APPENDIX 1

Prime Resources Personnel CVs

Prime Resources (Pty) Ltd
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prime | resources
environmental
consultants

Peter Theron PrEng – Principal Environmental Engineer

Present Appointment	Managing Director - Prime Resources (Pty) Ltd
Date of Birth	5 November 1963
Nationality	South African
Education	B Eng Civil (cum laude), University of Pretoria 1985 GDE (Hons.) Environmental Engineering, University of Witwatersrand 1995
Qualifications	Environmental / Civil Engineer, PrEng 950329, MSAIMM
Languages	English

Synopsis

Peter Theron PrEng is a Principal Environmental / Civil Engineer with 32 years' experience, the founding partner and Managing Director of the firm Prime Resources (Pty) Ltd. He has been involved in the auditing and due diligence process of the environmental, tailings and geotechnical aspects of mines, industrial plants and mineral beneficiation operations. Peter started his professional career, as a specialist geotechnical engineer and tailing dam designer and later more broadly, in the technical aspects of environment, geotechnical, tailings, water management and waste management design. The project management of large environmental impact assessments, in Africa and the developing World, has also been a key focus.

Current project work includes the role of technical advisor and Competent Person Reporting (CPR) on several Independent Technical Reports (ITR's) for Stock Exchange listings (JSE / TSX / ASX / AIM), due diligence audits and reports.

Implementation of environmental assessments, sustainable development, environmental project management, environmental due diligence and compliance auditing, geotechnical design, tailings and waste management, rehabilitation, mine closure and environmental costing are Peter's main areas of specialisation.

Peter has worked across most mining and industrial commodities including gold, uranium, platinum, chrome, nickel, manganese, diamonds, iron ore, coal, phosphate, limestone, silicates, lead/zinc, rare earths, vanadium and anthracite.

Prior to starting the firm Prime Resources (Pty) Limited, which specialises in all aspects of Environmental Consulting, Peter was a Director of the firm SRK Consulting. Peter has completed over 80 due diligence, compliance, bankable environmental and tailings dam audits for various international and local banks, lending institutions (including the World Bank and IFC) and various mining and industrial clients. Prime Resources, which Peter leads, has completed over 400 mining, waste, power and industrial projects over the last 14 years, a selection of these are included below.

Professional History:

Prime Resources (Pty) Ltd was started in October 2003 currently with twelve full time employees in our South African office and over fifteen sub-contractors and consultants focused on providing talented and dedicated resources to the mining and industrial sectors.

Between March 1999 and September 2003, Peter was employed as a principal engineer and as a Director of the consulting firm, Steffen, Robertson & Kirsten (later SRK Consulting) from April 2001. At SRK Consulting, his role was one of department Director managing a team of environmental and engineering professionals.

At Hatch Africa he was employed as the Discipline Consultant and manager of the Environmental & Mining Rehabilitation Department which comprised a team of eight professional staff. Previous appointments include Gencor (now BHP Billiton), Jones & Wagener, Sir William Halcrow & Partners, Arup and Eurotunnel plc.

During a varied career he has worked on environmental / tailings projects in India, Brazil, Russia, Serbia, Ukraine, Tajikistan, DRC, Republic of Congo, Angola, Lesotho, Sierra Leone, Mali, Togo, Ghana, Zambia, Mozambique, Botswana, Zimbabwe, Namibia and South Africa.

Recent Project History since 2009:

INTERNATIONAL

- **Araguaia Nickel Project, Brazil**
  - Feasibility Study (FS) for the Cooling Water Dam and Pipeline
  - Feasibility Study (FS) for the Plant Geotechnical / Foundation designs
  - Feasibility Design of slag disposal facility for FS
- **Ganajur Gold Project, India**
  - Feasibility Study (FS) design of the Tailings Storage Facility
  - Feasibility Study (FS) the Geochemistry, Hydrogeology and Hydrology aspects
  - Geotechnical investigation for TSF and Plant.
- **Maamba Coal Mine and 300MW Power Plant, Zambia**
  - Independent technical review of the environmental, social, permitting, tailings and water management according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Liqhobong Diamond Mine, Lesotho**
  - Independent technical review of the environmental and social aspects, permitting and water management according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Koidu Diamond Project, Sierra Leone**
  - Review of environmental, social, groundwater and tailings documentation for compliance with Equator Principles, IFC Performance Standards and EHS Guidelines, on behalf of Standard Chartered Bank
- **Araguaia Nickel Project, Brazil**
  - Environmental and Social Baseline Report Pre-Feasibility Study (PFS)
  - Preliminary Design of slag disposal facility for PFS
- **Cabinda Phosphate Project, Angola**
  - Social Impact Plan and Environmental Management Plan for Prospecting
  - Environmental and Social Baseline Report towards the Definitive Feasibility Study (DFS) stage

- **Owere Gold Project, Ghana**
  - Independent technical review of the environmental, social and permitting documentation according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Ghaghoo Diamond Project, Botswana**
  - Independent technical review of the environmental, social and permitting documentation according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Maminskoye Gold Project, Central Urals, Russia**
  - Environmental and social audit of the Pre-Feasibility Study (PFS)
- **Kinsevere Copper Project, Democratic Republic of Congo**
  - Review of tailings dam risks and opportunities for compliance with Equator Principles
- **Kipoi Copper Mine, Democratic Republic of Congo**
  - Review of Environmental, Social hydrological, heap leach and tailings of the Kipoi Central RDFS operations, Tiger Resources
  - Independent technical review of the environmental, social and permitting documentation according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Zanaga Iron Ore Project, Democratic Republic of Congo**
  - Environmental and social section of the Order of Magnitude study
- **Pakrut Gold Mine, Tajikistan**
  - Social and Environmental Impact Assessment process, baseline evaluations according to international best practice requirements.
- **Lece Gold Mine, Serbia**
  - Tailings retreatment project – tailings technical review and concept design work
- **Langer Heinrich Uranium Mine, Namibia**
  - Independent technical review of the tailings storage facility and storage strategy
- **North River Resources Lead Zinc, Namibia**
  - High level review of the Environmental and Social documentation according to Namibian legislative requirements
- **Minas Moatize Coal Expansion Project, Mozambique**
  - Independent technical review and due diligence of mine residue facilities (slurry and discard), water management, environmental and social aspects
- **Aquarius Shipping International, Warehouse and Container Depot, Beira, Mozambique**
  - Geotechnical investigation
- **Passendro Gold Project, Democratic Republic of Congo**
  - Independent Peer Review of tailings storage facility
- **Banro Twangiza Project, Democratic Republic of Congo**
  - Independent technical review of the environmental, social, tailings and water management aspects according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines

SOUTH AFRICAN

- **Coal of Africa Vele, Limpopo, South Africa**
  - Independent technical review of the environmental, social tailings and water management aspects according to the Equator Principles and IFC Performance Standards
- **Canyon Springs Coal Mine, Mpumalanga, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
  - Waste Management License
  - High level assessment of potential bulk water supply options

- **Gold One International, Modder East Operations, Gauteng, South Africa**
  - Original and amendment to the Environmental Impact Assessment and Environmental Management Programme
  - Basic Assessment for the Environmental Authorisation of a new return water dam
  - Water Use Licence Application and amendments thereto
  - Air Emissions License Application
  - Rehabilitation Strategy and Implementation Programme (RSIP)
  - Revision of Social and Labour Plan (SLP)
  - Equator Principles and IFC compliance review
- **Kalagadi Manganese Mine, Northern Cape, South Africa**
  - Review of environmental documentation compiled for the mine, smelter and railway line, to determine compliance with Equator Principles and international best practice, on behalf of Standard Bank
- **Vlakvarkfontein Colliery, Mpumalanga, South Africa**
  - Water Use Licence Application
  - Closure and Rehabilitation Plan
  - The technical design, 3D modelling and detailing of the conceptual backfill plan for an opencast pit
  - Compilation of an Invasive Alien Plant Eradication Plan
  - Amendment to the Social and Labour Plan
  - Basic Assessment and Environmental Management Programme for environmental authorisation of the haul/ access road and above ground diesel storage area
- **Western Bushveld Joint Venture Project 1, North West, South Africa**
  - Review of environmental, hydrology and tailings dam documentation for compliance with Equator Principles, IFC Performance Standards and EHS Guidelines, on behalf of Standard Bank
- **Tharisa Platinum Mine, North West, South Africa**
  - Due diligence for independent technical engineers report (ITE), review of the environmental, social and tailings documentation and reporting on behalf of Snowden mining consultants and annual updates thereto
- **Anglo American Platinum Limited, Rustenburg Platinum Mines, Limpopo, South Africa**
  - The consolidation of all existing approved EMPs and EMPRs and the alignment thereof with the requirements of the MPRDA
- **Amandelbult Chrome Recovery Plant, Limpopo, South Africa**
  - Basic Assessment and Environmental Management Programme for Environmental Authorisation
  - Addendum to the Environmental Impact Assessment and Environmental Management Programme
- **Steenkampskraal Project, Western Cape, South Africa**
  - Review of environmental, hydrology and tailings dam documentation for compliance for PEA Canadian NI 43-101 filing
- **Malelane Ferrex Iron Ore Project, Mpumalanga, South Africa**
  - Preliminary Environmental and Social Baseline Studies
- **Reclamation of Lindum Tailings Storage Facility, Gauteng, South Africa**
  - Addendum to the Environmental Impact Assessment and Environmental Management Programme
- **Scheiding Chrome Mine, Limpopo, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
  - Integrated Water Use Licence Application
- **T-Project Colliery, Mpumalanga, South Africa**
  - Geotechnical investigation (surface infrastructure area)
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
  - Closure and Rehabilitation Plan

- **Hlabisa Coal, KwaZulu-Natal, South Africa**
  - High-level, desktop environmental evaluation (sensitivity analysis)
- **Kilken Tailings, Limpopo Province, South Africa**
  - Independent technical review of the environmental and social aspects permitting and water management according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Tjate Platinum Mine, Limpopo Province, South Africa**
  - Environmental and Social Baseline Report
  - Baseline Environmental Assessments and project management of the Environmental inputs into the pre-feasibility study
  - Update of the Social and Labour Plan
  - Site selection and preliminary design for tailings storage facility
- **Mbila Anthracite Mine, KwaZulu-Natal, South Africa**
  - Basic Assessment and Environmental Management Programme for the Environmental Authorisation of the G-Block Underground Mining Activities
- **Msebe Opencast Anthracite Mine, KwaZulu-Natal, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
- **Mooiplaats Platinum Mine, Limpopo Province, South Africa**
  - Compilation of a Social and Labour Plan in support of a Mining Right Application
- **Rietkuil Coal Project, Mpumalanga Province, South Africa**
  - Independent technical review and due diligence of environmental documentation
- **Evander Gold Mine, Mpumalanga, South Africa**
  - Review of environmental, social and tailings dam documentation for compliance with South African Environmental and Social Standards
- **Springbok Flats Coal Fields, Limpopo, South Africa**
  - Competent Persons Report
  - High Level Assessment of potential bulk water supply
  - High level environmental review for the Western Complex Project
- **Kudumane Manganese Mine, Northen Cape, South Africa**
  - Independent technical review of the environmental and social aspects
- **KaNgwane Anthracite Mine, Mpumalanga, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
  - Closure and Rehabilitation Plan
- **Southern Anthracite Project, Mpumalanga, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
- **DRDGold's Blyvooruitzicht Mining Operation, Gauteng, South Africa**
  - High level environmental review
- **Akanani Platinum Project, Limpopo, South Africa**
  - Pre-feasibility study (PFS), review of the environmental and social documentation and reporting of high level risks and opportunities
- **Dishaba Mine, Limpopo, South Africa**
  - Environmental Impact Assessment and Environmental Management Programme
  - Amendment to the Water Use Licence
- **Majuba Colliery, Mpumalanga, South Africa**
  - Closure and Rehabilitation Plan
- **Rietfontein Prospect, Limpopo, South Africa**
  - Geotechnical investigation
  - Amendment to the Environmental Management Programme

- **Namaqualand Mines, Northern Cape, South Africa**
  - Independent technical review of the environmental, social and tailings aspects according to the Equator Principles and IFC Performance Standards
- **Leeuwfontein and Blinkpan project areas, Mpumalanga, South Africa**
  - Geotechnical investigation to inform a Feasibility Study
- **Bafokeng Rasimone Platinum Mine, North West, South Africa**
  - Compilation of a preliminary closure plan
- **Rand Uranium West Rand Operations, Gauteng, South Africa**
  - High level environmental review
- **Umtu (Manganese) Mine Project, Northern Cape, South Africa**
  - Independent technical review of the environmental and social aspects according to the Equator Principles and IFC Performance Standards
- **Koornfontein Mines, Mpumalanga, South Africa**
  - Environmental Impact Assessments and Environmental Management Programmes for the separate sections of the mining operations
  - Amendment to the EIA / EMP for the Leeuwfontein Block
  - Water Use Licence Applications for the separate sections of the mining operations
  - Identification of a suitable host area and conditions for resettlement and the compilation of the Resettlement Action Plan (RAP) and agreement on timeframes and responsibilities
- **Bafokeng Rasimone Platinum Mine, North West, South Africa**
  - Due diligence on environmental and tailings dam documentation for listing purposes on the JSE stock exchange
  - Competent persons report including environmental, social, hydrological and tailings aspects
- **Elandsdrift Heap Leach Pad, Mpumalanga, South Africa**
  - Geotechnical and slope stability investigation
  - Compile the "As Built" drawings for the Elandsdrift Heap Leach Pad
- **Bon Accord Nickel Mine, Northern Cape, South Africa**
  - Environmental screening assessment
- **Simmer & Jack Mines Limited Transvaal Gold Mining Estates, Mpumalanga, South Africa**
  - Design, Quality Control/Assurance Manual, Site Support and Part Time Project Management for the Design and Construction of a Heap Leach Dam Extension East of the existing TGME Tailings Dam
- **Afrikander Leases Gold Mine, North West, South Africa**
  - Amendment to the Environmental Impact Assessment and Environmental Management Programme
- **Grass Valley Platinum Project, Limpopo, South Africa**
  - Update the environmental aspects in the PFS Report
- **Lonmin PLC Western Platinum Mine, North West, South Africa**
  - Basic Assessment and Environmental Management Programme for the Environmental Authorisation of a hazardous waste storage facility

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environmental consultants

Gené Main – Principal Environmental Consultant, Pr. Sci. Nat.

Present Appointment	Principal Environmental Consultant
Professional Registration	South African Council for Natural Scientific Professions (SACNASP) registration 400370/13 (Environmental Science Registered Environmental Assessment Practitioner (EAP), EAPASA registration 2019/1257 IAIAsa member (5932)
Nationality	South African
Qualifications	BSc (Botany and Environmental Science), Rhodes University, 2002 BSc Hons (Environmental Science), Rhodes University, 2003 MSc (Botany), University of the Western Cape, 2006
Languages	English, Afrikaans

Synopsis Gené has 13 years of experience working on environmental and social aspects of development projects related to mining, waste management and water management, including EIAs, EMPs, closure and rehabilitation plans, monitoring and auditing. She has also been project lead in several environmental due diligence and technical review projects, most of these in terms of the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines.

Project History

International

Assessments and reporting in terms of Equator Principles (EPII) / IFC / World Bank
- Environmental and Social Impact Assessment for a gold mine, Tajikistan
- Order of Magnitude Study for Zanaga Iron Ore Mine, Republic of Congo
- Prospecting Environmental Management Plan for Cabinda Phosphate Project, Angola
- Environmental and social baseline report (pre-feasibility) for the Cabinda Phosphate Project, Angola
- Environmental and social baseline report (pre-feasibility) for the Horizonte Minerals, Araguaia Nickel Project, Brazil
- Environmental and social process, Pre-Feasibility, Ferrex Iron Ore, Malelane, South Africa
- Peer review and report compilation of Environmental and Social chapters of BFS, Ganajur Gold Mine, India

Due Diligence and compilation of Environmental and Social Action Plans (ESAPs) in terms of Equator Principles (EPII) / IFC / World Bank
- Review of Kipoi Central RDFS's operations, Democratic Republic of Congo
- Review of Anvil's Kinsevere Copper Mine, Democratic Republic of Congo

- Review of Koidu Kimberlite Project's expansion project on behalf of Standard Chartered Bank, Sierra Leone
- Review of Kipoi Stage 2 Phase 1 project, Independent Technical Review, Democratic Republic of Congo
- Review of Maamba Colliery's existing and proposed expansion project, Zambia (ongoing operational monitoring – to present)
- Review of Ghaghoo Diamond Mine, Botswana
- Review of Liqhobong Diamond Mine, Lesotho (ongoing operational monitoring – to present)
- Review of Beacon Hill Resources, Moatize Coal, Mozambique
- Review of North River Resources, Lead and Zinc project, Namibia
- Review of Konongo Gold Project, Ghana
- Review of Triton's Ancuabe and Balama Graphite projects, Mozambique
- Review of Khoemacau Copper Mine, Botswana
- Review of Segilola Gold Mine, Nigeria

National

Pre-Feasibility Studies (PFS)
- Environmental PFS report for Lonmin Hossy Shaft upgrade, South Africa
- Environmental PFS report for Jubilee Platinum's Tjate mine, South Africa

EIAs and EMPs, including closure planning
- Siyanda Coal, Koornfontein Mine, South Africa
- Anglo Platinum proposed chromite recovery plants, South Africa
- T-Project Colliery, South Africa
- Vlakvarkfontein Colliery, South Africa
- Prospecting EMP (gold) for De Beers Namaqualand Mines, South Africa
- Gold One International, Modder East Operations, South Africa (for various infrastructure)
- KaNgwane South Anthracite Mine, South Africa
- Holfontein Gold Mine, South Africa
- Ventersburg Gold Mine, South Africa
- Cons Modder Gold Mine, South Africa
- Middelvlei Gold Mine, South Africa

Water Use Licence Applications
- T-Project Colliery, South Africa
- Vlakvarkfontein Colliery, South Africa
- New Kleinfontein Goldmine, South Africa
- Holfontein Project Gold Mine, South Africa
- Ventersburg Gold Mine, South Africa
- Cons Modder Gold Mine, South Africa
- General Authorisation process for Far East Gold SPV, South Africa

Environmental audits
- Regulation 55 (MPRDA) Performance Assessment - Rustenburg Platinum Mines, Union Section, South Africa
- Regulation 55 Performance Assessment – Klipspringer Diamond Mine, South Africa
- Regulation 55 Performance Assessment – Ferrex Iron Ore, South Africa
- Regulation 55 Performance Assessment – Vlakfontein Colliery, South Africa
- Quarterly environmental compliance audits for landfill waste sites, Ekurhuleni Metropolitan Municipality, South Africa
- Environmental compliance audit for Interwaste Hazardous Waste Transfer Facility, Germiston, South Africa

- Environmental compliance audit for Interwaste Waste Transfer and Materials Recovery Facility, Western Cape, South Africa

Due Diligence and compilation of Environmental and Social Action Plans (ESAPs) in terms of Equator Principles (EPII) / IFC / World Bank

- Gold One International's Modder East Operations, South Africa
- Review of Kalagadi Manganese Mine on behalf of Standard Bank, South Africa (ongoing operational monitoring – to present)
- Review of Western Bushveld Joint Venture Project 1 on behalf of Standard Bank, South Africa
- Review of Tharisa Platinum Mine on behalf of HSBC, South Africa (ongoing operational monitoring – to present)
- Review of Pilanesberg Platinum Mine as part of an Independent Technical Review, South Africa
- Review of Kudumane Manganese Mine on behalf of Standard Chartered Bank, South Africa
- Review of the Steenkampskraal project, Preliminary Economic Assessment, South Africa
- Review of Vele Colliery, South Africa

Due Diligence (compliance with national requirements)

- Review of Scoping Report for proposed Eskom power line, Mpumalanga, South Africa
- Gap analysis of Waterberg Coal Project for Sekoko Resources, South Africa
- Environmental review of Harmony tailings storage facilities, South Africa
- Environmental review of Bafokeng Rasimone Platinum Mine (BRPM), South Africa
- Environmental review of Blyvooruitzicht Gold Mining Company, on behalf of Village Main Reef Ltd, South Africa
- Review of Rand Uranium West Rand Operations for Gold One International, South Africa
- Review of Ruighoek and Tuschenkomst Properties of Platmin Limited, South Africa
- Review of Transhex Iron Ore, South Africa
- Review of Evander coal operations, South Africa

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environmental consultants

Stephen Tarlton – Senior Environmental Scientist Pr. Sci. Nat.

Present Appointment	Senior Environmental Consultant
Professional Registration	South African Council for Natural Scientific Professions (SACNASP) registration No. 115011 (Environmental Science)
Nationality	South African
Education	BSc (Ecology and Plant Science) University of the Witwatersrand, 2006 BSc Hons (Plant Science) University of the Witwatersrand, 2007 MSc (Ecology and Plant Science) University of the Witwatersrand 2012
Languages	English

Synopsis Stephen is a Professional Natural Scientist with a background in ecology. He has undertaken environmental management assignments on various mining, waste, water and linier infrastructure projects in Africa. Projects include environmental authorisations, impact assessments, management plans, environmental monitoring, audits, and due diligence reporting. Additionally, he gained hands-on experience aligning site environmental performance to the IFC Standard, during his time on the Neckartal Dam construction site.

Project History

International

Environmental assessments and management plans

- Environmental and Social Impact Assessment Update, Neckartal Dam, Ministry of Agriculture Water and Forestry, //Karas Region, Namibia
- Environmental management plan for the Komsberg Farm Redevelopment, Fine Fare Food Market LLC, Namibia
- Environmental and Social Impact Assessment Update, Kinsevere Copper Mine, MMG, DRC
- Environmental and Social Impact Assessment for the Oniipa Sewage Treatment Plant near Onethindi, Oshikoto Region, Namibia
- Environmental and Social Impact Assessment, Farim phosphate project, GB Minerals LTD., Guinea-Bissau
- Environmental Impact Statement, Combination Plant and Fresh Rock Project, Siguiri Gold Mine, Société AngloGold Ashanti de Guinée, State of Guinea
- Environmental management system to the ISO: 14001 Standard, Mongbwalu Gold Project, Ashanti Gold Kilo, DRC.

Construction supervision and auditing

- Contractor supervision and monitoring for the construction of the Neckartal Dam Project, Ministry of Agriculture Water and Forestry, //Karas Region, Namibia
- Drafting and supervision of the implementation of Sustainable Rehabilitation Plan, Kinsevere Copper Mine, MMG, DRC
- Environmental Control Officer Audit, Oshoopala Bridge and Bridge in Extension 16 over the Okatana river, Oshakati, Namibia
- Environmental Control Officer Auditing for the Komsberg Farm Redevelopment, Fine Fare Food Market LLC, Namibia.

