletion of the respective municipality's landfill airspace. It might be necessary to establish the available airspace at the existing municipality's landfill to determine its lifespan with the additional waste to be disposed of. In addition, heavy industrial projects can potentially change these exposures by adding or removing substances in the air, water and/or soil. Some of the substances that may be added can remain in the environment and/or the food chain for decades after the closure of a project, and therefore may have transgenerational health impacts.

17.11.2.5 Food and Nutrition Related Issues – EHA#6

New projects have significant potential to alter underlying levels of community and household income positively (IFC, 2009). These potential positive effects may have a profound impact on a variety of health performance indicators for all populations in a community (for example, children under age 5, women of reproductive age, elderly, and so on). Conversely, projects can trigger significant inflation, impacting both food and housing in surrounding communities. Significant food inflation can adversely impact existing vulnerable groups, with negative consequences on individual and community level health performance indicators.

17.11.2.6 Accidents and Injuries – EHA#7

The accidents and injuries health effect category describe changes to fatal and non-fatal injury statistics that can be either intentional (e.g., suicide, homicide, assault, and self-harm) or unintentional (e.g., motor vehicle crashes and falls).

The proposed ferrochrome smelter Project may provide employment opportunities which are relatively safe and well-managed compared with other options available to many workers and can reduce work-related injuries in the population overall. However, project-related accidents, poorly controlled use of explosives or chemicals, equipment failure and truck movement can all potentially lead to physical injuries in local communities. If not well managed during decommissioning phase, the proposed Project may also pose injury risks, for example via falls, drowning, land slips and derelict buildings. The proposed Project may also affect injury rates indirectly through the social and economic changes they bring about. They may reduce the risk of violence in the community by providing gainful employment for young men, and by increasing the overall wealth of a community. However, the influx of large groups of, generally, male workers can sometimes lead to social unrest which may include violence and sexual assault.

The proposed Project would increase the number of commercial motor vehicles (e.g., trucks and other vehicles) on the roads, which could potentially produce a small increase in accidents and injuries in the region. In general, changes in this health impact are expected to be negative, resulting in an increase in morbidity and mortality outcome data.

17.11.2.7 Exposure to Potentially Hazardous Materials, Noise and Malodours – EHA#8

The gaseous emissions are generated as flue gases at furnaces in steel plant, rolling mill and producer gas unit. Fugitive emissions are generated in the industry during storage and handling of chrome and coking coal and other solid raw materials. Dust is generated during loading and unloading, movement in conveyors, crushing and screening operations of these products. Fugitive emission is also generated on due to vehicular movement in the premises. The information on gaseous emission from project activities is furnished in the Air Quality Impact Assessment Report.

Local communities may already be exposed to low background levels of potentially hazardous materials (e.g. dust and particulate matter) that can be associated with health problems such as respiratory illnesses, skin diseases, organ damage, circulatory problems, birth defects, cancers and neurological disorders.

17.11.2.8 Social Determinants of Health – EHA#9

It is not the intention of the cHIA to address social issues in detail. However, it is important to recognise the wellbeing and perceptions on quality of life have both a social and health basis. Impacts under this EHA can be summarised as:

- Change in morbidity and mortality data related to psychosocial distress such as depression, anxiety, substance abuse, and changes to family structure;
- Change in median household income;
- Change in unemployment;
- Change in the percentage of households living below poverty line;
- Change in educational attainment;
- With the expected population growth and influx of job seekers, who may bring their families along, household size may increase resulting in overcrowding;
- Construction workers and an influx of national and international people in search of economic opportunities are expected to put enormous pressure on the South African Police Services and immigration control;
- Increase in psychosocial problems, including depression as a result of retrenchment at decommissioning phase;
- A positive impact on poverty status for a number of people employed at the Project site; and
- Influx of people and increased income may result in illegal substances being available more freely.

17.11.2.9 Cultural Health Practices – EHA#10

The potential influx of people may result in an increase in the existing number of unregistered medical practices. More people are practicing and using traditional medicine which may contribute to reducing the health burden if they are trained and knowledgeable.

Conversely, these practices may include traditional healers who may obtain plants in (possibly) contaminated areas. An increase in the prevalence of malpractice by traditional healers may occur if the burden of disease increases due to a lack of health facilities or if there are more people with an increased income. Unscrupulous practices may result in negative health impacts.

17.11.2.10 Health Systems Issues – EHA#11

There are several healthcare facilities within the Makhado and Musina Local Municipalities and the greater Vhembe District Municipality. However, the capacity of these facilities remains a challenge. In terms of the proposed Project impacts, influx may create increased demand for what is already a scarce resource. This has the potential to create tension. Health information management is generally good in the health facilities that surround the proposed Project. This data is limited by the fact that diagnostics and human resource capacity is basic. However, it serves as the best form of health surveillance for the monitoring of health impacts if supported and managed well. Strategic investment in local health facilities can support this.

17.11.2.11 Non-Communicable Diseases – EHA#12

Industrial activities such as that of the proposed project has several implications for mental health and well-being, both for workers and the local community. Managing these expectations effectively is crucial to ensuring positive outcomes and mitigating potential negative impacts.

17.11.3 Significance Assessment

CONSTRUCTION PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**33**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
33				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**26.4**
OPERATIONAL PHASE:							
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	Medium	**3**	Long Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium to High**			**4**
SIGNIFICANCE RATING (WOM):				**Medium - ve**			**56**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
56				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium -ve**			**44.8**
DECOMMISSIONING PHASE:							
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	**3**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**33**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
33				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium -ve**			**26.4**
NO-Go OPTION:							
Should the ferrochrome smelter project not proceed, the current status quo will remain in Mopane – inclusive of lack of public health care facilities.							
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**			**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium -ve**			**27**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
27				**0.6**			
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**			**21.6**
CUMMULATIVE IMPACTS:							
Cumulative impacts are particularly important as they relate to the aggregate burden of exposure to environmental, social, and economic stressors on a community's health and well-being. These may include exposures to pollutants,							

noise, traffic, social displacement, mental health triggers, and strain on health services. Cumulative health impacts may arise when: Multiple developments occur within the same geographic area, leading to overlapping environmental or socio-economic changes; Communities are exposed repeatedly or chronically to stressors, even if each individual exposure is below a regulatory threshold; and Access to health care, housing, clean water, sanitation, and food is gradually eroded due to combined demands from multiple developments or changes in land use.						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	Medium	**3**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium to High**		**4**
SIGNIFICANCE RATING (WOM):				**Medium -ve**		**56**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
56				**0.8**		
SIGNIFICANCE RATING WITH MITIGATION:				**Low-ve**		**44.8**

17.12 Socio-Economic Assessment

17.12.1 Methodology Used

A study detailing the economic rationale for the establishment of the Musina-Makhado (MM) metallurgical cluster within the Special Economic Zone (SEZ) was conducted by Mintek in 2020. Another Socioeconomic Impact Assessment was also provided by Demacon as part of the EIA process for MMSEZ. Both reports are included as reference to the Specialist Studies accompanying the EIA report.

The desktop local and regional socio-economic analysis is based on local/regional socio-economic information. The regional information firstly elaborates on the legal and institutional framework, under which the Ferrochrome Smelter Project will operate. Secondly, it provides a detailed local and regional situation analysis for the provincial, district and surrounding communities. The data used in this study analysis were sourced from the district (Vhembe District) and local municipalities (Musina and Makhado) integrated development plans (IDPs).

Attention is primarily focused on four dimensions of information, namely demography, labour and employment, economic structure and performance, and infrastructure or access to services. Socioeconomic information is obviously not confined to these dimensions and the specialist undertaking the study also extend the analysis to include additional dimensions of information.

17.12.2 Description of Issues and Risks

The proposed ferrochrome smelter will have a huge beneficial economic input to the region – local and district municipalities - providing direct employment with well-planned training and the ongoing upgrading of skills. A large number of people will also be indirectly employed providing supplies and services. The multiplier effect of goods and services procurement during the operational life of the proposed smelter will also inject significant economic benefits in the local area and region.

The KDG ferrochome smelter will have the initial capital investment of over **R1.28 billion** for Phase 1 of the projectinto the Polokwane area. The monthly production and working capital of are approximately **R380 million** into the local economy of the Musina and Makhado area. A high percentage of locals around the proposed smelter are unemployed. KDG ferrochrome smelter will alleviates the unemployment problem to some extent, though it will does not eradicate it completely. Phase 1 will employ approximately 235 people permanently at the smelter with an estimated annual salary and labour costs of over **R52 million**.

Ramp-up for full production will realise a further construction and installation fo additional seven (07) smelter units to an overall capital investment of **R10.2 Billion** and a total labour force of 1880 people. The annual labour costs will increase to **R423 million**. Full production will be implemented within five (05) years from project start.

Local business will benefit by providing supplies and services to the smelter. Secondary industries are also likely to develop due the existence of the proposed KDG ferrochrome smelter. The life of operation for the proposed smelter is expected to be over 20 years, which translate to a definite 20 years and more of economic activity in the region.

Figure 112 outlines the various possible social change paths that can emanate from the proposed ferrochrome smelter operations.

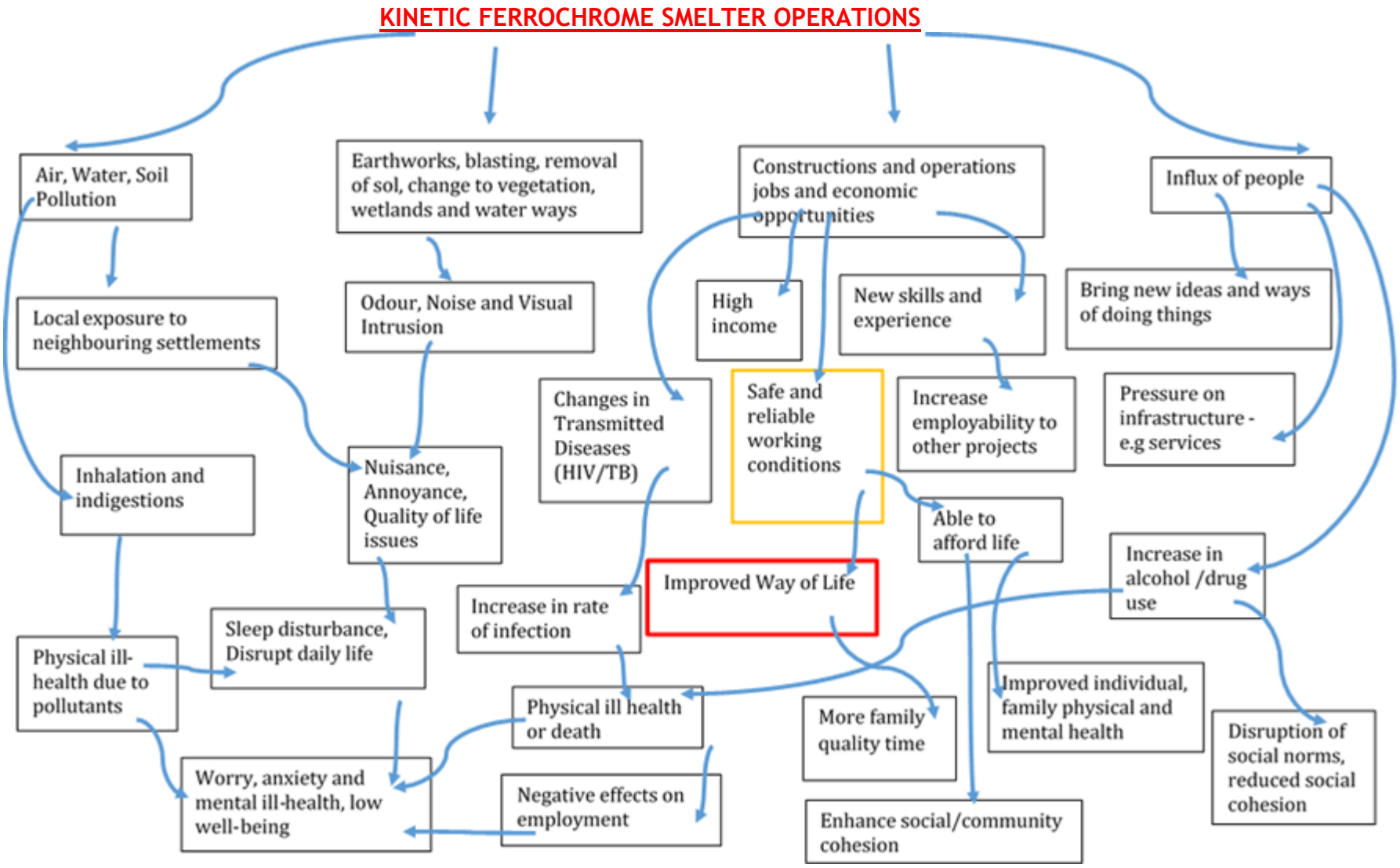
Construction and Operational Phase:
The impact will be positive to the local and regional economy and those who will get jobs at the smelter operations. The number of actual jobs and contracts that will be created render the smelter operation to be of **high positive** significance. This will further be enhanced by the possible secondary economic activities that may arise within Musina and Makhado Local Municipalities.

Increase in disposable income may create negative social impacts such as crime, alcoholism and prostitution in and around Mopane area, and adjacent settlements.

The proposed smelter will also stimulate development of other services in the area including schools, health care, recreational facilities, hotels/lodge, retail and banking.

Decommissioning and Closure:
KDG ferrochrome Smelter will inject revenue and income to Musina/Makhado towns and local residents during the 20 or more years life of operations. In addition, due to raw materials being sourced outside the proposed smelter premises the operational life of the smelter may go beyond the envisaged 20 years. Skilling and training of local people will make them more marketable to other industries in the region.

Figure 112: Potential Social Change Paths due to the Proposed Smelter Operations



17.12.3 Significance Assessment

CONSTRUCTION PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Medium	3	Medium-Term	**3**	Definite	**5**
WEIGHTING FACTOR:				**High**		**5**
SIGNIFICANCE RATING (WOM):				**Medium to High +ve**		**65**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
65				**0.6**		
SIGNIFICANCE RATING WITH MITIGATION:				**Medium +ve**		**52**
OPERATIONAL PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	High	**5**	Long Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**		**5**
SIGNIFICANCE RATING (WOM):				**High +ve**		**85**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
85				**1**		
SIGNIFICANCE RATING WITH MITIGATION:				**High +ve**		**85**
DECOMMISSIONING PHASE:						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**3**	Medium	**3**	Long-Term	**4**	Highly Likely	**4**
WEIGHTING FACTOR:				**Medium to High**		**4**
SIGNIFICANCE RATING (WOM):				**Medium +ve**		**56**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
56				**0.8**		
SIGNIFICANCE RATING WITH MITIGATION:				**Medium +ve**		**44.8**
NO-Go OPTION:						
The current high levels of employment and low economic empowerment and investment will remain in the adjacent communities – Mopane, Mudimeli, Mulambwane CPA and surrounding communities. Extreme poverty and low standards of living.						
EXTENT		**INTENSITY**		**DURATION**	**PROBABILITY**	
Ferrochrome Smelter Footprint	**2**	Low	**1**	Medium-Term	**3**	Likely	**3**
WEIGHTING FACTOR:				**Medium**		**3**
SIGNIFICANCE RATING (WOM):				**Low to Medium +ve**		**27**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME						
WOM				**ME**		
27				**0.8**		
SIGNIFICANCE RATING WITH MITIGATION:				**Low to Medium +ve**		**21.6**
CUMMULATIVE IMPACTS:						

Cumulative impacts of socio-economic change include job creation, indtrial development, improved quality of life, increase in crime, alcohol abuse, prostitutions, HIV and AIDS, other transmitted diseases, influx of foreign people and change in social fabric of the community.							
EXTENT		**INTENSITY**		**DURATION**		**PROBABILITY**	
Ferrochrome Smelter Footprint and Region	**3**	High	**5**	Long-Term	**4**	Definite	**5**
WEIGHTING FACTOR:				**High**			**5**
SIGNIFICANCE RATING (WOM):				**High +ve**			**85**
SIGNIFICANCE WITH MITIGATION (WM) = WOM x ME							
WOM				**ME**			
85				**0.8**			
SIGNIFICANCE RATING WITH MITIGATION:				**Medium to High +ve**			**68**

18.0 ASSESSMENT OF EACH IDENTIFIED POTENTIALLY SIGNIFICANT IMPACT AND RISK

18.1 Topography

Project Phase	Existing Impact	Project Impact – Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med	-Ve Med	-Ve Low/Med	-Ve Med	-Ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		Ve Med/High	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Change in the natural topography.
- Disturbance to geophysical and landscape features.
- Impacts of lowering of land elevation due to construction/operational activities.
- Construction of smelter infrastructure and office buildings.

18.2 Soils

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No Mitigate	Mitigate	No Mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve High	-Ve Med/High	-Ve Med/High	-Ve Med	-Ve Low/Med
Operational		-Ve High	-Ve Med/High			
Decommission		-ve Med/High	-Ve Med			

Environmental Impacts and Risks Identified:

- Loss of soil as vegetation growth medium.
- Loss of soil productivity.
- Erosion.
- Contamination of soils.

- Unsightly soil heaps around the smelter site.

18.3 Geology

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No Mitigate	Mitigate	No Mitigate	Mitigate	
Construction	-Ve Low	-Ve Low/Med	-Ve Low	-Ve Low/Med	-Ve Low	-Ve Low
Operational		-Ve Low/Med	-Ve Low			
Decommission		-Ve Low/Med	-Ve Low			

Environmental Risks Identified:

- Use and loss of geological resources in the area.
- Possible sterilization of minerals over the site.

18.4 Climate

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med	-Ve Low/Med	-Ve High	-Ve Med/High	-Ve Low/Med
Operational		-Ve High	-Ve Low/Med			
Decommission		-Ve Low/Med	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Greenhouse gas emissions – Smoke, Dust and Carbon Dioxide.
- Creation of microclimates.

18.5 Ecology and Bio-Diversity

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med/High	-Ve Med	-Ve Med/High	-Ve Med	-Ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		-ve Med	-ve Low/Med			

Environmental Impacts and Risks Identified:

- Disturbance of sites of conservation importance.
- Loss of species of conservation importance.
- Fragmentation and loss of habitats.
- Displacement of animal species, increased competition in areas where carrying capacity is already compromised.
- Biodiversity impacts.
- Spreading of invasive species.

18.6 Surface Water Resources

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med/High	-Ve Med	-Ve Med/High	-Ve Med	-Ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		-Ve Med	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Changes in natural surface water flow parameters.
- Disruption of stream banks and wetlands.
- Reduced catchment yield and water available to downstream users and environments.
- Flooding.

- Changes to water regime of pans, wetlands and affected streams.
- Contamination of surface water.
- Changes to water quality.
- Sedimentation of downstream areas.
- Decant / release of contaminated water to the environment.

18.7 Groundwater

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med/High	-Ve Med	-Ve Med/High	-Ve Med	-ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		-ve Med	-ve Med			

Environmental Impacts and Risks Identified:

- Contamination of groundwater.
- Impact on boreholes in area affected by draw down.
- Over abstraction of borehole water.

18.8 Landuse and Capability

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No Mitigate	Mitigate	No Mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve High	-Ve Med/High	-Ve Med/High	-Ve Med	-Ve Low/Med
Operational		-Ve High	-Ve Med/High			
Decommission		-ve Med/High	-Ve Med			

Environmental Impacts and Risks Identified:

- Loss of undisturbed space.

- Disruption of land uses.
- Damage to and disruption of existing services and infrastructure.
- Change in land use.
- Loss of agricultural land.

18.9 Noise

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Low/Med	-Ve Low/Med	-Ve High/Med	-Ve Low/Med	-Ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		-ve Low/Med	-ve Low/Med			

Environmental Impacts and Risks Identified:

- Increase in ambient noise levels.
- Disturbances to sensitive receptors.

18.10 Air Quality

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Low/Med	-Ve Low/Med	-Ve High	-Ve Med	-Ve Low/Med
Operational		-ve High	-Ve Med			
Decommission		-ve Low/Med	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Increase in dust level.
- Fallout dust nuisances.
- Air quality impacts on surrounding residents.

- Smoke, dust, carbon dioxide and other emissions.
- Health impacts due to fine particulate emissions and gaseous emissions.

18.11 Heritage, Cultural and Archaeological Aspects

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Low	-Ve Low	-Ve Low/Med	-Ve Low/Med	-Ve Low/Med
Operational		-Ve Low/Med	-Ve Low			
Decommission		-Ve Low/Med	-Ve Low			

Environmental Impacts and Risks Identified:

- Disturbance of graves, stone-age sites, iron age, historical age and other heritage sites and artefacts.
- Establishment of ferrochrome smelter and associated infrastructure.

18.12 Socio-Economic Aspects

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	+Ve Low/Med	+ve Med/High	+ve Med	+ve High	+ve Med/High	+Ve Low/Med
Operational		+ve High	+ ve High			
Decommission		+ve Med	+ve Med			

Environmental Risks Identified:

- Economic benefits and risks.
- Increased theft risk and potential for damage to private property during the construction phase.
- Impacts on neighbours and landowners.
- Impact on property/farm values.
- Influx of job seekers during construction phase.

- Provision and availability of adequate chrome supply.
- Industrial development and change of livelihoods.
- Poverty alleviation and job creation.

18.13 Visual Aspects and Sense of Place

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Med	-Ve Med	-Ve Med/High	-ve Med	-ve Low/Med
Operational		-Ve Med/High	-Ve Med			
Decommission		-ve Med	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Changes to landscape character, visual appeal and sense of place of the area.
- Visual intrusion.

18.14 Public Health

Project Phase	Existing Impact	Project Impact Ferrochrome Smelter		Cumulative Impacts		No-Go Option
		No mitigate	Mitigate	No mitigate	Mitigate	
Construction	-Ve Low/Med	-Ve Low/Med	-Ve Low/Med	-Ve Med	-ve Med	-ve Low/Med
Operational		-Ve Med	-Ve Med			
Decommission		-ve Low/Med	-Ve Low/Med			

Environmental Impacts and Risks Identified:

- Vector related diseases.
- Acute respiratory infections.
- Sexually transmitted diseases.
- Soil, water and waste related diseases.

- Food, nutrition related issues.
- Accidents and injuries.
- Exposure to hazardous materials, noise and bad odours
- Social determinants of health
- Health system issues
- Non-communicable disease.
- Visual intrusion.

19.0 SUMMARY OF SPECIALIST REPORTS

Specialist Study	Specialist Recommendations	Report Section	Appendix
Air Quality Airshed Planning Professionals	It is the specialist's opinion that the project can be authorised if the design of the plant ensures compliance with the Subcategory 4.9 MES and the above recommendations are taken into consideration in the Environmental Management Plan for the project. Simulated daily and annual PM10 and PM2.5 concentrations, as well as simulated annual average SO2 and NO2 concentrations, are in compliance with the NAAQS for all areas outside the Kinetic Project boundary, including at all identified sensitive receptor locations.	8.8 17.6 18.10	8A
Biodiversity, Ecology and Wetlands Redkite Environmental Solutions	The results of this study indicate that the site area is not in a Critical Biodiversity Area but is located within an Ecological Support Area 1, which is basically the entire area east of the Musina town and which forms part of the Vhembe Biosphere Reserve. A conclusion is that the results of the Screening Tool for animals is disputed, the proposed development would not seriously affect the mammal populations of the Mopaneveld. The proposed development may be supported. The proposed development will not affect amphibia species. The low aquatic biodiversity sensitivity and low plant species sensitivity is confirmed. It is suggested that the proposed development be supported.	8.4 17.3 18.5	8B
Surface Water Redkite Environmental Solutions	No significant watercourses, riparian areas or wetlands are located within 100 m of the project footprint, based on the study. Impacted drainage lines are non-perennial and expected to be of medium sensitivity. Therefore, in terms of surface water features, the entire project footprint and 100 m project area buffer is expected to be of medium sensitivity. Due to the high risk with the activities, high extent, as well as the potential intensity of the impacts, and taking into account the implementation of the recommended mitigation measures the cumulative risk should be in the region of medium to high significance.	8.5 17.4 18.6	8C

Noise Impact Assessment Enviro Acoustic Research	Though there is a potential for a noise impact during the construction and operational phases, the noise impact can be mitigated to a low significance. This finding is only relevant to the Ferrochrome project. Six-monthly noise monitoring is also recommended. While the development of the proposed smelter (and MMSEZ) project will elevate noise levels in the area, the noise impact can be mitigated and it is recommended that the Ferrochrome projects be authorized.	8.7 17.9 18.9	8D
Groundwater Assessment Geo Pollution Technologies – Gauteng (Pty) Ltd	Conduct a detailed assessment to identify potential contaminant sources. The study must include determining the types of chemical substances used during operations and performing a waste classification study on industrial materials and waste generated at the site. This should be done once the planned industries become operational. The assessment should incorporate the identification of potential contamination locations and improve understanding of the nature, extent, and environmental impact of waste production. Conduct bi-annual water level monitoring at the abstraction boreholes and additional selected boreholes within the anticipated cone of depression. (Once abstraction begins) After construction and the start of industrial activities, install a limited number of monitoring boreholes downstream of likely contamination sources. Coordinate the selection of these downstream monitoring locations with the waste classification assessment. These boreholes should be monitored on a bi-annual basis according to the report recommendations for analysis.	8.6 17.5 18.7	8E
Heritage Impact Assessment A Pelser Archaeological Consulting	From a Cultural Heritage point of view, the proposed Kinetic Development Group Limited ferroalloys/ferrochrome smelter plant development should be allowed to continue once the recommended mitigation measures provided above has been implemented. The often-subterranean nature of cultural heritage resources (including low stone-packed or unmarked graves) should always be taken into consideration. Should any previously unknown or invisible sites, features or material be uncovered during any development actions then an expert should be contacted to investigate and provide recommendations on the way forward.	8.11 17.9 18.11	8F

Public Participation Process Gudani Consulting		7.0	5
Socio-Economic Impact Assessment Gudani Consulting Demacon	South Africa is a developing country with extremely high levels of poverty and crime rate. The concept of Special Economic Zone (SEZ) – including the proposed ferrochrome smelter - is intended to accelerate economic growth, development, job creation and poverty alleviation in Limpopo through: Promoting industrialisation; Facilitating increased trade and investment, Supporting the development of sustainable enterprises; and Ensuring infrastructure development – within the framework of sound environmental assessment and management of impact to achieve sustainable development.	8.14 17.12 18.12	8H
Soil, Land Capability, Land-Use Rehab Green	In terms of approval or not, it should be clear that the development in principle is not opposed. However, the current layout that will significantly fragmentize agricultural units is not acceptable and approval thereof is therefore not recommended. It is recommended that the layout is refined to lessen the fragmentation as far as possible or it should be substantiated why this layout is the only or best option.	8.2 17.2 18.2	8I
Visual Impact Assessment Eco Elementum	Considering the characteristics of the affected environment, the viewshed and visual exposure results and the impact assessment, the proposed Project is supported from a visual perspective. However, the support of the proposed Project is subject to the strict implementation of the recommended mitigation measures and action plans throughout the proposed Project life. It is further recommended that the environmental authorities consider the results of this assessment before a final decision is made regarding the status of the proposed Project.	8.12 17.10 18.13	8J
Climate Change Airshed Planning Professionals	The impact of the project on climate change was assessed to have a high negative risk rating. The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan. From the perspective of climate change, it is the opinion of the specialist that the project be considered for authorisation, on condition that GHG emissions are reported annual according to legal requirements and that a GHG mitigation plan be established.	8.9 17.8 18.4	8K
Health Impact Assessment Naira Environmental Consultants	The Musina-Makhado Special Economic Zone (MMSEZ) presents significant opportunities for regional industrial growth, economic development, and job creation. However, its implementation also introduces potential risks to community health and well-being, particularly in relation to air	8.13 17.11 18.14	8L

	and water pollution, occupational hazards, vector-borne diseases, and increased pressure on local health systems and infrastructure. The project may be allowed to proceed provided that the recommended mitigation measures are rigorously followed and effectively integrated into the EMPR. This condition will help ensure that potential negative health impacts are minimized, while public health and environmental safety are safeguarded throughout the project's lifecycle. In conclusion, the true success of the MMSEZ should not only be assessed by its economic performance but also by its capacity to protect and promote the health and well-being of surrounding communities. A coordinated, health-informed approach guided by this CHIA will be vital in achieving a balanced and sustainable development path.		
Geotechnical Investigations Geo Equilibria	It is recommended that the structural engineer determine the best economical foundation preference for the proposed development based on the type of development based on the different available construction methods. Conditions prevailing at the site suggest that no problems are foreseen for the development of the proposed structures, provided the recommendations outlined in the report are adhered to. It must be understood that the ground conditions described in this report refer specifically to those encountered at the inspection positions on site. It is therefore possible that conditions at variance with those discussed above may be encountered elsewhere on the property. In terms of the geotechnical information gained from the investigation, the site is suitable for the proposed development.	X	8M

20.0 SUMMARY OF THE KEY FINDINGS

20.1.1 Summary of Key Findings of the Environmental Impact Assessment

20.1.1.1 Soils and Landuse

- The soils in the project are of medium to high fertility.
- It appears, however, that agricultural practices at the project area are not executed optimally.
- The proposed development will certainly cause unnecessary fragmentation of agricultural activities.
- The current proposed development consists of 4 structure footprints, covering a total of 1280 ha, that spreads over 4 farms and each footprint occupies approximately 10-40% of the farm on which it occurs.

20.1.1.2 Climate

- Scope 1 and Scope 2 emissions for the project operations is 11 414 285 tCO_2e over the 20-year life of the project (~570 714 tCO_2e per annum) and making up 71% and 29% of the total GHG emissions for the project respectively.
- The project activities would contribute approximately 0.16% of the remaining carbon budget per year and represent a contribution of 0.13% (operation) to the 2022 National GHG inventory total. The impact significance is therefore considered to be high.
- The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.

20.1.1.3 Ecology and Bio-Diversity

- The results of this study indicate that the site area is not in a Critical Biodiversity Area but is located within an Ecological Support Area 1, which is basically the entire area east of the Musina town and which forms part of the Vhembe Biosphere Reserve.
- No red data plant species occur, though three nationally protected trees Adansonia digitata (baobab) and Sclerocarya birrea (marula) and Boscia albitrunca and the provincially protected tree Boscia foetida occur on the site.
- Only the drainage lines have high ecological sensitivity but is very small and shallow and allocated High sensitivity.
- The low aquatic biodiversity sensitivity and low plant species sensitivity is confirmed.

20.1.1.4 Surface Water

- The project area is located in the A71K quaternary catchment, which is designated as a Freshwater Ecosystem Priority Area (FEPA).
- The project area is not located in a Strategic Water Source Area (SWSA).
- Multiple drainage lines were identified within and around the project site.
- All drainage lines in and around the activities are non-perennial.
- The site drains through two non-perennial unnamed tributaries of the Sand River on the north-eastern and north-western sections of the site. These drainage lines converge north of Mopane before the confluence with the Sand River further north.
- The area is largely undeveloped with limited mining and livestock being the main uses in the areas surrounding the sites.
- From the assessment, there appears to be no wetlands within 500 m of the project footprint, which is supported by the 1:50,000 ortho-maps, as well as the NFEPA database.

- No significant watercourses, riparian areas or wetlands are located within 100 m of the project footprint, based on the study. Impacted drainage lines are non-perennial and expected to be of medium sensitivity.

20.1.1.5 Groundwater

- The aquifer system in the study area can be classified as a Sole Aquifer System.
- Most boreholes show exceedances in several water quality parameters based on drinking, domestic, and industrial use standards.
- The GDT calculated a aquifer vulnerability value of 34%, which is medium.
- Production-related groundwater abstraction during both construction and operational phases are modelled to lower the water table in the vicinity of the production boreholes.
- Conduct bi-annual water level monitoring at the abstraction boreholes and additional selected boreholes within the anticipated cone of depression.
- The risk of contamination to the aquifer at this site is considered negligible due to the presence of a thick vadose zone, low recharge potential. The impacts on groundwater are found to be of low to medium negative significance.

20.1.1.6 Noise

- Medium significance for the daytime construction activities. This noise impact relates to high noise levels at NSR09, mostly due to construction activities associated with the Ferrochrome project.
- High significance for the night-time construction activities, even though there might be fewer night-time activities than daytime construction activities. This noise impact relates to high noise levels at NSRs 09 (construction activities associated with the Ferrochrome project).
- High significance for the daytime operational activities. This noise impact relates to high noise levels at NSR 05 and 09. Mitigation.
- High significance for the night-time operational activities. This noise impact relates to high noise levels at NSR 05 and 09, though noise levels may be elevated at the ferrochrome project project.

20.1.1.7 Air Quality

- The wind field for the area is dominated by easterly flow. The east-northeasterly wind flow is more dominant during the day, with increased flow from the east-southeast during night-time conditions.
- Identified sensitive receptors in the study area include the small village of Mopane, approximately 2 km to the north-west of the Kinetic Project, as well as an individual homestead to the north of the R525 road, and two homesteads approximately 2 km to the southwest of the Kinetic Project.
- The main sources of existing air pollution in the study area and surrounds include mining activities, agricultural activities (both commercial and subsistence farming), transportation activities (including vehicle entrainment and exhaust from private and public roads).
- Atmospheric emissions at the Kinetic Project will arise from tapping and charging of the submerged arc furnaces, transporting and handling of raw materials and ferrochromium alloy products, handling and deposition of slag, crushing of ferrochromium alloy product and various process emissions, which are served by dedicated extraction points and vented to the atmosphere through elevated stacks, these include dust removal from dry material handling, dust removal from raw material batching, taphole fume extraction and charging dust removal and primary dust removal and treatment of submerged arc furnace off-gas.
- Simulated daily and annual PM_{10} and $PM_{2.5}$ concentrations, as well as simulated annual average SO_2 and NO_2 concentrations, are in compliance with the NAAQS for all

areas outside the Kinetic Project boundary, including at all identified sensitive receptor locations.

20.1.1.8 Heritage, Cultural and Archaeological Aspects

- No Stone Age sites (including rock art) are known to occur in the immediate study area.
- There are no known Iron Age sites (EIA or LIA) in the immediate study area, although a large number of EIA to LIA sites are known to exist in the larger geographical landscape
- Two sites of historical significance were recorded in May 2025, but other than these no additional historical period sites were identified and recorded here.
- The status of the impact is considered as low negative significance since no cultural and heritage resources have been encountered within the proposed ferrochrome Smelter footprint and site.

20.1.1.9 Socio-Economic

- The impact will be positive to the local and regional economy and those who will get jobs at the smelter operations.
- The envisaged capital investment for the project ranges from R1.2 billion in the first phase to R10.2 billion at full production.
- The project will result in job creation and poverty alleviation in the area.
- Increase in disposable income may create negative social impacts such as crime, alcoholism and prostitution in and around Mopane area, and adjacent settlements.

20.1.1.10 Public Health

Low to medium impacts in the following environmental health areas:

- Vector related diseases.
- Acute respiratory infections.
- Sexually transmitted diseases.
- Soil, water and waste related diseases.
- Food, nutrition related issues.
- Accidents and injuries.
- Exposure to hazardous materials, noise and bad odours
- Social determinants of health
- Health system issues
- Non-communicable disease.
- Visual intrusion.

20.1.1.11 Visual Impacts

- Visual impacts of medium negative significance are expected during the construction phase of the proposed Project as a result of site clearance and project establishment activities.
- The remaining impacts within the construction phase, relating to construction waste generation and night lighting, are of low to medium negative significance.
- During the operational phase, impacts of high negative significance are expected on the total study areas unique sense of place and landscape character.
- Although the total study area has a moderate level of VAC created by the natural vegetation and topography, impacts of medium to high negative significance are expected post-mitigation due to the proposed Projects location within a mostly natural and undeveloped area.
- Regarding the visual impact on the identified visual receptors within the total study area during this phase, medium to high negative significance impacts are expected before the implementation of the recommended mitigation measures. The

significance of these impacts can be reduced to a medium negative significance post-mitigation.
- The impacts relating to night lighting, and increased human activity, operational vehicles and heavy machinery during the operational phase are of low to medium negative significance.
- The visual impacts expected during the decommissioning phase are of low to medium negative significance.

20.1.2 Final Site Map

Please refer to Appendix 4

20.1.3 Summary of Positive and Negative Implications and Risks of the Proposed Activity and Identified Alternatives

The site for the proposed ferrochrome/ferroalloys smelter project operations are within the already approved MMSEZ industrial area by LDEDET and Limpopo Government. The direct surface owners of the applicable farms – Mulambwane CPA have no objection to the proposed MMSEZ development. The No-Go option is the only other alternative identified during the scoping phase, which has been discussed in detail as part of the EIA/EMP phase.

The proposed ferrochrome smelter project is within the already approved MMSEZ area. The No-Go option is the only other alternative identified during the scoping phase, which has also been discussed in detail as part of the EIA/EMP phase – including the mitigation hierarchy. The positive and negative implications of the proposed ferrochrome smelter project is indicated for those aspects that have positive impacts – socio-economic. All other environmental aspects only have negative impacts and are described in other sections of the report in terms of the impacts that could occur.

Table 77: Summary of the Positive and Negative Implications and Risks of the Proposed Activity and Identified Alternatives

Aspect	Positive implications / risks	Negative implications / risks
Socio-Economic	**Construction and operational phase:** Creation of employment opportunities Contribution to local economy; Regional economic development; Community development; Training of local people / Skill transfer and development; Creation of local procurement opportunities; Poverty alleviation and improved standard of living.	**Construction and operational phase** Influx of job seekers to site Traffic congestion Site disturbance by local business forums Health and Safety Risk **Closure phase:** Loss of employment Reduced local and regional activity Reduced community development investments

21.0 PROPOSED IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES FOR INCLUSION IN THE EMP

All aspects have been identified and included in the EMPr.

22.0 ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORIZATION

- The impact of the project on climate change was assessed to have a high negative risk rating. The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.

- From the perspective of climate change, it is the opinion of the specialist that the project be considered for authorisation, on condition that GHG emissions are reported annual according to legal requirements and that a GHG mitigation plan be established.

23.0 DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINITIES AND GAPS IN KNOWLEDGE

23.1 Soil, Landuse and Land Capability Assessment

23.2 Climate Change

- Emissions due to project construction activities as insufficient detailed information was available for the assessment.
- Scope 3 emissions due to project operational activities as insufficient detailed information was available for the assessment.
- The diesel used for on-site mobile equipment was calculated based on the distance the trucks would travel assuming a capacity of 30 tonnes and a fuel consumption of 40 litres per 100 km.
- Scope 3 emissions were not quantified as insufficient upstream and downstream information was available for this assessment.

23.3 Ecology and Biodiversity

- It is assumed that all relevant project information provided by the applicant to the ecological specialist was correct and valid at the time that it was provided.
- A site survey was conducted in April 2025 which is generally in the dry season for the region. However, the rain season was extended, and the timing of the site visits was thus optimal, and the seasonal constraints on the comprehensiveness of the botanical findings are considered to be low.
- The vegetation is locally very dense, but in certain areas somewhat disturbed and degraded. The herbaceous layer is scanty and showed signs of long-term overgrazing. Access was limited due to the very limited road network and local very dense woody vegetation.

23.4 Surface Water and Wetlands

- The study was conducted with up to date resources. It might however be possible that additional information become available in time, because environmental impact assessments deal with dynamic natural ecosystems. It is therefore important that the report be viewed and acted upon with these limitations in mind.
- Field survey was also conducted for this assessment and all results given within this document are based on findings and assessments. Use was made of aerial photographs, digital satellite imagery, as well as provincial and national databases to identify areas of interest.
- Although all possible measures were undertaken to ensure all drainage lines were identified to form part of the assessment, some smaller ephemeral drainage lines may have been overlooked. Watercourses were not delineated as part of the Scope of Work of this assessment. Watercourses identified in this report were obtained from the National Geo-spatial Information (NGI), a component of the Department of Agriculture, Land Reform and Rural Development (DALRRD).
- The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information.

23.5 Groundwater

- Conduct a detailed assessment to identify potential contaminant sources. The study must include determining the types of chemical substances used during operations and performing a waste classification study on industrial materials and waste generated at the site. This should be done once the planned industries become operational. The assessment should incorporate the identification of potential contamination locations and improve understanding of the nature, extent, and environmental impact of waste production.

23.6 Noise

Ambient sound levels are the cumulative effects of innumerable sounds generated at various instances both far and near. A high measurement may not necessarily mean that the area is always noisy. Similarly, a low sound level measurement will not necessarily mean that the area is always quiet, as sound levels will vary over seasons, time of day, dependant on faunal characteristics (mating season, dawn chorus early hours of the morning, temperature etc.), vegetation in the area and meteorological conditions (especially wind).

Selecting an ideal measurement location could be difficult, with various criteria assessed to identify the viability of a certain location as a point to define ambient sound levels. When selecting a measurement location, the most important criteria would be:

1. Security of the instrument (minimise risk to the technician; prevent theft; sabotage of the equipment);

2. Safety of the equipment (ensure that it does not prevent, interfere or limit typical agricultural or household activities; ensure that the instrument are not in a location where an animal could damage the instrument); and lastly,

3. The suitability of the measurement location to define ambient sound levels (the presence of certain trees or equipment, wetland or other water resources will influence ambient sound level significantly).

As such, after ensuring that the instrument is safe and secure, there are various environmental factors that could influence ambient sound levels measured. These constraints and limitations are discussed below and could include:

- Seasonal changes in the surrounding environment can influence typical ambient sound levels, as many faunal species are more active during warmer periods than the colder periods. As an example, cicada is usually only active during warmer periods. Certain cicada species can generate noise levels up to 120 dB for mating or distress purposes, sometimes singing in synchronisation magnifying noise levels they produce from their tymbals;

- Defining ambient sound levels using the result of one 10-minute measurement may be very inaccurate (very low confidence level in the results) relating to the reasons mentioned above, and measurements over a longer-term period is critical;

- Some equipment that could influence measurements may be missed when deploying instruments, or, the equipment may not the audible. This could include equipment such as hidden water pumps and associated pipelines and outflows, ESKOM stepdown transformers, hidden compressors, inverters, condensers or other electrical equipment, etc. While not audible during deployment, such equipment may significantly influence ambient sound levels during quiet periods;

- Type, the number and sizes of trees in the vicinity of the instrument, as well as the distances between the microphone and these trees. Certain trees, especially fruiting trees could attract birds and other animals that will significantly impact on ambient sound levels;

- Type and number of animals in the vicinity of the microphone. Dogs, chickens, geese, etc. generate different noises randomly both night and day, and other livestock (sheep, goats, cattle, horses, etc.) kept in enclosures will also raise noise levels, especially if these animals are penned in large numbers;

- Measurements over wind speeds of 3 m/s could provide data influenced by wind-induced noises. However, when determining the ambient sound levels associated with increased wind speeds, it is desired to measure ambient sound levels at higher wind speeds;

- Ambient sound levels recorded near rivers, streams, wetlands, trees and bushy areas can be high due to faunal activity which can dominate the sound levels around the measurement point (specifically during summertime, rainfall event or during dawn chorus of bird songs). This generally is still considered naturally quiet and accepted as features of the natural environment, and in various cases sought after and pleasing. Ambient sound level data measured in such area however should not be used to develop an opinion in the potential prevailing ambient sound levels in the larger area;

- Exact location of a sound level meter in an area in relation to structures, infrastructure, vegetation, wetlands and external noise sources will influence measurements. It may determine whether you are measuring anthropogenic sounds from a receptors dwelling, or environmental ambient baseline contributors of significance (faunal, roads traffic, railway traffic movement etc.); and

- As a residential area develops the presence of people will result in increased dwelling related sounds. These are generally a combination of traffic noise, voices, animals and

equipment (incl. TV's and Radios). The result is that ambient sound levels will increase as an area matures.

- Ambient sound levels were measured considering these limitations, and, it is the opinion of the Author that sufficient data was collected to ensure a high confidence in the resulting information.

23.7 Heritage and Cultural Aspects

- Dense vegetation cover in sections of the project area limited visibility and mobility on the ground, although there were also some more open areas that could be focused on.

23.8 Socio-Economic Aspects

- Possible old and outdated statistical data from Stats SA.
- Use of Musina and Makhado Local Municipalities IDP Documents.

23.9 Visual Aspects and Sense of Place

- This VIA was undertaken during the planning stage of the proposed Project and is based on the information available at that time. It is assumed that all information regarding the proposed Project details provided by the Applicant and Client is correct and relevant to the proposed Project.
- Visual impacts beyond 10 km from the proposed Project are considered to be so reduced that it is almost negligible even if there is direct line of sight. Therefore, the core study area for the proposed Project is defined as the area with a radius of not more than 10 km from the proposed Project and the total study area is defined as the area with a radius of 15 km from the proposed Project.
- Where infrastructure heights were not available, the heights were extracted from the VIA conducted for the MMSEZ in 2019.
- Due to the lack of available and usable spatial data at the time of this assessment relating to the proposed Project, only the plant area and exhaust stacks were included in the visual analysis. Only this infrastructure was included in the visual analysis since these infrastructure types are expected to represent the tallest components of the proposed Project.
- At the time of this assessment, the location of the infrastructure within the proposed Projects site boundaries was not available in a usable GIS format for the visual analysis. Therefore, the point locations were assumed using GIS methods:
- To represent the worst-case scenario, the point locations of the plant area covered the site boundaries.
- The exhaust stack point locations were located only at the centroid of each site boundary as it is assumed that there will be minimal exhaust stacks as compared to the plant infrastructure. Furthermore, since the topography underlying the site boundaries is relatively flat, the expected viewshed of the exhaust stacks located at the centre of the site boundaries is expected to be similar to the resulting viewshed should the exhaust stacks be located elsewhere within the site boundaries.
- Additionally, it was ensured that the point locations were distributed systematically across the site boundaries to ensure that the entire area of the site boundaries were represented.
- The Screening Tool Report as per Regulation 16 (1)(v) of the EIA Regulations (2014, as amended) was not available at the time of this assessment therefore, a site sensitivity

verification relating to any landscape sensitivities was not undertaken as part of this assessment.