Reporting in terms of Equator Principles (EPII) / IFC / World Bank

- Desktop Environmental and Social Review of the Lomati Gold Mine, Eswatini
- Review of Lindi Jumbo Graphite Project, Tanzania
- Review of Bon Ami Bauxite Project, Republic of Guinea.
- Independent operational monitoring of environmental and social management, Maamba Collieries Limited, Zambia
- Independent operational monitoring of environmental and social management, Liqhobong Mining Development Company, Lesotho
- Reporting of IFC compliance progress to the Development Bank of Namibia, Neckartal Dam Project, Ministry of Agriculture Water and Forestry, //Karas Region, Namibia

Environmental Monitoring

- Water quality monitoring, Kinsevere Copper Mine, MMG, DRC
- Air quality monitoring, Kinsevere Copper Mine, MMG, DRC
- Meteorological monitoring / lightning warning system, Kinsevere Copper Mine, MMG, DRC
- Stream flow monitoring for proposed hydropower stations (Magembe and Ulindi), Banro, South Kivu, DRC
- Stream flow monitoring for proposed hydropower stations and the Kalungwishi River, Olympic milling, Zambia
- Stream flow monitoring / underwater survey for the 11 MW Azambi Hydroelectric Project, Kibali Goldmines S.A. (Barrick, AngloGold Ashanti, and Société Minière de Kilo-Moto), Haut-Uele, DRC.

National

Environmental assessment, environmental management plans and water use licences

- Environmental Impact Assessment and Water Use Licence amendment application for fine chrome recovery plants and rail extension, Siyanda Bakgatla Platinum Mine, North West Province, South Africa.
- Care and Maintenance Plan for the Buffelsfontein East and Mooinooi Chrome Mines, Western Chrome Mines, Samancor Chrome, Limpopo Province, South Africa
- General Authorisation application for the proposed FEG Project, Gauteng, South Africa
- Environmental and Social Impact Assessment for ERPM Ext 1 Mining Right, ERPM, Gauteng, South Africa
- Environmental Scoping process for Buffelsdoorn Mining Right Application, Bacarac Trading, North-West Province, South Africa
- Water use licence application for Scheiding Chrome Mine, Mpumalanga, South Africa.
- Basic Assessment Report for a Prospecting Right Application for Van Dyk, CGERO, Gauteng Province, South Africa
- Ecological Assessment of Johannesburg impoundments, City of Johannesburg, Gauteng, South Africa.
- Basic Assessment Report for rezoning of erf 23205 Milnerton, City of Cape Town, Western Cape Province, South Africa
- Environmental Management Plan amendments for various borrow pits and quarries for National route 17 upgrade (Davel to Ermelo), SANRAL, Mpumalanga, South Africa Scoping for the Klinkerstene Waste Management Licence Application, Mpumalanga, South Africa.

Environmental auditing

- Environmental Auditor for various waste disposal, storage, treatment and recovery facilities, Interwaste / Séché Environmental, Gauteng, Mpumalanga and Eastern Cape, South Africa.
- Environmental Control Officer Auditing for Gauteng Freeway Improvement Project (packages F, C K & I), SANRAL, Gauteng, South Africa
- Environmental Control Officer Auditing for National route 17 upgrade (Davel to Ermelo), SANRAL, Mpumalanga, South Africa
- Environmental Control Officer Auditing for the construction and rehabilitation of Provincial Roads D2690 and D636 between Provincial road P17/6, Yaverland and Plaston, Palabora Copper (Pty) Limited, Mpumalanga, South Africa.
- Section 20 Audit, Middleburg Ferrochrome, Samancor Chrome Limited, South Africa

Reporting in terms of Equator Principles (EPII) / IFC / World Bank

- Independent operational monitoring of environmental and social management, Tharisa Minerals, North-West Province, South Africa.

Environmental Monitoring

- Water quality monitoring for the Klinkerstene and FG Landfill, Interwaste / Séché Environmental, Gauteng, South Africa.
- Water quality monitoring for various sewage treatment works in Johannesburg, Johannesburg water, Gauteng, South Africa
- Water quality monitoring, Sedibelo Platinum Project, I.B.M.R., South Africa
- Water quality monitoring for Leeuwkop Platinum Project, Afplats, South Africa

Monique van der Westhuizen – Environmental Scientist

Present Appointment	Environmental Scientist – Prime Resources (Pty) Ltd
Nationality	South African
Education	BSc Hons. (Hydrogeology*)*, University of Pretoria, 2019 BSc. (Environmental and Engineering Geology), University of Pretoria, 2018
Languages	English; Afrikaans

Synopsis Monique is an environmental scientist with an aptitude for groundwater systems. She has experience in environmental monitoring; laboratory work; reporting; auditing; ECO work; groundwater, surface water and soil sampling; Water Use Licence Applications; and various Environmental Authorisation processes.

Project History

Water Quality Assessments & Reports

- Review of the water quality monitoring report for the Klinkerstene and FG Landfill, Interwaste / Séché Environmental, Gauteng, South Africa
- Water quality monitoring at Kikuyu Lifestyle Centre, South Africa
- Water quality monitoring at Skip Waste, South Africa
- Water quality monitoring at Kameeldrift Voere, South Africa
- Water quality monitoring at The Hills Eco-Estate WWTW, South Africa
- Water quality monitoring at Thaba Eco Village, South Africa
- Water quality monitoring at The Blyde Crystal Lagoon, South Africa
- Water quality monitoring at the Greencreek Lifestyle Estate, South Africa
- Water quality monitoring at Peach Tree WWTP, South Africa
- Water quality monitoring at Hebron Mall, South Africa
- Water quality monitoring at the Zwavelpoort Bulk Sewer Line, South Africa.

Soil Quality Assessments & Reports

- Soil quality monitoring at The Hills Eco-Estate WWTW, South Africa
- Soil quality monitoring at Kameeldrift Voere, South Africa.

Environmental Authorisation Processes and Management Plans

- Basic Assessment Report, Environmental Management Programme, and Rehabilitation Plan for the proposed Doornkloof Mixed-Use Development, Gauteng, South Africa (project manager)

- Water Use Licence Application, Environmental Management Programme, Rehabilitation Plan, Integrated Water and Waste Management Plan at the WWTW of The Hills Eco-Estate, Gauteng, South Africa (project manager)
- Water Use Licence Application of the proposed Mooikloof Eco-Estate residential development, Gauteng, South Africa
- Part 2 Environmental Impact Assessment Report and Environmental Management Programme for the proposed Footpaths at the Kikuyu Lifestyle Centre, Gauteng, South Africa (project manager)
- Part 2 Environmental Impact Assessment Report for the proposed Castle Gate Mall expansion
- Environmental Management Programme for the proposed Thaba Eco Village residential development.

Public Participation Process

- Doornkloof Residential, Gauteng, South Africa
- WWTW, The Hills Eco-Estate, Gauteng, South Africa
- Footpaths, Kikuyu Lifestyle Centre, Gauteng, South Africa
- Link Road, Riverwalk Development, Gauteng, South Africa
- Castle Gate Mall expansion, Gauteng, South Africa.

Compliance Auditing

- Environmental compliance auditing of the operational commercial farm, Kameeldrift Voere, Gauteng Province, South Africa
- Environmental compliance auditing of the operational WWTW, The Hills Eco-Estate, Gauteng, South Africa .

APPENDIX 2

Prime Resources Company Profile

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COMPANY PROFILE

Prime Resources (Pty) Ltd is a medium-sized group of consulting environmental engineers and scientists serving clients across a wide range of industries, although the majority of our project work is based around natural resources, waste and mining.

The company was established in Johannesburg in 2003. Our head offices are located in Parktown North, Johannesburg, South Africa.

Prime Resources employs a talented and innovative group of professional people. We also have an extensive network of specialist sub-contractors who, together with our team, provide specialist environmental and civil design services. We provide consulting services and solutions to clients in a wide range of fields including:

- Project Management and implementation of environmental solutions
- Environmental Social Impact Assessments (ESIA) and Environmental Management Programmes (EMPr)
- Public consultation and engagement with Interested and Affected Parties (IAPs)
- Water Use Licence Applications (WULA)
- Waste management strategies and licensing
- Mining Right Applications
- Mine closure and rehabilitation planning
- Social and Labour Plans (SLP)
- Environmental and social compliance auditing and performance assessments
- Geographic Information Systems (GIS) services
- Environmental / civil / geotechnical engineering solutions
- Geotechnical and tailings dam assessments
- Feasibility studies
- Environmental advisors on purchase and sale transactions – Independent Technical Advisors
- Environmental and social due diligence and risk assessments both in terms of national legislation and international best practice
- Advising on compliance with international best practice, most importantly the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines

KEY STAFF AND QUALIFICATIONS

PROFESSIONAL STAFF	ROLE	QUALIFICATIONS
Peter Theron	Company Director Environmental Engineer Project Manager	Professional Engineer (Pr. 950329) BSc Eng. (Civil) GDE Environmental Engineering, Tailings & Geotechnical
Gené Main	Project Manager Principal Environmental Scientist	Pr. Sci. Nat. (Environmental Science) Registered Environmental Assessment Practitioner (EAP) MSc Botany BSc (Hons) Environmental Science
Louise Jones	Senior Environmental Scientist GIS Specialist	MSc Environmental Sciences BSc (Hons) Applied Chemistry
Stephan Geyer	Senior Civil Engineer	BSc Eng. (Civil)
Stephen Tarlton	Senior Environmental Scientist	Pr. Sci. Nat. (Environmental Science) MSc Plant conservation ecology BSc Plant Sciences and Ecology
Dr Bronwyn Grover	Environmental Scientist Geochemistry	Pr. Sci. Nat. (Environmental Science) PhD Environmental Analytical Chemistry BSc Geology and Chemistry
Fernanda Smook	Office Manager	Business Management courses
Monique van der Westhuizen	Environmental Scientist	BSc (Hons) Hydrogeology BSc Environmental and Engineering Geology

ASSOCIATES:

PROFESSIONAL STAFF	ROLE	QUALIFICATIONS
Niel Scheepers	Civil Engineering Technician	B Tech (Civil)

PROJECT EXPERIENCE

Prime Resources has considerable in-house experience in the technical and civil design of mine and waste residue storage facilities, including geotechnical engineering, geochemical evaluation, barrier selection and design, hydrogeology and wastewater containment.

Our in-house technical project team includes Peter Theron, Director of Prime Resources and a Professional Engineer (Civil) with over 33 years' experience and specialising in Environmental Engineering, Tailings, Waste Management and Geotechnical Design.

We have further associated ourselves with a number of specialist service providers whom we work together with to provide a complete range of design solutions, including civil engineering technicians and draughtsmen, hydrogeologists and hydrologists.

INTERNATIONAL PROJECTS

- **Al Amar Tailings Storage Facility Design, Saudi Arabia**
  - Tailings and Waste disposal aspects of Al Amar Tailings Retreatment Project
  - Detailed design of the liner system and contract documentation
- **Minas Moatize due diligence, Mozambique**
  - Review of environmental, social and legislative aspects
  - Review of the waste disposal discard disposal aspects
- **Lemur Resources Coal Project, Madagascar**
  - High level review of the coal discard, environmental and social work undertaken during PFS
- **Avesoro New Liberty Access Road Review, Liberia**
  - Review of geotechnical, road design aspects
- **Tri-K due diligence, Guinea**
  - Review of environmental, social and legislative aspects
  - Review of the waste disposal discard disposal
  - Compilation of a Stage 2 Due Diligence report
- **Segilola Gold due diligence, Nigeria**
  - Review of environmental, social, geochemical and tailings aspects
  - Compilation of a Stage 2 Due Diligence report
- **Ar Rjum Due Dilligence, Saudi Arabia**
  - Independent Technical Review of tailings aspects
- **Nouvelle Gabon Manganese, Gabon**
  - Review of environmental, social, geochemical and tailings aspects
  - Compilation of a Stage 1 high level report
- **Itasca Africa Lubambe Extension Project, Zambia**
  - Review of environmental, social and legislative aspects for Pre-Feasibility Study
  - Compilation of an integrated environmental and social report
- **Araguaia Nickel Project, Brazil**
  - Detailed design of slag disposal facility for Feasibility Study
  - Site geotechnical investigations
  - Detailed design of cooling water dam and river abstraction pipeline

- **Lindi Jumbo Graphite Project, Tanzania**
  - Surface geotechnical study
  - Site selection for tailings storage facility
  - Pre-Feasibility Study design for tailings storage facility
  - Definitive Feasibility Study design for tailings storage facility
  - Terracing design for plant infrastructure
- **Cacata Phosphate Project, Angola**
  - Environmental licensing according to Angolan legislative requirements
  - Environmental and Social Impact Assessment process according to international best practice
- **Ganajur Gold Project, India**
  - Review of environmental aspects for Feasibility Study
  - Surface geotechnical study
  - Site selection for tailings storage facility
  - Feasibility Study design for tailings storage facility
- **Salamanca Uranium Project, Spain**
  - Feasibility Study design for lined surface waste disposal facilities
  - Feasibility Study design and detailing for an in-pit waste disposal liner system
- **Mpokoto Gold Project, Democratic Republic of Congo**
  - Surface geotechnical study
  - Site selection for tailings storage facility
  - Pre-Feasibility Study design for tailings storage facility
  - Bankable Feasibility Study design for tailings storage facility
  - Terracing design for plant infrastructure
- **Unki Platinum Slag Storage Facility, Zimbabwe**
  - Geotechnical investigation for the slag stockpile area and borrow material;
  - Detailed design for construction of a slag stockpile and water management infrastructure.
- **Olovo Terrace Design, Bosnia**
  - Geotechnical design of a terrace for a run-of-mine ore pad and access ramp.
- **Caula Graphite Project, Mozambique**
  - Site selection and sizing of a graphite tailings storage facility
  - Scoping level design aspects including seepage management, surface water management
- **Cinovec Project, Czech Republic**
  - Pre-feasibility Study (PFS) for the waste rock disposal facility
  - Pre-feasibility Study (PFS) for the terracing and earthworks
- **Lucunga Phosphate Project, Angola**
  - Environmental licensing according to Angolan legislative requirements
- **Veduga Gold Project, Russia**
  - Technical review of environmental and mine waste disposal aspects
- **Ghaghoo Diamond Project, Botswana**
  - Independent technical review of the environmental, social and permitting documentation according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
  - Preparation of an Equator Principles environmental and social action plan

- **Debswana Diamond Projects, Botswana**
  - Peer review of environmental and mine waste aspects for Pre-Feasibility Studies
- **Liqhobong Diamond Mine, Lesotho**
  - Independent technical review of the environmental and social aspects, permitting, water management and residue management - according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Koidu Diamond Project, Sierra Leone**
  - Review of environmental, social, groundwater and tailings documentation for compliance with Equator Principles, IFC Performance Standards and EHS Guidelines
- **Araguaia Nickel Project, Brazil**
  - Environmental and social baseline report Pre-Feasibility Study
  - Preliminary design of slag disposal facility for Pre-Feasibility Study
- **Maminskoye Gold Project, Central Urals, Russia**
  - Environmental and social audit of the Pre-Feasibility Study
- **Cabinda Phosphate Project, Angola**
  - Social impact plan and Environmental Management Plan for prospecting
  - Environmental and social baseline report towards the Definitive Feasibility Study stage
- **Owere Gold Project, Ghana**
  - Independent technical review of the environmental, social and permitting documentation
- **Kinsevere Copper Project, Democratic Republic of Congo**
  - Review of tailings dam risks and opportunities for compliance with Equator Principles
- **Kipoi Copper Mine, Democratic Republic of Congo**
  - Review of environmental, social, heap leach and tailings of the Kipoi Central RDFS operations, Tiger Resources
  - Independent technical review of the environmental, social and permitting documentation according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Zanaga Iron Ore Project, Democratic Republic of Congo**
  - Environmental and social section of the order of magnitude study
- **Pakrut Gold Mine, Tajikistan**
  - Social and Environmental Impact Assessment process, baseline evaluations according to international best practice requirements
- **Lece Gold Mine, Serbia**
  - Tailings technical review and concept design work for a tailings retreatment project
- **Langer Heinrich Uranium Mine, Namibia**
  - Independent technical review of the tailings storage facility and storage strategy
- **Maamba Coal Mine, Zambia**
  - Independent technical review of the environmental, social, permitting, discard and water management according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **North River Resources Lead Zinc, Namibia**
  - High level review of the environmental and social documentation according to Namibian legislative requirements
- **Minas Moatize Coal Expansion Project, Mozambique**

- Independent technical review and due diligence of mine residue facilities (slurry and discard), water management, environmental and social aspects

- **Aquarius Shipping International, Warehouse and Container Depot, Beira, Mozambique**
  - Geotechnical investigation
- **Passendro Gold Project, Democratic Republic of Congo**
  - Independent peer review for tailings storage facility
- **Banro Twangiza Project, Democratic Republic of Congo**
  - Independent technical review of the environmental, social, tailings and water management aspects according to the Equator Principles

NATIONAL PROJECTS

Projects are all conducted in terms of relevant National legislation, including the National Environmental Management Act, No. 107 of 1998 (NEMA); the Mineral and Petroleum Resources Development Act, No. 28 of 2002 (MPRDA); the National Environmental Management: Waste Act, No. 59 of 2008; the National Water Act, No. 36 of 1998 etc.

- **Bacarac Trading 104 – Buffelsdoorn Mine, North West**
  - Social and Labour Plan
  - Scoping Report and Environmental Management Programme
  - Water Use Licence Application
- **Middelvlei Minerals – Middelvlei Mine, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme
  - Waste Management Licence
  - Water Use Licence Application
- **CGERO – Van Dyk Prospecting Right, Gauteng**
  - Prospecting Right Application
  - Environmental Authorisation process incl. BAR, EMP and closure plan
- **ERPM Extension Area 1 – ERPM Ext 2 Mine, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme
  - Waste Management Licence
  - Water Use Licence Application
- **Sebilo Resources – Perth Mine, Northern Cape**
  - Assessment of the quantum for rehabilitation-related financial provision
- **Samancor^{Cr} – TC Smelters, North West**
  - Closure, Decommissioning and Rehabilitation Plan
  - Assessment of the quantum for rehabilitation-related financial provision
- **Samancor^{Cr} – Ferrometals, Mpumalanga**
  - EMP performance assessment for decommissioning of the IC3 facility
  - Slag dump waste management licence compliance audit
  - Water use license compliance audit
- **Tawana Investment Holdings – Prospecting Right, Northern Cape**
  - Prospecting Right Application
  - Environmental Authorisation process incl. BAR, EMP and closure plan

- **Pan African Mineral Development Company – Prospecting Right, Northern Cape**
  - Prospecting Right Application
  - Environmental Authorisation process incl. BAR, EMP and closure plan
- **Newshelf – Cons Modder Project, Gauteng**
  - Social and Labour Plan
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
- **Imperial Cargo Solutions – Flammable Goods Store, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme
- **Gold One Africa – Ventersburg Project, Free State**
  - Social and Labour Plan
  - Environmental Impact Assessment and Environmental Management Programme
  - Waste Management Licence
  - Water Use Licence Application
  - Atmospheric Emission Licence
- **WRE – EJV Gold Project, Free State**
  - Site selection for tailings storage facility
  - Pre-Feasibility Study design for tailings storage facility
- **Rietvlei Mine, Mpumalanga**
  - Technical input on discard dump and pollution control dam design
- **Gold One Africa – Holfontein Gold Project, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application and water dam designs
- **New Kleinfontein Goldmine – Modder East Operations, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme and amendments thereto
  - Basic Assessment for a return water dam and Environmental Management Programme amendment
  - Water Use Licence Application and amendments thereto
  - Atmospheric Emission Licence application
  - Rehabilitation Strategy and Implementation Programme
  - Social and Labour Plan revision
  - Equator Principles and IFC compliance review
  - Alien invasive vegetation eradication plan
  - Emergency preparedness and response plan
  - Stormwater management plan
- **Interwaste – Various sites in Gauteng, Mpumalanga and Western Cape**
  - Environmental compliance auditing at various landfill sites and depots
  - Water quality monitoring and reporting
  - External environmental control officer for the Klinkerstene Landfill Site, Environmental Authorisation and construction Environmental Management Programme compliance auditing
- **Ekurhuleni Metropolitan Municipality – Various landfill sites in Gauteng**

- Environmental compliance auditing at various landfill sites and transfer stations
- Permit amendment application
- Water quality monitoring and reporting

- **Royal Bafokeng Platinum, North West**
  - Annual assessment of the quantum for rehabilitation-related financial provision for Prospecting Rights
- **Samancor^{Cr} – Various sites in Limpopo**
  - Performance assessments and assessment of the quantum for rehabilitation-related financial provision for various Prospecting Rights
- **Modikwa Platinum Mine, Mpumalanga**
  - Water Use Licence compliance audit and action plan
  - Annual assessment of the quantum for rehabilitation-related financial provision
  - Annual Rehabilitation Plan
  - Final Rehabilitation Decommissioning and Closure Plan
  - Environmental Risk Assessment
  - Waste Management Licence Amendment
- **Coal of Africa – Vele Colliery, Limpopo**
  - Independent technical review of the environmental, social, tailings and water management aspects according to the Equator Principles and IFC Performance Standards
- **Canyon Springs Coal Mine, Mpumalanga**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
  - Waste Management Licence application
  - High level bulk water supply assessment
  - External environmental control officer, construction Environmental Management Programme compliance auditing
  - Water Use Licence execution
- **Elsmore Pafuri Camp, Limpopo**
  - Environmental Authorisation amendment
- **Elsmore Luvuvhu Camp, Limpopo**
  - External environmental control officer, Environmental Authorisation and construction Environmental Management Programme compliance auditing
- **Bio-2-Watt – Biogas Plant, Gauteng**
  - External environmental control officer, construction Environmental Management Programme compliance auditing
  - Technical advice
- **Samancor^{Cr} – Scheiding Chrome Mine, Limpopo**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
- **African Exploration Mining Finance Corporation – T-Project Colliery, Mpumalanga**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application

- Closure and rehabilitation plan
- Bulk water supply assessment
- Equator Principles compliance review and gap analysis
- Stakeholder engagement plan and grievance mechanism
- Emergency preparedness and response plan
- Alien invasive vegetation eradication plan
- Water Use Licence execution