- Comments regarding landscape and visual impacts raised by Interested and Affected Parties (I&APs) during the scoping phase of the proposed Project related mostly to the impact of the proposed Project on the tourism and the natural beauty of the land and environment of the area. While this VIA does not directly address each comment, the VIA does consider and address the potential visual and landscape impacts of the proposed Project on the total study areas sense of place, landscape character and surrounding visual receptors.
- This VIA and all associated mapping have been undertaken for the worst-case scenario with the layout and data provided.
- It is assumed that there are no alternative locations for the infrastructure, therefore only the proposed Project site was assessed.
- Visual perception is by nature a subjective experience, as it is influenced largely by personal values. For instance, what one viewer experiences as an intrusion in the landscape, another may regard as positive. Such differences in perception are greatly influenced by culture, education, and socio-economic background. A degree of subjectivity is therefore bound to influence the identification of visual impacts. To limit such subjectivity, a combination of quantitative and qualitative assessment methods were used. A high degree of reliance has been placed on GIS-based analysis viewsheds, visibility analyses, and on making transparent assumptions and value judgements, where such assumptions or judgements are necessary.
- The GIS tools used to quantify the overall visual exposure levels only incorporates the variables as described in this report. Factors such as real time and micro scale vegetation are not considered, thus the actual level of visual exposure may be lower or higher depending on the updated land use in the vicinity or latest vegetation growth/height on a micro and macro scale. The results are by no means a rating of visual quality; it is rather used to determine the likelihood of the proposed Project being visible from the visual receptors.
- The results generated in GIS cannot be guaranteed as 100% accurate. Some critical viewpoints/receptors, which are indicated on the viewshed as being inside of the viewshed, can be outside of the viewshed. This is due to the change of the natural environment by surrounding activities as well as natural vegetation that play a significant role and can have a positive or negative influence on the viewshed.
- The modelling of visibility is merely conceptual. Being based on the ALOS DSM, it does not fully consider the real-world effect of buildings, trees etc., that could shield the structures from being visible or could have changed over time. The viewshed analysis therefore signifies a worst-case scenario.
- The identified visual receptors in the area may differ from those present as some areas may not have been successfully identified from the imagery.
- Any uncertainties resulting from the assumptions and limitations do not substantially affect the results/findings so as to make the VIA fatally flawed.

23.10 Public Health

This HIA has focused on understanding the high-level health issues associated with the proposed ferrochrome smelter Project site. The HIA also assessed health data gaps that may exist and determined whether additional information would be required to inform a more comprehensive health evidence-base.

The gap analysis included a critical appraisal of data quality of sources identified during the HIA process. The following are the recognised limitations of the HIA study:

- As the proposed Project is still in the planning phase, several parameters required for the air quality modelling (conducted by Airshed Planning) were unavailable.

Average values from the literature were used for many of the parameters, and in some cases, conservative estimates and 'worst case' values were used in their model.

- The HIA study often refers to local level data which has some limitations that need to be understood and respected. Recording and reporting of the health data within the visited Healthcare facilities is completed manually, and it is likely that the recording may lack required accuracy. However, this information is invaluable in understanding the health challenges in the area, although the limitation must be considered when evaluating information, as its ability to be used as a robust baseline and to monitor relevant health impacts is limited; and
- Interviews and any other discussions are normally based on respondents' self-declaration which may be prone to recall or response bias. Moreover, when it comes to questions on one's private life, study participants tend to be affected by a social desirability bias, where they may choose to give answers that are socially acceptable.
- This HIA must be viewed as a prospective / predictive study as there has as yet been no initiation of any construction activities on the proposed site.

24.0 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

24.1 Reasons Why the Activity Should be Authorized or Not

Kinetic Development Group has assessed all potential impacts that could occur as a result of the new activities and comprehensive management measures has been identified for implementation to reduce the impact rating of the identified impacts as far as possible. Taking the current economic climate of the country in to consideration as well as the positive socio-economic impacts that the current and the proposed activities will ensure for the foreseeable future, and the impact rating after the implementation of the management measures, it is believed that the balance between environment, social and economics will be maintained and thus the activities should be authorised.

24.2 Conditions that must be included in the Authorization

- The impact of the project on climate change was assessed to have a high negative risk rating. The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.
- From the perspective of climate change, it is the opinion of the specialist that the project be considered for authorisation, on condition that GHG emissions are reported annual according to legal requirements and that a GHG mitigation plan be established.
- Recommendations made by specialist need to be implemented as far as practical and possible.
- Monitoring and audits as outlined in the EMPr need to be conducted as per the locations, aspects and frequencies specified.
- An offset strategy for the impacted groundwater should be agreed upon between KDG and DWS.

24.3 Period for Which the Authorization is Required

The maximum timeframe of 30 years for the construction, operation and rehabilitation for the KDG ferrochrome smelter is proposed from the date that the Environmental Authorisation is granted.

25.0 UNDERTAKING

Undertakings by the EAP and Applicant are included in Part C of this document.

26.0 FINANCIAL PROVISION

The aim of financial provisions is to ensure that the necessary funds are available for the rehabilitation and restoration of the disturbed environmental area to an acceptable state. The holder of an environmental authorization and project proponent remains responsible for any environmental liability, pollution or ecological degradation, and the management thereof.

26.1 Explain How the Aforesaid Amount was Determined

The life of operations and decommissioning for the proposed ferrochrome smelter is based on the principles described in the environmental management programme (EMP) report and rates calculated as per Department of Minerals and Energy (DMRE) approved rates for financial provision. The estimated life of construction, operations and decommissioning KGG ferrochrome smelter is thirty (30) years.

The following ferrochrome smelter working areas and infrastructure have been included in the current closure costing calculation:

▪ High-carbon ferrochrome production workshop ▪ Chromium furnace baking workshop (reserved) ▪ Raw materials, batching and feeding system ▪ Charcoal dry ▪ 132KV (power supply) substation and the capacitor compensation ▪ Device ▪ machine repair shop ▪ Electrode shell production workshop ▪ Raw material storage yard, spare parts warehouse, finished product warehouse, etc ▪ slag disposal area	▪ Furnace gas purification and dust removal system ▪ Dust removal system in the production area ▪ Compressed air preparation ▪ Raw materials into the factory, finished products factory ▪ loadometer duty room ▪ Fire protection, safety, environmental protection and other basic facilities ▪ General map of transport and roads, walls, gates ▪ Factory area office building ▪ Laboratory room
▪ Power supply and distribution, electrical control, automation ▪ instruments, telecommunications facilities ▪ Whole-plant control system ▪ Industrial TV monitoring system	▪ Water source is connected to the production plant purification ▪ water supply system ▪ Net ring water system ▪ Turbring water system ▪ Production and living water supply and drainage system ▪ Whole-plant fire protection system ▪ Ventilation and air-conditioning system

CALCULATION OF THE QUANTUM (FLAT RATES - AVERAGE CPI)

Applicant: KDG FERROCHROME SMELTER
Evaluators: GUDANI CONSULTING
Ref No: LEDET REFERENCE: 12/1/9/2-V196
Date: Jul-25

No.	Description	Unit	A Quantity	B Master Rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
1	Dismantling of processing plant and related structures (including overland conveyors and powerlines)	m3	500000	21.87	1	1	R10 935 000.00
2 (A)	Demolition of steel buildings and structures	m2	50000	304.68	1	1	R15 234 000.00
2(B)	Demolition of reinforced concrete buildings and structures	m2	10000	449	1	1	R4 490 000.00
3	Rehabilitation of access roads	m2	100000	54.52	1	1	R5 452 000.00
4 (A)	Demolition and rehabilitation of electrified railway lines	m	0	529.18	1	1	R0.00
4 (A)	Demolition and rehabilitation of non-electrified railway lines	m	0	288.64	1	1	R0.00
5	Demolition of housing and/or administration facilities	m2	5000	609.36	1	1	R3 046 800.00
6	Opencast rehabilitation including final voids and ramps	ha	0	310 130.00	1	1	R0.00
7	Sealing of shafts adits and inclines	m3	0	163.56	1	1	R0.00
8 (A)	Rehabilitation of overburden and spoils	ha	10	212 953.80	1	1	R2 129 538.00
8 (B)	Rehabilitation of processing waste deposits and evaporation ponds (non-polluting potential)	ha	0	265 230.10	1	1	R0.00
8 (C)	Rehabilitation of processing waste deposits and evaporation ponds (polluting potential)	ha	0	770 353.94	1	1	R0.00
9	Rehabilitation of subsided areas	ha	0	178 316.73	1	1	R0.00
10	General surface rehabilitation	ha	150	168 695.33	1	1	R25 304 299.50
11	River diversions	ha	0	168 695.33	1	1	R0.00
12	Fencing	m	10000	192.43	1	1	R1 924 300.00
13	Water management	ha	20	64 142.71	1	1	R1 282 854.20
14	2 to 3 years of maintenance and aftercare	ha	150	22 449.95	1	1	R3 367 492.50
15 (A)	Specialist study	Sum	0	0	1	1	R0.00
15 (B)	Specialist study	Sum	0	0	1	1	R0.00
					Sub Total 1		**R73 166 284.20**

1	Preliminary and General	R8 779 954.10	weighting factor 2 / 1	**R8 779 954.10**
2	Contingencies	R7 316 628.42		**R7 316 628.42**
			Subtotal 2	**R89 262 866.72**
			VAT (15%)	**R13 389 430.01**
			Grand Total	**R102 652 296.73**

Figure 113: Estimated Financial Provision for Environmental Rehabilitation

26.2 Confirm that the Amount can be Provided from Operating Expenditure

It is confirmed that the financial provisioning amount will be available through operating costs over the 20-30 year life of operations for the proposed ferrochrome smelter.

Amount currently available for rehabilitation at the time of this EIAR/EMP	**R 0.00**
Closure Liability Estimate Over 30 Years	**R102 652 296.73**
Amount currently be made available for rehabilitation at commencement of project	**R 3 500 000.00**
Annual operational allocation towards closure liability	**R 3 421 743.00**

27.0 DEVIATIONS FROM THE APPROVED SCOPING REPORT

The prescribed impact assessment method was not implemented by all the specialists, every effort was made by the author of this report to convert the method used to a similar impact rating using the method as outlined in this report.

PART B – ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1.0 COMPOSITE MAP

Please refer to Appendix 4 of this report.

2.0 IMPACT MANAGEMENT OBJECTIVES AND STATEMENTS

Table 78: Management Objectives and Outcomes

Aspect	Objective	Outcome
Air quality	• To minimise the deterioration in air quality. • To determine the impacts on the surrounding environment. • To reduce emissions from the site. • To reduce the impact on air quality as a result of dust.	• Compliance with applicable Legislations relating to prescribed air quality parameter limits. • No complaints from I&APs relating to dust impacts.
Geology	• To prevent sterilization of minerals.	• Any excavation or earthworks activity to be rehabilitated as far as possible. • Determination of possible mineral resource over the smelter site footprint.
Groundwater and Hydropedology	• To minimise the impact to groundwater levels as a result of drawdown in local groundwater levels. • To minimise any negative impact on existing users with regards to lowering of the water table and water quality impacts. • To minimise the impact of loss of base flow to Wetlands and Surface water resources. • To manage the long-term impacts of the smelter on groundwater, specifically the impacts relating to decant. • To limit the long-term impact on groundwater quality. • To gather data that will allow a predictive understanding of the groundwater environment and how it will be affected by surface activities.	• Compliance with DWS reserve determination and water quality objectives. • Detailed records of groundwater monitoring data that can be used to show trend lines and possible impacts relating to water levels and water quality.
Agricultural	• To return agricultural capability after smelter operations have been completed.	• High agricultural capability.
Soils	• To minimise the loss of topsoil during stripping, handling and placement on rehabilitated areas (preservation of topsoil). • To maintain or improve the pre-smelter fertility status of usable soil. • To prevent / reduce the impact on soils as a result of hydrocarbon spills.	• Soil is fertile and suitable for use when needed.
Land capability	• To limit the adverse effects of smelter operations on the post land use capability.	• After closure and decommissioning the land use is achieved and the site is self-maintaining.
Land use	• To facilitate the sustainable and productive use of rehabilitated land. • To ensure the continued fitness of the natural areas, or which lie outside of the smelter footprint.	• After closure and decommissioning the land use is achieved and the site is self-maintaining.

Aspect	Objective	Outcome
Terrestrial Biodiversity	• To minimise the adverse effects of smelter operations on indigenous fauna, by preventing the needless death, injury or hindrance to fauna particularly with regard to protected, endemic and species of conservational concern. • To minimise the impact on rare plant species by preventing the needless loss of or damage to flora particularly with regard to protected, endemic and species of conservation concern. • Prevent significant alteration to the ecosystems in the area. • To control the spread of, and to eradicate invasive alien flora that could outcompete indigenous vegetation on the whole of the smelter site and adjacent areas. The aim will be to rehabilitate towards naturally sustainable vegetation and habitat as was present before the implementation of the project. • To establish vegetation on disturbed areas and rehabilitated areas and ensure that it becomes self-sustaining. • To demonstrate that the re-vegetated areas have become self-sustaining. • To ensure that rehabilitated land becomes self-maintaining. • Properly assess and determine final land-use and ensure Closure and Rehabilitation Plan is formal, feasible and site specific.	• No alien vegetation on site. • After closure and decommissioning the land use is achieved and the site is self-maintaining. • No species of conservational concern have been impact.
Noise and Vibration	• To reduce noise impacts of the smelter activities on residential areas and nearby land owners. • To minimise the startle effect of blast noise on the receiving public.	• Compliance with recommended noise levels. • No complaints from I&APs relating to noise.
Surface water	• To reduce the impact on catchment yield as a result of smelter activities. • To implement good water management practises. • To reduce and prevent the impact on nearby surface water resources. • To minimise impacts on watercourses and drainage lines. • To reduce or prevent decant and impact on surface water resources. • General maintenance.	• Compliance with DWS reserve determinations and water quality objectives. • Compliance with the National standard relating to water conservation and water demand management water use efficiency targets. • All water use is licenced in terms of Section 40 of the National Water Act, 1998 (Act No. 36 of 1998).
Topography	• To reinstate a landform that is similar to the pre-smelter environment. • To reduce the impact left by excavations. • The post smelter landform must be free draining. • To return post smelter topography to as close as possible to pre-smelter topography.	• After closure and decommissioning the land use is achieved and the site is self-maintaining.

Aspect	Objective	Outcome
Visual aspects	• To reduce the visual impact of the smelter activity and associated equipment and infrastructure.	• Reduce visibility of all infrastructures.
Archaeological and Heritage	• To ensure full compliance with the National Heritage Resources Act (Act 25 of 1999). • To reduce the impact resulting from the destruction of, or damage to, archaeological remains. • To immediately isolate any newly identified heritage areas during the construction phase to avoid further disturbance to the site, to call in an archaeologist and heritage expert and notify the authorities of the find. No further disturbance of the site would take place until information of significant value has been recovered as described above.	• Compliance with the National Heritage Resources Act (Act 25 of 1999). • Obtain relevant permits as needed for removal of artefacts.
Socio Economic	• To encourage recruitment from local communities and to encourage development within the local community, and skills acquisition. • To encourage effective communication with the local community and an increased standard of living by effectively addressing the concerns of interested and affected parties. • To try and limit influx of migrants. • To encourage effective safety and security measures. • To reduce the impact on roads. • To reduce / prevent impacts on health. • To mitigate the impacts of the termination of the project. Smelter closure will result in cessation of employment, with a limited number of workers benefiting from closure and decommissioning activities. • To mitigate impact of closure.	• Training and skilling for possible secondary employment outside the ferrochrome smelting industry.

3.0 ENVIRONMENTAL MANAGEMENT OBJECTIVES, STATEMENTS AND CLOSUE OBJECTIVES

3.1 Measures Required to Contain/Remedy Causes of Pollution/Degradation or the Mitigation of Pollutants for Closure of Smelter and Post Closure

3.1.1 Topography

<table>
<tr><td colspan="2"><u>CLOSURE OBJECTIVE:</u>

Topsoil stockpiles will be created smelter at KDG. If any are left behind at the time of closure, these will be sloped and graded to an angle suitable for application of topsoil, and re-vegetated, where practical. The slope to conform to the surrounding topography. Safety signs placed around the smelter site.

Sloped configuration that conforms to the surrounding topography.

Demolition and removal of all structures – including all the product and raw material stockpiles, dumps, surface infrastructure (furnaces, baghouse, buildings, workshops etc), and access roads when smelter ceases.

Topsoil stockpiles removed and used in various rehabilitation purposes.

Prevention of storm water pollution from any remaining overburden.</td></tr>
<tr><td><u>IMPACT:</u>
The topsoil stockpiles will be created of elevated topography that rises above the natural horizontal configuration.

Excavation created by the smelter development and infrastructure</td><td><u>MITIGATION:</u>
Where practical, if any topsoil and construction rubble, minor excavations are still left at the time of closure, these will be sloped to resemble the surrounding land configuration / landscape and rehabilitated with indigenous vegetation. It is expected that no smelter operations will take place after the rehabilitation.</td></tr>
<tr><td><u>IMPACT:</u></td><td><u>MITIGATION:</u></td></tr>
</table>

Removal and stockpiling of topsoil for subsequent rehabilitation.	Natural weathered rock and topsoil will be removed from the areas to be developed for any infrastructure, raw material stockpile and/or access roads prior to the commencement of such activities, and stored separately for later use in rehabilitation.
IMPACT: Temporary raw material stockpiles and slag.	**MITIGATION:** Some temporary slag/raw material stockpiles may be created as smelting progresses, at the designated waste stockpile areas. dump sites, sloped and re-vegetated as part of the overall waste dump rehabilitation. Care must be enforced not to scatter waste and over-burden all over the smelter working sites at the site as this will be unsightly and difficult to rehabilitate.
IMPACT: Construction of access roads and smelter surface infrastructure. Stockpiling of raw materials.	**MITIGATION:** All buildings and surface infrastructure will be demolished and removed when smelter activities cease. All stockpiles of chrome ore and any unused raw materials will be removed and sold for various markets in the region, nationally and internationally. All the processed ferrochrome will be loaded onto tipper trucks and transferred to the market area. Surface or storm water control structures (berms or trenches) will be constructed around high pollution areas such as smelter infrastructure, raw materials and slag areas in line with the prevailing contours and drainage patterns. The said raw materials and slag areas will be concrete lined.
ENVIRONMENTAL MONITORING: Progressive rehabilitation and sloping of used-up/completed - (annual). Demolition of any unused or defunct surface infrastructure during smelter operations – (annual).	

3.1.2 Soil and Land Capability

<table>
<tr><td colspan="2"><u>CLOSURE OBJECTIVE:</u>

To conserve topsoil that will be used in various rehabilitation and re-vegetation programmes when melter ceases.

To ensure rapid and easy establishment of vegetation over rehabilitated areas.

Progressive rehabilitation and re-vegetation.

To prevent and minimize soil erosion, which is crucial in rehabilitation.

To minimize wind erosion, and loss of soil needed for rehabilitation.

To contain any oil, fuel or chemical pollution and the spread of such pollution into the soil and underground and surface water structures.

To clean any oil contaminated soil for reuse during rehabilitation.</td></tr>
<tr><td><u>IMPACT:</u>
Vegetation clearance, removal and stripping of topsoil prior to development and construction of surface infrastructure and waste/overburden dumps, raw material stockpiles, access/haul roads and storage for later rehabilitation.

Topsoil management and protection during smelter operations.</td><td><u>MITIGATION:</u>
Topsoil (top 200mm – 400mm layer minimum) must be removed prior to the commencement of construction/development of any new Surface Infrastructure – Access Roads, Waste and Over-Burden Dumps, Raw Stockpile Areas - by earthmoving equipment. Topsoil must be stored in heaps of not higher than 3m in the designated stockpile areas, and in a way that prevents damming. Storm water control structures should be constructed to preserve the soil and prevent erosion. The soil stockpiles should be vegetated to maintain soil ecology and micro-organism life. Stored topsoil must not be compacted.

Prior to topsoil stripping any large trees or obstacles will be removed to ensure a safe and efficient topsoil stripping operation. Any rare species of trees will be transplanted. All grasses and organic material will be left in-situ to be stripped with the general topsoil horizon. This will have the effect of preserving the seed content of the soil horizon.</td></tr>
</table>

	Topsoil must not be used as fill material for backfilling of any excavations on site. Over-burden/waste rock material must be used for such purposes. The A-horizon should be removed to a depth of 200-400 mm and stored as a berm along the edges. The aim (on the long term) is to leave the B-horizon undisturbed and later replace the A-horizon in its original position, which implies a reconstruction of the original soil horizon sequences and subsequent less deterioration from pre-smelter to post-smelter land capability. The footprint should then be covered with the required base materials as specified by the engineering design. During the decommissioning phase the footprint should be thoroughly cleaned and all base material should be removed to a suitable disposal facility. The cleaned footprint (or exposed upper part of the B-horizon) should be ripped thoroughly prior to replacement of the stored A-horizon to alleviate all compaction caused by the structure and related activities. The stored A-horizon should be graded evenly over the total structure footprint. Soil samples should be taken after soil replacement and the soil should then be ameliorated according to soil chemical analysis as recommended by a registered soil specialist. The footprint should be re-vegetated with a grass seed mixture.
IMPACT: Topsoil compaction by heavy vehicles and machinery.	**MITIGATION:** Compacted soils on the smelter site will during operations and after smelter closure be loosened to a depth of 300mm, scarified and stabilized. The soil will then be shaped according to the prevailing contours, fertilized and re-seeded with indigenous vegetation seeds.
IMPACT: Erosion of bare and exposed areas and other disturbed places as result of storm water run-off and wind.	**MITIGATION:** Monitoring of the success of the re-vegetation programme will form part of the concurrent rehabilitation and EMP performance assessment during the operational phase of the smelter.

	All surface infrastructure, access and haul roads, waste and over-burden dumps will be equipped with storm water control structures such as culverts, and drainage trenches to minimize erosion. Access Roads will be wetted periodically with a water-truck/sprinklers to suppress dust and minimize wind based soil erosion.
IMPACT: Diesel and fuel storage tanks and chemical storage. Possible contamination by fuel, oil and chemical spillages.	**MITIGATION:** All fuel, oils and chemical storage and use areas must be paved with concrete floors and bunded with at least a 50cm wall around to contain any spillages. Workshop areas must be equipped with properly designed and installed concrete sump systems to contain all the waste grease, oil and the chemicals during vehicle and machinery maintenance and repairs. These buildings must have storm water control structure around their entire perimeter to prevent surface runoff from coming into contact with contaminated areas. All heavy machinery and other vehicles must be checked regularly and maintained for leakages. In the event of accidental/emergency spillages (e.g. puncture of a diesel tank or breaking of the containment wall) a competent industrial hazardous waste collection consultant/company must be contacted immediately for cleanup operations. Where minor spillages do occur, the contaminated soil must be removed and collected into backs/bins for disposal at the hazardous waste disposal site by the appointed competent contractor. Another measure that can be employed to deal with oil and fuel spillages is application of bio-remediation process to clean the contaminated soil, and re-use the treated soil for rehabilitation purposes.
ENVIRONMENTAL MONITORING: Topsoil stockpiles to manage incidents of erosion – (quarterly); Hydro-carbon spillages – (monthly); Topsoil stripping for new and expansion developments – (annual);	

Soil bio-remediation – (Ongoing).