- **Mbila Anthracite Mine, KwaZulu-Natal**
  - Basic Assessment and Environmental Management Programme
  - Water Use Licence amendment
- **Msebe Opencast Anthracite Mine, KwaZulu-Natal**
  - Environmental Impact Assessment and Environmental Management Programme
- **Tjate Platinum Mine, Limpopo**
  - Environmental and social baseline report
  - Baseline environmental assessments and project management of the environmental inputs into the Pre-Feasibility Study
  - Social and Labour Plan update
  - Site selection and preliminary design for a tailings storage facility
- **Tharisa Platinum Mine, North West**
  - Due diligence for independent technical engineers report (ITE), review of the environmental, social and tailings documentation and reporting and annual updates thereto
- **Anglo American Platinum Limited – Rustenburg Platinum Mines, Limpopo**
  - The consolidation of existing approved Environmental Management Programmes and the alignment thereof with the requirements of the MPRDA
- **Kalagadi Manganese Mine, Northern Cape**
  - Review of environmental documentation to determine compliance with Equator Principles and international best practice, on behalf of Standard Bank
- **African Exploration Mining Finance Corporation – Vlakvarkfontein Colliery, Mpumalanga**
  - Water Use Licence Application
  - Closure and rehabilitation plan
  - The technical design, 3D modelling and detailing of the conceptual backfill plan for an opencast pit
  - Compilation of an alien invasive vegetation eradication plan
  - Social and Labour Plan amendment
  - Basic Assessment and Environmental Management Programme for a haul/ access road and above ground diesel storage area
- **Western Bushveld Joint Venture – Project 1, North West**
  - Review of environmental, hydrology and tailings dam documentation for compliance with Equator Principles, IFC Performance Standards and EHS Guidelines, on behalf of Standard Bank
- **Anglo American Platinum Limited – Amandelbult Chrome Recovery Plant, Limpopo**
  - Basic Assessment and Environmental Management Programme for a chrome recovery plant
  - Addendum to the existing Environmental Impact Assessment and Environmental Management Programme in terms of the MPRDA

- **Steenkampskraal Project, Western Cape**
  - Review of environmental, hydrology and tailings dam documentation for compliance for PEA Canadian NI 43-101 filing
- **Malelane Iron Ore Project, Mpumalanga**
  - Preliminary environmental and social baseline studies
- **Rand Uranium – Reclamation of Lindum Tailings Storage Facility, Gauteng**
  - Environmental Impact Assessment and Environmental Management Programme addendum
- **Hlabisa Coal, KwaZulu-Natal**
  - High-level, desktop environmental evaluation (sensitivity analysis)
- **Anglo American Platinum Limited – Kilken Tailings, Limpopo**
  - Independent technical review of the environmental and social aspects permitting and water management according to the Equator Principles, IFC Performance Standards, and World Bank EHS Guidelines
- **Mooiplaats Platinum Mine, Limpopo**
  - Social and Labour Plan
- **Rietkuil Coal Project, Mpumalanga**
  - Independent technical review and due diligence of environmental documentation
- **Evander Gold Mine, Mpumalanga**
  - Review of environmental, social and tailings dam documentation for compliance with South African Environmental and Social Standards
- **Holgoun Energy – Springbok Flats Coal Fields, Limpopo**
  - Competent Persons Report
  - High level bulk water supply assessment
  - High level environmental review for the Western Complex Project
- **Kudumane Manganese Mine, Northern Cape**
  - Independent technical review of the environmental and social aspects
- **ZYL Limited – KaNgwane Anthracite Mine, Mpumalanga**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence Application
  - Closure and rehabilitation plan
- **ZYL Limited – Southern Anthracite Project, Mpumalanga**
  - Environmental Impact Assessment and Environmental Management Programme
- **DRDGold – Blyvooruitzicht Mining Operation, Gauteng**
  - High level environmental review
- **Lonmin – Akanani Platinum Project, Limpopo**
  - Pre-Feasibility Study, review of the environmental and social documentation and reporting of high level risks and opportunities
- **Anglo American Platinum Limited – Dishaba Mine, Limpopo**
  - Environmental Impact Assessment and Environmental Management Programme
  - Water Use Licence amendment
- **Majuba Colliery, Mpumalanga**
  - Closure and rehabilitation plan

- **Rietfontein Prospect, Limpopo**
  - Geotechnical investigation
  - Environmental Management Programme amendment
- **Namaqualand Mines, Northern Cape**
  - Independent technical review of the environmental, social and tailings aspects according to the Equator Principles and IFC Performance Standards
- **Leeuwfontein and Blinkpan project areas, Mpumalanga**
  - Geotechnical investigation
- **Bafokeng Rasimone Platinum Mine, North West**
  - Preliminary closure and rehabilitation plan
- **Umtu (Manganese) Mine Project, Northern Cape**
  - Independent technical review of the environmental and social aspects according to the Equator Principles and IFC Performance Standards
- **Koornfontein Mines, Mpumalanga**
  - Environmental Impact Assessments and Environmental Management Programmes for the separate sections of the mining operations
  - Environmental Impact Assessments and Environmental Management Programmes amendment for the Leeuwfontein Block
  - Water Use Licence Applications for the separate sections of the mining operations
  - Identification of a suitable host area and conditions for resettlement and the compilation of the Resettlement Action Plan and agreement on timeframes and responsibilities
- **Bafokeng Rasimone Platinum Mine, North West**
  - Due diligence on environmental and tailings dam documentation for listing purposes on the JSE stock exchange
  - Competent Persons Report including environmental, social, hydrological and tailings aspects
- **Simmer & Jack Limited – Elandsdrift Heap Leach Pad, Mpumalanga**
  - Geotechnical and slope stability investigation
  - As built drawings for the Elandsdrift heap leach pad
- **Simmer & Jack Mines Limited Transvaal Gold Mining Estates, Mpumalanga**
  - Design, quality control/assurance manual, site support and part time project management for the design and construction of a heap leach dam extension
- **Afrikander Leases Gold Mine, North West**
  - Environmental Impact Assessment and Environmental Management Programme amendment
- **Grass Valley Platinum Project, Limpopo**
  - Update the environmental aspects in the Pre-Feasibility Study report
- **Lonmin PLC Western Platinum Mine, North West**
  - Basic Assessment and Environmental Management Programme for a hazardous waste storage facility
  - Waste Management Licence application

APPENDIX 3

Public Participation

APPENDIX 3.1a

Landowner Notification Letter

Monique van der Westhuizen

From: Gené Main
Sent: Friday, 13 May 2022 08:13
To: cwtheron@zipplink.co.za
Cc: Monique van der Westhuizen; 'Jon Hericourt'
Subject: Notification of proposed gas bulk sampling on Portion 1 of Vogels Rand 720
Attachments: Notification AM Theron_13.05.2022.pdf

Dear Ms Theron

Attached please find a notification letter describing proposed gas bulking sampling activities to be undertaken on Portion 1 of the farm Vogels Rand 720. As the landowner, our client is required to notify you of the proposed activities as well as the application to obtain Environmental Authorisation to undertake these activities.

The Environmental Authorisation process involving Scoping and EIA has not yet commenced. You will be informed about progress in these processes as you have been added as an Interested and Affected Party.

Please feel free to contact either myself or our client directly should you have any questions.

Kind Regards

Gené Main
Principal Consultant
Pr.Sci.Nat. & Reg. EAP (EAPASA)

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consultants

13 May 2022

Attention: Ms Anna Margaretha Theron / Mr Wynand Theron
Sent via email (cwtheron@zipplink.co.za)

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir / Madam

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

The proposed Ventersburg Natural Gas Bulk Sampling Project will take place at an existing borehole (AFO-024) which was drilled during historic gold prospecting activities. Gas sampling will be done by means of using a blower / portable compression unit; therefore, no hydraulic fracturing (fracking) will be involved. The extent of the proposed sampling will require a 70m x 50m test rig surface area which will be securely fenced off. Access to the test site will be gained via the existing farm road and a short section of new gravel road of approximately 300m. Upon completion of the bulk sampling, the test rig area and the road will be rehabilitated to its pre-exploration state.

Prime Resources is conducting the Environmental Authorisation processes for the proposed project. As the landowner of property affected by the project, the applicant (Gold One Africa Limited) is required to notify you of the proposed project. Your contact details have also been added to the Interested and Affected Party (IAP) database.

More detail regarding the project will be made available during the EIA phase of the process, and relevant documentation will be submitted to you for review and comment. Specialist studies have been completed and will be incorporated into the environmental documentation.

Should you wish to discuss the project, or associated regulated processes further, please feel free to contact us at:

Applicant	Environmental Assessment Practitioner
Gold One Africa Limited	Prime Resources
Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main
Principal Environmental Consultant
Prime Resources (Pty) Ltd

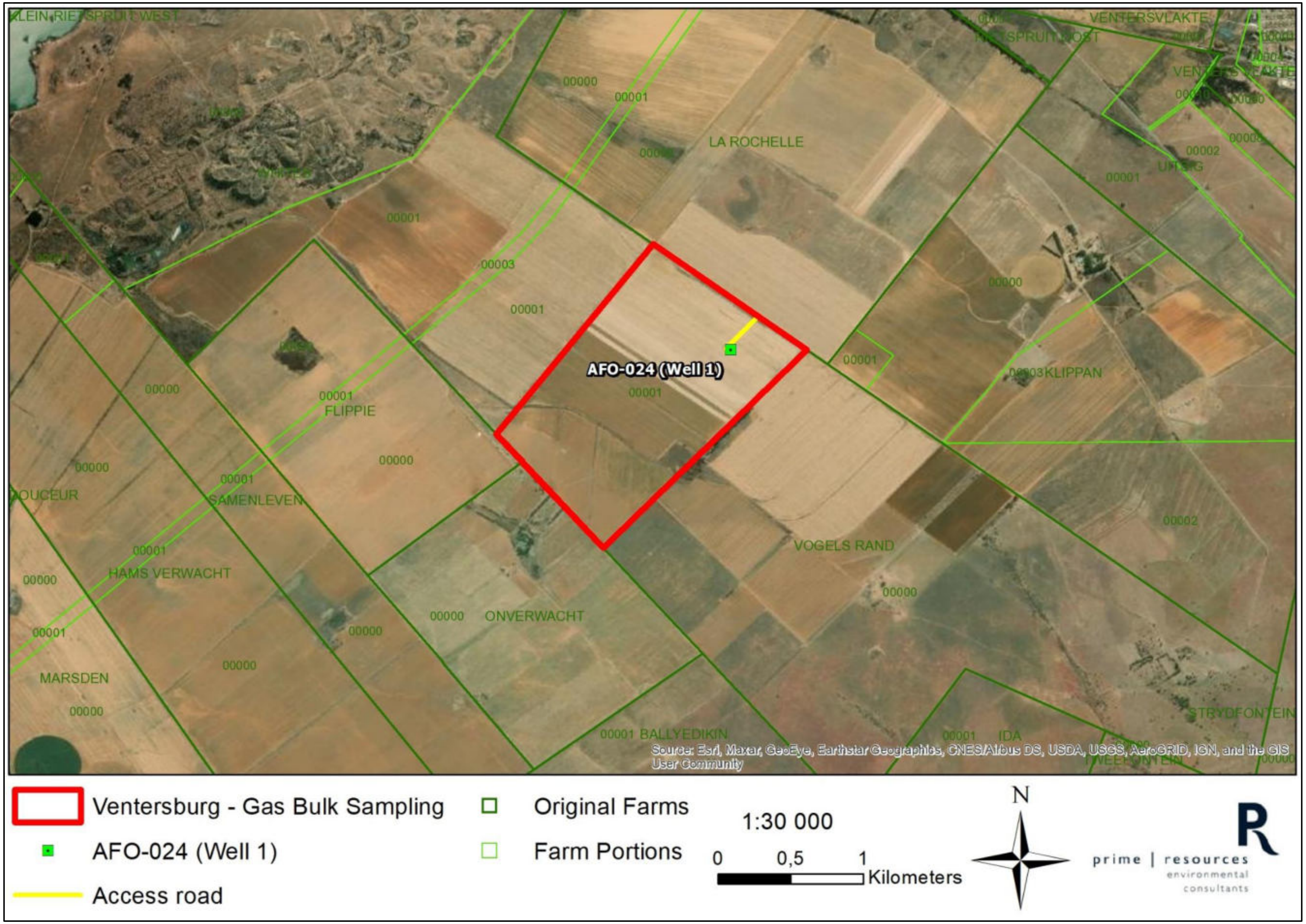

Figure 1: Proposed layout for Ventersburg gas bulk sampling

APPENDIX 3.1b

Tenant Notification Letter

Monique van der Westhuizen

From:	Gené Main
Sent:	Friday, 13 May 2022 08:00
To:	pjcoetzer@zipplink.co.za
Cc:	Monique van der Westhuizen; 'Jon Hericourt'
Subject:	Notification of proposed gas bulk sampling on Portion 1 of Vogels Rand 720
Attachments:	Notification PJ Coetzer_13.05.2022.pdf
Follow Up Flag:	Follow up
Flag Status:	Flagged

Dear Mr Coetzer

Attached please find a notification letter describing proposed gas bulking sampling activities to be undertaken on Portion 1 of the farm Vogels Rand 720. As the current tenant, our client is required to notify you of the proposed activities as well as the application to obtain Environmental Authorisation to undertake these activities.

The Environmental Authorisation process involving Scoping and EIA has not yet commenced. You will be informed about progress in these processes as you have been added as an Interested and Affected Party.

Please feel free to contact either myself or our client directly should you have any questions.

Kind Regards

Gené Main
Principal Consultant
Pr.Sci.Nat. & Reg. EAP (EAPASA)

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13 May 2022

Attention: Mr Flippie Coetzer
Sent via email: pjcoetzer@zipplink.co.za

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

The proposed Ventersburg Natural Gas Bulk Sampling Project will take place at an existing borehole (AFO-024) which was drilled during historic prospecting activities. Gas sampling will be done by means of using a blower / portable compression unit; therefore, no hydraulic fracturing (fracking) will be involved. The extent of the proposed sampling will require a 70m x 50m test rig surface area which will be securely fenced off. Access to the test site will be gained via the existing farm road and a short section of new gravel road of approximately 300m. Fair compensation for any loss in agricultural revenue as a result of the use of this area will be negotiated prior to commencing with the sampling exercise. Upon completion of the bulk sampling, the test rig area and the road will be rehabilitated to its pre-exploration state.

Prime Resources is conducting the Environmental Authorisation processes for the proposed project. As the current tenant of property affected by the project, the applicant (Gold One Africa Limited) is required to notify you of the proposed project. Your contact details have also been added to the Interested and Affected Party (IAP) database.

More detail regarding the project will be made available during the EIA phase of the process, and relevant documentation will be submitted to you for review and comment. Specialist studies have been completed and will be incorporated into the environmental documentation.

Should you wish to discuss the project, or associated regulated processes further, please feel free to contact us at:

Applicant	Environmental Assessment Practitioner
Gold One Africa Limited	Prime Resources
Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main

Principal Environmental Consultant

Prime Resources (Pty) Ltd

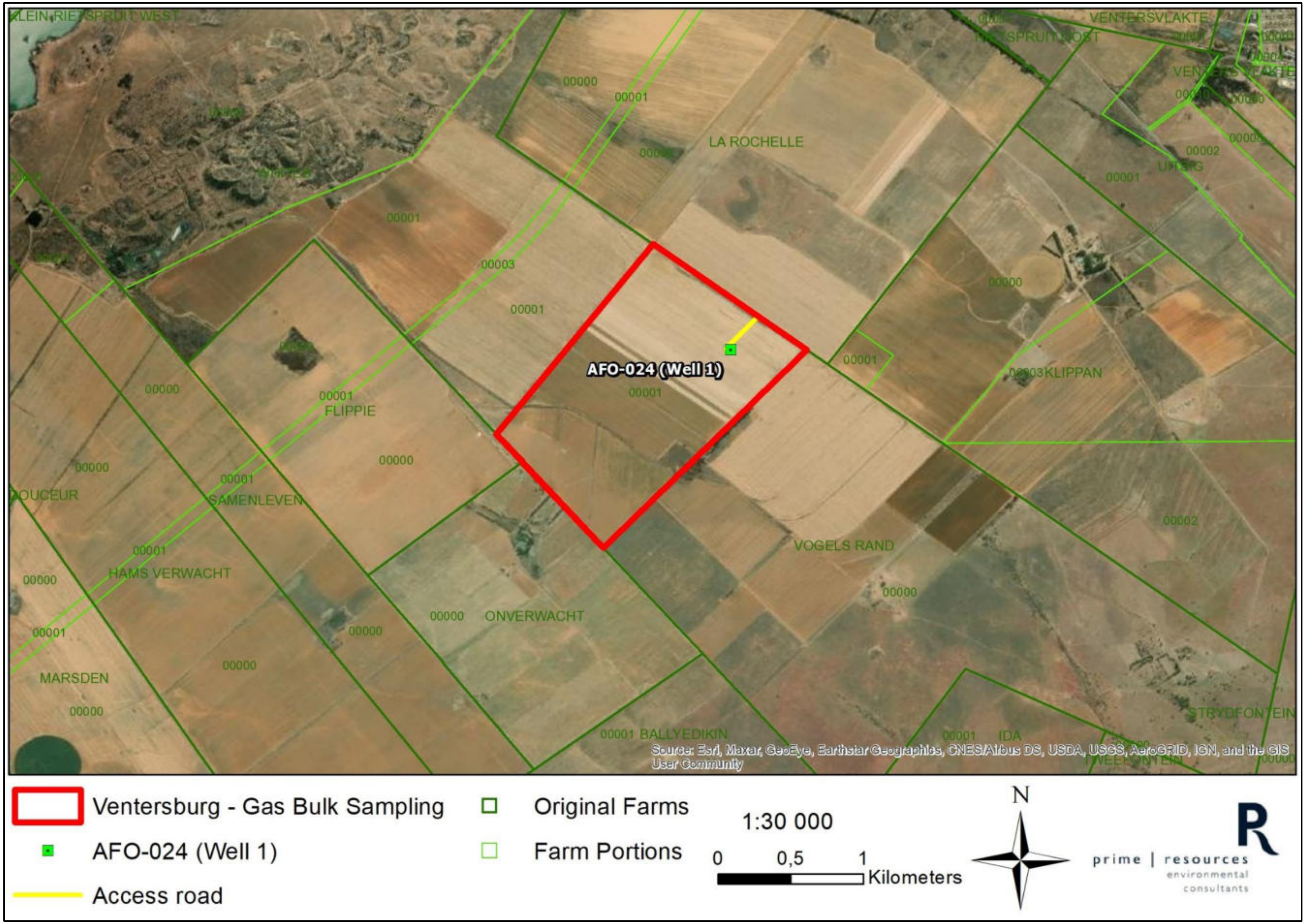

Figure 1: Proposed layout for Ventersburg gas bulk sampling

Monique van der Westhuizen

From:	Gené Main
Sent:	Monday, 23 May 2022 11:01
To:	'FE Vogel <vogelsrand@gmail.com> (vogelsrand@gmail.com)'
Cc:	Monique van der Westhuizen
Subject:	Notification of adjacent landowners - Ventersburg Gas Bulk Sampling Project
Attachments:	FE Vogel_RE Vogels Rand 720.pdf; FE Vogel_RE La Rochelle 760.pdf

Good day Mr Vogel

As the adjacent landowner, we are required to notify you of the gas bulk sampling project proposed by Gold One Africa. Please find attached notification letter.

Please feel free to contact me should you wish to discuss anything.

Kind Regards

Gené Main
Principal Consultant
Pr.Sci.Nat. & Reg. EAP (EAPASA)

prime | resources

T: +27 11 447 4888
F: +27 86 604 2219
E: gene@resources.co.za

the workshop ▪ 70 - 7th avenue ▪ parktown north ▪ johannesburg ▪ 2193
postnet suite # 002 ▪ private bag x1 ▪ woodhill ▪ 0076

www.resources.co.za

Prime Resources (Pty) Ltd
The Workshop 70–7th Avenue Parktown North 2193
PO Box 2316 Parklands 2121
T +27 11 447 4888 **F** +27 86 604 2219 **E** prime@resources.co.za
www.resources.co.za

prime | resources
environmental
consultants

23 May 2022

Attention: Frederik Evert Vogel / CHENMAR CC
Sent via email (vogelsrand@gmail.com)

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

The proposed Ventersburg Natural Gas Bulk Sampling Project will take place at an existing borehole (AFO-024) which was drilled during historic prospecting activities. Gas sampling will be done by means of using a blower / portable compression unit; therefore, no hydraulic fracturing (fracking) will be involved. The extent of the proposed sampling will require a 70m x 50m test rig surface area which will be securely fenced off. Access to the test site will be gained via the existing farm road and a short section of new gravel road of approximately 300m. Fair compensation for any loss in agricultural revenue as a result of the use of this area will be negotiated prior to commencing with the sampling exercise. Upon completion of the bulk sampling, the test rig area and the road will be rehabilitated to its pre-exploration state.

Prime Resources is conducting the Environmental Authorisation processes for the proposed project. As an adjacent landowner of the property affected by the project, the applicant (Gold One Africa Limited) is required to notify you of the proposed project. Your contact details have also been added to the Interested and Affected Party (IAP) database.

More detail regarding the project will be made available during the EIA phase of the process, and relevant documentation will be submitted to you for review and comment. Specialist studies have been completed and will be incorporated into the environmental documentation.