3.1.3 Ecology and Biodiversity

CLOSURE OBJECTIVE - FLORA: Disturb and destroy as little as possible of the vegetation around the smelter site. Progressively re-establish the destroyed vegetation. Conserve vegetation. Enable successful re-establishment of the vegetation. Limit the areas (habitats) disturbed or destroyed. Demolition and removal of all structures when smelter ceases. Rehabilitation of disturbed land surfaces.	
IMPACT: Clearing of vegetation for stockpile areas, and smelter surface infrastructure. Loss of habitat for vegetation.	**MITIGATION:** Wherever possible, any soil that can serve as a growth medium for plants must be stripped and stockpiled for future landscaping or rehabilitation after or during the operational phase and should be used as soon as possible after "harvesting" to ensure that seed sources does not become worthless due to decomposition of the seed over time. Water control structures should be constructed and well maintained to minimize erosion and to create a favorable habitat for the establishment of vegetation during and after rehabilitation/landscaping. Further destruction, pollution or any form of degradation of natural watercourses areas as well as their immediate catchment areas should be avoided as far as possible.

	Eradication and control of declared weed and invader populations in KDG smelter operations area must take place as part of the ongoing environmental management of the smelter. According to law in South Africa all natural wetlands are to be delineated and protected. There are no wetlands within the smelter site and immediate vicinity. A legitimate and well-designed rehabilitation plan must be set in place and be strictly enforced during the rehabilitation phase. Clearing of vegetation should be confined to the areas necessary for the any future developments/expansions at smelter and associated smelter infrastructure establishments. Adequate care will be implemented to above endangered plant species and trees. Baobab trees will be avoided, and where not possible, the necessary permits will be obtained for transplanting. All the cleared areas will be re-vegetated, where possible, concurrent with and following the smelter activities as outlined in this report. Water control structures should be constructed on rehabilitation areas to minimize erosion and to create a favourable habitat for the establishment of vegetation during rehabilitation. If any protected or medicinal plant species are identified during smelter operations, a plant nursery will be established through the smelter Environmental Section, under the auspices of a qualified Botanist, to confirm the species and conserve the said protected species to maintain bio-diversity within the smelter site. Medicinal plants will be made available to local users from the nursery.
ENVIRONMENTAL MONITORING: Progressive Rehabilitation – (Annual). Monitoring and eradication of alien plant vegetation (Annual).	

CLOSURE OBJECTIVE - FAUNA: Protect and conserve any faunal life in and around the smelter area.

Maintain safety and protection of animals and persons. Re-create the disturbed or destroyed micro habitats.	
IMPACT: Loss of faunal habitat, Displacement of fauna.	**MITIGATION:** The sites for KDG ferrochrome smelter operations – including raw materials and slag stockpile areas, furnace plants, baghouses and surface infrastructure should be properly fenced to prevent trespassing and uncontrolled entry into the dangerous smelter site by both wild and domestic animals. No hunting, snaring or trapping of any kind and of any animal or bird should be allowed on the smelter area and the surrounding property. All animals – both wild and domestic that become trapped as a result of smelter activities must be assisted and released into the surrounding area again. Should the animal or bird be of a species that cannot be caught by hand the matter must be immediately report to the local Department of Nature Conservation for assistance and involvement.
ENVIRONMENTAL MONITORING: Progressive rehabilitation and stray animals trapped within the smelter site - (Ongoing).	

3.1.4 Surface Water

CLOSURE OBJECTIVE: To conserve water resources, optimize water use and prevent pollution. To prevent and minimize soil erosion and conserve vegetation. Separation of clean and dirty water and compliance with Regulation 704. Compliance with water resource use legal requirements.

IMPACT: Water use and management	**MITIGATION:** The proposed KDG ferrochrome smelter will follows a zero discharge policy and the pollution control facilities and associated water management infrastructure will be designed in accordance with the requirements as contained in GN 704 Regulations. In this instance clean water separation from dirty water on the smelter footprint is induced allowing direct runoff of clean water towards natural watercourses and containment of dirty water. Surfaces within the dirty areas will be kept to a minimum to reduce the volume of dirty runoff generated by smelter activities. Storm water control structures will be constructed to properly contain run-off from the site – especially the channels to the raw materials area, slag area and return water dams within the smelter site. All ponds and small pools must be de-watered immediately following rains or storms. The said water must be pumped into the on-site water reservoir or used as process water for dust control on the access roads and mineral processing. Quantitative and qualitative assessment of the water resources on the project property to effectively conduct Integrated Water Resource Management. Surface water management: o Identify any potential risks from the project on the surface water resources. o Strive for zero effluent discharge site. o Keep clean water clean and collect and contain dirty water. o Ensure sustainable storm water management over the project life cycle. Implement an environmental management programme to adhere to the suggested mitigation measures as provided above with the goal to: o Protect and conserve the aquatic and surface water environment from any impacts. o Prevent the aquatic and surface water environment from degrading due to the activities of the project. o Minimisation and, where possible, prevention of water pollution stemming from activities.

	Create a Water Conservation and Demand Management plan to: o Track efficiency of water use for the operation. o Identify and validate potential water conservation measures to minimise waste and maximise reuse and recycling. o Track implementation and success of water conservation measures. Implement a rehabilitation programme to ensure the site is returned to a natural state once activities have seized.
IMPACT: Construction of Smelter Infrastructure: • Clearance of operations foot print could lead to increased sedimentation and siltation; • Haul road construction will alter the natural characteristics of the drainage system; • Accidental spills could lead to water pollution.	**MITIGATION:** Water quality (for surface and groundwater) should adhere and comply with the Resource Quality Objectives set for the catchment. Eco-classification for the affected catchment in terms of PES and EISC shall be maintained at **Class C.** In the event of construction of pipelines, haul roads and road servitudes (disturbance zones) in or adjacent to riparian zone is to be managed and strictly controlled to minimize damage to the impoundment, rivers and wetlands (none identified within the vicinity of TKDG Smelter – except for non-perennial drainage channels within the smelter area) In-stream habitat conditions (with regard to the river's morphology) should be recreated as far as possible; this pertains to those areas where construction activities will disturb the in-stream habitat beyond the operational footprint of the haul road crossings, culverts or bridges. KDG smelter operations does not affect any of the surrounding rivers or drainage channels.
IMPACT: Ferrochrome smelting activities: • Accidental fuel, oil and chemical spills could lead to water pollution; • Runoff from raw material stockpiles, furnace plant area and other surface	**MITIGATION:** Obtain IWULA for all water uses at KDG Ferrochrome Smelter. Operate a Zero Effluent Discharge Facility – Contain and reuse all process water. Dirty and clean storm-water should be separated systems. Dirty storm-water to be contained.

infrastructure to pollute water resources.	The erosion down verges on the approach to a water course should be minimised by including frequent discharge points with energy dissipaters before discharging storm water into the adjacent grasslands (where applicable). Infiltration down the verges of the roads rather than surface runoff should be encouraged (this could for example include the use of grassed swales, Hyson Cells or grass blocks). The construction of small detention ponds filled with *Phragmites* reeds would allow sediment and debris/litter to be trapped before entering the main drainage lines. Where storm water enters the water resource sediment and debris trapping, as well as energy dissipation control structures should be put in place. Litter traps should be incorporated into the storm-water designs to ensure that litter runoff from the site cannot enter the nearby drainage channels and Sand River catchment or other tributaries directly. Turbidity, sedimentation and chemical changes to the composition of the water must be limited. Storm water systems to be designed in such a way that it can be easily sealed off after the occurrence of a spill. If a spill occurs during the operational phase of the water use, a qualified team of experts will need to be consulted, rehabilitation plan drawn up and implemented and the Regional DWS Office should be informed immediately. **General Management Actions:** ▪ Clean water diversion (bunds/ canals). ▪ Good housekeeping (clean-up of spills and minimise informal storage of materials). ▪ Leak detection through inspection. ▪ Good housekeeping (maintenance of equipment). ▪ Storm water diversion upstream of the smelter facilities. ▪ Isolate pollution sources with roofs, concrete bases, traps, sumps and bund walls (e.g. diesel/petrol storage, wash bays and workshops). ▪ Roads will be maintained. ▪ Vehicle maintenance will be conducted on bunded concrete surfaces/workshops.

ENVIRONMENTAL MONITORING: Surface water monitoring program - (Monthly); Ground water monitoring program - (Bi-Annually); Where vegetation removal has occurred within the smelter area, monitoring should take place to ensure successful re-establishment of natural vegetation – (Ongoing); Alien vegetation should be removed from these disturbed areas on an ongoing basis to ensure the successful re-vegetation by indigenous species - (Ongoing).

3.1.5 Groundwater

CLOSURE OBJECTIVE: Conserve and re-use water resources in the smelter operations. To contain any oil, fuel or chemical pollution and the spread of such pollution into the soil and underground and surface water structures. Water quality management and pollution prevention. Compliance with water resource use legal requirements.	
IMPACT: Abstraction of ground water. Over extraction of borehole water for domestic and operational requirements.	**MITIGATION:** Obtain IWULA for all water uses at KDG ferrochrome smelter. The development of the on-site reservoirs to store and recycle water for smelter processes (mainly dust suppression, cooling and ore dressing) will greatly reduce the need to pump ground water for operational purposes.
IMPACT: Effect of smelter operations on the surrounding water table levels and ground water quality.	**MITIGATION:** Ground water will be routinely monitored at dedicated boreholes around the smelter site to test and determine the water quality and table levels.

	Identify and where possible, maximise areas of the smelter that will result in clean storm water runoff (for example open veld areas) as well as infrastructure associated with the smelter (for example haul/access roads) and ensure that runoff from these areas is routed directly to natural watercourses and not contained or contaminated. Prevent the erosion or leaching of materials from any slag or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources. Water quantity and quality data should be collected on a regular, ongoing basis during KDG smelter operations. These data will be used to recalibrate and update the smelter water management model, to prepare monitoring and audit reports, to report to the regulatory authorities against the requirements of the IWMP and other authorisations and as feedback to stakeholders in the catchment. Water that has been in contact with residue/slag, raw materials and must therefore be considered polluted, must be kept within the confines of the smelter area – slag dam) until evaporated, treated or rendered acceptable for release, or re-used in some other way. In the unlikely event that any surrounding boreholes decrease in yield, KDG smelter may be required to supply the owners with a volume of water as agreed upon between the parties involved – should the said decrease be attributed to the smelter operations. Separate any future acid generating material and non-acid generating material, as may be characterised by geochemical sampling and analyses, during smelter operations. Currently the no acid generating entities have been identified. The raw materials and slag area will be concrete lined.
IMPACT: Ground water pollution as a result of fuel, oil, and chemicals contamination.	**MITIGATION:** KDG smelter operations will follow a zero discharge policy and the pollution control facilities and associated water management infrastructure will be designed in accordance with the requirements as contained in GN 704 Regulations. Water quality (for surface and groundwater) should adhere and comply with the Resource Quality Objectives set for the catchment.

	All workshops and fuel, oil and chemical storage area must be properly constructed and maintained, and must have emergency procedures in place to deal with accidental spillages to avoid underground water contamination. All spillages (fuel, oil, chemicals) should be immediately removed and stored in designated area – such as bunded wall waste oil storage areas to prevent possible contamination of ground water. These spillages must be properly disposed-off to the hazardous waste site by the appointed competent contractor. Monitoring boreholes around the smelter site and near water resource entities will be drilled to continuously monitor the ground water regime, water table levels and quality alterations and detection of any pollution that may result from smelter operations.
ENVIRONMENTAL MONITORING: Surface water monitoring program - (Monthly); Ground water monitoring program – (Quarterly);	

3.1.6 Air Quality

CLOSURE OBJECTIVE: Protect and maintain the health and welfare of employees against dust and other are pollutants. Minimize smoke, emissions and dust pollution on the smelter and the surrounding settlement areas – such as Mopane and adjacent farm homesteads. Keep records of pollution levels to inform adequate impact management and minimization measures. Minimize and prevent greenhouse gas emissions into the atmosphere.	
IMPACT:	**MITIGATION:**

Smoke and dust pollution due to use of earth moving equipment (bulldozers and front-end loaders). Smoke, GHG, emissions from furnace, and baghouse Dust generated by stockpiling, ore dressing processing and handling and dust generated from vehicles transporting materials via haul roads crossing the smelter site. In windy conditions dust/fume may be blown into the residential area (Mopane and farm homesteads close to the smelter. Dust generated by ore dressing activities.	Repair and maintenance of vehicles and machinery to prevent exhaust emissions. Use of clear and greener technologies and fuel. Dust and GHG monitoring will be conducted during the life of smelter operations to determine the prominent wind directions and dust / GHG levels at various points around the smelter site. The bag-house system must be maintained regularly to work at least 96% efficiency or more to minimise fume emissions onto the atmosphere. In terms of the requirements of the Occupational Health and Safety Act, 1993, KDG smelter (or its appointed contractor) must provide protective clothing and equipment for all its employees, and must periodically conduct risk assessments and medical check-ups to analyse and monitor the effects of dust, silicon fume and smoke on the staff members and the surrounding receiving environment. Wetting of the access roads to smelter operations with water periodically to suppress the dust will greatly reduce the impact of dust. This wetting with water must be done daily during dry and windy seasons. Due to water scarcity in the area, it is recommended that access and haul roads be tarred. Dust and air quality monitoring will be conducted during the life of smelter to determine the prominent wind directions and dust/emissions levels at various points around the smelter site. Progressive re-vegetation of the smelter site to minimize and prevent wind-blown dust pollution. Short term dust fallout monitoring be conducted at the project boundary closest to the raw material stockpiles and slag stockpile to confirm dust fallout at the site boundary is in compliance with the National Dust Control regulations once the project is operational. A once-off sampling campaign for NO2 and SO2 concentrations be conducted at the project boundary to confirm compliance with the NAAQS.
ENVIRONMENTAL MONITORING: Dust Monitoring - (Monthly);	

Air Quality and Emissions Monitoring – (Bi-Annual)

3.1.7 Noise

CLOSURE OBJECTIVE: Keep noise pollution as low as possible, and minimize disturbance to the surrounding settlements/businesses during smelter operations. Minimize disruptions of the daily practices and social fabric. Protect the health of the employees and surrounding communities during smelter operations. Record and maintain the records on the health of in-coming and out-going employees.	
IMPACT: Noise pollution generated from the smelter, baghouses, haul roads and surface infrastructure operations working sites.	**MITIGATION:** The proposed smelter will operate both daytime and night-time shifts. As a guideline night-time work/any rock crushing should be limited to localities that are further than: ➢ 2,000 m from a noise-sensitive community when there is a direct line of sight (no barrier between the activity and receptor); ➢ 1,000 m from a noise-sensitive community when there exists a barrier (stockpiles) between the activity and receptor. The following factors/specifications should be considered when implementing a berm as an acoustical screen: ➢ It is recommended that the barrier be built as close as feasibly possible to the smelter operations or receptor; ➢ It is recommended that the height of the berms/barriers be at least 2 - 3 m higher than the line of sight to the highest noise source from operational areas, although the higher the berm/barrier the better acoustical screen tool it will be[19]. Certain heavy vehicles have their exhaust ports above the cabin of the vehicle and needs to be considered as the noise source point. Barriers must also be sufficiently dense

[19] Norton, M.P. and Karczub, D.G, *"Fundamentals of Noise and Vibration Analysis for Engineers",* Second Edition, 2003, p.600.

	(at least 10 kg/m^2) [20] and sufficient in thickness. A brick wall provides a surface density of 244 kg/m^2 at thickness of 150 mm[21] and is considered as a typically good acoustical barrier. Certain metrological conditions (particularly during night-times) can see refraction of noise over the barriers due to the various temperature inversion layers. This means that noise levels from a smelter may propagate back down to the ground at a receptors dwelling due to the curvature of sound in the warmer upper night-time atmosphere. Barrier height cannot effect this propagation[22]; ➢ The barrier should be sufficiently long to block the line of sight from receptors to the sides of the smelter operations; ➢ No apertures (gaps, entrances) should be implemented at berms/high-walls and facing a receptors dwelling. This is due to security points and berm entrances where haul trucks need to stop and make use of air brakes and reverse alarms, which may cause a noise annoyance at a receptors property; The use the smaller/quieter equipment when operating near receptors; Ensuring that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Acoustical mufflers (or silencers) should be considered on equipment exhausts at the ODP/waste rock and stockpile areas. A noise absorption braid could be mounted on the front of heavy equipment radiators (ADT's, FEL's etc.) to prevent excess mechanical fan noise into the surrounding environment. Engine bay covers over heavy equipment could be pre-fitted with sound absorbing material. Heavy equipment that fully encloses the engine bay should be considered, ensuring that the seam gap between the hood and vehicle body is minimised; KDG Smelter should investigate the use of white-noise generators instead of tonal reverse alarms on heavy vehicles operating on roads, and at raw material stockpile areas[23]. This option

[20] International Finance Corporation. General EHS Guidelines – Environmental Noise Management.

[21] Everest and Pohlmann, "Master Handbook of Acoustics", Fifth Edition, 2009, p. 121.

[22] Norton, M.P. and Karczub, D.G, *"Fundamentals of Noise and Vibration Analysis for Engineers",* Second Edition, 2003, p.600.

[23] White Noise Reverse Alarms: http://www.brigade-electronics.com/products.

	is highly recommended although it must be noted that reverse alarms is exempt from an acoustical assessment due to Government Notice R154 of 1992 (Noise Control Regulations) – Clause 7(1) – *"the emission of sound is for the purposes of warning people of a dangerous situation"; and* When noisy processes are to take place very close to potentially sensitive receptors (this could include smaller scale construction activities such as construction of boundary fencing, digging of trenches for cabling or development of access routes within 500 meters from a receptor), co-ordinate the working time with periods when the receptors are likely not at home. An example would be to work within the 8 am to 2 pm time-slot to minimise the significance of the impact due to: ➢ Potentially receptors are most likely at school or at work, minimizing the probability of an impact happening; and ➢ Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening. Ensure a good working relationship between the smelter environmental representative and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potentially sensitive receptor(s) include: ➢ Proposed working times; ➢ How long the activity is anticipated to take place; ➢ What is being done, or why the activity is taking place; and ➢ Contact details of a responsible person where any complaints can be lodged should there be an issue of concern. The KDG Smelter (or its appointed contractor) must provide protective clothing and equipment for all its employees, and must periodically conduct risk assessments and medical check-ups to analyse and monitor the effects of noise on the staff members and the surrounding environment. Medical check-ups must be conducted by external specialists. All staff must have an exit medical check-up when leaving the employ of KDG Smelter. Environmental awareness training should include a noise component, allowing employees and contractors to realize the potential noise risks that activities (especially night-time activities

	– if any) pose to the surrounding environment. All employees and contractors should receive this training. Minimize equipment or processes at high levels, such as the development of the material tip being significantly higher than the surrounding landscape. It limits the mitigation of this noise using berms/high-walls. The smelter may consider keeping the material tip at ground height or even slightly below ground level – However this may not be practical for KDG Smelter since the entire operation is on elevated ground. Ensuring that equipment is well maintained and fitted with the correct and appropriate noise abatement measures. Limit the maximum speed on the haul roads to 40 km/h or less. Road speeds should be kept as consistent as is feasibly possible between the various working areas/sites within KDG Smelter (i.e. no speed bumps to reduce noise or stop junctions). This would help in keeping road traffic noise more "linear" opposed to hearing different noise contributors from heavy vehicles (i.e. no ADT air brakes on long stretches of roads, no acceleration of vehicles from a stop junction using maximum capacity of engine in lower gears for pulling power etc.). If feasible road shoulders facing receptors should incorporate a kerb roughly half or more than the height of road vehicle tyres. The kerb could be constructed from any soil (likely the quickest and most feasible material option). The kerb could likely help in reducing noise from vehicle tyre and road interaction.
ENVIRONMENTAL MONITORING: Noise Monitoring - (Bi-Annual);	

3.1.8 Climate Change

CLOSURE OBJECTIVE: Management of greenhouse gas emissions and prevention of climate change	
IMPACT:	**MITIGATION:** Use of cleaner technologies to prevent greenhouse emissions;

Use of natural resources and fossil fuels, emission of greenhouse gases (CO_2, NO_x) and clearance of vegetation. Emissions from furnace, baghouse, machinery and use of fuel.	Setting objectives and target to reduce use of fossil fuels, and other natural resources in the smelter operations; Determination of the KDG Smelter Carbon Footprint, and reduction thereof; Off-setting of the environmental impacts from the smelter with some rehabilitation programmes/operations within the area – including outside the smelter (such as working for wetlands or for waste); Re-vegetation and rehabilitation programme to replace removed vegetation. The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.
ENVIRONMENTAL MONITORING: Carbon Footprint – (annual); Objectives and targets to reduce use of fossil fuel - (quarterly); Objectives and targets to reduce GHG emissions into the atmosphere – (annual); Progressive rehabilitation and re-vegetation – (annual).	

3.1.9 Heritage and Cultural Aspects

CLOSURE OBJECTIVE: To protect and conserve any artefacts or finds of cultural, historic or pre-historic significance for the present and future generations. Educate and sensitize staff on the importance of the historical/heritage artefacts or structures and preservation thereof. Demolition and removal of all structures when smelter ceases.	
IMPACT: Destruction of possible historical, heritage and cultural artefacts and resources	**MITIGATION:** All archaeological, paleontological, and heritage sites and resources must be preserved if they are of cultural, historic or pre-historic significance. This must be done under the auspices of a competent and qualified person. Some sites of historical significance were identified within the vicinity of Mopane and KDG smelter operations, but not within the smelter footprint.

Destruction of possible archaeological late iron age resources.	Finds, if encountered during operations of KDG smelter, must be reported to the SAHRA and responsible Smelter Manager who will decide, after consultation with authorities, company representatives and local communities whether work may go ahead. Special precautions may be instituted to enable the operations or work to proceed. Workers and staff must be made aware of the different aspects of the smelter and how their specific job functions may affect historical artefacts if encountered via the environmental awareness plan and must report any findings immediately to the smelter manager, who must in turn contact LIHRA/SAHRA. When smelter activities are completed, all buildings and structures will be demolished and removed. This process will be in consultation with local communities. Any building structures identified and agreed upon with local authorities and communities to have heritage/historic/cultural value will be preserved and protected, taking cognizance of the health and safety requirements. The local authorities/communities will assume responsibility for any such structures after smelter closure.
ENVIRONMENTAL MONITORING: Ongoing awareness to possible heritage/historical/cultural finds.	

3.1.10 Visual Aspects

CLOSURE OBJECTIVE: Rehabilitate the land and minimize visual impact during and after smelter operations. Revert back the land to as much as possible the original status before smelter operations. Rehabilitate the land and minimize visual impact during and after smelter operations. Demolition and removal of all structures when smelter ceases.	
IMPACT:	**MITIGATION:**

Visual impacts of the KDG smelter Surface Infrastructure and Access Roads.	Topsoil stockpiles at KDG Smelter will, where practical, and sloped to resemble the surrounding land configuration/landscape and rehabilitated with indigenous vegetation. Plant species should be cultured in and around the smelter site. The smelter operations will be screened will vegetation to reduce the visual intrusion from adjacent communities – where possible. Progressive rehabilitation must be implemented on the smelter site. Overburden and topsoil stockpiles side slopes with be graded to an angle suitable for plant growth and re-vegetated to blend and musk the visual intrusion. When smelter activities are completed, all buildings and structures will be demolished and removed. This process will be in consultation with local communities. The surface and soil area where these structures were must be scarified, leveled according to the prevailing contours and re-vegetated with indigenous plant species. Mitigations measures as outlined in ECOE Visual Impact Report – Appendix 8J.
ENVIRONMENTAL MONITORING: Progressive rehabilitation and re-vegetation of the smelter site.	