Should you wish to discuss the project, or associated regulated processes further, please feel free to contact us at:

Applicant	Environmental Assessment Practitioner
Gold One Africa Limited	Prime Resources
Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main
Principal Environmental Consultant
Prime Resources (Pty) Ltd

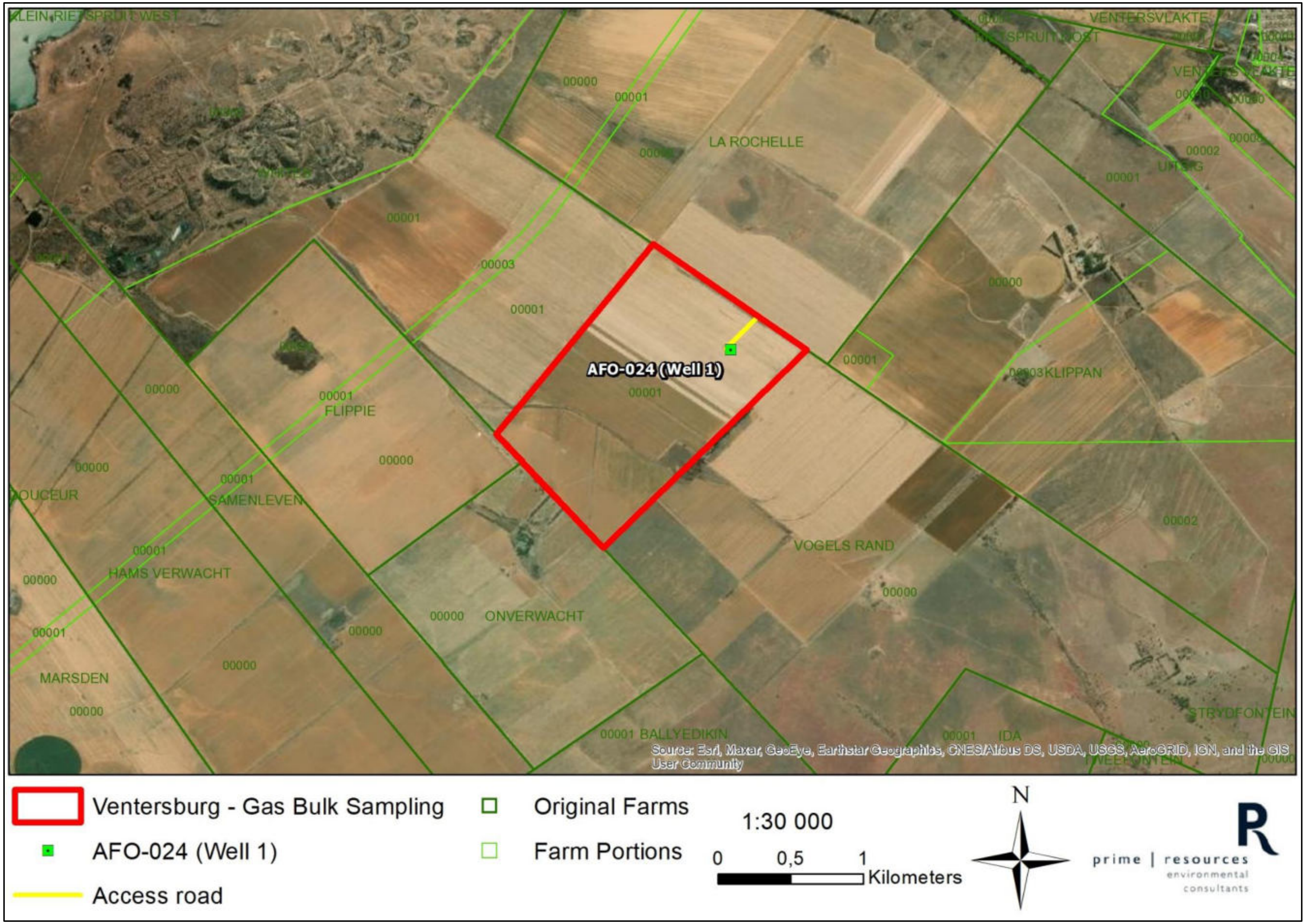

Figure 1: Proposed layout for Ventersburg gas bulk sampling

Prime Resources (Pty) Ltd
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PO Box 2316 Parklands 2121
T +27 11 447 4888 **F** +27 86 604 2219 **E** prime@resources.co.za
www.resources.co.za

prime | resources
environmental
consultants

23 May 2022

Attention: Frederik Evert Vogel / Vogel Trust
Sent via email (vogelsrand@gmail.com)

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

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Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main
Principal Environmental Consultant
Prime Resources (Pty) Ltd

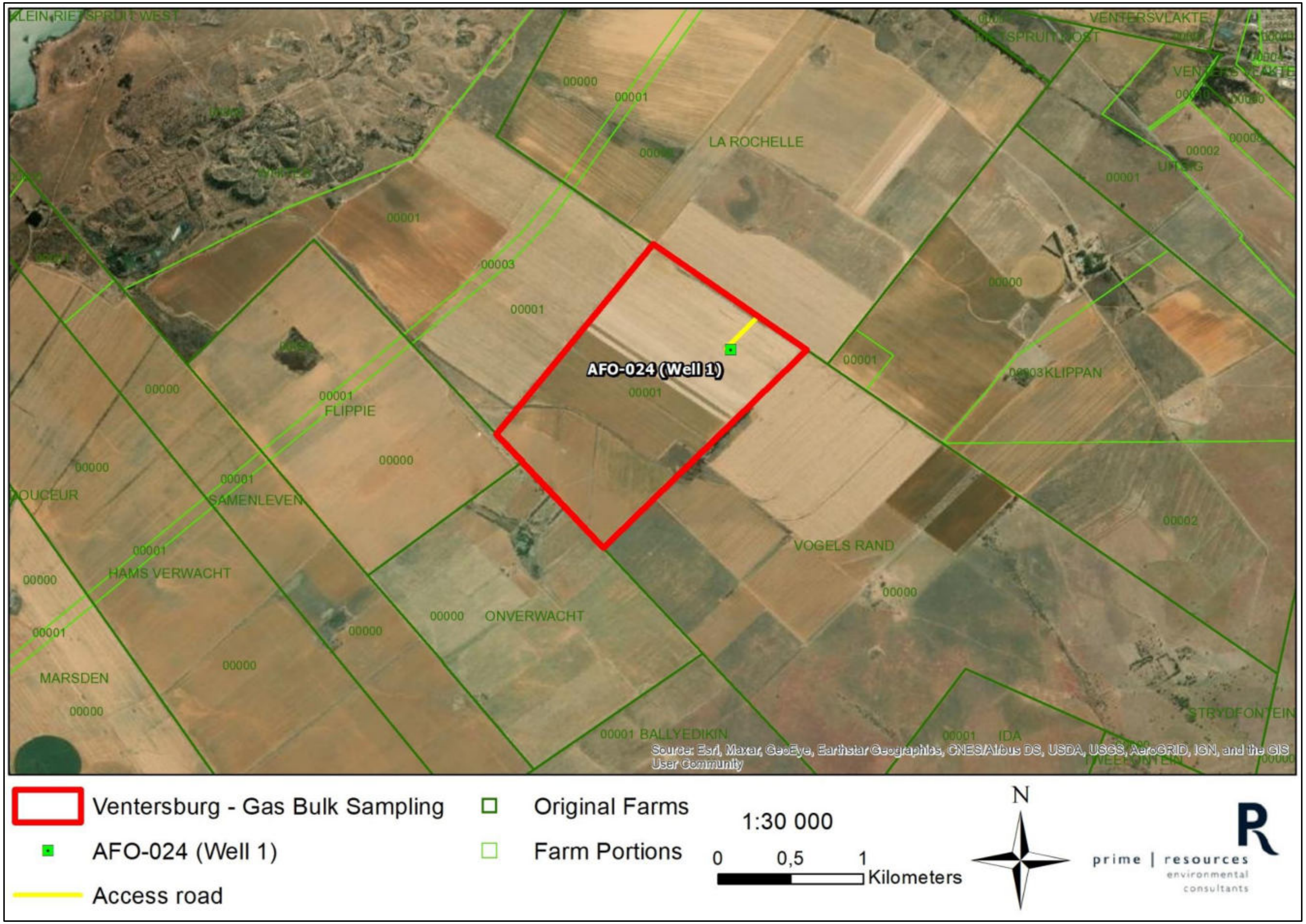

Figure 1: Proposed layout for Ventersburg gas bulk sampling

Monique van der Westhuizen

From: Gené Main
Sent: Monday, 23 May 2022 11:01
To: cwtheron@zipplink.co.za
Cc: Monique van der Westhuizen
Subject: Notification of adjacent landowners - Ventersburg Gas Bulk Sampling Project
Attachments: W Theron_Ptn 1 Whites 747.pdf; W Theron_RE Flippie 738.pdf

Good day Mr Theron

As the adjacent landowner, we are required to notify you of the gas bulk sampling project proposed by Gold One Africa. Please find attached notification letter.

Please feel free to contact me should you wish to discuss anything.

Kind Regards

Gené Main
Principal Consultant
Pr.Sci.Nat. & Reg. EAP (EAPASA)

prime | resources

T: +27 11 447 4888
F: +27 86 604 2219
E: gene@resources.co.za

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www.resources.co.za

prime | resources
environmental consultants

23 May 2022

Attention: Mr Wynand Theron / TP&M Boerdery Pty Ltd
Sent via email (cwtheron@zipplink.co.za)

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

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Applicant	Environmental Assessment Practitioner
Gold One Africa Limited	Prime Resources
Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main

Principal Environmental Consultant

Prime Resources (Pty) Ltd

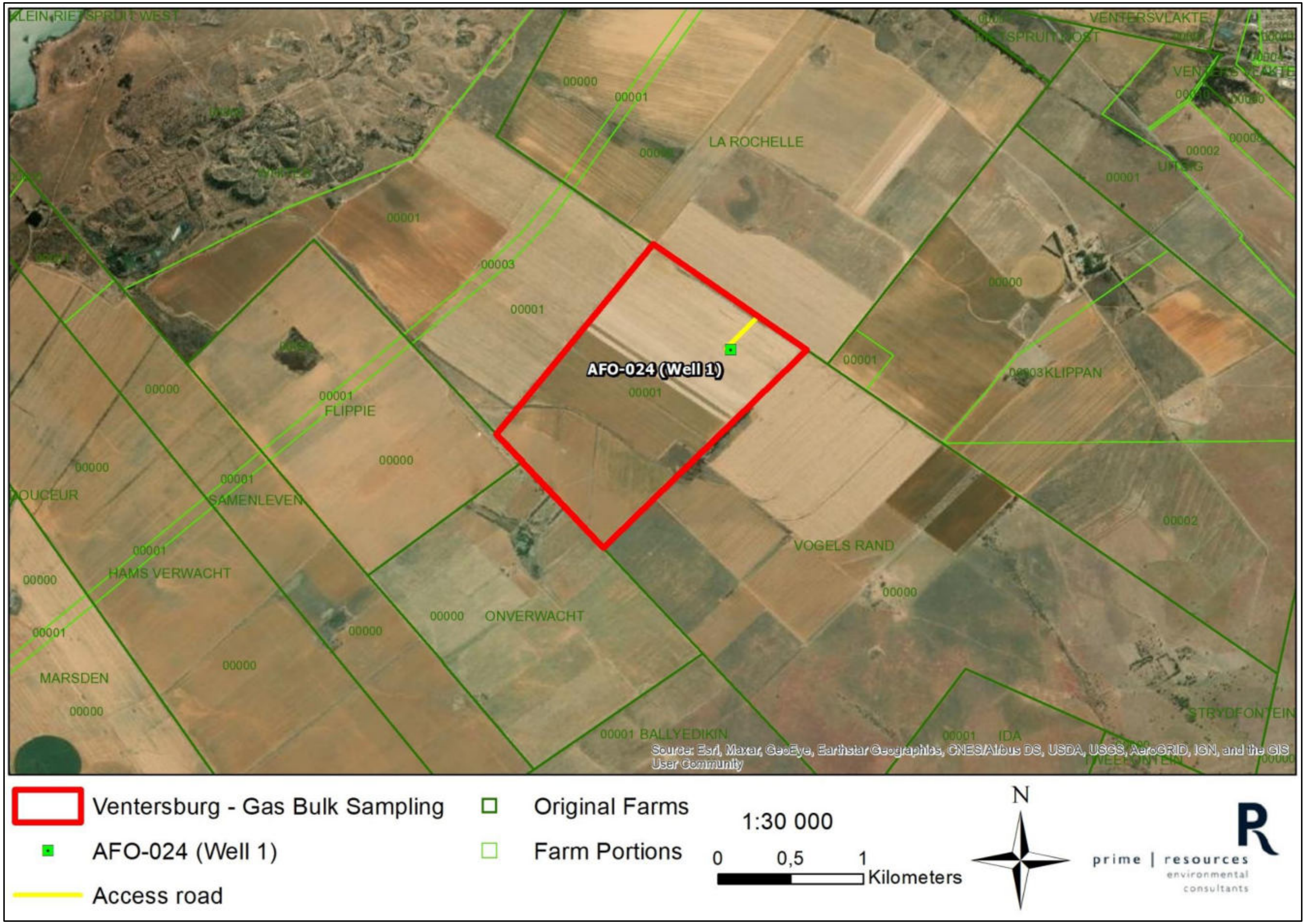

Figure 1: Proposed layout for Ventersburg gas bulk sampling

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www.resources.co.za

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environmental
consultants

23 May 2022

Attention: BIZ AFRIKA 1495 PTY LTD
Sent via email (cwtheron@zipplink.co.za)

PROPOSED GAS BULK SAMPLING ON PORTION 1 OF THE FARM VOGELS RAND 720, NEAR HENNENMAN, FREE STATE

Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

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Jon Hericourt	Gené Main
Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
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Yours sincerely,

Gené Main

Principal Environmental Consultant

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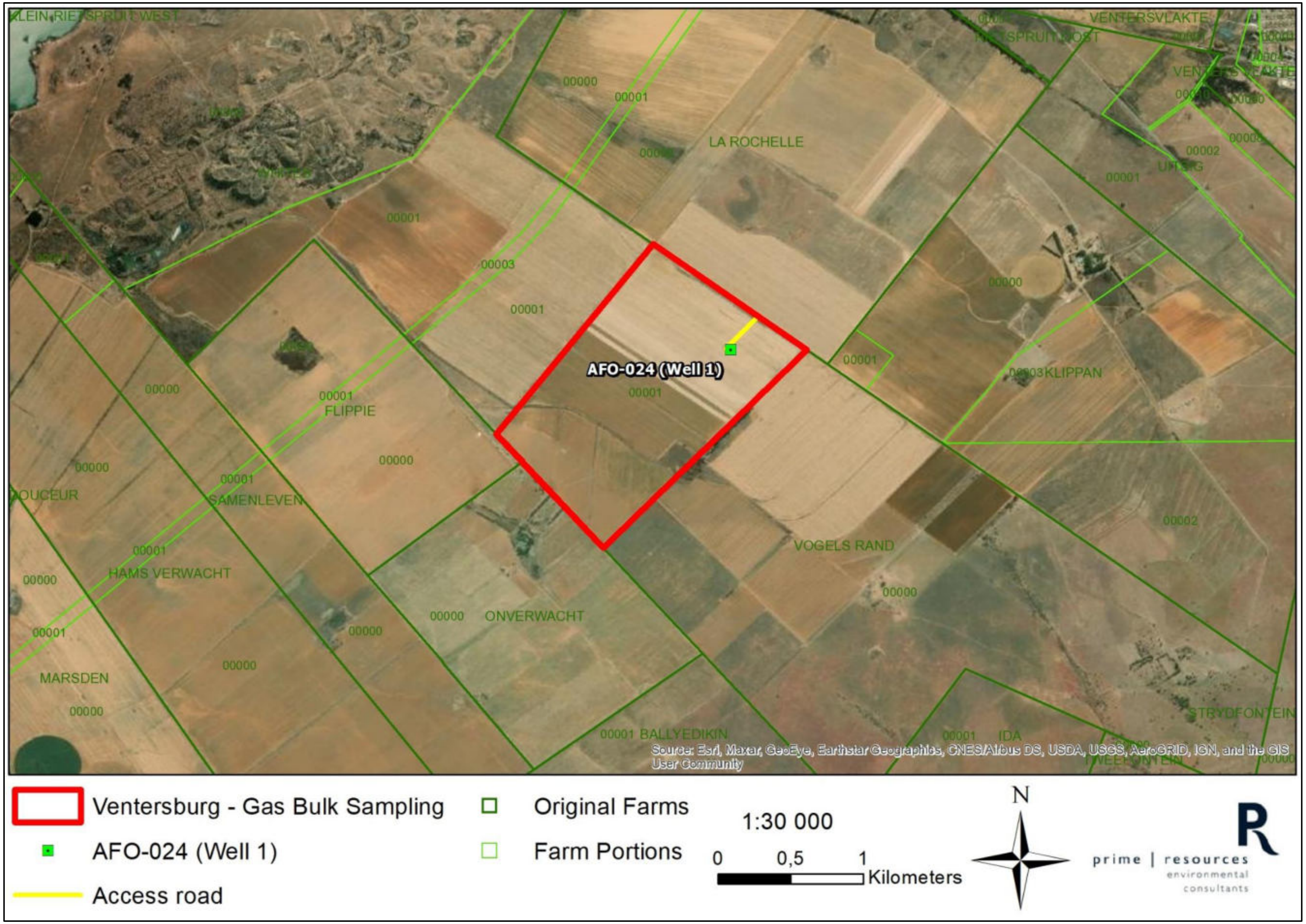

Figure 1: Proposed layout for Ventersburg gas bulk sampling

Monique van der Westhuizen

From:	Gené Main
Sent:	Monday, 23 May 2022 11:01
To:	pjcoetzer@zipplink.co.za
Cc:	Monique van der Westhuizen
Subject:	Notification of adjacent landowners - Ventersburg Gas Bulk Sampling Project
Attachments:	PJ Coetzer_Onverwacht 342.pdf

Good day Mr Coetzer

As the adjacent landowner, we are required to notify you of the gas bulk sampling project proposed by Gold One Africa. Please find attached notification letter.

Please feel free to contact me should you wish to discuss anything.

Kind Regards

Gené Main
Principal Consultant
Pr.Sci.Nat. & Reg. EAP (EAPASA)

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www.resources.co.za

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environmental
consultants

23 May 2022

Attention: PJ Coetzer / BIZ AFRIKA 1495 PTY LTD
Sent via email (pjcoetzer@zipplink.co.za)

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Dear Sir

Gold One Africa Limited is applying for Environmental Authorisation in terms of the National Environmental Management Act (1998), as amended and the Environmental Impact Assessment (EIA) Regulations (2014), for the bulk sampling of methane gas over a 2-year period. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable biogenic methane and associated gases.

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Email Jon.hericourt@gold1.co.za	Email gene@resources.co.za
Tel. 072 849 5453	Tel. 078 247 6737

Yours sincerely,

Gené Main

Principal Environmental Consultant

Prime Resources (Pty) Ltd

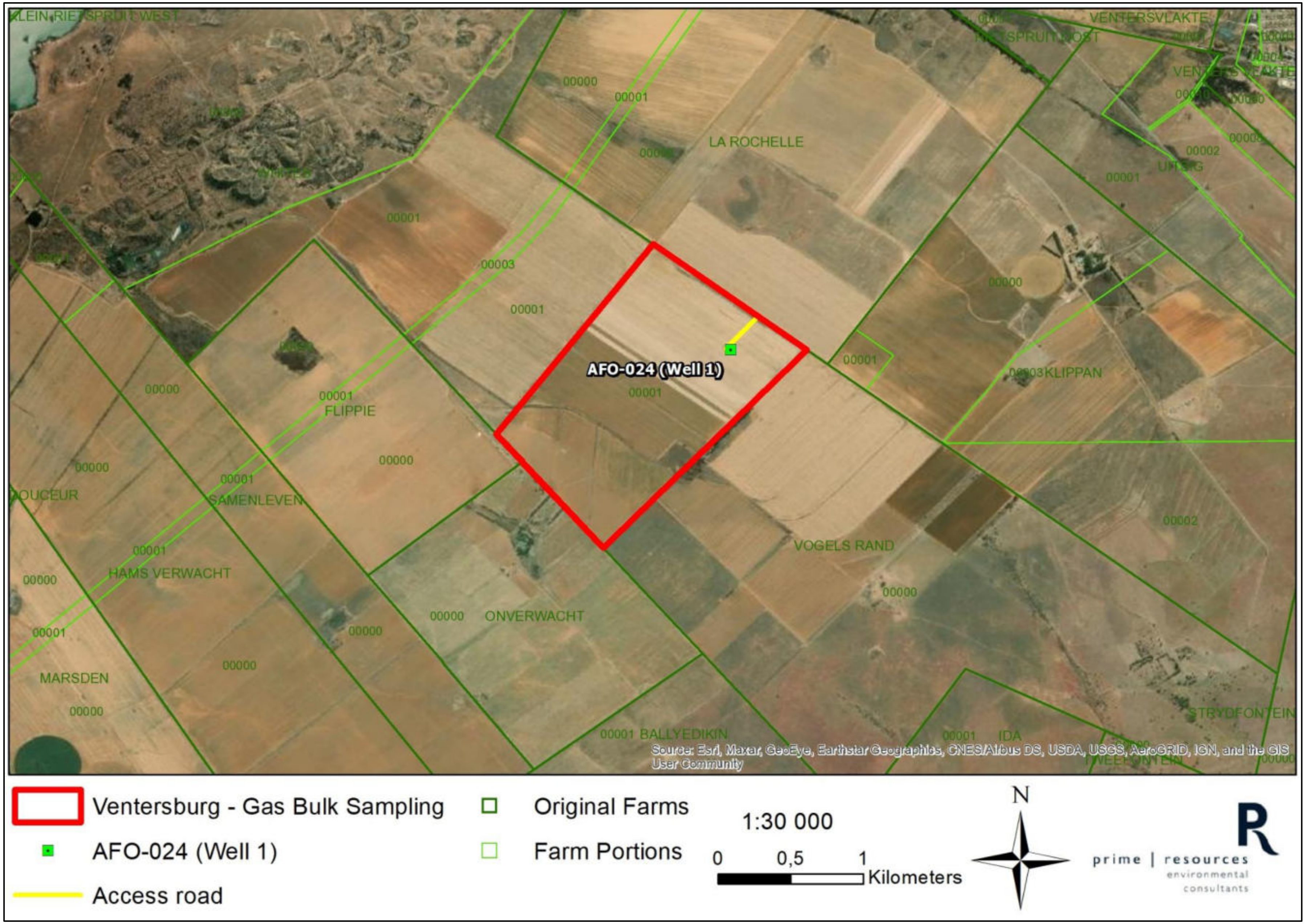

Figure 1: Proposed layout for Ventersburg gas bulk sampling

APPENDIX 3.1c

Adjacent Landowner Notification Letters

APPENDIX 3.2

Media Notice

NOTIFICATION OF PUBLIC PARTICIPATION PROCESS

Gold One Africa Limited (Gold One Africa) holds an Exploration Right over various farm portions between the towns of Hennenman and Ventersburg in the Free State and proposes to pursue an application to conduct **bulk gas sampling**. **This does not involve hydraulic fracturing (fracking).** The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable natural gas.

Gold One Africa has applied in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, No. 28 of 2002 (MPRDA), to undertake bulk sampling of natural gas identified during historic gold prospecting activities. The sampling site is located on Portion 1 of the Farm Vogels Rand 720, within the Lejweleputswa District Municipality and Matjhabeng Local Municipality, Free State Province.

Gold One Africa is applying for Environmental Authorisation for activities listed in terms of the National Environmental Management Act (NEMA), No. 107 of 1998 Environmental Impact Assessment Regulations (GNR982 of 2014). The following listed activities are triggered: GNR 984 Activities 5 and 18.

A Water Use Licence may be required in terms of Section 21 of the National Water Act, No. 36 of 1998. A pre-application enquiry has been submitted to the Department of Water and Sanitation.

Prime Resources (Pty) Ltd has been appointed as the Environmental Assessment Practitioner in terms of S12 of the NEMA to facilitate the above process.

The draft Scoping Report will be made available for review for a period of 30 days, from **26 May to 26 June 2022**. The reports will be available for review at the following locations:

- Phomolong Public Library, Phomolong, Hennenman
- Hennenman Public Library, Hennenman

The report can also be downloaded at www.resources.co.za and can be provided via email upon request. Please forward queries and comments to Prime Resources by **26 June 2022**. Contact details: (SMS or WhatsApp) 076 403 3386 (T) 011 447 4888 (E) prime@resources.co.za. Please use subject line "**VB Gas".**

BOEDELS: KREDITEURE EN DEBITEURE
4201

AG SEFO ATTORNEYS & CONVEYANCERS BABUELLI/AMAGWETHA/ PROKUREURS

Estate Late: P Wessie
Estate Number: 000542/2022

NOTICE TO CREDITORS IN DECEASED ESTATES

All persons having claims against the under-mentioned estate must lodge it with the Executor concerned within 30 days (or as indicated) from date of publication hereof.
Province: FREE STATE
Estate Number: 000542/2022
Surname: WESSIE
First Names: PETRUS
Date of Birth: 1958-02-05
ID Number: 5802055023083
Last Address: WELKOM, FREE STATE
Date of Death: 2021-05-09
Master's Office: BLOEMFONTEIN, FREE STATE
First Names of Surviving Spouse: SEBOLELO SELINA
Surname of Surviving Spouse: WESSIE
Date of Birth of Surviving Spouse: 1967-10-01
ID Number of Surviving Spouse: 6710010347084
Name of Executor or Authorised Agent: SEBOLELO SELINA WESSIE
Address of Executor or Authorised Agent: 68 NORMAN STREET, RIEBEECKSTAD, WELKOM, FREE STATE PROVINCE

A G SEFO ATTORNEYS & CONVEYANCERS
SUITE 101
329 STATEWAY CHAMBERS
STATEWAY
WELKOM
9460
ADVERTISER EMAIL: info@agsefoattorneys.net
TEL. 057-3574440

Badenhorst Prokureurs
Prokureurs, Notaris & Aktebesorger

Estate Late: R J Van Den Berg
Estate Number: 10014/2021

NOTICE TO CREDITORS IN DECEASED ESTATES

All persons having claims against the under-mentioned estate must lodge it with the Executor concerned within 30 days (or as indicated) from date of publication hereof.
Province: FREE STATE
Estate Number: 10014/2021
Surname: VAN DEN BERG
First Names: ROELOF JOHANNES VAN DEN BERG
Date of Birth: 1951-01-31
ID Number: 5101315044082
Last Address: 16 VAN RIEBEECK STREET, HENNENMAN, 9445
Date of Death: 2021-08-28
Master's Office: BLOEMFONTEIN
First Names of Surviving Spouse: PETRONELLA JOHANNA
Surname of Surviving Spouse: VAN DEN BERG
Date of Birth of Surviving Spouse: 1949-08-19
ID Number of Surviving Spouse: 4908190027086
Name of Executor or Authorised Agent: ORPA BADENHORST
Address of Executor or Authorised Agent: 40 STEYN STREET, HENNENMAN, 9445

ADVERTISER NAME: BADENHORST ATTORNEYS
ADVERTISER ADDRESS: 40 STEYN STREET HENNENMAN 9445
ADVERTISER E-MAIL: badenhorst@badenhorstprok.co.za
ADVERTISER TELEPHONE: 057-5731114
(REF: BADENHORST/cn/777)

PIET HAASBROEK PROKUREURS

Estate late: S S Dikole
Estate Number: 4314/2022

NOTICE

In the estate of the late SELLO SAMUEL DIKOLE (ID: 621107 5339 08 2) in life from Welkom and who was a married in community of property to MAMPHO JOSEPHINE DIKOLE (BORN HADEBE) (ID: 620706 0510 08 3).
DATE OF DEATH: 9 FEBRUARY 2022
ESTATE NUMBER: 4314/2022
NOTICE IS HEREBY GIVEN to Debtors and Creditors to pay amounts due to the estate and to institute claims against the estate with the undersigned within 30 (THIRTY) days from the date of publication hereof.

ATTORNEY FOR EXECUTOR
PIET HAASBROEK ATTORNEYS
LAW CENTRE, FIRST FLOOR
SUITE 105
4 HEEREN STREET
WELKOM
9459
P.O. BOX 876
VIRGINIA
9430
DOCEX 25, WELKOM
TEL: 057-3522783
E-MAIL: estates@piethaas.co.za
(REF: JC/AK/BD0027)

BOEDELS: LIKWIDASIE EN DISTRIBUSIE
4205

J.H. Reyneke
LIKWIDASIE- EN DISTRIBUSIEREKENING IN BESTROWE BOEDELS WAT TER INSAE LÊ

Boedel wyle JOHANNA HENDRIKA REYNEKE, ID-nr. 600731 0118 08 7, datum van afsterwe 27/05/2020 van Nasina Tehuis, Swartstraat 21, Ventersburg 9450. Boedelnr. 003135/2020.
Die gewysigde eerste en finale likwidasie- en distribusierekening in bogenoemde boedel ter insae sal lê ten kantore van die Meester te Vrystaats en die Landdros te Ventersburg vir 'n tydperk van 21 dae gereken vanaf 27 Mei 2022.
PRICEWATERHOUSECOOPERS, Hesna Aletta Rheeder, Genomineerde, Tweedelaan 61, Westdene, Bloemfontein 9301. Tel. 051 503 4100.

Du Randt & Louw
Ingelyf/Incorporated
(Reg No 1997/11218/21)

A. JANSEN VAN RENSBURG

IN DIE BOEDEL VAN WYLE ANNETTE JANSEN VAN RENSBURG, Identiteitsnommer 550419 0022 08 3, woonagtig te , VLEISTRAAT 6, DISTRIK HENNENMAN, Provinsie Vrystaat Boedelnommer: 6012/2021
Kennis geskied hiermee dat die Eerste en Finale Likwidasie en Distribusierekening in bogemelde boedel ter insae sal lê vir 'n periode van een en twintig dae, gereken vanaf 27 Mei 2022 ten kantore van die Meester van die Hooggeregshof te BLOEMFONTEIN en die Landdros te KROONSTAD.

G L HARTMAN(CHJ020)
Prokureur vir die Eksekuteur
Du Randt & Louw Ingelyf
Posbus 26 KROONSTAD
Tel 056 - 2124275

Geklas - sifiseerd

BOEDELS: LIKWIDASIE EN DISTRIBUSIE
4205

NEUMANN VAN ROOYEN

Boedel Wyle: J Carstens
Boedelnommer: 5680/2020

LIKWIDASIE- EN DISTRIBUSIEREKENING IN BESTORWE BOEDELS WAT TER INSAE LÊ

In die boedel van wyle:
Van: CARSTENS
Voorname: JOHANNES
Boedelnommer: 5680/2020
Identiteits-/paspoortnommer: 4311275135082
Datum van Afsterwe: 1/07/2020
Laaste adres: ERASMUSSTRAAT 1, ODENDAALSRUS, 9480
Die EERSTE EN FINALE Likwidasie- en Distribusierekening in bogenoemde boedel ter insae sal lê ten kantore van die Meester te en die Landros te ODENDAALSRUS vir 'n tydperk van 21 dae gereken vanaf 27 MEI 2022.
Name en adres van Eksekuteur/rise of Gemagtigde Agent:
André Styger, p/a Neumann van Rooyen, Law Centre, Heerenstraat 6, Welkom, 9459.

ADVERTEERDER:
NAAM: NEUMANN VAN ROOYEN
ADRES: POSBUS 4
WELKOM
9460
EPOS: admin2@nvrlaw.co.za
TELEFOON: 057 9166666
VERWYSING: A Styger/jf/BL2254

NEUMANN VAN ROOYEN

Boedel Wyle: M C Ackerman
Boedelnommer: 2274/2020

LIKWIDASIE- EN DISTRIBUSIEREKENING IN BESTORWE BOEDELS WAT TER INSAE LÊ

In die boedel van wyle:
Van: ACKERMAN
Voorname: MARTHINUS CHRISTOFFEL
Boedelnommer: 2274/2020
Identiteits-/paspoortnommer: 7709165119081
Datum van Afsterwe: 6/12/2019
Laaste adres: JAN HOFMEYRWEG 132, DOORN, WELKOM
Die EERSTE EN FINALE Likwidasie- en Distribusierekening in bogenoemde boedel ter insae sal lê ten kantore van die Meester te en die Landros te vir 'n tydperk van 21 dae gereken vanaf 27 MEI 2022.
Voorname en van van nagelate gade: TRACEY ACKERMAN
Identiteits-/paspoortnommer: 8611010026082
Name en adres van Eksekuteur/rise of Gemagtigde Agent:
André Styger, Neumann van Rooyen, Law Centre, Heerenstraat 6, Welkom.

ADVERTEERDER:
NAAM: NEUMANN VAN ROOYEN
ADRES: POSBUS 4
WELKOM
9460
EPOS: admin2@nvrlaw.co.za
TELEFOON: 057 9166666
VERWYSING: A Styger/JF/BL2216

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Gold One Africa Limited (Gold One Africa) holds an Exploration Right over various farm portions between the towns of Hennenman and Ventersburg in the Free State and proposes to pursue an application to conduct **bulk gas sampling. This does not involve hydraulic fracturing (fracking)**. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable natural gas.

Gold One Africa has applied in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, No. 28 of 2002 (MPRDA), to undertake bulk sampling of natural gas identified during historic gold prospecting activities. The sampling site is located on Portion 1 of the Farm Vogels Rand 720, within the Lejweleputswa District Municipality and Matjhabeng Local Municipality, Free State Province.
Gold One Africa is applying for Environmental Authorisation for activities listed in terms of the National Environmental Management Act (NEMA), No. 107 of 1998 Environmental Impact Assessment Regulations (GNR982 of 2014). The following listed activities are triggered: GNR 984 Activities 5 and 18.

A Water Use Licence may be required in terms of Section 21 of the National Water Act, No. 36 of 1998. A pre-application enquiry has been submitted to the Department of Water and Sanitation.
Prime Resources (Pty) Ltd has been appointed as the Environmental Assessment Practitioner in terms of S12 of the NEMA to facilitate the above process.

The draft Scoping Report will be made available for review for a period of 30 days, from **26 May to 26 June 2022**. The reports will be available for review at the following locations:
- Phomolong Public Library, Phomolong, Hennenman
- Hennenman Public Library, Hennenman

The report can also be downloaded at www.resources.co.za and can be provided via email upon request. Please forward queries and comments to Prime Resources by **26 June 2022**. Contact details: (SMS or WhatsApp) 076 403 3386 (T) 011 447 4888 (E) prime@resources.co.za. Please use subject line **"VB Gas"**.

X1X8TQLR-VI260522

Botha
PROKUREURS-ATTORNEYS-BABUELLI
Notaries / Notarisse
Conveyancers / Aktebesorgers
Administrators of Estates / Boedelberedderaars
Draftsmen of Wills / Opsteller van Testamente

X321RC0-KN240117

Estate Late: M L Mahlatsi
Estate Number: 9114/2021

ESTATE NOTICE

In the estate of the late:
MAMPAI LYDIA MAHLATSI
Born on: 09-07-1960
Identity Number: 600709 0651 08 3
Occupation: PENSIONER
Date of death: 10-05-2021
Marital status: MARRIED IN COMMUNITY OF PROPERTY TO MOJALEFA ROBERT JOHANNES MAHLATSI, IDENTITY NUMBER 591025 5694 08 0
Address: 626 BLOCK 7 KUTLWANONG, ODENDAALSRUS
Estate Number: 9114/2021
NOTICE IS HEREBY GIVEN that the FIRST & FINAL LIQUIDATION AND DISTRIBUTION ACCOUNT in the above estate will lay for inspection in the offices of the Master of the High Court BLOEMFONTEIN and the Magistrate's office ODENDAALSRUS for a period of TWENTY ONE (21) days from the date of publication hereof for all parties which may have an interest therein.
IF no objections are received by the Master of the High Court within the mentioned period, the EXECUTOR(S) will proceed with payment in terms of the account.

F J SCHOEMAN
EXECUTOR
BOTHA ATTORNEYS
P.O. BOX 250
KROONSTAD
9500
TEL. NR: 056 2122131
(REFERENCE: F J SCHOEMAN)

NEUMANN VAN ROOYEN

Estate Late: S V Ramalitse
Estate Number: 3618/2020

LIQUIDATION AND DISTRIBUTION ACCOUNTS IN DECEASED ESTATES LYING FOR INSPECTION

In the Estate of the Late:
Surname: RAMALITSE
First names: SELLO VINCENT
Estate number: 3618/2020
Identity/Passport number: 6903045925087
Date of death: 10/06/2020
Last address: 12 ALBERT MULER STREET, JOELPARK, VIRGINIA
The FIRST AND FINAL Liquidation and Distribution Account in this estate will be open for inspection for a period of 21 DAYS from 27 MAY 2022 at the office of the Master of the High Court Bloemfontein and the Magistrate's Office, Virginia.
Name and Address of Executor or Authorised Agent: André Styger, Neumann van Rooyen Inc. First Floor, Galaxy House, 2 Heeren Street, Welkom, 9460

ADVERTISER NAME: NEUMANN VAN ROOYEN
ADVERTISER ADDRESS: P.O. BOX 4
WELKOM
9460
ADVERTISER E-MAIL: admin3@nvrlaw.co.za
ADVERTISER TELEPHONE: 0579166666
REFERENCE: A Styger / Lodene
NOTE: BL1980

EKSEKUSIE VERKOPING
4500

GEREGTELIKE VEILING
4501

F.B. COETZER PROKUREURS
FRANCOIS BERTRAM COETZER
FRANCOIS COETZER

THEUNISSEN ABATTOIR / JACO KEMP
SAAKNOMMER: 50/2021

KENNISGEWING VAN GEREGTELIKE VERKOPING VAN ONROERENDE EIENDOM

In die Landdroshof vir die distrik van LEJWELEPUTSWA, gehou te THEUNISSEN, Saaknr: 50/2021 in die saak tussen:

THEUNISSEN ABATTOIR
Eiser
en
JACO KEMP
Verweerder

TEN UITVOERLEGGING van 'n vonnis van die Landdros, THEUNISSEN gedateer 20 APRIL 2021 sal ondervermelde goedere om 08:00 op 17 JUNIE 2022 per publieke veiling te LANDDROSKANTOOR, H/V ANDRIES PRETORIUS EN LE ROUXSTRATE, THEUNISSEN deur die BALJU vir die Landdroshof van aan die hoogste bieër vir kontant verkoop word.

EIENDOM:
ERF 788 THEUNISSEN, DISTRIK THEUNISSEN, PROVINSIE VRYSTAAT OOK BEKEND AS BREESTRAAT 3, THEUNISSEN, PROVINSIE VRYSTAAT (GESONEER VIR WOONDOELEINDES).
GROOT: 3 214 (DRIEDUISEND TWEEHINDERD EN VEERTIEN) VIERKANTE METER.
EIENDOM GEHOU KRAGTENS TRANSPORTAKTE T14416/2008.
WOONHUIS BESTAANDE UIT:
3 X SLAAPKAMERS / 2 X BADKAMERS / 3 X APARTE TOILETTE / INGANGSPORTAAL / 1 WOONKAMER / 1 EETKAMER / 1 X KOMBUIS / 4 X MOTORHUISE / WERKERSKWARTIERE / WERKERSBADKAMER / 1 X STOOR / 1 X TUINHUIS - 1 X BADKAMER / 1 X SLAAPKAMER / 1 X WOONKAMER / 1 X KOMBUIS / SWEMBAD / EIENDOM BEHOORLIK OMHEIN.

1. Die verkoopsvoorwaardes sal beskikbaar wees by die Balju se kantoor, 24 uur voor die vasgestelde tyd.
2. Registrasie as 'n koper is 'n vereiste in terme van die volgende: Die Wet op Verbruikersbeskerming 68 van 2009; Die Wet op Finansiële Intelligensiesentrum 38 van 2001.
3. Goedere word net vir kontant verkoop aan die hoogste bieër of verkoop onderhewig aan bevestiging volgens die Wet op Verbruikersbeskerming in opdrag van die vonnisskuldeiser of sy/haar prokureur.
4. Goedere wat te koop aangebied word is soos volg: [Beskrywing van bates]

GETEKEN te THEUNISSEN op die 26STE dag van April 2022.

(GET) FRANCOIS COETZER
PROKUREUR VIR EISER
F.B. COETZER PROKUREURS
VAN HEERDENSTRAAT 45
THEUNISSEN
9410
TEL: 057-7330091
FAKS: 086-604-3475
E-POS: admin@fbcoetzer.co.za
Docex:
(VERW: FRANCOIS COETZER
Lêernr: THA003)

JENN MAREMATLOU
A Division of Marematlou Group Holdings

STUDY OPPORTUNITY

MAREMATLOU GROUP HOLDINGS, through its subsidiary – **Marematlou Training Institute**, is offering a learnership (study) opportunity to assist financially strained candidates in applying for the following academic qualification:

- Further Education and Training Certificate: Information Technology: Technical Support (NQF Level 4).
  SAQA Qualification ID: 78964

Requirements
To be considered you must meet the following criteria:
- South African Citizen between the ages of 18-35.
- Should have at least passed Grade 12.

Computer Literacy will be an added advantage.

Marematlou reserves the right to select the possible candidates based on locality (Welkom and surrounding areas), academic performance, household income and/or any other previous acceptance to Higher Education Institutions.

Should you meet this criterion, kindly send your Motivational letter, CV, Certified copies of your qualifications and ID to: marematlou.gh@mare-gh.co.za

Closing Date: 31 May 2022.

For any enquiries contact Ms Shireen Persens via email: s.persens@mare-gh.co.za or Mr Olebogeng Shuping via email: o.shuping@mare-gh.co.za.

Kindly note that Marematlou Group Holdings will only correspond with the shortlisted candidates. And should you not hear from its subsidiary within 21 working days of the closing date, please deem your application unsuccessful.

MICTSETA
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Bloemfontein Office: 20/21 Floris Coetzee • Rayton • Bloemfontein • 9300 • PO Box 4305 • South Africa
Tel: +27 51 430 1924 or +27 51 447 1094 • Fax: +27 86 663 2880
Eastern Cape Office: Suite 1, 7 Frere Rd, Vincent, East London, 5201
Tel: +27 43 721 2778
Email: marematlou.gh@mare-gh.co.za
Web: www.mare-gh.co.za

X1X8TQPW-VI260522

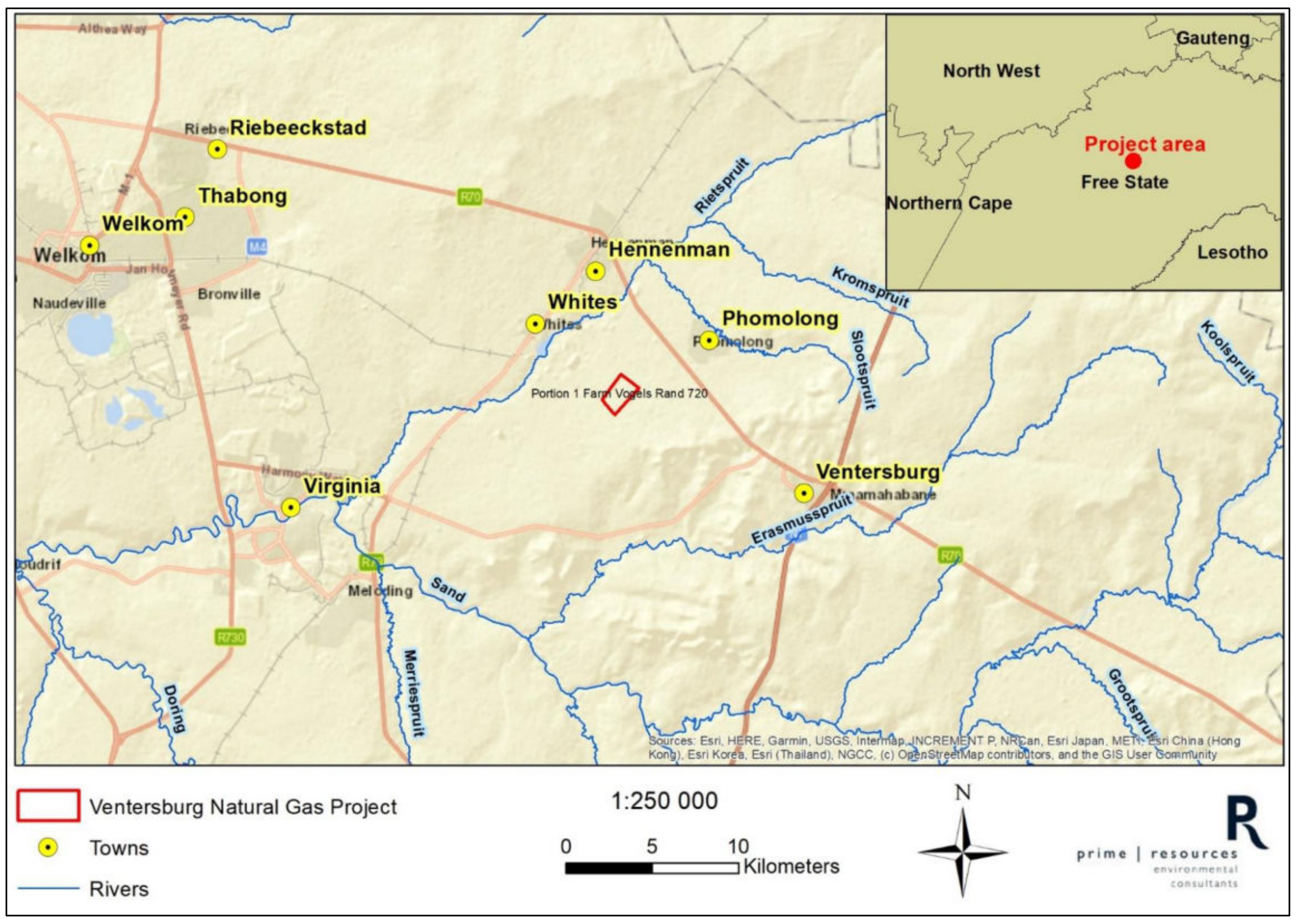
APPENDIX 3.3

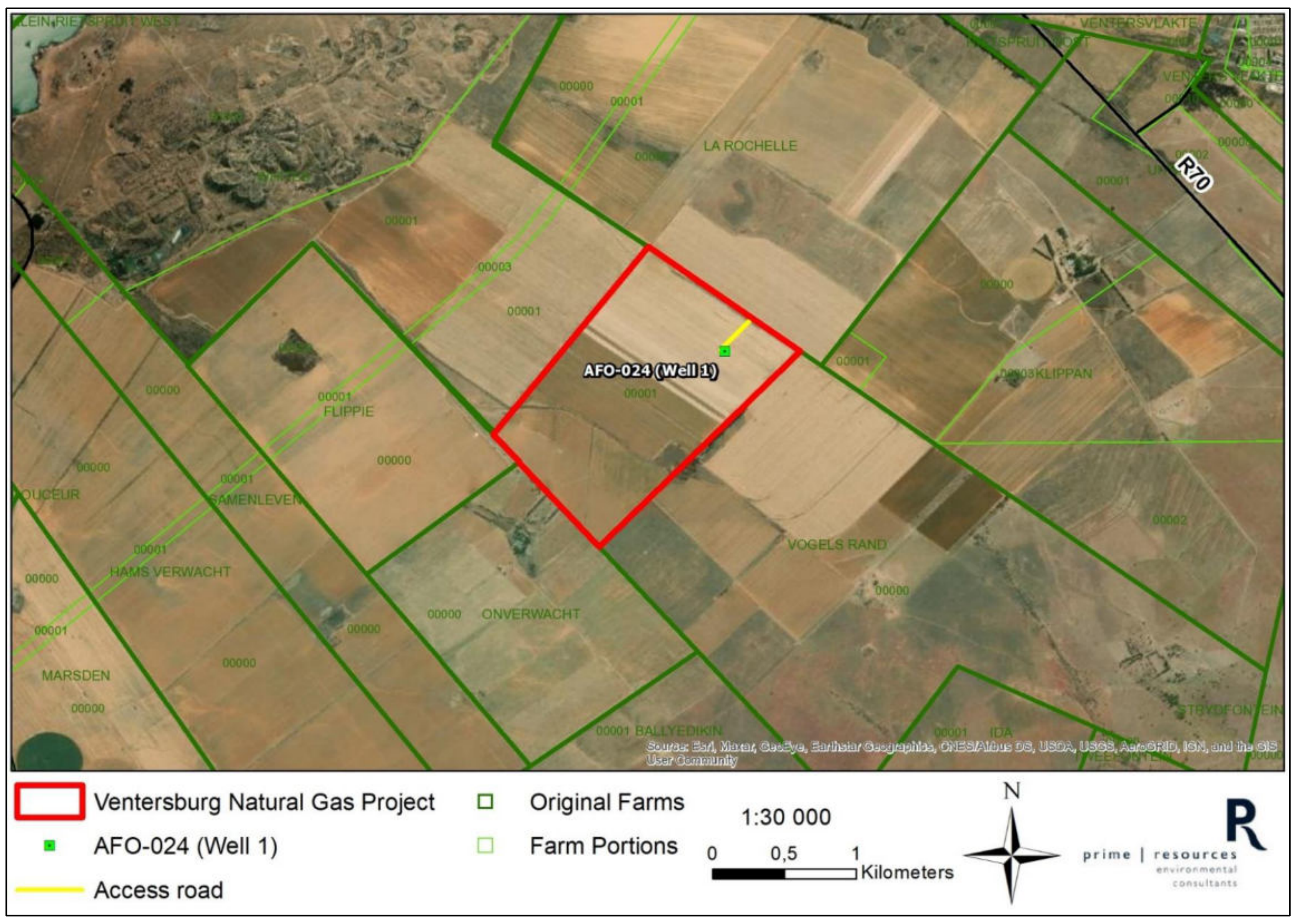
Site Notices

NOTICE OF PUBLIC PARTICIPATION PROCESS:
FOR THE VENTERSBURG NATURAL GAS BULK SAMPLING PROJECT PROPOSED BY GOLD ONE AFRICA LIMITED

Notice is hereby given in terms of Chapter 6 of the Environmental Impact Assessment (EIA) Regulations, 2014, as amended, that an application for a Full Scoping and Environmental Impact Assessment (S&EIA) Process will be lodged with the Department of Mineral Resources and Energy (DMRE), as per the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998, as amended).