3.1.11 Socio-Economic Aspects

CLOSURE OBJECTIVE: Create economic activity, job market around Mopane/Musina, Makhado area, and in turn poverty alleviation. Improved economic activity and opportunities and creation of multiplier economic effects due to the smelter around Musina/Makhado area. Provincial and Local economic growth and improved way of life within Musina/Makhado area. Prevention and minimization of social impacts such as alcoholism, crime, prostitution and teenage pregnancies.

IMPACT: Create economic activity, job market around Musina/Makhado area, and in turn poverty alleviation. Improved economic activity and opportunities and creation of multiplier economic effects due to the smelter around Musina/Makhado area. Provincial and Local economic growth and improved way of life within Musina/Makhado area. Prevention and minimization of social impacts such as alcoholism, crime, prostitution and teenage pregnancies.	**MITIGATION:** KDG smelter operations will result in some limited direct and indirect employment and training opportunities with improved standard of living for local communities as labour is sort locally. Phase 1 will employ 235 people, and ramp-up to full production will see 1880 people employed at the smelter. The smelter operation may contribute to improved road infrastructure and other services in and around Musina/Makhado Local Municipalities. The smelter will create opportunities for the local suppliers to become part of the procurement process, and thus stimulate the local business and services. Labour will continually be sort from the local settlement areas to prevent influx of foreign people and job seekers who are likely to disrupt the social fabric, values and norms of the local people. Reduced influx of foreigners will reduce other negative social issues such as crime, prostitution, and disruption of local values and cultural norms. Socio-economic opportunities should be enhanced, and local procurement for supplies and services should be implemented to ensure full economic benefit to the local communities – including Mopane/Musina/Makhado communities and adjacent businesses. Agreed and market related compensation for loss of private and communal property. Housing and school developments within the local area will improve and enhance local property values.
ENVIRONMENTAL MONITORING: Local Economic Development - Ongoing	

4.0 IMPACTS TO BE MITIGATED AND THEIR RESPECTIVE PHASES

Table 78: Measures to rehabilitate the environment affected by the undertaking of any listed activity

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Geology	KDG Smelter Activities	300 Ha	C, O	The mineral ore resource will be sterilized over the site	There is no mitigation measure.	N/A	N/A
Topography	KDG Smelter Activities	300 Ha	C, O	During the construction and operational phases, the pre-smelting topography will be altered to allow for the construction.	Concurrent rehabilitation to reinstate natural and free flowing topography.	Best Practices and EMPr	Construction and Operational phases
Topography	KDG Smelter Activities	300 Ha	Cl, Post Cl	During closure the pre-smelting topography will be recreated as far as possible.	Concurrent rehabilitation to reinstate natural and free flowing topography. Final shaping of the impacted area.	Best Practices and EMPr	Construction and Operational phases
Air Quality	Stockpiles	300 Ha	C, O	Increase in Fugitive Dust.	Practice dust suppression techniques;	Best Practices and EMPr	Operational phase
Air Quality	Movement of material	300 Ha	C, O	Increase in Fugitive Dust.	Practice dust suppression techniques;	Best Practices and EMPr	Operational phase
Air Quality	GHG emissions	300 Ha	C, O	Increase in GHG	The industry should explore and adopt best available technologies to improve energy efficiency and reduce CO2 emissions from production processes Carbon Offset	Best Practices and EMPr	Operational phase
Air Quality	Vehicle movement on gravel roads	300 Ha	C, O	Increase in Fugitive Dust.	Practice dust suppression techniques;	Best Practices and EMPr	Operational phase
					Consider alternative techniques to reduce the extent by which vehicles are used to move material Tarring of all access roads.	Best Practices and EMPr	Operational phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Air Quality	General vehicle use	300 Ha	C, O	Increase in noxious vehicle exhaust fumes	Manage vehicle fleet and movement of vehicles on site	Best Practices and EMPr	Operational phase
					Limit the use of vehicles in poorly ventilated areas	Best Practices and EMPr	Operational phase
					Where possible / practical, plan vehicle travel routes in such a manner as to allow for exhaust fumes to disperse sufficiently and not to affect air quality to the extent whereby exceedances of standards could occur;	Best Practices and EMPr	Operational phase
					Consider alternative options to vehicles with combustion engines	Best Practices and EMPr	Operational phase
Air Quality	Increase LCV	300 Ha	Cl/Rehab	Increase in Fugitive Dust	Manage site access and control movement on site;	Best Practices and EMPr	Closure and Rehabilitation phases
					Practice dust suppression techniques;	Best Practices and EMPr	Closure and Rehabilitation phases
Air Quality	Excavation works	300 Ha	Cl/Rehab	Increase in Fugitive Dust	Practice dust suppression techniques;	Best Practices and EMPr	Closure and Rehabilitation phases
Air Quality	Movement of material	300 Ha	Cl/Rehab	Increase in Fugitive Dust	Practice dust suppression techniques;	Best Practices and EMPr	Closure and Rehabilitation phases
Air Quality	Stockpiles	300 Ha	Cl/Rehab	Increase in Fine Fugitive Dust	Practice dust suppression techniques;	Best Practices and EMPr	Closure and Rehabilitation phases
Air Quality	General Vehicle Use	300 Ha	Cl/Rehab	Increase in noxious vehicle exhaust fumes	Manage vehicle fleet and movement of vehicles on site	Best Practices and EMPr	Closure and Rehabilitation phases
					Limit the use of vehicles in poorly ventilated areas	Best Practices and EMPr	Closure and Rehabilitation phases
					Where possible / practical, plan vehicle travel routes in such a manner as to allow for exhaust fumes to disperse sufficiently and not to affect air quality to the	Best Practices and EMPr	Closure and Rehabilitation phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					extent whereby exceedances of standards could occur;		
					Consider alternative options to vehicles with combustion engines	Best Practices and EMPr	Closure and Rehabilitation phases
Air quality	Stockpiles	300 Ha	Post Closure	Increase in fugitive Dust	Practice dust suppression techniques;	Best Practices and EMPr	Post Closure
Soil, Land Use and Land Capability	KDG Ferrochrome Smelter footprint - complete stripping of all productive soil horizons (A and B) and stockpiling thereof and replacement during the decommissioning phase.	300 Ha	C, O, Decom	Complete cease of arable and grazing land capability and crop farming land use and subsequent loss of agricultural production and food supply at smelter footprint until topsoil replaced and the footprint re-vegetated or reintroduced to crop farming.	An Environmental Control Officer (ECO) should be appointed with suitable responsibilities.	Best Practices and EMPr SACNASP / EAPASA	During appointed timeframe
					Soil types should be stripped at depth and stockpiled as described and indicated on the soil stripping plan.	Best Practices and EMPr	All phases
					Controls should be put in place to constantly monitor soil stripping depths;	Best Practices and EMPr	All phases
					Commence preparation of sections to be rehabilitated (replacement of topsoil) as soon as possible, preferably during the operational phase;	Best Practices and EMPr	All phases
					Topsoil replacement should only commence on sections declared to have the correct elevation and slope and singed off by the surveyor.	Best Practices and EMPr	All phases
					Controls should be put in place to constantly monitor soil replacement depths;	Best Practices and EMPr	All phases
					Soil fertility should be determined by representative sampling and laboratory analysis after replacement, prior to seeding. For soil amelioration a soil specialist should evaluate soil analytical results and provides a fertilizer recommendation;	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					A registered soil specialist should be appointed to perform the monitoring actions.	Best Practices and EMPr SACNASP / EAPASA	During appointed timeframe
Soil, Land Use and Land Capability	KDG Ferrochrome Smelter footprint - complete stripping of all productive soil horizons (A and B) and stockpiling thereof and replacement during the decommissioning phase.	300 Ha	O, Decom	Degradation of soil potential and quality during stripping and stockpiling due to complete disturbance of the original natural soil horizon sequence (mixing A and B-horizons), which negatively impact on the original effective soil depth, soil fertility and water holding capacity.	Disturbance and mixing of soil horizons cannot be avoided.	N/A	N/A
					In order to keep the impact as low as possible the soil types should be stripped at depth and stockpiled as indicated on the soil stripping plan	Best Practices and EMPr	All phases
					Controls should be put in place to constantly monitor soil stripping depths.	Best Practices and EMPr	All phases
					Replace topsoil as indicated on the soil replacement plan.	Best Practices and EMPr	All phases
Soil, Land Use and Land Capability	KDG Ferrochrome Smelter footprint - complete stripping of all productive soil horizons (A and B) and stockpiling thereof and replacement during the decommissioning phase.	300 Ha	O, Decom	Possible degradation of soil quality and potential by stripping and stockpiling lower quality subsoil material together with high quality A and B horizons.	Soil types should be stripped at depth and stockpiled as indicated on the soil stripping plan.	Best Practices and EMPr	All phases
					Controls should be put in place to constantly monitor soil stripping depths.	Best Practices and EMPr	All phases
Soil, Land Use and Land Capability	Construction of overburden dumps and topsoil stockpiles that cover natural productive soils	300 Ha	O, Decom	Compaction of the productive soil horizons due to the weight of the dumped material, which negatively influences soil density, water infiltration rates, root development and	Contain overburden and topsoil stockpile footprints as far as possible;	Best Practices and EMPr	All phases
					Remove stockpiles as soon as possible;	Best Practices and EMPr	All phases
					Cross rip stockpile footprints to a depth of at least 600 mm to alleviate compaction directly after removal;	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
				plant growth. Complete cease of arable and grazing land capability and crop farming land use and subsequent loss of agricultural production and food supply at stockpile footprint, until stockpile is removed, compaction alleviated and the footprint re-vegetated or reintroduced to crop farming.	Ameliorate soil fertility by representative sampling and analytical analysis and interpretation thereof by a qualified soil specialist prior to re-vegetation. General rate: lime @3t/h and 1:1:1(40) at 100kg/ha;	Best Practices and EMPr SACNASP / EAPASA	During appointed timeframe
					Re-vegetative footprint with a grass seed mixture that contains a fair percentage of local climax species or reintroduce original land use.	Best Practices and EMPr	All phases
					The position of topsoil stockpiles should be properly planned by the smelting engineer, based on the smelting sequence plan in order to prevent the unnecessary relocation of stockpiles somewhere during the smelting period or unnecessary transporting topsoil over far distances. It should preferably, if possible, be placed on levelled spoil surfaces and not natural/undisturbed topsoil.	Best Practices and EMPr	All phases
					High potential, arable soils (green sections) should be stripped and stored on stockpile 1.	Best Practices and EMPr	All phases
					Soils should be stripped to suitable depths as far as practical possible order to ensure that only the soil material with the required properties is stripped.	Best Practices and EMPr	All phases
					The soil specialist should provide a final stripping block plan that coincides with the construction sequence plan in order to facilitate easy and accurate	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					stripping and stockpiling and later replacement of topsoil.		
					A final post-smelting rehabilitation and topography plan is compulsory to enable proper post-smelting surface drainage. Backfilling of spoil material to precise elevation, based on the final rehabilitation plan is crucial because the topography of the backfilled soil material dictates the post-smelting surface drainage pattern. It should be a compulsory control that the elevation and slope of post-smelting spoil surfaces that are prepared for topsoil replacement are declared correct and signed off by the surveyor prior to replacement of topsoil.	Best Practices and EMPr	All phases
					The post-smelting soil replacement plan must be implemented for the 3 soil sections. The 3 sections should be covered with different soil types that were stored on 3 different stockpiles.	Best Practices and EMPr	All phases
					The boundaries of the planned post-smelting soil types should be staked by the soil specialist or surveyor.	Best Practices and EMPr	All phases
					The soil specialist should provide a final soil replacing block plan to facilitate accurate replacing of topsoil.	Best Practices and EMPr SACNASP/EAPASA	During appointed timeframe
					No topsoil should be replaced unless the prepared section is surveyed by the surveyor and the	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					surface elevation and slope are declared correct and signed off by the surveyor.		
					When topsoil is replaced on prepared and signed off sections, care should be taken to tip enough soil per square unit to reinstate the total required post smelting soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used.	Best Practices and EMPr	All phases
					The replaced topsoil thickness should be progressively monitored by an appointed Environmental Coordinating/Control Officer (ECO) during replacement to verify if it is similar to the replacing depth to prevent encountering shortages of topsoil.	Best Practices and EMPr EAPASA/SACNASP	All phases
Ecological Biodiversity	KDG Ferrochrome Smelter Activities	300 Ha	C, O	Development related activities will lead to damage or degradation of habitats and	A control of access should be implemented for all remaining natural areas to prevent unnecessary destruction of habitats or disturbance of	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
				vegetation communities and overall loss of biodiversity and ecosystem function within the clearance area. As a result of the construction and operational activities degradation or compression may occur if heavy on vehicles are not kept to the demarcated roads and/or development footprint.	species. It is also vital that no additional fragmentation occurs and that all roads are clearly demarcated and kept to without any exceptions. No vehicles or personnel are permitted outside of these demarcated roads.		
					The vegetation removal during the construction phase should be controlled, very specific and the clearance area kept as small as possible.	Best Practices and EMPr	All phases
					Demarcate specific areas to be developed and remain clear of other areas where activities are not necessary.	Best Practices and EMPr	All phases
					To minimize potential impacts to animal species, animals (wildlife and domestic animals) may under no circumstances be handled, removed, killed or interfered with by the Contractor, his employees, his Sub-Contractors or his Sub-Contractors' employees.	Best Practices and EMPr	All phases
					Prevent impacts from reaching downstream water resources by ensuring installation and proper functioning of stormwater systems and drains to prevent contaminated water entering the natural environment.	Best Practices and EMPr	All phases
					Continuous rehabilitation of the areas impacted which are outside of the development footprint should occur during construction, where re-vegetation practices should be prioritised.	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Ecological Biodiversity	Ferrochrome Smelter development and smelting	300 Ha	C, O	Construction, human and vehicle movement and introduction of foreign material e.g., soils may lead to the introduction of alien invader species, impacting on the floral characteristics of the project site and adjacent natural areas.	A management plan for the control of invasive and exotic plant species needs to be implemented. Specialist advice should be used in this regard. This plan should include pre-treatment, initial treatment and follow-up treatment. Removal of alien and invasive species must continue for a two-year maintenance period after development, on a biannual basis.	Best Practices and EMPr SACNASP/EAPASA	All phases
Ecological Biodiversity	Ferrochrome Smelter development and smelting	300 Ha	C, O	Development related activities may lead to the loss of species of conservation concern. Although no SCC were found to occur on the project footprint or are likely to occur on the project footprint.	All footprint areas should remain as small as possible. This can be achieved by fencing footprint areas to contain all activities within designated areas.	Best Practices and EMPr	All phases
					If any SCC are encountered within the subject property in the future, the following should be ensured:	Best Practices and EMPr	All phases
					If any threatened species will be disturbed, ensure effective relocation of individuals to suitable offset areas or within designated open space on the subject property.	Best Practices and EMPr	All phases
					All rescue and relocation plans should be overseen by a suitably qualified specialist.	Best Practices and EMPr SACNASP/EAPASA	All phases
					Obtain relevant permits/consent, if applicable, for each protected or endangered floral species identified within the proposed development area that will be destroyed.	Best Practices and EMPr	All phases
Ecological Biodiversity	Ferrochrome Smelter development	300 Ha	C, O	The continuous human activity over a longer-term period may	Animals may get used to movement by people in designated areas if it is	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
				further impact on the faunal communities within the area. Associated noise, waste, the smell of humans and physical infiltration into remaining natural areas are problematic and may lead to ever declining populations (where the disturbance of habitat has caused habitat remaining to become unfavourable).	predictable. A control of access should be implemented for all remaining natural areas to prevent infiltration of remaining natural habitats or disturbance of species.		
					Noise impacts should be monitored and kept in accordance with the regulated standard prescribed for the zoning of the area.	Best Practices and EMPr Noise Regulations	All phases
					Prevent impacts and waste from reaching the various water resources and areas outside the smelting footprint areas.	Best Practices and EMPr	All phases
					Hazardous wastes should be stored in impermeable and bunded areas. Domestic waste and other waste should be managed in the appropriate manner and applying good housekeeping practices will aid this issue.	Best Practices and EMPr	All phases
Ecological Biodiversity	Ferrochrome smelter development	300 Ha	Cl, Decom	The results may be positive if rehabilitation has been done correctly and the site may be rehabilitated back to a natural landscape. Rehabilitation could be ineffective if measures are not appropriately complied to or rehabilitation is not planned well in advance. Without the necessary mitigation	A management plan for control of invasive/exotic plant species needs to be implemented. This will be ongoing until the end of the smelting closure phase.	Best Practices and EMPr	All phases
					Rehabilitation plans should be planned long before the closure phase is due. Continuous rehabilitation should also take place during the operational phase.	Best Practices and EMPr	All phases
					Close monitoring of plant communities to ensure that ecology is restored and self-sustaining. The monitoring of the flora after rehabilitation should	Best Practices and EMPr EAPASA/SACNASP	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
				measures, rehabilitation will be unsuccessful and the environment will not be self-sustaining. Without mitigation the alien invasive species will increase and result in a degraded veld condition making the property less viable for post-closure land use activities such as wilderness, grazing and agriculture.	be conducted annually by the environmental practitioner, until a suitably qualified specialist deems the monitoring to no longer be necessary. A report should be written and stored and should be available at all times.		
					When closure is considered successful and rehabilitation complete, unnecessary fences should be lifted to restore larger foraging areas, especially for larger mammalian species within the area.	Best Practices and EMPr	Closure and rehabilitation phase
Ecological Biodiversity	Ferrochrome Smelter Development	300 Ha	C, O	Development related activities will lead to damage or degradation of habitats and vegetation communities and overall loss of biodiversity and ecosystem function within the clearance area. As a result of the construction and operational activities degradation or compression may occur if heavy on vehicles are not kept to the demarcated roads and/or development footprint.	A control of access should be implemented for all remaining natural areas to prevent unnecessary destruction of habitats or disturbance of species. It is also vital that no additional fragmentation occurs and that all roads are clearly demarcated and kept to without any exceptions. No vehicles or personnel are permitted outside of these demarcated roads.	Best Practices and EMPr	All phases
					The vegetation removal during the construction phase should be controlled, very specific and the clearance area kept as small as possible.	Best Practices and EMPr	Construction phase
					Demarcate specific areas to be developed and remain clear of other areas where activities are not necessary.	Best Practices and EMPr	Construction phase
					To minimize potential impacts to animal species, animals (wildlife	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					and domestic animals) may under no circumstances be handled, removed, killed or interfered with by the Contractor, his employees, his Sub-Contractors or his Sub-Contractors' employees.		
					Prevent impacts from reaching downstream water resources by ensuring installation and proper functioning of stormwater systems and drains to prevent contaminated water entering the natural environment.	Best Practices and EMPr Engineering principles	All phases
					Continuous rehabilitation of the areas impacted which are outside of the development footprint should occur during construction, where re-vegetation practices should be prioritised.	Best Practices and EMPr	All phases
Ecological Biodiversity	Ferrochrome Smelter Development	300 Ha	C, O	Construction, human and vehicle movement and introduction of foreign material (e.g., soils) may lead to the introduction of alien invader species, impacting on the floral characteristics of the project site and adjacent natural areas.	A management plan for the control of invasive and exotic plant species needs to be implemented. Specialist advice should be used in this regard. This plan should include pre-treatment, initial treatment and follow-up treatment. Removal of alien and invasive species must continue for a two-year maintenance period after development, on a biannual basis.	Best Practices and EMPr	All phases
Ecological Biodiversity	KDG Smelter Activities	300 Ha	C, O	Development related activities may lead to the loss of species of conservation concern. Although no SCC were found to occur on the project footprint or are likely to occur on	All footprint areas should remain as small as possible. This can be achieved by fencing footprint areas to contain all activities within designated areas.	Best Practices and EMPr	All phases
					If any threatened species will be disturbed, ensure effective relocation of individuals to	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
				the project footprint.	suitable offset areas or within designated open space on the subject property.		
					All rescue and relocation plans should be overseen by a suitably qualified specialist.	Best Practices and EMPr SACNASP/EAPASA	All phases
					Obtain relevant permits/consent, if applicable, for each protected or endangered floral species identified within the proposed development area that will be destroyed.	Best Practices and EMPr	All phases
Ecological Biodiversity	Ferrochrome Smelter Development	300 Ha	C, O	The continuous human activity over a longer-term period may further impact on the faunal communities within the area. Associated noise, waste, the smell of humans and physical infiltration into remaining natural areas are problematic and may lead to ever declining populations (where the disturbance of habitat has caused habitat remaining to become unfavourable).	Animals may get used to movement by people in designated areas if it is predictable. A control of access should be implemented for all remaining natural areas to prevent infiltration of remaining natural habitats or disturbance of species.	Best Practices and EMPr	All phases
					Noise impacts should be monitored and kept in accordance with the regulated standard prescribed for the zoning of the area.	Best Practices and EMPr Noise Regulations	All phases
					Prevent impacts and waste from reaching the various water rsources and areas outside the smelting footprint areas.	Best Practices and EMPr	All phases
					Hazardous wastes should be stored in impermeable and bunded areas. Domestic waste and other waste should be managed in the appropriate manner and applying good housekeeping practices will aid this issue.	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Ecological Biodiversity	Ferrochrome Smelter Development	300 Ha	Cl, Decom	The results may be positive if rehabilitation has been done correctly and the site may be rehabilitated back to a natural landscape. Rehabilitation could be ineffective if measures are not appropriately complied to or rehabilitation is not planned well in advance. Without the necessary mitigation measures, rehabilitation will be unsuccessful and the environment will not be self-sustaining. Without mitigation the alien invasive species will increase and result in a degraded veld condition making the property less viable for post-closure land use activities such as wilderness, grazing and agriculture.	A management plan for control of invasive/exotic plant species needs to be implemented. This will be ongoing until the end of the smelting closure phase.	Best Practices and EMPr	All phases
					Rehabilitation plans should be planned long before the closure phase is due. Continuous rehabilitation should also take place during the operational phase.	Best Practices and EMPr	All phases
					Rehabilitation plan should be implemented. This includes the process of replanting the vegetation. Rehabilitation plans should be compiled with the use of a specialist and the correct seeding techniques and mixtures should be applied.	Best Practices and EMPr	All phases
					Close monitoring of plant communities to ensure that ecology is restored and self-sustaining. The monitoring of the flora after rehabilitation should be conducted annually by the environmental practitioner, until a suitably qualified specialist deems the monitoring to no longer be necessary. A report should be written and stored and should be available at all times.	Best Practices and EMPr SACNASP/EAPASA	All phases
					When closure is considered successful and rehabilitation complete, unnecessary fences should be lifted to restore larger foraging areas, especially for larger mammalian species within the area.	Best Practices and EMPr	Closure and Rehabilitation phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Heritage / Archaeological	Smelting activities	300 Ha	C, O	The impact of any future smelting operations or related development actions on the existing homesteads and structures if they cannot be preserved in situ and needs to be demolished as a result.	Detailed assessment and recording of structures older than 60 years of age before demolition.	Best Practices and EMPr SAHRA	All phases
Noise	The construction process will consist of the following principal activities: • Site survey and preparation; • Development of internal access roads and security fencing; • Site preparation activities will include clearance of vegetation at the footprint of the site infrastructure. These activities will require the removal of the vegetation and the stripping of topsoil which will need to be stockpiled (or used in other areas for rehabilitation); • Drilling of the overburden, as well	300 Ha	C	Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 55.6 (average impulse-weighted equivalent value) and 46 dBA (arithmetic fast-weighted average) (see section 6.3). With ambient sound level measurement indicating the potential that existing levels may already exceed the IFC recommended noise limits for residential use, daytime construction activities should not change the existing ambient sound levels with more than 3 dB.	The potential significance of the noise impact is low and no specific mitigation measures are required. It is however, recommended that the smelter use available topsoil or waste residue to develop a noise berm between the smelting section and NSR 05. This is due to the potential risk from a night-time noise impact during the operational phase. It is recommended that the construction of this berm only take place during the daytime period.	Best Practices and EMPr SACNASP/EAPASA Noise Regulations	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	as the excavation and loading of the blasted overburden; and • The establishment of infrastructure such as stormwater management trenches/berms, contractor offices, stockpiles and waste residue facilities.			Considering the ambient sound level measurements collected in the area, night-time sound levels could range between 50 (average impulse-weighted equivalent value) and 41 dBA (arithmetic fast-weighted average). With ambient sound level measurement indicating that existing levels already exceed the IFC recommended noise limits for night-time residential use, night-time construction activities should not change the existing ambient sound levels with more than 3 dB.	The potential significance of the noise impact is low-medium, mainly due to the strict impact assessment criteria and the high weighting factor. Projected noise levels are low and the proposed night-time construction activities will not change ambient sound levels with more than 3 dB. No specific mitigation measures are required. A berm between NSR 05 and 09 and the smelter is recommended, but it is recommended that the construction of this berm only take place during the daytime period.	Best Practices and EMPr SACNASP/EAPASA Noise Regulations	All phases
Noise	The smelting method will include: • Vegetation and topsoil will be stripped ahead of smelting using a bulldozer or grader; • The topsoil will be loaded onto dump trucks by excavators and hauled to the stockpiles or areas	300 Ha	O	Considering the ambient sound level measurements collected in the area, daytime sound levels could range between 55 (average impulse-weighted equivalent value) and 45 dBA (arithmetic fast-weighted average). With ambient sound level measurement indicating the	The potential significance of the noise impact is medium and specific mitigation measures are required.	Best Practices and EMPr SACNASP/EAPASA Noise regulations	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	that require rehabilitation; •A source of noise during the operational phase will be traffic to and from the site, traffic around the infrastructure facilities, product transport and activities associated with waste management.			potential that existing levels may already exceed the IFC recommended noise limits for residential use, daytime operational activities should not change the existing ambient sound levels with more than 3 dB.			
				Considering the ambient sound level measurements collected in the area, night-time sound levels could range between 50 (average impulse-weighted equivalent value) and 40 dBA (arithmetic fast-weighted average). With ambient sound level measurement indicating that existing levels already exceed the IFC recommended noise limits for night-time residential use, night-time operational activities should not change the existing ambient sound levels with more than 3 dB.	The potential significance of the noise impact is low-medium, mainly due to the strict impact assessment criteria and the high weighting factor. Projected noise levels are low and the proposed night-time operational activities will not change ambient sound levels with more than 3 dB. A berm between NSR 05 and 09 and the smelter is recommended, but it is recommended that the construction of this berm only take place during the daytime period.	Best Practices and EMPr SACNASP/EAPASA Noise Regulations	All phases
Socio-Economic	Construction activities associated with the	300 Ha	C	Creation of a number of jobs for locals Positive	Development of clear policies and procedures for local labour recruitment	Best Practices and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	KDG Ferrochrome Smelter Project				Employ majority locals from the surrounding communities, especially Mopane and Mudimeli areas	Best Practices and EMPr	All phases
					Employ only South Africans	Best Practices and EMPr	All phases
					Employ a local community liaison or labour desk officer	Best Practices and EMPr	All phases
Socio-Economic	Construction activities associated with the KDG Ferrochrome Smelter Project	300 Ha	C	Influx of job-seekers to site	Employ security officers to keep the entrance area free of jobseekers	Best Practices and EMPr	Construction and Operational phases
					Establish database and jobseeker registration points at a local municipality office	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Construction activities associated with the KDG Ferrochrome Smelter Project	300 Ha	C	Training of local people	Develop a database of young people who need opportunities for on-the-job training (use community liaison officer or labour desk officer)	Best Practices and EMPr	Construction and Operational phases
					Recruit from the local communities,	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Construction activities associated with the KDG Ferrochrome Smelter Project	300 Ha	C	Traffic congestion	Run awareness campaign (traffic safety) including installation of warning signs	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Construction activities associated with the KDG Ferrochrome Project	300 Ha	C	Creation of local procurement opportunities	Early identification of opportunities for local suppliers and service providers.	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Construction activities associated with the KDG Ferrochrome Project	300 Ha	C	Site disturbance by local business forums	Develop local sub-contractor and supplier procurement policy and procedures	Best Practices and EMPr	Construction and Operational phases
					Use community liaison officer to develop a database of local businesses	Best Practices and EMPr	Construction and Operational phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Employment creation and retention.	Develop measures to ensure that smelting contractors use local labourers for unskilled and semi-skilled labour	Best Practices and EMPr	Construction and Operational phase
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Contribution to Local Economy. Positive	Develop local procurement policy and increase expenditure on local businesses (e.g., Procure 50% minimum locally)	Best Practices and EMPr	Construction and Operational phases
					Provide opportunities for local beneficiation (egg running of crush plants	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Regional Economic Development. Positive	Coordinate with local authorities and other industries to contribute towards regional development programmes linked to the smelting and energy generation sector.	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Community development. Positive	Implement targeted social and labour plans informed by socio-economic baseline studies undertaken in the communities	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Skills transfer and development. Positive	Develop human resource development programmes	Best Practices and EMPr	Construction and Operational phases
					Develop bursary programme	Best Practices and EMPr	Construction and Operational phases
Socio-Economic	Operational activities associated with the KDG Smelter Project	300 Ha	O	Health and safety risks. Positive	The smelter shall be maintained during its lifetime in a manner that ensures a safe working environment for personnel.	Best Practices and EMPr	Construction and Operational phases
					Ensure a safe environment for neighbouring communities.	Best Practices and EMPr	Construction and Operational phases
					Adherence to rigorous operational health and safety programmes.	Best Practices and EMPr	Construction and Operational phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Socio-Economic	Closure and Decommissioning activities associated with the KDG Smelter Project	300 Ha	Cl, Decom	Loss of Employment	Exit planning including timely and adequate consultation with employees who are dependent on the smelter for employment.	Best Practices and EMPr	Operational and Closure phases
					Training and education of employees to equip them with skills that could benefit them in other industries. During the operational phase, members of the workforce will be encouraged to obtain skills or qualifications that are recognised by the National Qualifications Framework and are registered through the Smelting Qualifications Authority. These qualifications include non-smelting skills that will assist employees in areas other than smelting.	Best Practices and EMPr	Operational and Closure phases
Socio-Economic	Closure and Decommissioning activities associated with the KDG Smelter Project	300 Ha	Cl, Decom	Reduced local and regional activity	No mitigation	N/A	N/A
Socio-Economic	Closure and Decommissioning activities associated with the KDG Smelter Project	300 Ha	Cl, Decom	Reduced community development investments	Develop exit strategies and empower communities to choose and implement sustainable programmes.	Best Practices and EMPr	Operational and Closure phases
Surface Water	Removal of vegetation and exposure of soils Construction and use of hydrocarbon storage facilities Movement of heavy machinery and	300 Ha	C, O, Cl	Surface water quality - Sedimentation and pollution of surface water resources resulting in the deterioration of water quality	Construction phase management		
					Development of the storm water management structures to ensure that sediment generated during the construction phase is conveyed to the silt trap, and clean water is diverted away from dirty water areas.	Best Practises and EMPr	Construction phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	vehicles during the construction phase Runoff from the smelting area, stockpiles, and haul roads				Ensure that storm water management structures are in good working condition through regular inspection, especially after large storm events.	Best Practises and EMPr	Construction phase
					If excessive erosion is observed, soil management and erosion protection structures and measures should be implemented.	Best Practises and EMPr	Construction phase
					Soils compacted by heavy machinery in areas that are not utilised post construction can be ripped to allow infiltration.	Best Practises and EMPr	Construction phase
					Roads should be maintained regularly to ensure that surface water drains freely off the road preventing erosion.	Best Practises and EMPr	Construction phase
					A topsoil stripping and stockpiling guideline must be completed to ensure rehabilitation success.	Best Practises and EMPr	Construction phase
					Earth berms should be vegetated in order to avoid erosion and sedimentation.	Best Practises and EMPr	Construction phase
					Limit refuelling and maintenance of machinery and vehicles to specified locations and ensure the appropriate spill prevention and incident management measures are in place.	Best Practises and EMPr	Construction phase
					Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.	Best Practises and EMPr	Construction phase
					The proper storage and handling of hazardous substances	Best Practises and EMPr	Construction phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					(hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage containers must be regularly inspected so as to prevent leaks.		
					Ensure that any rubbish/litter is cleared once a month to minimise litter.These will need to be cleaned out in accordance with a regular maintenance programme.	Best Practises and EMPr	Construction phase
					Portable toilets must be placed on impervious level surfaces that are lipped to prevent spillage. The general consensus is that they should be within 30 m to 50 m of a work face.	Best Practises and EMPr	Construction phase
					Avoid encroaching on natural areas directly adjacent to proposed activities.	Best Practises and EMPr	Construction phase
					Demarcate and avoid sensitive areas identified.	Best Practises and EMPr	Construction phase
					Alien Invasive Plant (AIP) species should be eradicated and controlled to prevent their spread within or beyond the footprint. An AIP Control Plan should be compiled and implemented.	Best Practises and EMPr	Construction phase
					Alien vegetation must be cleared prior to clearing/stripping new areas, to ensure alien vegetation is not spread to other areas.	Best Practises and EMPr	Construction phase
					Where feasible, rehabilitate disturbed areas as soon as possible after construction.	Best Practises and EMPr	Construction phase
Surface Water	Implementation of surface water runoff management	300 Ha	C, O, Cl	Surface water quantity - changes in the runoff flow	Operational phase management:		
					Ensure that effective separation of clean and dirty water systems	Best Practises and EMPr	Operational phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	mechanisms during construction Movement of heavy machinery and vehicles during the construction phase Development and operation of surface infrastructure			velocity and volume increasing erosion and sedimentation	is implemented, as designed by an engineer. No contaminated ("dirty") water should be allowed to enter the natural environment, clean water systems or water resources.		
					The dirty water collection trenches should be cleaned regularly to reduce the build-up of sediment and to ensure they are able to accommodate the 1:50 year peak flows.	Best Practises and EMPr	Operational phase
					A topsoil stripping and stockpiling guideline must be completed to ensure rehabilitation success.	Best Practises and EMPr	Operational phase
					Earthen berms should be vegetated in order to avoid erosion and sedimentation.	Best Practises and EMPr	Operational phase
					Stockpiling should be monitored so that the side slopes do not encourage erosion of the slopes resulting in silt transported into the trenches from the stockpiles.	Best Practises and EMPr	Operational phase
					Stockpiling areas need to be licenced and constructed as per the requirements of the Competent Authority.	Best Practises and EMPr	Operational phase
					Water quality in the PCD/slag area should be monitored. This ensures that pollution sources are monitored during the operational phase and in the unlikely event of any spillages the downstream impacts can be estimated.	Best Practises and EMPr	Operational phase
					Seepage or discharge of waste water from the waste water containment facilities should be prevented to reduce pollution of surface water resources as well as	Best Practises and EMPr	Operational phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					to improve water conservation. Dirty water containment facilities and residue stockpiles should be appropriately lined as per the recommendations of the Geohydrological Study.		
					Ongoing implementation of the recommended monitoring plan to ensure that impacts to the surface water environment are detected timeously.	Best Practises and EMPr	Operational phase
					Implement erosion prevention measures and structures.	Best Practises and EMPr	Operational phase
					Avoid contamination of soils and implement appropriate remedial measures if incidents of spillage occur.	Best Practises and EMPr	Operational phase
					No washing of any equipment in close proximity to a watercourse is permitted.	Best Practises and EMPr	Operational phase
					No releases of any substances that could be toxic to fauna or faunal habitats within the watercourses is permitted.	Best Practises and EMPr	Operational phase
					Education of workers is key to establishing good pollution prevention practices. Training programs must provide information on material handling and spill prevention and response, to better prepare employees in case of an emergency.	Best Practises and EMPr	Operational phase
					The proper storage and handling of hazardous substances (hydrocarbons and chemicals) needs to be ensured. All employees handling fuels and other hazardous materials are to be properly trained. Storage	Best Practises and EMPr	Operational phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					containers must be regularly inspected so as to prevent leaks.		
					Portable toilets must be placed on impervious level surfaces that are lipped to prevent spillage. The general consensus is that they should be within 30 m to 50 m of a work face.	Best Practises and EMPr	Operational phase
					Concurrent rehabilitation to be implemented, specifically revegetation of disturbed areas.	Best Practises and EMPr	Operational phase
					Avoid encroaching on natural areas directly adjacent to proposed activities.	Best Practises and EMPr	Operational phase
					Demarcate and avoid sensitive areas identified. All demarcated sensitive zones outside of the smelter site area are strictly off limits during any smelting activity.	Best Practises and EMPr	Operational phase
					Alien Invasive Plant (AIP) species should be eradicated and controlled to prevent their spread within or beyond the footprint.	Best Practises and EMPr	Operational phase
					Alien vegetation must be cleared prior to clearing/stripping new areas, to ensure alien vegetation is not spread to other areas.	Best Practises and EMPr	Operational phase
Surface Water	Implementation of surface water runoff management mechanisms during construction	300 Ha	C, O	Surface water quantity - Reduction of Catchment Yield as dirty water runoff within the smelter will be contained in the PCD/Slag area.	Closure phase management		
					Leaving the storm water management structures in place during the decommissioning and post closure phase until the rehabilitation process is completed. This will ensure that sediment generated during this phase is captured.	Best Practises and EMPr	Closure phase
					Storm water management structures should be inspected	Best Practises and EMPr	Closure phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					after large storm events to ensure that there are no blockages or damage. Should blockages or damage occur, immediate action should be undertaken to remove debris or to repair damaged areas.		
					Soils compacted by heavy machinery can be ripped to allow infiltration.	Best Practises and EMPr	Closure phase
					Rehabilitation processes such as restoring the topography to a pre-activity state, and re-vegetation of disturbed areas will assist in returning natural surface water drainage patterns.	Best Practises and EMPr	Closure phase
					Establish free-draining final landform.	Best Practises and EMPr	Closure phase
Surface Water	Removal of storm water management mechanisms	300 Ha	Cl	Surface water quantity - Reinstatement of surface drainage patterns	See above	See above for construction, operational and closure phases	See above
Surface Water	Removal of storm water management mechanisms	300 Ha	Cl	Surface water quantity - Reinstatement of surface drainage patterns	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Nutrient enrichment leading to decline of Dissolved Oxygen (DO), thereby impacting the aquatic invertebrate communities found in flowing watercourses.	300 Ha	C, O	Construction and operational activities resulting in impacts to biodiversity and ecological function. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	Interference with ecological corridor functioning Removal of watercourses, wetlands, and sensitive areas. Alteration of drainage patterns Leading to decrease and changes in water quantity and availability.						
Aquatic Ecology	Activities in and around sensitive areas	300 Ha	C, O	Loss of biodiversity and ecological function. Impacts to ecological corridor functioning due to prolonged activity in proximity to watercourses. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Implementation of surface water runoff management mechanisms during construction Movement of heavy machinery and vehicles during the construction phase	300 Ha	C, O	Alteration of drainage patterns leading to decrease and changes in water quantity and availability. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Removal of vegetation and exposure of soils Construction and use of hydrocarbon storage facilities	300 Ha	C, O	Deterioration of water quality in the surrounding and downstream water resources due to polluted water runoff,	See above	See above for construction, operational and closure phases	See above