Gold One Africa Limited (Gold One Africa) holds an Exploration Right over various farm portions between the towns of Hennenman and Ventersburg in the Free State and is applying to conduct **bulk sampling of natural gas** on Portion 1 of the Farm Vogels Rand 720. **This does not involve hydraulic fracturing (fracking).** The application area is situated 4.6 km southwest of Phomolong, 6.5 km south of Hennenman and 11.2 km northwest of Ventersburg. The objective of the bulk sampling is to determine whether it is economically viable to extract natural gas.





PROJECT DESCRIPTION

The proposed bulk sampling will take place at an existing borehole (AFO-024) which was drilled during previous prospecting activities. Bulk sampling of natural gas will be conducted over a 2-year period. Gas sampling will be done by means of using a blower / portable compression unit. The extent of the proposed sampling will require a 70 m x 50 m test rig surface area which will be securely fenced off. Access to the test site will be gained via the existing farm road and an additional gravel road of approximately 300 m. Other than the establishment of a fence, no construction activities will be required for the proposed bulk gas sampling project. Upon completion of the bulk sampling, the test rig area and the dirt road will be rehabilitated to its pre-exploration state.

LEGISLATIVE PROCESS

Gold One Africa has applied in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, No. 28 of 2002 (MPRDA), to undertake bulk sampling of natural gas. In order to proceed with bulk sampling, Gold One Africa is applying for an Environmental Authorisation for activities listed in terms of the National Environmental Management Act, No. 107 of 1998 (NEMA) Environmental Impact Assessment (EIA) Regulations (GNR982 of 2014).

An Environmental Authorisation in terms of the NEMA is required for activities 5 and 18 as listed in Listing Notice GNR984 of 2014, as amended. The listed activities require that a full Scoping and EIA process be undertaken.

A Water Use License may be required in terms of Section 21 of the National Water Act, No. 36 of 1998. A pre-application enquiry has been submitted to the Department of Water and Sanitation.

REGISTER AS AN INTERESTED AND AFFECTED PARTY (IAP)

To register as an IAP, make comments, or request additional information, use subject line "VB Gas" and provide your contact information via SMS / WhatsApp (076 403 3386), email (prime@resources.co.za) or call (011 447 4888).

OPPORTUNITY TO PARTICIPATE

A Scoping Report has been prepared for review and comment. The Scoping Report can be downloaded from www.resources.co.za and is available for review and comment from **26 May 2022 to 26 June 2022**. The Scoping Report can be provided by email upon request and is available for review at the Phomolong and Hennenman Public Libraries.

Please forward comments to Prime Resources by 26 June 2022.

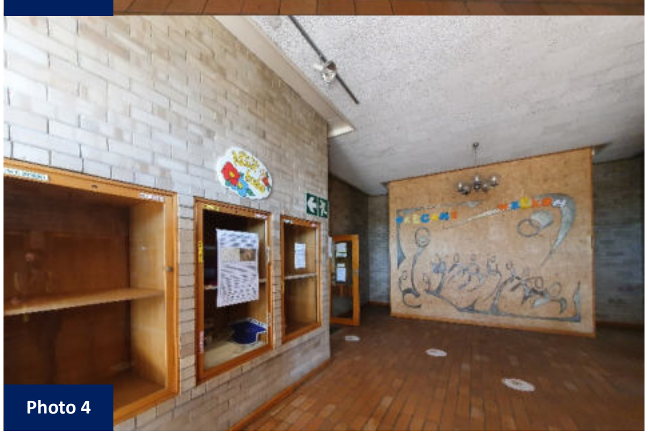
Prime Resources (Pty) Ltd has been appointed as the Environmental Assessment Practitioner to facilitate all aforementioned processes.

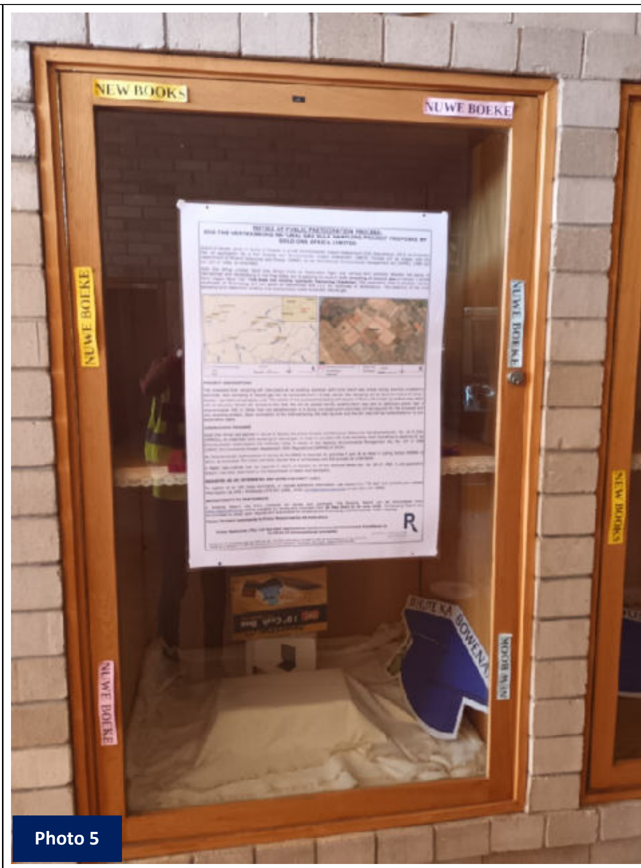
prime | resources environmental consultants

Disclaimer: In accordance with the POPI Act, No. 4 of 2013, information provided by IAPs will be processed by Prime Resources insofar as is necessary to fulfill the abovementioned legal obligations. For further information, please contact the EAP.

PHOTOGRAPHS OF SITE NOTICES AT VARIOUS LOCATIONS (26-05-2022)

Photos 1 and 2: Site notice placed at the entrance of the Farm Onverwacht which leads to Portion 1 of the Farm Vogels Rand.





Photos 3, 4 and 5: Site notice placed at the entrance of the Hennenman Public Library.

PHOTOGRAPHS OF SITE NOTICES AT VARIOUS LOCATIONS (26-05-2022)


Photo 6

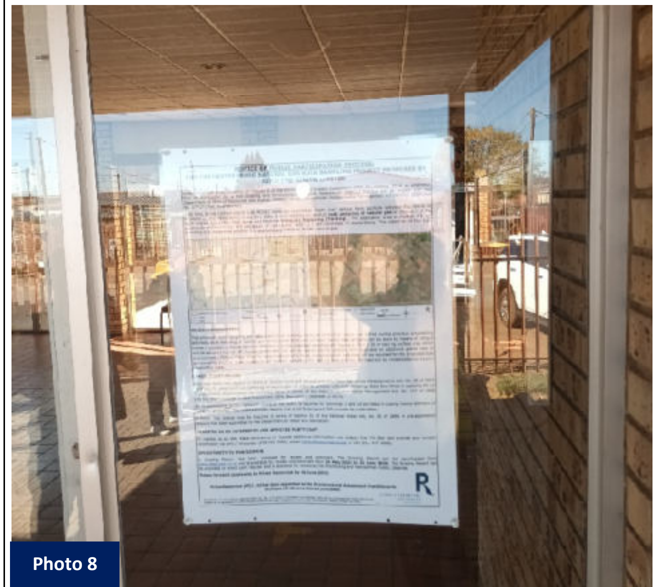


Photo 8


Photo 7

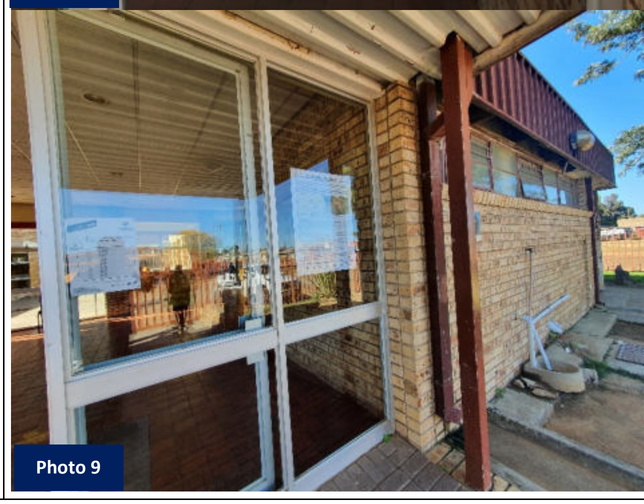


Photo 9

Photos 6, 7, 8 and 9: Site notice placed at the entrance of the Phomolong Public Library.


Photo 10

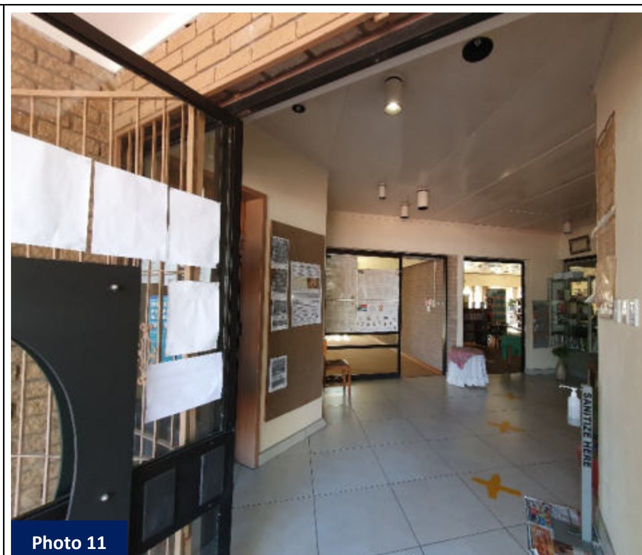


Photo 11

Photos 10 and 11: Site notice placed at the entrance of the Ventersburg Public Library.

APPENDIX 3.4

Interested and affected parties (IAPs) register

		Name	Department / Community / Property	Designation	Telephone	Email
Authorities	Mr	Dewald Kirsten	Lejweleputswa District Municipality	Manager of Environmental Health	0573533094/5/8/9/ 0837747979	dewald@lejwe.co.za
	Mr	Charel Schlebusch	Matjhabeng Local Municipality	Ward Councillor Ward 3	0825534451	cjs@gcs.co.za
	Mr	Sello Tshabangu		Ward Councillor Ward 2	0823453889	tshabangusello7@gmail.com
	Ms	Lebogang Kobue		Acting Director for Local Economic Development	0579164077	Lebogang.Kobue@matjhabeng.co.za
	Ms	Malehbo Leballo		LED Department	0579164137	lydia.leballo@matjhabeng.co.za
	Mr	Fanie Nieuwoudt		LED Department	0579164187	Fanie.Nieuwoudt@matjhabeng.co.za
	Mr	Ndlelenhle Zindela	Department of Mineral Resources	Regional Manager	057391 1300	Ndlelenhle.Zindela@dmr.gov.za
		Nozipho Dlamini	Free State Department of Rural Development and Land Reform	Free State land claim enquiries	-	Nozipho.Dlamini@dalrrd.gov.za
		Khomotso Mahlatji		Free State land claim enquiries	-	Khomotso.Mahlatji@dalrrd.gov.za
	Mr	Mbulelo Kelly		-		mbulelo.kelly@dalrrd.gov.za
	Ms	Wongiwe Mngwambe	Free State Department of Agriculture and Rural Development	Vice Principal	720831672	wmngwambe@fs.agric.za
		Boitumelo Melato	Department of Water and Sanitation	Free State Provincial Office		melatoB@dws.gov.za
	Mr	Aron Fhatuwani Magonono		Environmental Officer (Water Use Authorisation)	051 405 9246 / 072 663 9669	magononof@dws.gov.za
	Mr	Patle Mohajane	National Nuclear Regulator	Manager: Naturally Occurring Radioactive Material (NORM)	0126747130	pemohajane@nnr.co.za
	Mr	Sipho Thomas	Free State Dep of Cooperative Governance and Traditional Affairs	Deputy Director-General: Cooperative Governance and Traditional Affairs	-	sipho@fscogta.gov.za
	Ms	Malintja Molahloe	Free State Provincial Heritage Resources Agency	ATTN: Mr. C.K Lebona (Chairperson) Dr. C. Twala (Chairperson)		malintjam@sacr.fs.gov.za
	Mr	Tankiso Zola	Free State Provincial Heritage Resources Agency	Head of Communications	051 410 4735	tankiso@sacr.fs.gov.za
	Ms	Phumla Ngesi	Petroleum Agency SA (PASA)			NgesiP@petroleumagencysa.com
	Ms	Sharon Adams	Petroleum Agency SA (PASA)			SharonA@petroleumagencysa.com
	Ms	Michelle Mtshemla	Petroleum Agency SA (PASA)			MtshemlaM@petroleumagencysa.com
	Ms	Natasha Thomas	Petroleum Agency SA (PASA)			ThomasN@petroleumagencysa.com
	Ms	Lizell Stroh	South African Civil Aviation Authority (SACAA)	Obstacle Inspector	+27 11 545 1232 +27 83 461 6660	Strohl@caa.co.za
	Ms	Itumeleng Mogashoa		Senior Legal Advisor: Legal and Aviation Compliance	076 943 2494	MogashoaI@caa.co.za

		Name	Department / Community / Property	Designation	Telephone	Email
NGOs, Associations and Businesses	Mr	Alexis Moshodi	Phomolong	Owner at Motswedi wa Boitumelo- Professional Training & Coaching	0832765023	alexismoshodi@icloud.com
	Ms	Cynthia Troost	Agri Free State	Admin Officer	(051) 444 4609	cynthia@vslandbou.co.za
	Mr	Bradley Gibbons	Endangered Wildlife Trust	Senior Field Officer, Threatened Grassland Species Programme Endangered Wildlife Trust	0825665803	bradleyg@ewt.org.za
		Adrian Nel				adriannel1@yahoo.com
		Rabrand Mocola				mossmosebi@gmail.com
		Lizelle Brits				lizelle@vitalhygiene.co.za
		Maipato Kapotsa				mikatekocreations@gmail.com
		Natasha Duvenage				natashafullimput@gmail.com
		Tladi Pamoshe				mossworks@gmail.com
		Marlaine Anderson			+27 33 343 11 30	marlaineA@l2b.co.za
	Mr	Flippie Coetzer	Hennenman Farmers Association	Chairperson	0828097203	
Land-owner	Ms	Anna Margaretha Theron	Ptn 1 of the Farm Vogels Rand 720	Landowner	0724501344 (Mr Theron)	cwtheron@zipplink.co.za
Farm tenant	Mr	Flippie Coetzer	Ptn 1 of the Farm Vogels Rand 720	Farm tenant	0828097203	pjcoetzer@zipplink.co.za
Adjacent Landowners	Mr	WinDeed - CHENMAR CC	RE Vogels Rand 720	Landowner / Close corporation	0834494535 (Mr Vogel)	vogelsrand@gmail.com
	Mr	Vogel Trust	RE La Rochelle 760	Landowner / Trust	0834494535 (Mr Vogel)	vogelsrand@gmail.com
	Mr	TP&M Boerdery Pty Ltd	Ptn 1 Whites 747	Landowner / Company	0724501344 (Mr Theron)	cwtheron@zipplink.co.za
		BIZ AFRIKA 1495 PTY LTD	RE Farm Flippie 738	Company	0828097203	pjcoetzer@zipplink.co.za
		BIZ AFRIKA 1495 PTY LTD	Farm Onverwacht 342	Landowner / Company	0828097203	pjcoetzer@zipplink.co.za
Members of the Public						

APPENDIX 3.5

Background Information Document (BID)

Prime Resources (Pty) Ltd
The Workshop 70–7th Avenue Parktown North 2193
PO Box 2316 Parklands 2121
T +27 11 447 4888 **F** +27 86 604 2219 **E** prime@resources.co.za
www.resources.co.za

prime | resources
environmental
consultants

SCOPING PHASE INFORMATION BOOKLET

Ventersburg Natural Gas Bulk Sampling Project

Gold One Africa Limited

APPLICATION FOR ENVIRONMENTAL AUTHORISATION TO CONDUCT BULK SAMPLING IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (NEMA, NO. 107 OF 1998)

GOLD ONE
AFRICA LIMITED

This document summarises the currently available information. Registered Interested and Affected Parties (IAPs) will be notified of the availability of the EIA Phase Information Booklet.

The Scoping Report is currently available for public review and comment and **can be requested via email (prime@resources.co.za) or can be downloaded from the Prime Resources website (www.resources.co.za)**.

You are invited to review the Scoping Report and/or this Information Booklet.

Please submit comments by 26 June 2022.

All comments submitted will be included into the final documentation to be sent to the Petroleum Agency of South Africa (PASA) for consideration, and to make a recommendation to the Minister of Mineral Resources for the decision-making process.

In accordance with the POPI Act, No. 4 of 2013, information provided by IAPs will be processed by Prime Resources insofar as is necessary to fulfill the abovementioned legal obligations. For further information, please contact the EAP.

Background

Gold One Africa Limited (Gold One Africa) has applied in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, 2002 (MPRDA, Act No. 28 of 2002) to undertake bulk sampling of natural gas near Hennenman and Ventersburg, in the Free State Province. Gold One Africa is the holder of an Exploration Right (12/3/214 ER) which covers various farms situated in the Magisterial Districts of Hennenman, Virginia and Ventersburg in the Free State.

In order to proceed with bulk sampling, Gold One Africa is applying for an Environmental Authorisation for activities listed in terms of the National Environmental Management Act, No. 107 of 1998 (NEMA) Environmental Impact Assessment (EIA) Regulations (GNR982 of 2014). All components of bulk sampling are within the boundaries of an existing mining right held by Gold One Africa.

The application area is situated 4.6 km southwest of Phomolong, 6.5 km south of Hennenman and 11.2 km northwest of Ventersburg (refer to map on last page). The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable natural gas. If viable, this energy source can be utilized to generate electricity for Gold One Africa's approved mining activities.

The proposed Ventersburg Natural Gas Bulk Sampling Project will take place at an existing borehole (AFO-024), which was drilled during previous prospecting activities. Bulk sampling of natural gas will be conducted over a 2-year period by means of using a blower / portable compression unit. No fracking will be involved.

It is proposed that a high-efficiency flare equipped with a flow meter will be installed at the existing well. The flare will combust methane flowing from the well for approximately 2 weeks. Thereafter, a sample will be collected from venting holes via low-pressure pipes from the venting well leading to a portable compressor. Gas samples will be compressed into individual high-pressure cylinders for storage and transported to the Nuclear Energy Corporation of South Africa (NECSA) for analyses.

The extent of the proposed sampling will require a 70 m x 50 m test rig surface area which will be securely fenced off. Access to the test site will be gained via the existing farm road and a new dirt road of approximately 300 m. Other than the establishment of the fence, no construction activities will be required for the proposed bulk gas sampling project. Equipment such as the generators and compression unit will be placed upon pre-cast concrete plinths. Upon completion of the bulk sampling, equipment and plinths will be removed, and the test rig area and the dirt road will be rehabilitated to its pre-exploration state.

Locality

The proposed bulk sampling is situated on Portion 1 of the Farm Vogels Rand 720, within the Lejweleputswa District Municipality and Matjhabeng Local Municipality.

The general surrounding area is highly developed and land uses almost exclusively comprise of agricultural fields.

Please refer to the map on the final page.

Regulatory requirements

South Africa's main environmental law is the National Environmental Management Act, No. 107 of 1998 (NEMA). NEMA contains Regulations, which include lists of activities (listed activities), which have been identified as activities that are potentially harmful to the environment. Before undertaking any of these activities, a company is required to apply for Environmental Authorisation (EA) for these activities. Depending on the nature of these activities, a *Basic Assessment* (BA) or *Scoping and Environmental Impact Assessment* (EIA) process will be required to support the application for EA.

Environmental Authorisation (EA)

An EA in terms of NEMA is required for the following activities as listed in terms of the NEMA EIA Regulations (GNR982 of 2014) and listing notices GNR983, GNR984 and GNR985 of 2014, as amended.

- Listing Notice 2 (GNR 984 of 2014, as amended), Activity 5

The development and related operation of facilities or infrastructure for the processing of a petroleum resource, including the beneficiation or refining of gas, oil or petroleum products with an installed capacity of 50 cubic metres or more per day….