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	Movement of heavy machinery and vehicles during the construction phase			affecting aquatic communities. The KDG Smelter Activities will have the same impact rating			
Aquatic Ecology	Removal of vegetation and exposure of soils Movement of heavy machinery and vehicles during the construction phase Removal of watercourses, wetlands, and sensitive areas	300 Ha	C, O	Nutrient enrichment due to sedimentation, leading to decline of Dissolved Oxygen (DO), thereby impacting aquatic invertebrate communities. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Removal of vegetation and exposure of soils Construction and use of hydrocarbon storage facilities Movement of heavy machinery and vehicles during the construction phase Removal of watercourses, wetlands, and sensitive areas	300 Ha	C, O	Deterioration of surface water quality may lead to a deterioration of the Present Ecological Status (PES). The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Implementation of surface water runoff management mechanisms during construction	300 Ha	C, O	Surface water quantity reducing the capacity available to sustain aquatic diversity. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Aquatic Ecology	Loosening of soil during rehabilitation processes Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes	300 Ha	Cl, Decom	Decommissioning impacts resulting in impacts to biodiversity and ecological function within buffer zones or regulated zones. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Removal of storm water management mechanisms	300 Ha	Cl, Decom	Alteration of drainage patterns after or during removal of the infrastructure, leading to decrease and changes in water quantity and availability. The KDG Smelter Activities will have the same impact rating	See above	See above	See above
Aquatic Ecology	Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	300 Ha	Cl, Decom	Deterioration of water quality in the surrounding and downstream water resources due to polluted water runoff, affecting aquatic communities during decommissioning and removal of infrastructure. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
Aquatic Ecology	Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	300 Ha	Cl, Decom	Nutrient enrichment due to sedimentation, leading to decline of Dissolved Oxygen (DO), thereby impacting aquatic invertebrate communities. The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Aquatic Ecology	Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	300 Ha	Cl, Decom	Deterioration of surface water quality may lead to a deterioration of the Present Ecological Status (PES). The KDG Smelter Activities will have the same impact rating	See above	See above for construction, operational and closure phases	See above
Wetland Ecosystem	Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm	300 Ha	C	Flow alterations due to erosion and sedimentation	See above	See above for construction, operational and closure phases	See above

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	water management mechanisms. Loosening of soil during rehabilitation processes.						
Wetland Ecosystem	Movement of heavy machinery and vehicles compacting soils during demolition of infrastructure and rehabilitation processes. Removal of storm water management mechanisms. Loosening of soil during rehabilitation processes.	300 Ha	C	Pollution of watercourses Spread of alien vegetation	See above	See above for construction, operational and closure phases	See above
Groundwater	KDG Smelter Activities	300 Ha	O	Spread of pollution	Identify and where possible, maximise areas of the smelter that will result in clean storm water runoff (for example open veld areas) as well as infrastructure associated with the smelter (for example office areas) and ensure that runoff from these areas is routed directly to natural watercourses and not contained or contaminated.	Best Practises and EMPr	Construction and Operational phases
					Ensure that clean storm water is only contained if the volume of the runoff poses a risk, if the water cannot be discharged to watercourses by gravitation, for attenuation purposes, or when the clean area is small and	Best Practises and EMPr	Construction and Operational phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					located within a large dirty area. This contained clean water should then be released into natural watercourses under controlled conditions.		
					Ensure the minimisation of contaminated areas, reuse of dirty water wherever possible and planning to ensure that clean areas are not lost to the catchment unnecessarily.	Best Practises and EMPr	Construction and Operational phases
					Ensure that seepage losses from storage facilities (such as pollution control dams) are minimised and overflows are prevented.	Best Practises and EMPr	Construction and Operational phases
					Ensure that all possible sources of dirty water have been identified and that appropriate collection and containment systems have been implemented and that these do not result in further unnecessary water quality deterioration.	Best Practises and EMPr	Construction and Operational phases
					Ensure that less polluted water or that: moderately polluted water is not further polluted. Where possible less and more polluted water should be separated. This will assist in the reuse water strategy and improve possibilities for reuse based on different water quality requirements by different water uses.	Best Practises and EMPr	Construction and Operational phases
					Where contaminants are transported along construction roads, emergency containment and mitigation measures must be developed to minimize impacts	Best Practises and EMPr	Construction and Operational phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					should accidental spillages occur along the transport routes.		
					Store all potential sources of contamination in secure facilities with appropriate storm water management systems in place to ensure that contaminants are not released to the water resource through storm water runoff.	Best Practises and EMPr	Construction and Operational phases
					Separate and collect all storm water that has a quality potentially poorer than the water quality specified and negotiated for the specific catchment into dirty water storage facilities for reuse within the smelting operations.	Best Practises and EMPr	Construction and Operational phases
					Ensure that all storm water structures that are designed to keep dirty and clean water separate can accommodate a defined precipitation event. (The magnitude of the precipitation event used in such an objective statement must, as a minimum, adhere to the relevant legal requirements.)	Best Practises and EMPr	Construction and Operational phases
					Route all clean storm water directly to natural watercourses without increasing the risk of a negative impact on safety and infrastructure, (e.g., loss of life or damage to property due to an increase in the peak runoff flow).	Best Practises and EMPr	Construction and Operational phases
					Ensure that the maximum volume of clean water runoff is diverted directly to watercourses and the minimum amount of storm water reports to the slag area floor.	Best Practises and EMPr	Construction and Operational phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					Develop and implement proper environmental management and auditing systems to ensure that pollution prevention and impact minimisation plans and measures developed in the design and feasibility stages are fully implemented.	Best Practises and EMPr	Construction and Operational phases
					The size of unrehabilitated areas (e.g. spoils, unvegetated areas) that produce contaminated runoff should be minimised.	Best Practises and EMPr	Construction and Operational phases
					Rehabilitation should be planned to promote free drainage and to minimise or eliminate ponding of storm water. On-going rehabilitation as smelting operations progress is required.	Best Practises and EMPr	Construction and Operational phases
					The clean and dirty water flow areas on a smelter site should be identified.	Best Practises and EMPr	Construction and Operational phases
					Every effort should be made to maximise the clean area and minimise the dirty area when locating the diversion berms, channels and dams. In the case of a new smelter area, the maximisation of the clean areas should have an influence in overall planning and the location of the infrastructure	Best Practises and EMPr	Construction and Operational phases
					The smelter planning should consider concurrent rehabilitation of smelter workings and waste management facilities, to maximise the areas of clean runoff that can be discharged to the natural watercourses	Best Practises and EMPr	Construction and Operational phases
Groundwater		300 Ha	O				