- Listing Notice 2 (GNR 984 of 2014, as amended), Activity 18

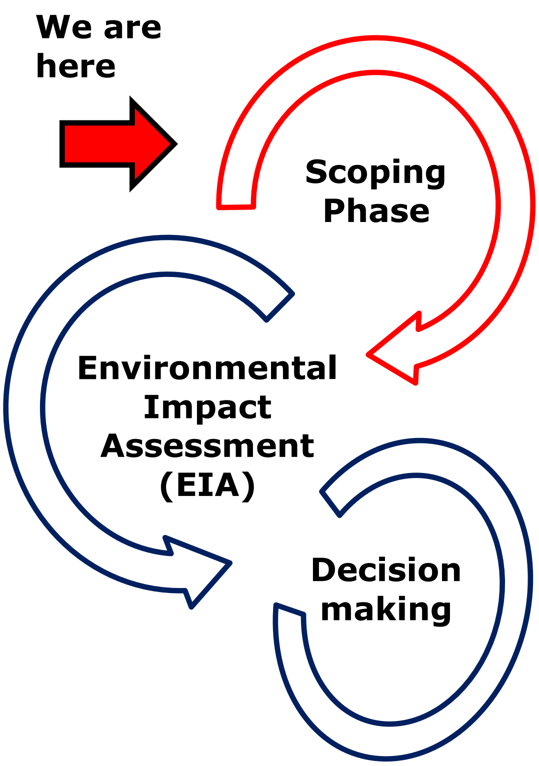
Any activity including the operation of that activity which requires an exploration right in terms of section 79 of the MPRDA, as well as any other applicable activity … required to exercise the exploration right….

The listed activities triggered require that a full Scoping and Environmental Impact Assessment (EIA) process be followed. The two phases, Scoping and EIA, each have a 30-day public participation period, allowing review of documents and raising of comments / questions / concerns – which need to be included in the final documentation submitted to the authorities.

Water Use License

A Water Use License in terms of the National Water Act, No. 36 of 1998 may be required for the proposed project. A pre-application enquiry has been submitted to the Department of Water and Sanitation (DWS).

Scoping and Environmental Impact Assessment (EIA) process



- Public consultation period 26 May to 26 June 2022
- Public notified via site notices, media notices and information booklets
- Registration of IAPs
- Public submits comments and queries
- All comments and queries included in documents sent to PASA

- Registered IAPs notified of the EIA / EMPr and Closure Plans available for review and comment
- IAPs send comments to Prime Resources
- All comments included in the final report to be sent to PASA

- IAPs notified of the decision by PASA (accept or reject application)
- IAPs informed of Appeals Process

The Petroleum Agency SA (PASA) is the Competent Authority for this project, will decide whether to grant Environmental Authorisation for the activities.

Prime Resources has been appointed as the independent Environmental Assessment Practitioner (EAP) to conduct the regulated environmental processes for the project. Independent specialists have been appointed to undertake studies for the project. Neither Prime Resources nor these specialists have any vested interest in the project proceeding.

Potential impacts on the environment and the community

The key potential issues, which will be investigated further, were identified with the aid of the National Screening Tool. Potential issues include:

- Impacts on agricultural potential
- Impacts on terrestrial biodiversity
- Palaeontological sensitivity
- Civil aviation theme.

Register as an Interested and Affected Party (IAP)

If you would like to register as an IAP, please submit your contact details to Prime Resources via SMS (to 076 403 3386) or email (prime@resources.co.za). Please include the subject line "**VB Gas**" and indicate your interest.

Opportunity to comment

The Scoping Report can be downloaded from www.resources.co.za during the 30-day public commenting period, from 26 May to 26 June 2022. The Scoping Report can be provided via email upon request, and is available for review at the following locations:

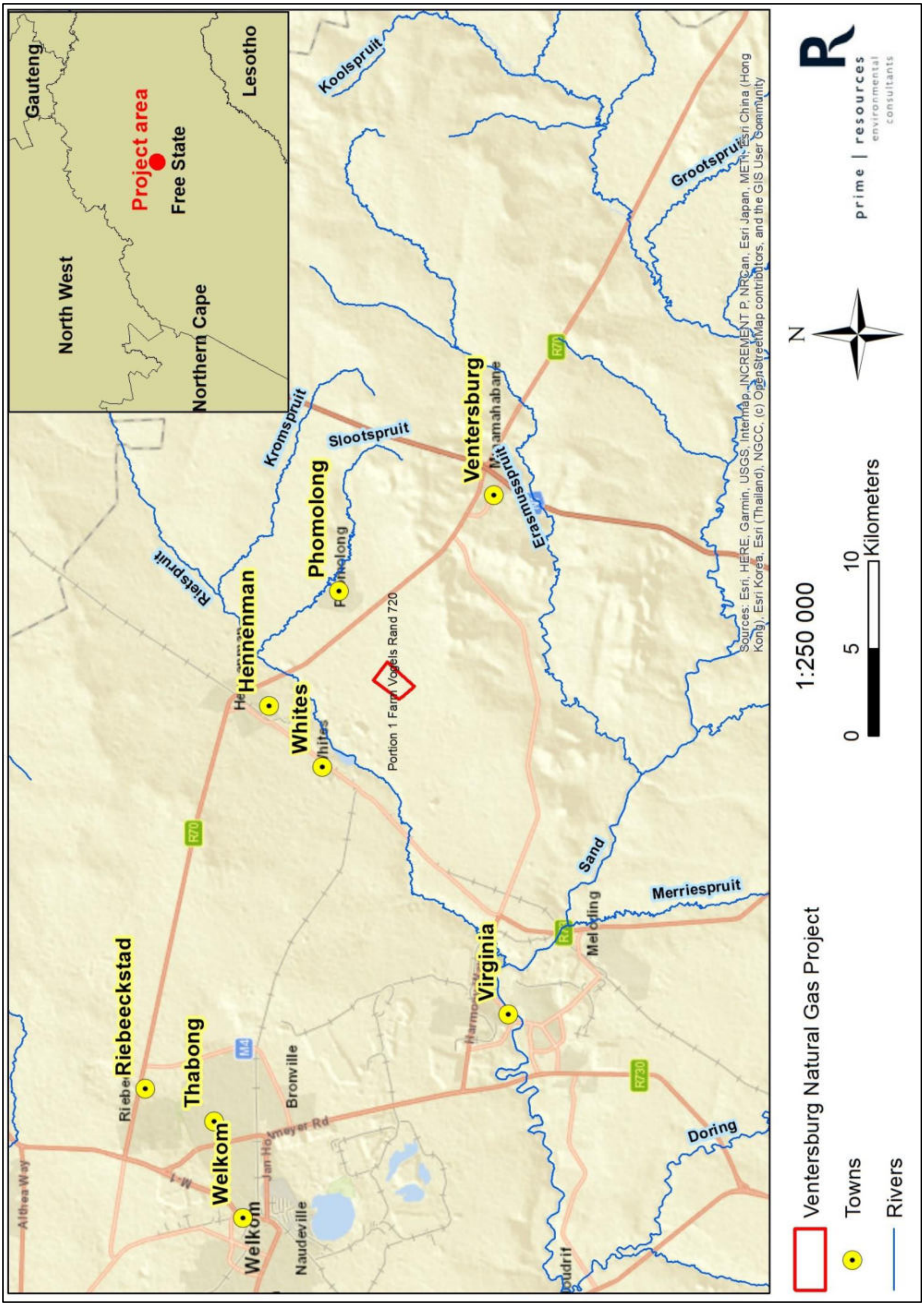
- Phomolong Public Library, Phomolong, Hennenman
- Hennenman Public Library, Hennenman

All comments regarding the proposed project are welcome. In particular we would like to invite comments or suggestions on:

- How the project might affect you and your community
- Information on any environmental or social features that may have been overlooked
- Suggestions to lessen any anticipated environmental or social impacts
- Suggestions as to the standard you feel the site should be rehabilitated to

Please ensure that you submit your comments or concerns to Prime Resources by 26 June 2022.

- Telephone: 011 447 4888
- SMS / WhatsApp: 076 403 3386
- Email: prime@resources.co.za


Ventersburg Natural Gas Project
Towns
Rivers
1:250 000
0
5
10
Kilometers
N
prime | resources
environmental consultants
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Gauteng
North West
Project area
Free State
Northern Cape
Lesotho
Riebeeckstad
Thabong
Welkom
Bronville
Naudeville
Hennenman
Whites
Phomolong
Ventersburg
Virginia
Meloding
Portion 1 Farm Vogels Rand 720
Rietspruit
Kromspruit
Slootspruit
Koolspruit
Grootspruit
Erasmusspruit
Sand
Merriespruit
Doring
R70
R730
M4
M-1
Althea Way
Jan Hofmeyer Rd

Prime Resources (Pty) Ltd
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www.resources.co.za

prime | resources
environmental
consultants

OMVANGBEPALINGSFASE AGTERGRONDINLIGTINGSDOKUMENT

Ventersburg Natuurlike Gas Monsterneming Projek

Gold One Africa Limited

AANSOEK VIR OMGEWINGSMAGTIGING TEN EINDE GROOTMAAT MONSTERONDERNEMING UIT TE VOER IN TERME VAN DIE NASIONALE OMGEWINGSBESTUURWET, 1998 (WET 107 VAN 1998) (NOBW)

Hierdie dokument is saamgestel om die huidige beskikbare inligting op te som. Geregistreerde Belanghebbende en Geaffekteerde Partye (BGPs) sal in kennis gestel word oor die beskikbaarheid van die OIB-fase inligtingsvoubiljet.

Die Omvangsbepalingstudie is tans beskikbaar vir publieke oorsig en kommentaar. Eksemplare van die Omvangsbepalingstudie kan **via e-pos aangevra word (prime@resources.co.za)** en kan ook **afeglaai word vanaf Prime Resources se webwerf (www.resources.co.za)**.

U word uitgenooi om die Omvangsbepalingstudie en/of die Agtergrondinligtingsdokument na te sien en kommentaar te lewer.

Lewer asseblief kommentaar teen 26 Junie 2022.

Alle kommentaar wat ingedien word, sal ingesluit word in die finale dokumentasie wat aan die Petroleumagentskap van Suid-Afrika (PASA) gestuur word vir oorweging en aanbeveling aan die Minister van Minerale Hulpbronne vir die besluitnemingsproses.

In ooreenstemming met die Wet op die Beskerming van Persoonlike Inligting (POPI-wet), No. 4 van 2013, sal inligting verskaf deur BGPs deur Prime Resources verwerk word in soverre dit nodig is om die bogenoemde wetlike verpligtinge na te kom. Vir verdere inligting, kontak asseblief die OAP.

Beskrywing en Agtergrond

Gold One Africa Beperk (Gold One Africa) het ingevolge Artikel 20 van die Wet op die Ontwikkeling van Minerale en Petroleumhulpbronne, 2002 (MPRDA, No. 28 van 2002) aansoek gedoen om grootmaat monsters van aardgas naby Hennenman en Ventersburg te onderneem, in die Vrystaat Provinsie. Gold One Africa is die houer van 'n eksplorasiereg (12/3/214 ER) wat verskeie plase in die landdrosdistrikte Hennenman, Virginia en Ventersburg in die Vrystaat dek.

Om voort te gaan met grootmaat monsterneming, doen Gold One Africa aansoek vir ‘n Omgewingsmagtiging vir aktiwiteite in terme van die Nasionale Omgewingsbestuurswet No. 107 van 1998 (NOBW) Omgewingsimpakbepaling (OIB) Regulasies (GNR 982 van 2014). Alle komponente van die grootmaat monsterneming is binne die grense van die bestaande Gold One Africa mynreg.

Die projek area is ongeveer 4.6 km suidwes van Phomolong, 6.5 km suid van Hennenman en 11.2 km noordwes van Ventersburg (verwys na kaart op laaste bladsy). Die doel van die beoogde grootmaat monsterneming is om te identifiseer of daar enige ekonomiese ontginbare en kommersiële kwantifiseerbare aardgas beskikbaar is. Indien suksesvol, kan hierdie energiebron gebruik word om elektrisiteit op te wek vir Gold One Africa se goedgekeurde mynbou-aktiwiteite.

Die voorgestelde Ventersburg Natuurlike Gas Monsterneming sal plaasvind by 'n bestaande boorgat (AFO-024), wat tydens historiese prospekteeraktiwiteite geboor is. Grootmaat monsterneming van aardgas sal oor 'n tydperk van 2 jaar uitgevoer word deur middel van 'n blaser / draagbare kompressie-eenheid. Geen hidrouliese breking sal betrokke wees nie.

Dit word beoog dat 'n hoë-doeltreffende fakkel toegerus met 'n vloeimeter by die bestaande boorgat geïnstalleer gaan word. Die fakkel gaan metaan wat uit die boorgat vloei vir ongeveer 2 weke verbrand. Daarna sal 'n monster versamel word uit ventilasiegate via laedrukpype vanaf die ventilasieput wat na 'n draagbare kompressor lei. Gasmonsters sal in individuele hoëdruksilinders saamgepers word vir berging en na die Suid-Afrikaanse Kernenergiekorporasie (SAKEK) vervoer word vir analise.

Die omvang van die voorgestelde monsterneming benodig 'n 70 m x 50 m toetstuig-oppervlakte wat veilig omhein gaan wees. Toegang tot die toetsterrein sal verkry word via die bestaande plaaspad en 'n nuwe grondpad van ongeveer 300 m. Behalwe vir die vestiging van die heining, sal geen konstruksie-aktiwiteite vir die voorgestelde grootmaat gasmonsterprojek plaasvind nie. Toerusting soos die kragopwekkers en die kompressie-eenheid sal op voorafgegote beton voetstukke geplaas word. Na voltooiing van die grootmaat monsterneming, sal toerusting en voetstukke verwyder word. Die toetstuigarea en die grondpad sal gerehabiliteer word na die toestand wat dit voor-eksplorasie was.

Ligging

Die voorgestelde projek is geleë op Porsie 1 van die Plaas Vogels Rand 720 in die gebied van die Lejweleputswa Distriksmunisipaliteit en die Matjhabeng Plaaslike Munisipaliteit, Vrystaat Provinsie.

Die algemene omliggende gebied is hoogs ontwikkeld en grondgebruike bestaan hoofsaaklik uit landbouvelde.

Verwys asseblief na die kaart op die laaste bladsy.

Toepaslike wetgewing

Suid-Afrika se hoof omgewingswet is die Wet op Nasionale Omgewingsbestuur, No. 107 van 1998 (NOBW). Die NOBW bevat regulasies, insluitende gelyste aktiwiteite, wat geïdentifiseer is as aktiwiteite wat potensieël die omgweing kan affekteer. Voordat enige van hierdie aktiwiteite onderneem kan word, moet 'n Omgewingsmagtiging eers toegeken word aan die toepaslike applikant. Afhangende van die aard van hierdie aktiwiteite, sal of 'n *Basiese Assesseringsaansoek (BA)* of 'n *Omvangsbepalingstudie en Omgewingsimpakbe-palingstudie (OIB)* proses gevolg word ten einde die Omgewingsmagtiging-aansoek te ondersteun.

Omgewingsmagtiging

Omgewingsmagtiging ingevolge NOBW word vereis vir die volgende aktiwiteite soos gelys in die Omgewingsimpakbepaling Regulasies (GNR982 van 2014) en gelyste kennisgewings GNR983, GNR984 en GNR985 van 2014, soos gewysig.

- Gelyste Kennisgewing 2 (GNR 984 van 2014, soos gewysig), Aktiwiteit 5

Die ontwikkeling en verwante bedryf van fasiliteite of infrastruktuur vir die verwerking van 'n petroleumhulpbron, insluitend die veredeling of raffinering van gas, olie of petroleumprodukte met 'n geïnstalleerde kapasiteit van 50 kubieke meter of meer per dag...

- Gelyste Kennisgewing 2 (GNR 984 van 2014, soos gewysig), Aktiwiteit 18

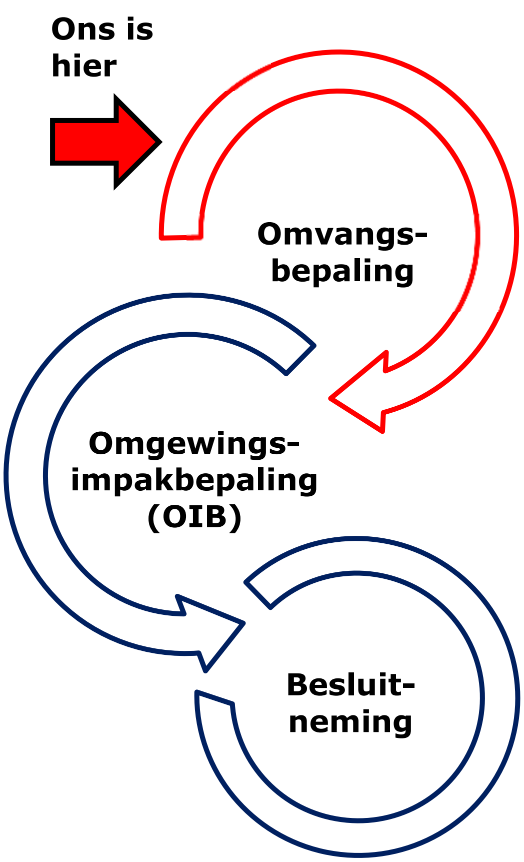
Enige aktiwiteit insluitend die bedryf van daardie aktiwiteit wat 'n eksplorasiereg vereis ingevolge artikel 79 van die MPRDA, sowel as enige ander toepaslike aktiwiteit … wat vereis word om die eksplorasiereg uit te oefen….

Die gelyste aktiwiteite wat van toepassing is, vereis dat 'n volledige Omvangsbepalingstudie en Omgewingsimpakbepalingstudie (OIB) proses onderneem word. Die twee fases, Omvangsbepalingstudie en OIB, word elk 'n 30 dae openbare deelname geleentheid verleen wat die hersiening van dokumente moontlik maak en kommentaar / vrae / bekommernisse word uitgelig – die laasgenoemde word in die finale dokumentasie wat aan die owerhede voorgelê word, ingesluit.

Watergebruiklisensie

'n Watergebruikslisensie in terme van die Nasionale Waterwet, No. 36 van 1998, mag dalk vir die beoogde projek vereis word. ’n Vooraansoek-navraag is reeds by die Departement van Water en Sanitasie (DWS) ingedien.

Omvangsbepalingstudie en Omgewingsimpakbepalingstudie (OIB) proses



- Openbare deelname periode 26 May to 26 June 2022
- Publiek in kennis gestel via terrein-kennisgewings, mediakennisgewings en inligtingsvoubiljette
- Registrasie van BGPs
- Publiek dien kommentaar en navrae in
- Alle kommentaar en navrae word ingesluit in die dokumente wat aan PASA ingedien word

- Geregistreerde BGPs word in kennis gestel van die OIB/OBPr en sluitingsplanne wat beskikbaar is vir hersiening en kommentaar
- BGPs stuur kommentaar aan Prime Resources
- Alle kommentaar word in die finale verlsag ingesluit wat ten einde aan PASA ingedien gaan word.

- BGPs word in kennis gestel van die besluit deur PASA (aansoek aanvaar of verwerp)
- BGPs word ingelig oor die Appèlproses.

Die Petroleumagentskap van Suid-Afrika (PASA) is die Bevoegde Owerheid vir hierdie projek en sal ‘n aanbeveling aan die Minister van Minerale Hulpbronne maak om die Omgewingsmagtiging vir die aktiwiteite toe te staan.

Prime Resources is aangestel as die onafhanklike Omgewingsassessor Praktisyn (OAP) om die gereguleerde omgewingsprosesse vir die projek uit te voer. Onafhanklike spesialiste is aangestel om studies vir die projek te onderneem. Nie Prime Resources of die aangestelde spesialiste het enige gevestigde belang in die projekverrigting nie.

Potensiële impakte op die omgewing en die gemeenskap

Die potensiële sleutel kwessies, wat verder ondersoek gaan word, is met behulp van die Nasionale Siftingsinstrument geïdentifiseer. Potensiële probleme sluit in:

- Impakte op landboupotensiaal
- Impakte op aardse biodiversiteit
- Paleontologiese sensitiwiteit
- Burgerlugvaart-tema.

Registreer as 'n Belanghebbende en Geaffekteerde Party (BGP)

Indien u as 'n BGP wil registreer, stuur asseblief u kontakbesonderhede na Prime Resources via SMS (076 403 3386) of via e-pos (prime@resources.co.za). Gebruik asseblief die onderwerplyn "**VB Gas**" en dui u belangstelling aan.

Geleentheid om kommentaar te lewer

Die Omvangsbepalingstudie kan afgelaai word vanaf www.resources.co.za gedurende die 30-dae openbare kommentaartydperk, vanaf 26 Mei tot 26 Junie 2022. Die Omvangsbepalingstudie kan ook op versoek per e-pos verskaf word en is beskikbaar vir hersiening by die volgende liggings:

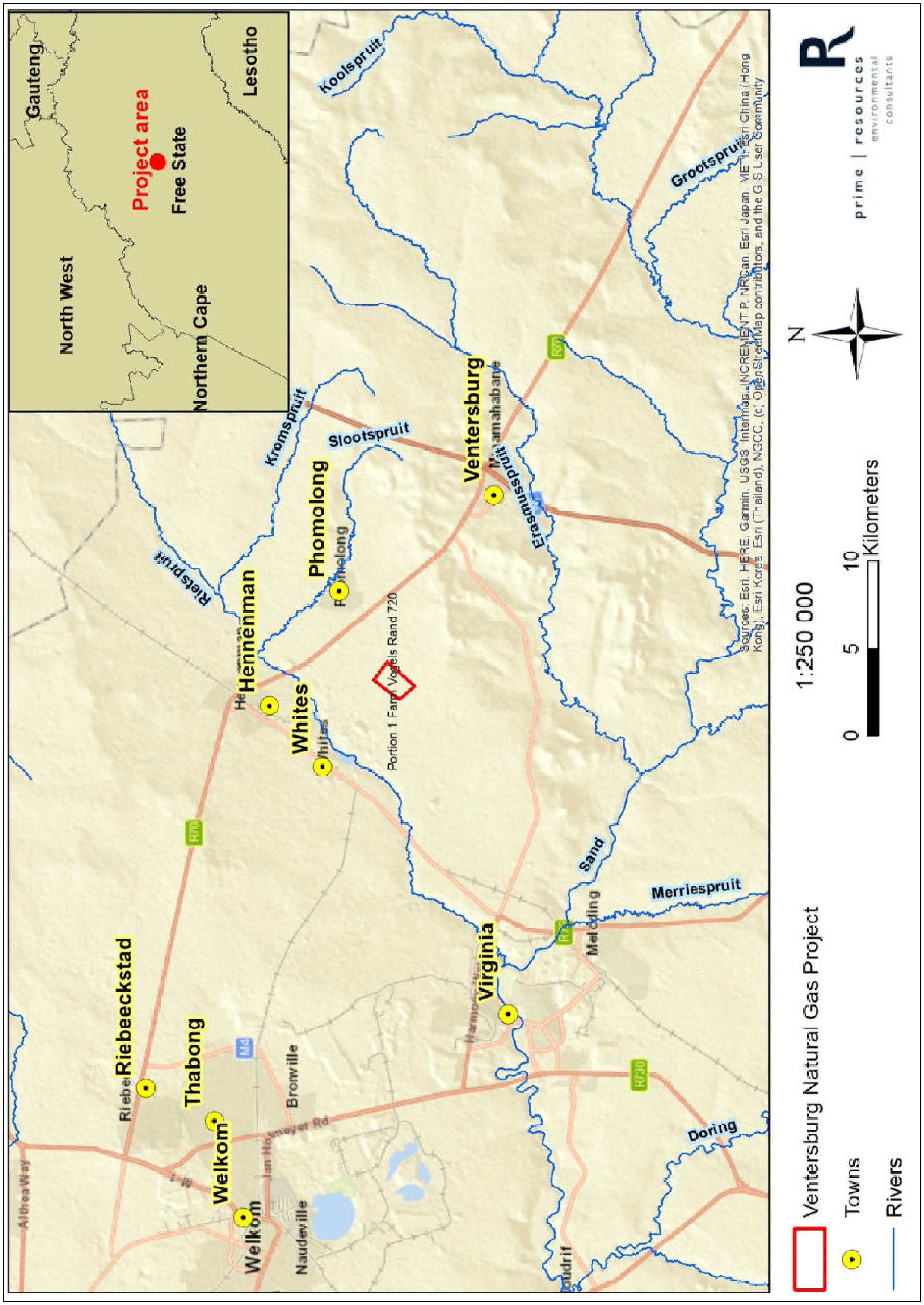
- Phomolong Openbare Biblioteek, Phomolong, Hennenman
- Hennenman Openbare Biblioteek, Hennenman

Alle kommentaar aangaande die voorgestelde projek is welkom. Spesifieke kommentaar en/of voorstelle met betrekking tot die onderstaande word aangemoedig:

- Hoe die voorgestelde projek u en die gemeenskap moontlik gaan affekteer
- Inligting oor enige omgewings- of sosiale kenmerke wat dalk oorgesien is
- Voorstelle om enige verwagte omgewings- of sosiale impakte te verminder
- Voorstelle oor die standaard wat jy voel die terrein moet gerehabiliteer word.