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
	Dewatering of aquifer at the Ferrochrome Smelter site			Drawdown: lowering of the water table	Monitoring of water storage facilities, particularly pollution control dams, is imperative to manage the risk of spillage from the dams. Stage-storage (elevation-capacity) curves are useful tools to monitor the remaining capacity within a water storage facility.	Best Practises and EMPr	All phases
					Prevent the erosion or leaching of materials from any stockpile from any area and contain material or substances so eroded or leached in such an area by providing suitable barrier dams, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources.	Best Practises and EMPr	All phases
					Water quantity and quality data should be collected on a regular, ongoing basis during smelter operations. These data will be used to recalibrate and update the water management model, to prepare monitoring and audit reports, to report to the regulatory authorities against the requirements of the Integrated water management plan (IWMP) and other authorisations and as feedback to stakeholders in the catchment, perhaps via the Catchment management area (CMA).	Best Practises and EMPr	All phases
					Water that has been in contact with residue, must be considered polluted, and must be kept within	Best Practises and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					the confines of the slag area until evaporated, treated to rendered acceptable for release, or re-used in some other way.		
					All water that falls within the catchment area of the slag area must be retained within that area.	Best Practises and EMPr	All phases
					The design, operation and closure of water return dams should incorporate consideration of the risk of changes in the smelting and plant operations, and hence the water balance, through the life cycle of the smelter.	Best Practises and EMPr	All phases
					A system of storm water drains must be designed and constructed to ensure that all water that falls outside the smelter area is diverted. Provision must be made for the maximum precipitation to be expected over a period of 24 hours with a probability of once in one hundred years.	Best Practises and EMPr	Construction phase
					Ensure that the water use practices on and around the slag area do not result in unnecessary water quality deterioration, e.g., use of the return water dam for storage of poorer quality water.	Best Practises and EMPr	All phases
					Should the above be insufficient to capture polluted surface and groundwater moving towards the water courses an interception trench can be designed as follows:	Best Practises and EMPr	All phases
					The depth of the trench should be at least 4 mbgl (or 2 m below the groundwater level) to intercept polluted seepage.	Best Practises and EMPr	All phases

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					The design of the trench gradient must be such that the water is free-flowing without eroding the channel;	Best Practises and EMPr	All phases
					The water from the trench must be captured, retained and managed within the smelter water systems.	Best Practises and EMPr	All phases
					The following boreholes may be affected by dewatering activities during smelting:		
					KB03, KB04, KB05, KB06 KB07, KB08, and KB09	Best Practises and EMPr	All phases
					Should these boreholes decrease in yield the smelter should supply the owners with a volume of water as agreed upon between the parties involved.	Best Practises and EMPr	All phases
					The capacity to rapidly pump water into storage dams should be maintained. This will assist in minimising water quality deterioration due to long-term retention of storm water in contact with materials that may cause water quality deterioration.	Best Practises and EMPr	All phases
					Berms should be constructed around the smelter to minimise the flow of any surface water or floodwater into smelter workings. These berms should be constructed to allow free drainage away from the smelter.	Best Practises and EMPr	All phases
					Concurrent rehabilitation should take place during the operational phase, where applicable, to:	Best Practises and EMPr	All phases
					▪ Meet the post-smelting topography requirements.	Best Practises and EMPr	Closure phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					▪ Minimise the post-closure water management requirements, by maximising free-draining areas and minimising contamination of clean water.	Best Practises and EMPr	Closure phase
					▪ The above water management principles should play a key and decisive role when evaluating and deciding on rehabilitation and closure strategies.	Best Practises and EMPr	Closure phase
					▪ Additionally, adding lime to backfill material could be considered to minimise the generation of acidity.	Best Practises and EMPr	All phases
					Water quantity and quality data should be collected on a regular, ongoing basis during smelter operations. The data will be used to recalibrate and update the smelter water management model, to prepare monitoring and audit reports, to report to the regulatory authorities against the requirements of the IWMP and other authorisations and as feedback to stakeholders in the catchment, perhaps via the CMA. See the Monitoring Network section.	Best Practises and EMPr	All phases
					If excessive groundwater recharge and rainfall is encountered other than the predicted volumes the water could be managed as follows:		

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					▪ Manage seepage and rainfall through a collection and storage system. Water stored should be utilised locally for dust suppression, as far as possible. Excess water should be pumped and incorporated into the water balance,	Best Practises and EMPr	All phases
					▪ Maximise the abstraction and discharge of clean groundwater ahead of the smelter development.	Best Practises and EMPr	All phases
Groundwater	Backfilling of excavations and voids	2015 Ha	Post Cl	Spread of pollution			
					Should monitoring indicate the passive methods employed during the rehabilitation of any excavations are ineffective and water quality is unacceptable for release the following can be implemented.	Best Practises and EMPr	Closure phase
					Passive Method		
					Should low volumes of water be encountered (< 5 ℓ/s or 432 m3/d) an interception trench can be designed as follows:	Best Practises and EMPr	Closure phase
					The depth of the trench should be at least 4 mbgl (or 2 m below the groundwater level) to intercept polluted seepage.	Best Practises and EMPr	Closure phase
					The design of the trench gradient must be such that the water is free-flowing without eroding the channel;	Best Practises and EMPr	Closure phase
					The water from the trench must be captured, retained and managed within the smelter	Best Practises and EMPr	Closure phase

Aspect	Activity	Size and Scale of Disturbance	Phase	Potential Impact	Mitigation Measures	Compliance with Standards	Time period for implementation
					water systems i.e., lined evaporation dams until the decant water quality reached equilibrium.		
					Should high volumes of water be encountered (> 5 ℓ/s or 432 m3/d), Treatment strategies may include a greater or lesser degree of water treatment in order to render the water suitable for reuse. If there is still a residual water management problem, then the operation could evaluate and negotiate options with DWS for the discharge of such water to the water resource.	Best Practises and EMPr	Closure phase
Groundwater	Potential decant from smelting areas	300 Ha	Post Cl	Drawdown: lowering of the water table	As Above	As Above	As Above
Visual	KDG Ferrochrome Smelter activities	300 Ha	C	Potential visual impact on the viewpoints that had a visual exposure rating for the construction phase	The visual impact can be minimized by creating a visual barrier.	Best Practises and EMPr	All phases
					The construction area will be rehabilitated as soon as construction of the infrastructure is finished.	Best Practises and EMPr	Closure and Rehabilitation phases
Visual	KDG Ferrochrome Smelter activities	300 Ha	O, Cl, Post Cl.	Potential permanent visual impact on the viewpoints that had a visual exposure rating for the operational, closure and post-closure phases.	The visual impact can be minimized creating a visual barrier.	Best Practises and EMPr	All phases
					The construction area will be cleared as soon as construction of the infrastructure is finished.	Best Practises and EMPr	Closure and Rehabilitation phases

5.0 ENVIRONMENTAL AWARENESS PLAN

5.1 Introduction

In terms of Regulation 51 (b) (vi) of the Act, KDG Ferrochrome Smelter operations is required to submit an Environmental Awareness Plan (EAP) as part of the Environmental Impact Assessment (EIA) and Management Programme (EMP) for the its operations.

The EAP must describe the following:

- The manner in which the KDG Ferrochrome Smelter intends to inform it's employees of any environmental risks, which may result from their work; and
- The manner in which the risks must be dealt with in order to avoid pollution or the degradation of the environment.

KDG Ferrochrome Smelter operations will aim to implement the ISO14001 Environmental Management System (EMS), even though KDG Ferrochrome Smelter is currently not certified. As a result, the EAP is based on the ISO14001 requirements.

5.2 Implementing Environmental Awareness

Roles and Responsibilities

The first step in the implementation of an EAP is to identify roles and responsibilities of individuals within the mine/smelter. The responsibility lies with the management of KDG Ferrochrome Smelter operations to establish an Environmental Department within the Safety Health Environment and Quality (SHEQ) department. It is the responsibility of the Environmental Department / Environmental Manager to implement the Environmental Awareness Plan, and to identify training and awareness needs on a continual basis. Specialists may be contracted in by KDG Ferrochrome Smelter operations where required for specialised environmental training.

Objectives

The objectives of the Environmental Awareness Plan are as follows in terms of competence, training and awareness:

1. The organisation shall ensure that any person(s) performing tasks for it or on its behalf that have the potential to cause a significant environmental impact(s) identified by the organisation is (are) competent on the basis of appropriate education, training or experience, and shall retain associated records.

2. The organisation shall identify training needs associated with its environmental aspects and its environmental management system. It shall provide training or take other action to meet these needs, and shall retain associated records.

3. The organisation shall establish, implement and maintain a procedure(s) to make persons working for it or on its behalf aware of:

- The importance of conformity with the environmental policy and procedures and with the requirements of the environmental management system;
- The significant environmental aspects and related actual or potential impacts associated with their work, and the environmental benefits of improved personal performance;
- Their roles and responsibilities in achieving conformity with the requirements of the environmental management system, and
- The potential consequences of departure from specified procedures.

KDG Ferrochrome Smelter operations is committed to identifying training needs and ensuring that all personnel whose work may create a significant impact upon the environment receive appropriate training.

Identification of Training Needs
An employee's job description will be used to identify the activities that the individual undertakes. Impacts and environmental aspects as described in the EMP are specific to each activity, and will be used in the identification of the environmental risks associated with each job description.

The following training needs will be required: -

- General Environmental Awareness Training;
- Understanding of the Environmental policy;
- Awareness of environmental legislation that the KDG Ferrochrome Smelter subscribes to;
- Awareness of significant environmental aspects associated with their work activities;
- Awareness of environmentally related operational procedures that need to be followed when conducting work activities; and
- Awareness of the potential consequences of not following environmentally related operational procedures.

Training Methods
Training methods should be developed to suit the requirements of KDG Ferrochrome Smelter operations. Training could take the form of:

- Environmental awareness training as part of the induction training.
- A job specific training program for the operational areas based on the significant environmental aspects and associated impacts as specified in the EMP. Training topics could include: -

    - ▫ No development zones;
    - ▫ Protected trees;
    - ▫ Waste prevention and control;
    - ▫ Waste sorting and handling;
    - ▫ Resource consumption;
    - ▫ Storing and handling of petroleum hydrocarbons;
    - ▫ Storing and handling of chemicals;
    - ▫ Rehabilitation/Housekeeping; and
    - ▫ Spills prevention/clean up.

Training on environmental legislation; and
Training of Management specific to the Environmental Policy and the EMS.

The following training programs will be put into place:

- Induction Training
- On-The-Job Training
- Internal Training
- External Training
- Educational Assistance
- Skills Promotion

Training Record
Training records must be kept of the training undertaken by each individual.

5.3 Dealing with Environmental Risks and Emergencies

Objectives
The following requirements of ISO14001 are relevant:

- The organisation shall establish, implement and maintain a procedure(s) to identify potential emergency situations and potential accidents that can have an impact(s) on the environment and how it will respond to them.
- The organisation shall respond to actual emergency situations and accidents and prevent or mitigate associated adverse environmental impacts.
- The organisation shall periodically review and, where necessary, revise its emergency preparedness and response procedures, in particular, after the occurrence of accidents or emergency situations.
- The organisation shall also periodically test such procedures where practicable.

Identification of environmental risks
Environmental risks must be identified and procedures will be set in place by the KDG Ferrochrome Smelter operations to deal with potential environmental risks, which could include:

- Environmental emergency situations;
- Potential accidents that can have an impact on the environment; and
- General environmental ignorance that could lead to unnecessary pollution or disturbance to the environment.

5.4 Environmental Non-Conformances

A non-conformance is specific to an EMS and is interpreted to include legal non-compliance, deviations from policy, accidents, near misses where damage or injury could have occurred, ineffective procedures, and deviations from specified conditions and from other requirements of the EMS.

Response to environmental non-conformances
The following requirement of ISO14001 is relevant:

- The organisation shall establish, implement and maintain a procedure(s) for dealing with actual and potential nonconformity/(ies) and for taking corrective action and preventative action.

General Responsibilities

All the employees of KDG Ferrochrome Smelter operations and contractors must report non-conformances. Reporting of non-conformances must take place according to the procedure as outlines in the EMS. This will involve:

- Reporting to the relevant manager;
- Investigation of the incident (including details of the incident);
- Recording of the incident;
- Reporting to the relevant authorities if necessary;
- Identifying corrective actions;
- Follow up on the corrective actions;
- Drafting of progress reports; and
- Keeping of records.

6.0 ENVIRONMENTAL OBJECTIVES AND SPECIFIC GOALS FOR MANAGEMENT OF IMPACTS AND MONITORING ARRANGEMENTS

6.1 Introduction

Regular monitoring of all the environmental management measures and components shall be carried out by the holder of the environmental authorization, in order to ensure that the provisions of this programme are adhered to.

Ongoing and regular reporting of the progress of implementation of this programme will be done. Various points of compliance have been identified with regard to the various impacts that the operations will have on the environment. Inspections and monitoring shall be carried out on both the implementation of the programme and the impact on the social and environmental components.

6.2 List of Identified Impacts that Require Monitoring Programme

Aspect	Monitoring Required
Surface Water	Water Quality Monitoring at Identified Points
	Water Quality – River/Stream
	Water Quantity Monitoring
	Bio-Monitoring
Ground Water Monitoring	Impact on Water Levels - Boreholes
	Groundwater Quality - Boreholes
Air Quality Monitoring	Increase in Dust – Dust Buckets at Selected Sites GHG Emissions
Noise Monitoring	Noise Measurements
Waste Monitoring	Waste Quantities Disposed

6.3 Functional Requirements for the Monitoring Programme

Aspect	Monitoring Required	Functional Requirements
Surface Water	Surface Water Quality – River / Streams	There is a legal obligation on the water user to establish a monitoring programme on site, which needs to be registered on the National Monitoring System administered by D: RQS. Water can only be monitored if there is water flow within the river / stream / treatment works / treatment unit.
	Surface Water Quantity	
	Surface Water Quality	
	Biodiversity	This assessment needs to be conducted during the rainy season and during the period when the nearby drainage channels and the water channels are flowing.
Ground Water Monitoring	Ground Water Levels - Boreholes	The boreholes need to be accessible. These holes can be monitored on discretion of the smelter and in relation to the requirements of the DWS and or water use licence depending on the locality of the smelter operations.
	Groundwater Quality and Levels - Boreholes	Boreholes within 1km radius used for operational and domestic water requirements.

Air Quality Monitoring	Dust and PM10, PM2.5 GHG Emissions	The monitoring data will be analysed and interpreted on a quarterly basis from the approval of the EMPR. This will enable verification of the information contained in regard to pre-operations ambient concentrations. An annual air quality report may be produced and presented to both landowners and relevant Departments as required. The positioning of the buckets and the PM_{10} sampler will be done in conjunction with the landowners that reside around the KDG Ferrochrome Smelter operations site. The project will be required to report CO2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.
Noise Monitoring	Noise Levels	Quarterly noise monitoring by an Acoustic Consultant as well as when noise complaints are registered. If no noise complaints or issues are registered or noise monitoring registers compliance with the National Noise Control Regulations, the frequency of the noise monitoring can be reduced.
Waste Monitoring	Waste Quantities	Volumes of waste removed and/or stored on site to be recorded.

6.4 Roles and Responsibilities for the Execution of the Monitoring Programme

Aspect	Monitoring Required	Roles and Responsibilities
Surface Water	Surface Water Quality – River / Streams	Environmental Manager/Officer
	Surface Water Quantity	
	Surface Water Quality	
	Biodiversity	Bio-Monitoring Specialist
Ground Water Monitoring	Ground Water Levels - Boreholes	Environmental Manager/Officer
	Groundwater Quality and Levels - Boreholes	
Air Quality Monitoring	Dust and PM10, PM2.5 GHG Emissions	Independent Specialist Environmental Manager/Officer
Noise Monitoring	Noise Levels	Acoustic Specialist
Waste Monitoring	Waste Quantities	Environmental Manager/Officer

6.5 Time Frames for Monitoring and Reporting

Aspect	Monitoring Required	Time Frames
Surface Water	Surface Water Quality – River / Streams	Monthly Quarterly Reporting
	Surface Water Quantity	
	Surface Water Quality	
	Biodiversity	Annual
	Ground Water Levels - Boreholes	Monthly Quarterly Reporting

Ground Water Monitoring	Groundwater Quality and Levels - Boreholes	
Air Quality Monitoring	Dust and PM10, PM2.5 GHG Emissions	Quarterly Annual
Noise Monitoring	Noise Levels	Quartely As per complaints
Waste Monitoring	Waste Quantities	Weekly Recording Monthly Reporting

6.6 List of Source Activities that may cause Impacts that Require Management

The list is comprehensive and some of the activities (marked**) may not be applicable to KDG Ferrochrome Smelter operations.

Construction and Operational Phase

- River crossings
- Bridges**
- Additional lighting during night-time
- Change of land use from natural vegetation and agriculture (livestock grazing) to industrial.
- Collision of operational vehicles with faunal species
- Containment and use of precipitation
- Contamination from smelter infrastructure
- Creation of dumps and temporary stockpiles
- Crushing and Screening Processes, Beneficiation
- Dirty water run-off
- Discharge and contamination from all operational facilities and smelter infrastructure
- Drilling, Bulldozing, Excavator and Trucks.
- Dumping of hazardous and non-hazardous waste into the wetland areas
- Dust generation due to movement of vehicles and smelter activities
- Emission fallout
- Erosion and sedimentation
- General operational activities
- Increase of alien plant species
- Increased erosion, dust generation and potential chemical contaminants
- Increased fire frequency and intensity
- Increased runoff volumes
- Increased vehicular and pedestrian movement
- Influx of foreigners and job seekers and increase in disposable income for local people may create negative social impacts such as crime, alcoholism and prostitution in and around the operations area.
- Irrigation of the stockpile vegetation
- Land clearance
- Leakage from waste storage facilities.
- Loading of material (raw material and silicon ore);
- Loss of habitat
- Material handling
- Oil and fuel spills from vehicles

- Ongoing disturbance of soils
- Ongoing edge effects from smelter operations
- Permanent River diversions
- Poaching
- Presence and movement of vehicles
- Proliferation of alien plant species
- Pumping and discharging of poor quality water
- River diversions
- Road wetting (dust suppression)
- Runoff and potential sewage discharge from the smelter
- Runoff and seepage from operational facilities
- Runoff form stockpiles
- Runoff, seepage and discharge from the waste rock dump and other smelter infrastructure
- Spillages and seepage of hazardous waste material
- Spillages from sanitary conveniences, fuel deposits or storage facilities
- Stockpiling
- Return water dams
- Stormwater channels and dams
- The dust and vehicle emissions generated by the smelter activities
- Transformation of natural faunal habitat
- Trenches for the laying of pipelines
- Trucks dumping material at stockpiles (topsoil / softs / overburden).
- Uncontrolled fires
- Use of Potable water
- Vehicle movement
- Vehicle wash bays and workshop
- Vehicles accessing site through sensitive faunal habitat areas
- Waste generation

Decommissioning and Closure Phase

- Alien plant species proliferation
- Change of land use from industrial back to natural vegetation and agriculture (livestock grazing).
- Containment and use of precipitation
- Continued erosion and sedimentation
- Decommissioning activities
- Decommissioning of the plant and smelter infrastructure
- Demolition activities
- Discharge from smelter infrastructure
- Discharge from the dirty water systems
- Disturbance of faunal habitat
- Disturbance of soils
- Erosion and sedimentation
- Failure to implement a comprehensive alien floral control plan
- Failure to monitor rehabilitation efforts and implement the alien floral control plan

- Fire hazards
- Ineffective monitoring of rehabilitation
- Ineffective rehabilitation and monitoring
- Ineffective rehabilitation of exposed and impacted areas
- Insufficient aftercare and maintenance
- Lighting during the decommissioning and rehabilitation phase
- Smelter Operations Cease
- New disturbances during decommissioning and closure
- Ongoing risk of discharge
- Ongoing seepage and runoff from smelter infrastructure
- Permanent River diversions**
- Poor rehabilitation planning
- Poor vegetation cover,
- Pumping and discharging of poor quality water
- Seepage and runoff from decommissioned smelter areas
- Spillages from sanitary conveniences, fuel deposits or storage facilities
- Stockpile areas
- The dust and vehicle emissions generated by the decommissioning activities
- Trenches for the laying of pipelines
- Uncontrolled fires
- Vehicle wash bays and workshop

6.7 Description of How the Implementation of Action Plans will be Monitored

Regulation 26(e) of GN326 of 2017 indicate that "the frequency of auditing of compliance with the conditions of the environmental authorisation and of compliance with the approved EMPr, and where applicable the closure plan, in order to determine whether such EMPr and closure plan continuously meet mitigation requirements and addresses environmental impacts, taking into account processes for such auditing prescribed in terms of these Regulations: provided that the frequency of the auditing of compliance with the conditions of the environmental authorisation and of compliance with the EMPr may not exceed intervals of 5 years".

To ensure that the smelter operations are in accordance with current legislation, (Applicant - KDG) will audit the EMPR and environmental performance on an annual basis.

In addition, the requirements of the Environmental Authorisation, Waste and Water Use License will require additional internal and external audits to be conducted for the period of which the license is valid.

6.8 Frequency of Proposed Reporting for EMP Performance Assessment/Audit

A performance audit report will be submitted to the LDEDET after the audit done every one year, and/or as per the conditions of the EA.

Generally, the Environmental Authorisation, Waste and Water Use License require that an internal and external audit be conducted on an annual basis and the external audit report will be forwarded to the relevant authority as specified within the authorisation or licence.

6.9 Management Activities which, where applicable, will be Conducted Daily, Monthly, Quarterly, Annually or Periodically to Pollution or Environmental Degradation

Soil Management
Background information
The Guidelines for the Rehabilitation of Land (as provided by the South Africa Chamber of Mines) states that soil management during construction/expansion is the key process in determining rehabilitation effectiveness and that soil stripping guidelines should be developed for the construction crews which clearly defines the soil horizons to be removed and where and how to store them.

Stripping and stockpiling of topsoil is usually executed before the waste or slime dumps are created in order to preserve topsoil for re-vegetation of the waste/slime dumps. The aim of the soil management plan is to provide guidelines that should be followed during any phase of land preparation, clearing of vegetation or general construction activities. This will not be applicable to KDG Ferrochrome Smelter since the waste rock and slime dumps are already in existence.

Strip a suitable distance ahead of the (disturbance) at all times, to avoid loss and contamination
Do not strip too large an area ahead of any construction/expansion, because this exposes the stripped surface to the risk of water and wind erosion, with the associated dust and water sediment pollution problems. However, if the stripping face is too close to the intended activity, it will result in the loss of valuable soil material. Contamination by overburden materials as well as chemical soil pollution by oil and fuel spills, etc. will occur.

Supervise stripping to ensure soils are stripped correctly
Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly for common failings are stripping too little or too much. When too little, valuable rehabilitation materials are lost, when too much, good quality soil is contaminated with poorer quality and unsuitable materials which are frequently highly compactable and tend to cement when exposed at surface. Risks of soil loss or contamination are particularly high when soil stripping contracts are purely issued on volume stripped, rather than on volume and quality. Monitoring requires assessment of the depth stripped, the degree of mixing of soil materials and the volumes of material replaced directly or placed on stockpiles.

Avoid vegetation clearance and earthworks during the rainy season when chances of runoff and water erosion are highest.

The indigenous vegetation currently protects the highly erodible soil profiles of the KDG Ferrochrome Smelter site. The A-horizon is also the most fertile horizon that stabilises plant roots and contains sufficient organic material to allow good water infiltration in the rainy season. This horizon will most likely be stripped and once this layer is removed, the rest of the profile will be extremely susceptible to water erosion.

Strip soils only when moisture content will minimise compaction risk
Most soils are highly susceptible to compaction. Compaction is usually greatest when soils are moist, so soils should be stripped when moisture content is as low as possible. Stripping and replacement of soil should be done during the dry season when rainfall is at its lowest and soils are driest. When not practical, every effort must be made to minimise compaction by the methods used for soil stripping, stockpiling and replacement.

Strip and replace in one action wherever possible
Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to increase the viability of the seed bank contained in the stripped surface soil horizons. Stockpiling both increases compaction and decreases the viability of the seed bank, and should only be done when no areas of reshaped impacted land are available for direct placement.

Locate soil stockpiles so that re-handling of soil is minimised
Soil stockpiles should not be moved after initial stripping unless the soil is being replaced in its final location in the rehabilitated profile. This is because each re-handling damages soil structure and increases compaction. Soil losses occur with each re-handling and additional cost is considerable. While it may cost more initially, it is better to place stockpiles in areas where they will not have to be moved. There will always be some soil that has to be stripped before any rehabilitated areas are available for direct placement (for example, soils stripped for roads infrastructure and stockpile area development during operations), but these materials should be stockpiled as close as possible to where they are going to be ultimately used.

Ensure free draining location
Placing soil stockpiles in drainage lines has two major harmful effects: the soils become waterlogged and lose desirable physical and chemical characteristics and the risk of loss of soil materials due to erosion is directions. Alternatively, a side-slope location with suitable cut-off berm construction upslope is acceptable and with a down gradient berm to prevent sedimentation of the surrounding receiving environment.

Minimise compaction during stockpile creation
Soils should be stockpiled loosely. The degree to which soils become compacted during stripping is largely dependent on the equipment used. If shovel and truck are used, the ideal is for soils to be dumped in a single lift. The use of heavy equipment over soil piles results in soil structure damage. If direct dumped soil piles are too low, then it is possible to increase stockpile height using a dozer blade or back-actor bucket to raise the materials.

Running trucks over the piles or using bowl scrapers or graders to level and shape stockpiles, is not recommended. When the only alternative to losing soil material is the use of unsatisfactory (i.e. bowl scraper) equipment, compaction damage can be reduced to some extent by stripping as thick a cut as possible and by dumping it as thickly as possible. In addition, deposition in a single track line may reduce to some extent the overall compaction of the dumped or replaced soil through the minimisation of the footprint area of disturbance.

Fauna Management

Smelter footprint should remain as small as possible and should not encroach on any wetland areas and associated buffers. This can be achieved by fencing footprint areas to contain all activates within designated areas. No wetlands were identified at the KDG Ferrochrome Smelter site.

During operation it is advised to 'flush out' and help warn faunal species to move and relocate naturally due to smelter activities.

It is recommended that a speed limit of 40-60km/h is implemented on all roads running through the footprint area in order to minimise risk to owls and other fauna from vehicles. Speed humps must be constructed to help slow vehicles. However, this must be done taking cognizance of the noise impact mitigation requirements.

Special care and thought when designing any future infrastructure should be taken into account to decrease the footprint left behind after decommissioning and closure.

Demarcate all open veld areas and ensure that these areas are off-limits to vehicles and personnel.

Educate smelter personnel about the importance of the natural faunal species and biodiversity of the natural surroundings.

All informal fires on the property should be prohibited. Where a burning regime is implemented, it should be overseen by a qualified and experienced professional.

No trapping or hunting of fauna is to take place. Access control must be implemented to ensure that no illegal trapping or poaching takes place.

Ensure that migratory connectivity is maintained between open veld and drainage channels. Education on identification for any RDL faunal species that may be found within the KDG Ferrochrome Smelter site.

All unauthorised poaching and trapping must be prohibited.

No dumping of waste should take place within the subject property. If any spills or waste deposits occur, they should be immediately cleaned up.

Flora Management

The footprint of the KDG smelter activities to occur on surface should be confined to transformed areas and which are of low ecological importance. Smelter and

related activities must be avoided within the riparian and their associated buffer zones.

The existing integrity of flora surrounding the smelter site should be upheld and no activities be carried out outside the footprint of the designated smelter areas.

Disturbance of the trees must be avoided as far as possible. If no option other than destruction of the trees remains, the necessary permits must be applied for in terms of the National Forest Act (NFA) of 1998.

Furthermore, it is recommended that a nursery is developed which focuses on the propagation of these protected species. The seedlings of these species can then be utilised during rehabilitation and closure for landscaping purposes.

Vehicles should be restricted to travelling only on designated roadways to limit the ecological footprint of the KDG Ferrochrome Smelter activities.

All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas.

Proliferation of alien and invasive species is expected within disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the site boundary. Alien plant seed dispersal within the top layers of the soil within footprint areas that will have an impact on rehabilitation in the future, have to be controlled.

All soils compacted as a result of operational activities falling outside the smelter footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all phases of the smelter and beyond decommissioning.

A detailed alien invader control plan should be developed during the operations in order to ensure that timeous control of alien vegetation takes place throughout the subject property and taking into account priority areas, areas of high recruitment and sensitive habitats. A detailed breakdown of control substances should be developed as part of the process. All KDG Ferrochrome Smelter footprint areas should remain as small as possible and should not encroach onto more sensitive riparian areas. This can be achieved by considering the sensitivity map during the planning phases.

Proliferation and a further increase of alien and invasive floral species are expected within disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the site boundary. Seed dispersal within the top layers of the soil within footprint areas, will have an impact on rehabilitation in the future and also needs to be controlled.

Removal of the alien and weed species encountered on the property in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998).

Removal of species should take place throughout the operational, and rehabilitation/maintenance phases. Species specific and area specific eradication recommendations:

- Care should be taken within riparian areas with the choice of herbicide to ensure no additional impact on aquatic resources due to the herbicide used.
- Footprint areas should be kept as small as possible when removing large trees and the natural drainage patterns in these areas should be re-instated,
- No vehicles should be allowed to drive through designated sensitive areas during eradication of alien and weed species.

Ensure that all roads and operational areas are regularly sprayed with water or treated with other dust suppressants in order to curb dust generation. This is particularly necessary during the dry season when increased levels of dust generation can be expected. These areas should not be over-sprayed causing water run-off and subsequent sediment loss into adjacent waterways.

Planning of temporary roads and access routes that will be utilised during the operational phase should take the site sensitivity plan into consideration. If possible, such roads should be constructed a distance from the more sensitive areas and not directly adjacent thereto.

Ensure that all topsoil stockpiles and all waste rock dumps are re-vegetated by utilizing indigenous/endemic grass mixtures.

Ensure that sufficient rehabilitation takes place to ensure that post closure land cover is re-instated to levels that will prevent dust generation. No informal fires whatsoever should be allowed on the KDG Ferrochrome Smelter site.

Ensure that all hazardous storage containers comply with the relevant SABS standards to prevent leakage.

Regularly inspect all smelter vehicles for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.

Development of a rehabilitation plan by a suitably qualified specialist. This plan should emphasize rehabilitation throughout all phases of the operations.

The plan must not only ensure structural rehabilitation but must also ensure that the functional attributes of the landscape are re-instated.

Once functional status has been re-instated, measures to ensure that biodiversity is reinstated.

Particular mention is made here of reseeding and re-vegetation programs which must be undertaken in such a way as to ensure that the post closure land use objectives are supported and in any areas to be returned to open veld that the re-vegetation of these areas will afford the natural climax vegetation communities to become re-established.

Ensure that all disturbed and exposed areas are rehabilitated and covered with indigenous vegetation to prevent post-closure dust generation.

Development of a terrestrial monitoring plan to ensure the affectivity of the rehabilitation plan.

Ensure that funds and management measures are in place to ensure that post decommissioning monitoring and management take place in the aftercare and maintenance phase of the operations.

During the operational phases of the KDG Ferrochrome Smelter erosion berms should be installed to prevent gully formation and siltation of the surface water resources.

The following points should serve to guide the placement of erosion berms:

- Where the track has slope of less than 2%, berms every 50m should be installed.
- Where the track slopes between 2% and 10%, berms every 25m should be installed.
- Where the track slopes between 10%-15%, berms every 20m should be installed.
- Where the track has slope greater than 15%, berms every 10m should be installed.

As much vegetation growth as possible should be promoted within the KDG Ferrochrome Smelter area in order to protect soils and to reduce the percentage of the surface area which is paved. In this regard special mention is made of the need to use indigenous vegetation species as the first choice during landscaping.

No dumping of waste should take place within the sensitive and associated buffer zone. If any spills occur, they should be immediately cleaned up.

Surface Water

Quantitative and qualitative assessment of the water resources on the KDG Ferrochrome Smelter property to effectively conduct Integrated Water Resource Management. Optimise water use by means of waste minimisation, re-use and recycling

- Effective and efficient use of the existing available water resources in all water use sectors within the smelter (Water Conservation and Demand Management: WCDM)
- Responsible development in a sensitive environment (drainage lines / Rivers)
- Minimisation and where possible prevention of water pollution stemming from smelter activities by compliance with and adherence to management commitments as specified in the EMP(R)
- Appropriate storm water management over the entire footprint of the operations area to ensure reduction in pollution of surface water quality; and
- Assessment of the cumulative impacts from nearby commercial activities with the implementation of appropriate management measures to ensure sensitive downstream water users are not detrimentally impacted. In terms of the KDG Ferrochrome Smelter operations, the following management measures are essential in implementing mitigation measures to prevent and/or reduce environmental impacts:
    - Development of an Integrated Water Resource Management Plan

- Separation of clean and dirty water systems as part of a Storm Water Management Plan
- Reducing the catchment of dirty areas
- Diversion of drainage lines and release of diverted water in a responsible manner
- Containment of all contaminated water in dedicated design facilities; and
- Re-use, recycle and minimise or reduce all waste water generated on the site

Noise Management

- Design a noise monitoring programme.
- Implement a noise monitoring programme.
- Establish a line of communication and notify all stakeholders of the means of registering any issues, complaints or comments.
- Notify potentially sensitive receptors about work to take place at least 2 days before the activity in the vicinity (within 500 meters) is to start. Following information to be presented in writing:
  - Description of Activity to take place;
  - Estimated duration of activity;
  - Working hours;
  - Contact details of responsible party.
- Ensure that all equipment is maintained and fitted with the required noise abatement equipment.
- When any noise complaints are received, noise monitoring should be conducted at the complainant, followed by feedback regarding noise levels measured.

The KDG Ferrochrome Smelter operations must abide by the local by-laws regarding noise. Where possible work should be undertaken during normal working hours (06H00 – 18H00), from Monday to Saturday; If agreements can be reached (in writing) with the all the surrounding (within a 1000m distance) potentially sensitive receptors, these working hours can be extended. KDG Ferrochrome Smelter will be a 24-hour operation.

Establish a line of communication and notify all stakeholders of the means of registering any issues, complaints or comments.

6.10 The Roles and Responsibilities for the Execution of the Monitoring and Management Programme

The applicant/holder of the environmental authorization remains ultimately responsible for ensuring that the smelter operation is implemented according to the requirements of the EMP. Although the applicant/holder appoints specific role players to perform functions on their behalf, the responsibility is up to the role

player to ensure compliance with the EMP. The applicant/holder is ultimately responsible for ensuring that sufficient resources (time, financial, capacity, equipment) are available to the role players to efficiently perform their tasks in terms of the EMP.

KDG Ferrochrome Smelter Responsibility for EMP Implementation:

- Responsibility for implementation of the EMP rests with the General Manager.
- The General Manager needs to appoint an Environmental Control Officer (ECO), who will be based on site. The environmental control officer will report directly to the SHEQ Manager.
- The ECO will ensure that all environmental activities delegated to contractors operating on site are implemented.
- Similarly, the ECO will ensure that all conditions of the EMP are implemented.
- It will be the responsibility of the ECO to resolve any conflicts that may arise between KDG Ferrochrome Smelter and contracting parties regarding implementation of the EMP.
- KDG Ferrochrome Smelter will ensure that all contracting companies tendering for work, receive a copy of summary and key points of the EMP and understand their responsibility to operate within the framework of the measures defined in this EMP. When adjudicating tenders (KDG Ferrochrome Smelter) will ensure that contractors have made appropriate allowance for management of environmental matters.
- KDG Ferrochrome Smelter will ensure that, on appointment, all contracting companies operating on the site receive a copy of the summary and key points of the EMP and understand their responsibility to operate within the framework of the measures defined in the EMP.
- KDG Ferrochrome Smelter will ensure that contractor SHE induction to site includes environmental and social issues and awareness training to build capacity of staff and contract staff regarding management of the environment.
- KDG Ferrochrome Smelter to ensure that the responsibility for implementing and adhering to the conditions of the EMP will form part of the conditions of appointment of all contractors.
- The ECO will brief contractors about no development / no go areas. These to include:
    - No access to neighbouring properties without prior approval. KDG Ferrochrome Smelter to inform land owners of need for access and secure approval to access site.
    - No access to fenced-off sensitive areas.
    - KDG Ferrochrome Smelter to appoint a responsible person to audit the implementation of, and adherence to, the EMP. This party will be an independent environmental practitioner.
    - The KDG Ferrochrome Smelter ECO will bring to the attention of the smelter general manager any environmental incident or breach of the conditions of the EMP, within 8 hours of occurrence of such event.
- The smelter general manager will notify the controlling authority within 48 hours of such an incident, if the environmental incident constitutes a breach of any permit or licence condition.

Contractors

The contractors, as the applicant/holder's implementing agents on site, are bound to the conditions as stipulated in the EMP through contractual agreements and are therefore responsible for ensuring that they adhere to all the conditions of the EMP. The contractors must thoroughly familiarise themselves with the EMP requirements prior to commencing with work on site. Furthermore, the contractors must request clarification on any aspect of the EMP, where required. The contractors must ensure that all workers undergo an environmental induction in terms of the EMP. The contractors must ensure that they provide sufficient budget for complying with all the EMP conditions at the tender stage.

Responsibility of Contractors
All contracting companies will receive a copy of the EMP at time of tender. Each contractor is to familiarise himself with the environmental management framework for the site and ensure that contracting prices allow for environmental costs.

At appointment the appointed contractor will receive a copy of the EMP. It is the responsibility of the contractor to ensure that all of their staff is aware of the measures applicable to their area of work on site.

It is the responsibility of the contractor to bring to the attention of the ECO any environmental incident or breach of the conditions of the EMP, within 8 hours of occurrence of such event.

Environmental Control Officer (ECO)
A fulltime ECO will be appointed during the Construction and Operational Phase. The responsibilities of the ECO will be transferred to the SHEQ Department. The ECO employed during the construction and operational phase must attend relevant operations meetings, conduct inspections to assess compliance with the EMP and be responsible for providing feedback on potential environmental problems associated with the KDG Ferrochrome Smelter operations. In addition, the ECO is responsible for:

- Liaison with relevant authorities;
- Liaison with contractors regarding environmental management; and
- Undertake routine monitoring.

The ECO has the right to enter the site and undertake monitoring and auditing at any time, subject to compliance with all environmental requirements applicable to the site.

7.0 ENVIRONMENTAL IMPACT STATEMENT

The purpose of this report is to provide the relevant authority (LDEDET) with sufficient information to make an informed decision regarding the potential/current impacts of the proposed Kinetic Development Group ferrochrome smelter within the MMSEZ area. Current and potential impacts were identified primarily through the technical expertise of the experience of Gudani Consulting and the specialist team, as well as in consultation with IAPs.

5.1 Key Environmental Findings

Summary of the key findings of the environmental impact assessment are outlined on Part A – Section 20. The proposed Smelter will entail the following infrastructure and facilities:

▪ High-carbon ferrochrome production workshop ▪ Chromium furnace baking workshop (reserved) ▪ Raw materials, batching and feeding system ▪ Charcoal dry ▪ 132KV (power supply) substation and the capacitor compensation ▪ Device ▪ machine repair shop ▪ Electrode shell production workshop ▪ Raw material storage yard, spare parts warehouse, finished product warehouse, etc ▪ slag disposal area	▪ Furnace gas purification and dust removal system ▪ Dust removal system in the production area ▪ Compressed air preparation ▪ Raw materials into the factory, finished products factory ▪ loadometer duty room ▪ Fire protection, safety, environmental protection and other basic facilities ▪ General map of transport and roads, walls, gates ▪ Factory area office building ▪ Laboratory room
▪ Power supply and distribution, electrical control, automation ▪ instruments, telecommunications facilities ▪ Whole-plant control system ▪ Industrial TV monitoring system	▪ Water source is connected to the production plant purification ▪ water supply system ▪ Net ring water system ▪ Turbring water system ▪ Production and living water supply and drainage system ▪ Whole-plant fire protection system ▪ Ventilation and air-conditioning system

The main impacts associated with the proposed smelter operations and related infrastructure includes impacts on the topography, soils, land use, air quality, noise, terrestrial ecology, groundwater, surface water, climate change, visual impact and socio-economic impacts. All of these impacts identified are significant without mitigation measures; however, with the implementation of appropriate mitigation measures as outlined in the EMP (Part B, Section 3.0), the impacts significance is reduced. Impacts on the topography, land use, flora and fauna, air quality, noise, climate change, surface water, public health and visual impact will be reduced to "low to medium and/or medium" with the implementation of appropriate mitigation measures.

The most significant impacts, which will still be of significance after mitigation will be in terms of:

- The sterilization of the topsoil layer will have negative impacts on the fertility and nutrient levels of the topsoil layer;
- Disturbance of areas with high soil fertility within the smelter site;
- Possible borehole drawdown water levels due to smelter operations within 1 km radius;
- Disturbing noise, air quality and visual will continue during the operational phase and will be seen as a nuisance especially for people living in close proximity to the operations. The mitigation measure proposed will minimise the impact, to a level of medium significance;
- Enhance socio-economic benefits in terms of job creation and supply of goods and services to the smelter.

5.2 Recommendations

The mitigation measures proposed by Gudani and the specialists were incorporated into the Environmental Management Programme and must be adhered to by KDG Ferrochrome Smelter. Roles and Responsibilities must be assigned to each mitigation measure. Monitoring must take place for the surface water, groundwater, noise and atmospheric emissions (dust/GHG), and waste management. Monitoring measures were included in the EMP (Part B - Section 6)

The proponent will comply with any additional conditions of authorisation / approval by the respective competent authorities, and other reasonable measures that may be stipulated by authorities that have jurisdiction in the matters relevant to the smelter operations and update the EMP accordingly (if and when required).

5.3 Conclusion

Kinetic Development Group has assessed all potential impacts that could occur as a result of the new activities and comprehensive management measures has been identified for implementation to reduce the impact rating of the identified impacts as far as possible. Taking the current economic climate of the country in to consideration as well as the positive socio-economic impacts that the current and the proposed activities will ensure for the foreseeable future, and the impact rating after the implementation of the management measures, it is believed that the balance between environment, social and economics will be maintained and thus the activities should be authorised.

It is recommended that the environmental authorization for Kinetic Development Group Ferrochrome Smelter and associated infrastructure be authorised for 30 years to proceed for the following reasons:

- A Biodiversity Action Plan (BAP) should be developed to guide the management of the ecological resources in the operations area throughout the entire life-cycle of the operations in line with the requirements of NEMBA;

- Development of the smelter wide rehabilitation plan by a suitably qualified specialist and specific input by a suitably qualified ecologist must be provided into the rehabilitation plan by providing methods of rehabilitation and the required design criteria and closure objectives. This plan should emphasise rehabilitation throughout all phases of the operations and concurrent rehabilitation needs to take place as far as possible;
- Ensure that funds and management measures are in place to ensure that post decommissioning monitoring and management take place in the aftercare and maintenance phase of the operations.
- The project will be required to report CO_2e emissions annually via the NAEIS and provide a greenhouse gas mitigation plan.
- Recommendations made by specialist need to be implemented as far as practical and possible.
- Monitoring and audits as outlined in the EMPr need to be conducted as per the locations, aspects and frequencies specified.
- An offset strategy for the impacted groundwater should be agreed upon between KDG and DWS.

PART C – ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1.0 EAP UNDERTAKING

The EAP herewith confirms
a) the correctness of the information provided in the reports
b) the inclusion of comments and inputs from stakeholders and I&APs ;
c) the inclusion of inputs and recommendations from the specialist reports where relevant; and
d) the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed;

Name of EAP: Mulanga Sikhitha
Date: 02nd July 2025

Signature: ……

2.0 APPLICANT UNDERTAKING

I, ……,

The undersigned and duly authorised thereto hereby:
Confirm that the financial provision as required will be available; and
Undertake to adhere to the requirements and to the conditions as set out in the EMPr submitted to LDEDET.

Signed at.....on this..... day of……2025

Signature of applicant …….

Designation ……

LIST OF APPENDICES

LIST OF APPENDICES:

Appendix 1: Qualification of the EAP
Appendix 2: Summary of the EAP's Past Experience
Appendix 3: Locality Maps – Kinetic Ferrochrome Smelter
Appendix 4: Site Layout Map – MMSEZ – Including Kinetic Ferrochrome Smelter
Appendix 5: Public Participation Report – Issues and Response Table
Appendix 6: Closure and Environmental Rehabilitation Liability Costing
Appendix 7: Kinetic Development Group Limited Feasibility Report
Appendix 8A: Specialist Reports

Specialist Study	Specialist	Appendix
Air Quality	Airshed Planning Professionals	8A
Biodiversity, Ecology and Wetlands	Redkite Environmental Solutions	8B

Appendix 8B: Specialist Reports

Specialist Study	Specialist	Appendix
Surface Water	Redkite Environmental Solutions	8C
Noise Impact Assessment	Enviro Acoustic Research	8D
Groundwater Assessment	Geo Pollution Technologies – Gauteng (Pty) Ltd	8E
Heritage Impact Assessment	A Pelser Archaeological Consulting	8F
Public Participation Process	Gudani Consulting	Appendix 5
Socio-Economic Impact Assessment	Demacon	8H
Soil, Land Capability, Land-Use	Rehab Green	8I
Visual Impact Assessment	Eco Elementum	8J
Climate Change	Airshed Planning Professionals	8K
Health Impact Assessment	Naira Environmental Consultants	8L
Geotechnical Investigations	Geo Equilibria	8M

Appendix 1: Qualification of the EAP

Appendix 2: Summary of the EAP's Past Experience

Appendix 3: Locality Maps – Kinetic Ferrochrome Smelter

Appendix 4: Site Layout Map – MMSEZ – Including Kinetic Ferrochrome Smelter

Appendix 5: Public Participation Report – Issues and Response Table

Appendix 6: Closure and Environmental Rehabilitation Liability Costing

Appendix 7: Kinetic Development Group Limited Feasibility Report

Appendix 8A: Specialist Reports

Specialist Study	Specialist	Appendix
Air Quality	Airshed Planning Professionals	8A
Biodiversity, Ecology and Wetlands	Redkite Environmental Solutions	8B