Maak asseblief seker dat u kommentaar of kwessies van kommer teen 26 Junie 2022 by Prime Resources ingedien is.

- Telefoon: 011 447 4888
- SMS / WhatsApp: 076 403 3386
- E-pos: prime@resources.co.za


Gauteng
North West
Project area
Free State
Northern Cape
Lesotho
Riebeeckstad
Thabong
Welkom
Welkom
Hennenman
Whites
Phomolong
Ventersburg
Virginia
Portion 1 Farm Vogels Rand 720
Rietspruit
Kromspruit
Slootspruit
Koolspruit
Grootspruit
Erasmusspruit
Sand
Merriespruit
Doring
Bronville
Naudeville
Meloding
Jan Hofmeyer Rd
Althea Way
R70
R730
M4
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Ventersburg Natural Gas Project
Towns
Rivers
1:250 000
0 5 10
Kilometers
N
prime | resources
environmental consultants

APPENDIX 3.6

Proof of distribution via email of the Scoping Report and BIDs

PROOF OF DISTRIBUTION VIA EMAIL OF THE SCOPING REPORT AND BIDs

Notification of Scoping Phase: Proposed Natural Gas Bulk Sampling near Hennenman - Gold One Africa

Gené Main
To Monique van der Westhuizen
Bcc dewald@lejwe.co.za; cjs@gcs.co.za; tshabangusello7@gmail.com; Lebogang.Kobue@matjhabeng.co.za; lydia.leballo@matjhabeng.co.za; Fanie.Nieuwoudt@matjhabeng.co.za; Nkumbikazi.Dakile@dmr.gov.za; mpho.zwane@dmr.gov.za; Ndlelenhle.Zindela@dmr.gov.za; Disebo Khunong; lezzane.rungasamy@drdlr.gov.za; olivier@fs.agric.za; melatoB@dws.gov.za; magononof@dws.gov.za; pemohajane@nnr.co.za; **+33 others**

Reply | Reply All | Forward

Thu 2022/05/26 11:39

Scoping Info booklet_Afrikaans.pdf 549 KB
Scoping Info booklet_English.pdf 544 KB

Good day

Gold One Africa Limited (Gold One Africa) has applied in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, 2002 (MPRDA, Act No. 28 of 2002) to undertake bulk sampling of natural gas near Hennenman and Ventersburg, in the Free State Province. Gold One Africa is the holder of an Exploration Right (12/3/214 ER) which covers various farms situated in the Magisterial Districts of Hennenman, Virginia and Ventersburg in the Free State. The proposed project will take place at an existing borehole (AFO-024), which was drilled during previous prospecting activities. The proposed bulk sampling is situated on Portion 1 of the Farm Vogels Rand 720, within the Lejweleputswa District Municipality and Matjhabeng Local Municipality. Bulk sampling of natural gas will be conducted over a 2-year period by means of using a blower / portable compression unit. **No fracking will be involved.**

In order to proceed with bulk sampling, Gold One Africa is applying for an Environmental Authorisation for activities listed in terms of the National Environmental Management Act, No. 107 of 1998 (NEMA) Environmental Impact Assessment (EIA) Regulations (GNR982 of 2014). All components of bulk sampling are within the boundaries of an existing mining right held by Gold One Africa.

Prime Resources has been appointed as the Environmental Assessment Practitioner to undertake the Scoping and EIA process for the project.

The Scoping Phase Information Booklet is attached in order to provide further context. The project is currently in the Scoping Phase. The Scoping Report can be located on our website (http://primeresourcesza.com/downloads) and can be provided via email upon request. It is also available for review at the Hennenman and Phomolong Public Libraries.

Kindly furnish all comments or queries to Prime Resources (prime@resources.co.za) by **26 June 2022.**

Notification of Scoping Phase: Proposed Natural Gas Bulk Sampling near Hennenman - Gold One Africa

Gené Main
To Monique van der Westhuizen
Bcc Naudew@freetrans.gov.za; mokete@sscogta.gov.za; winnie@sscogta.gov.za; malintjam@sacr.fs.gov.za; tankiso@sacr.fs.gov.za; Strohl@caa.co.za; Mogashoal@caa.co.za; alexismoshodi@icloud.com; cynthia@vslandbou.co.za; bradleyg@ewt.org.za; thampulizois@gmail.com; adriannel1@yahoo.com; kingsley435@webmail.co.za; kinglsleylempe6@gmail.com; motsamailb212@gmail.com; mossmosebi@gmail.com; lizelle@vitalhygiene.co.za; mikatekocreations@gmail.com; natashafullimput@gmail.com; melinda@surveyhouse.com; mossworks@gmail.com; marlaineA@l2b.co.za; epretorius@hotmail.co.za; amme@vodamail.co.za; cwtheron@zipplink.co.za; vogelsrand@gmail.com; cwtheron@zipplink.co.za; pjcoetzer@zipplink.co.za; 'Jon Hericourt'; NgesiP@petroleumagencysa.com; SharonA@petroleumagencysa.com;

Reply | Reply All | Forward

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Notification of Scoping Phase: Proposed Natural Gas Bulk Sampling near Hennenman - Gold One Africa

GM Gené Main
To Monique van der Westhuizen
Reply | Reply All | Forward
Thu 2022/05/26 11:39

Bcc cynthia@vslandbou.co.za; bradleyg@ewt.org.za; thampulizois@gmail.com; adriannel1@yahoo.com; kingsley435@webmail.co.za; kinglsleylempe6@gmail.com; motsamailb212@gmail.com; mossmosebi@gmail.com; lizelle@vitalhygiene.co.za; mikatekocreations@gmail.com; natashafullimput@gmail.com; melinda@surveyhouse.com; mossworks@gmail.com; marlaineA@l2b.co.za; epretorius@hotmail.co.za; amme@vodamail.co.za; cwtheron@zipplink.co.za; vogelsrand@gmail.com; cwtheron@zipplink.co.za; pjcoetzer@zipplink.co.za; 'Jon Hericourt'; NgesiP@petroleumagencysa.com; SharonA@petroleumagencysa.com; MtshemlaM@petroleumagencysa.com; ThomasN@petroleumagencysa.com

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Notification of Scoping Phase: Proposed Natural Gas Bulk Sampling near Hennenman - Gold One Africa

GM Gené Main
To Monique van der Westhuizen
Reply | Reply All | Forward
Thu 2022/06/02 17:02

Bcc mokoenad@detea.fs.gov.za; molokwanen@destea.fs.gov.za; Nozipho.Dlamini@dalrrd.gov.za; Khomotso.Mahlatji@dalrrd.gov.za; mbulelo.kelly@drdlr.gov.za; mbulelo.kelly@dalrrd.gov.za; moeng@fs.agric.za; wmngwambe@fs.agric.za; sipho@fscogta.gov.za; buthelezi@fscogta.gov.za

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APPENDIX 3.7

Copies of Comments Received and Responses thereto

Monique van der Westhuizen

From: Gené Main
Sent: Monday, 20 June 2022 11:50
To: Monique van der Westhuizen
Subject: FW: Comments - Draft Scoping Reports for Bulk Sampling - 12-3-214
Attachments: Gold One Africa 12-3-214- DSR Comments Letter.doc

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From: Phumla Ngesi <NgesiP@petroleumagencysa.com>
Sent: Monday, 20 June 2022 09:52
To: Gené Main <gene@resources.co.za>
Cc: Sinazo Mnyaka <MnyakaS@petroleumagencysa.com>; Natasha Thomas <ThomasN@petroleumagencysa.com>
Subject: Comments - Draft Scoping Reports for Bulk Sampling - 12-3-214

Good morning Gene

Herewith attached our comments for your consideration.

Kindly contact us if you need clarity on the issues raised.

Kind Regards

Phumla Ngesi |Environmental Compliance| Petroleum Agency SA

T: 021 938 3570| Cell: 082 850 0274| E: ngesip@petroleumagencysa.com

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Petroleum Agency SA

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Tel: +27 21 938 3500 · Fax: +27 21 938 3520
E-mail: plu@petroleumagencysa.com

05 July 2022

Enquiries: Sinazo Mnyaka

Email: mnyakas@petroleumagencysa.com

Our Ref: 12/3/214

Attention: Gene` Main **Email: gene@resources.co.za**

Prime Resources (Pty) Ltd

The workshop, 70-7th Avenue

Parktown North

Johannesburg

2193

Dear Gene`

Comments on Draft Scoping Report (DSR) for the proposed bulk sampling activities on well AFO-024 situated on Portion 1 of the Farm Vogels Rand 720 within Gold One Africa exploration right area in Free State Province.

The Draft Scoping Report received on the 26th May 2022 refers.

The Petroleum Agency SA (hereafter referred to as the "Agency") has reviewed the submitted DSR and would like to provide the following comments:

1. **Section 3b:** The statement that Gold One Africa applied and obtained a mining right over the area in question is not correct. Gold One Africa applied for and obtained an exploration right.
2. **Section 4:** It is stated that Gold One Africa will undertake decommissioning activities if no feasible gas is found during bulk sampling activities. Decommissioning is a listed activity and is not included in both the EA application form and in the scoping report. Kindly indicate if the plan is to apply for authorisation of the decommissioning activity after the analysis of bulk sampling results.
3. **Section 5:** The need and desirability must be aligned with the Guidelines on Need and Desirability.

4. **Section 6:** The period of the EA should not be limited to 2 years considering that the exploration right can be renewed 3 times for a period of 2 years each time.
5. **Section 7:** The process followed to decide on the preferred activity is not described. Kindly explain the importance of having the proposed activity on the same development footprint as the future gold mine operations/infrastructure. The applicant has an existing exploration right and not a mining right as stated in this section.
6. **Section 9:** It is indicated that the media and site notices will be in English. The notifications sent to the affected stakeholders are also in English. Notifications and notices must also be in other languages spoken in the area of interest and that makes consultation process inclusive. Proof of all notifications should have been included in the draft scoping report. These must be included in the final scoping report.
7. **Table 5:** The following potential impacts must be included and considered in the assessment:
    a. Air quality: List potential sources of GHG and other pollution emissions from the proposed activity and assess their impacts.
    b. Social: Potential positive and negative impacts relating to employment/business opportunities, introducing external people (who are contracted by the applicant to undertake the work on site) into the community and potential theft of farm produce or equipment.
8. **Section 10c (ii & iii):** These two subsections could be combined. You are required to discuss or describe each of the potential impacts identified in table 5 and indicate whether they are positive or negative impacts. If the impacts require mitigation measures, you must indicate what measures will be implemented. It is further suggested that the entire impact assessment section be separated from section 10.

Please do not hesitate to contact the aforementioned should you need clarity on any of the comments raised.

Yours sincerely,

Phumla Ngesi
Manager: Environmental Compliance Department

Monique van der Westhuizen

From:	Gené Main
Sent:	Monday, 20 June 2022 12:52
To:	Phumla Ngesi
Cc:	Sinazo Mnyaka; Natasha Thomas; Monique van der Westhuizen
Subject:	RE: Comments - Draft Scoping Reports for Bulk Sampling - 12-3-214

Dear Phumla

Thank you for your comments. Please see below a response to some of the comments.

1. **Section 3b:** The statement that Gold One Africa applied and obtained a mining right over the area in question is not correct. Gold One Africa applied for and obtained an exploration right.

Gold One Africa has obtained a mining right via a separate application process. The mining right extends over the current area in which the exploration borehole is located. Gold One Africa has also obtained an exploration right for natural gas.

2. **Section 4:** It is stated that Gold One Africa will undertake decommissioning activities if no feasible gas is found during bulk sampling activities. Decommissioning is a listed activity and is not included in both the EA application form and in the scoping report. Kindly indicate if the plan is to apply for authorisation of the decommissioning activity after the analysis of bulk sampling results.

Gold One Africa will undertake decommissioning should the bulk sampling results prove the resource to be unfeasible. However, the June 2021 listing notices exclude the decommissioning listed activity.

3. **Section 5:** The need and desirability must be aligned with the Guidelines on Need and Desirability.

Noted.

4. **Section 6:** The period of the EA should not be limited to 2 years considering that the exploration right can be renewed 3 times for a period of 2 years each time.

Noted.

5. **Section 7:** The process followed to decide on the preferred activity is not described. Kindly explain the importance of having the proposed activity on the same development footprint as the future gold mine operations/infrastructure. The applicant has an existing exploration right and not a mining right as stated in this section.

Only one borehole has been identified for use for bulk sampling. This borehole is already in use. Should the bulk sampling prove feasible then it is likely that the gas will be used to generate power for the proposed mining operations. It is therefore considered to be efficient and cost-effective to be located close to the proposed mining infrastructure.

Please see response to question 1 above re the mining right.

6. **Section 9:** It is indicated that the media and site notices will be in English. The notifications sent to the affected stakeholders are also in English. Notifications and notices must also be in other languages spoken in the area of interest and that makes consultation process inclusive. Proof of all notifications should have been included in the draft scoping report. These must be included in the final scoping report.

Prime Resources has previously (during 2017) undertaken public consultation in the area, for the EA process for the mining right application. During this process it was identified that English was widely spoken and read in the area. Afrikaans was also considered to be equally preferred as a reading language. For this reason, Background Information Documents were made available in English and Afrikaans.

7. **Table 5:** The following potential impacts must be included and considered in the assessment:
   a. Air quality: List potential sources of GHG and other pollution emissions from the proposed activity and assess their impacts.

Noted.

   b. Social: Potential positive and negative impacts relating to employment/business opportunities, introducing external people (who are contracted by the applicant to undertake the work on site) into the community and potential theft of farm produce or equipment.

Noted.

8. **Section 10c (ii & iii):** These two subsections could be combined. You are required to discuss or describe each of the potential impacts identified in table 5 and indicate whether they are positive or negative impacts. If the impacts require mitigation measures, you must indicate what measures will be implemented. It is further suggested that the entire impact assessment section be separated from section 10.

Noted.

Where possible, updates to the Scoping Report will be based on the above comments.

Kind regards
Gené Main

From: Phumla Ngesi <NgesiP@petroleumagencysa.com>
Sent: Monday, 20 June 2022 09:52
To: Gené Main <gene@resources.co.za>
Cc: Sinazo Mnyaka <MnyakaS@petroleumagencysa.com>; Natasha Thomas <ThomasN@petroleumagencysa.com>
Subject: Comments - Draft Scoping Reports for Bulk Sampling - 12-3-214

Good morning Gene

Herewith attached our comments for your consideration.

Kindly contact us if you need clarity on the issues raised.

Kind Regards

Phumla Ngesi |Environmental Compliance| Petroleum Agency SA

T: 021 938 3570| Cell: 082 850 0274| E: ngesip@petroleumagencysa.com

APPENDIX 4

Soil, Land Use and Land Capability Compliance and Impact Statement

ZIMPANDE RESEARCH COLLABORATIVE (PTY) LTD

29 Arterial Road West, Oriel, Bedfordview, 2007
Tel: 011-616-7893
Fax: 011-615-6240/086-724-3132
admin@sasenvgroup.co.za

Name: Stephen van Staden
Date: Friday, 13 May 2022
Ref: ZRC: SAS22-1048

Prime Resources Environmental Consultants
The Workshop, 70-7th Avenue
Parktown North, 2193
Johannesburg, South Africa
Tel: (Office) +27 (0)11 447 4888
Fax: +27 (0)11 447 0355
Email: gene@resources.co.za

Attention: Ms. Gené Main

RE: SOIL, LAND USE AND LAND CAPABILITY COMPLIANCE AND IMPACT STATEMENT CONSIDERING THE GAS EXTRACTION WELL, IN VENTERSBURG, FREE STATE PROVINCE.

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed by Prime Resources to prepare a Soil, Land use and Land Capability verification memorandum as per the National Web-based Environmental Screening Tool (accessed 2022) (hereafter "screening tool") for a gas extraction on farm 720 portion 1 of Vogelsrand within the town of Hennenman, near Ventersbrug, Free State Province (hereafter referred to as the "investigation area").

The investigation area is located in the Matjhabeng Local Municipality, and the Lejweleputswa District Municipality of the Free State. The investigation area is located approximately 10 km north-west of Ventersburg and 22 km east of Welkom. The R70 is the closest main road from the investigation area, approximately 2.8 km north-east while the N1 is approximately 10 km east of the investigation area, and the R73 is located approximately 13.7 km south-west thereof. The general surrounding area is highly developed and land uses surrounding the gas extraction well are mostly comprised of agricultural fields that have been cultivated with sunflower crops.

The activities will include a gas extraction well and an associated area of approximately 50 m x 70 m fenced off around the gas well in which vegetation will be cleared. An associated access road will be included as part of the activities and will mostly follow existing farm roads, apart from a short stretch crossing through agricultural fields at which the gas extraction well will be located.

2. LEGISLATIVE REQUIREMENTS

The legislation considered during this investigation with reference to the management of soils included the following:

- The Constitution of the Republic of South Africa, 1996;
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA); and
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA).

3. ASSUMPTIONS AND LIMITATIONS

- The soil survey conducted as part of the land capability was confined within the investigation area. This includes the agricultural fields and the 50 m x 70 m fenced area;
- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. For this reason, the classifications presented in this report are based on the "best fit" to the soil classification system of South Africa; and
- It is virtually impossible to achieve 100% purity in soil mapping, thus the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not absolute but rather form a continuum and gradually change from one type to another.

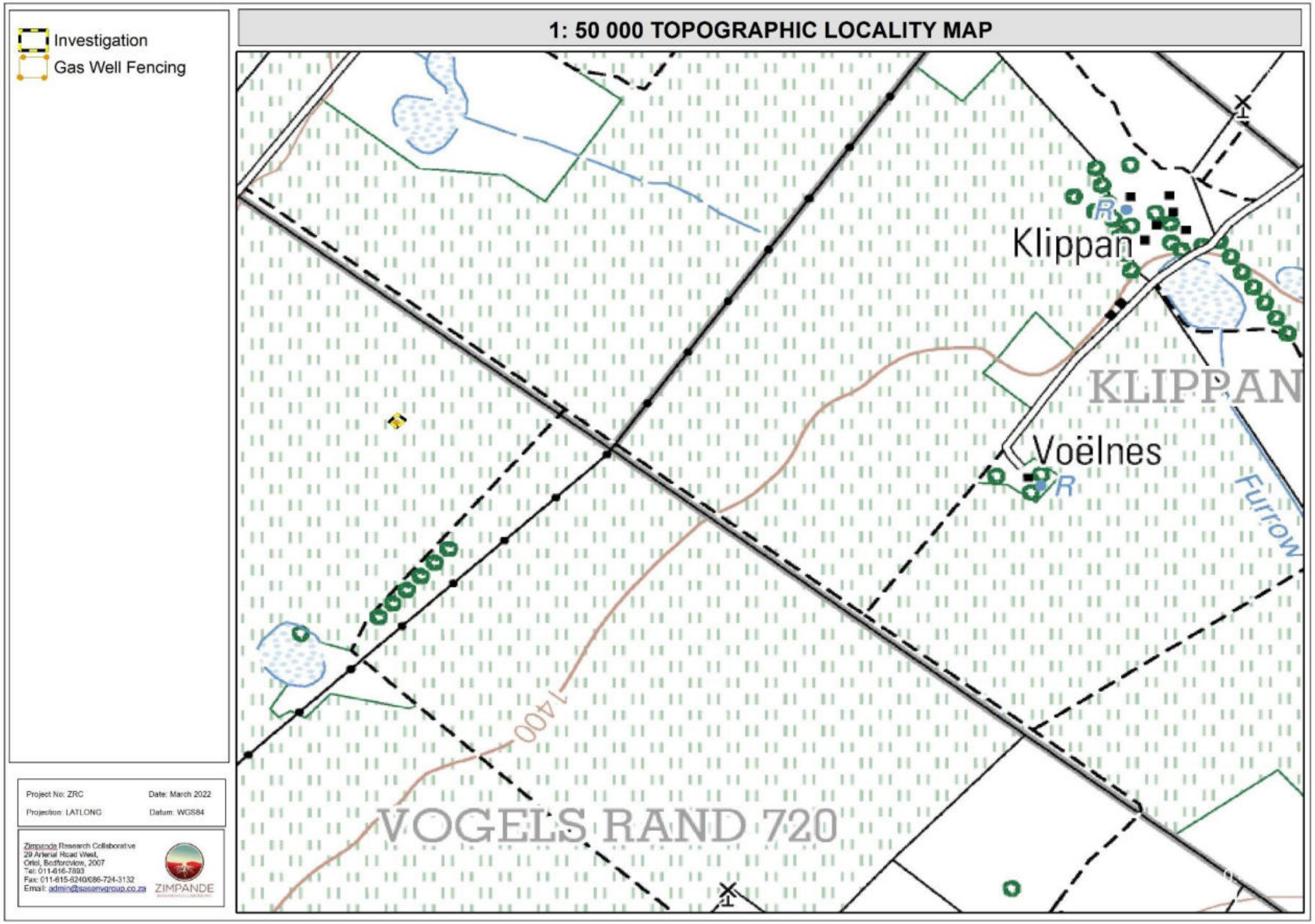

Figure 1: Topographic locality map depicting the investigation area in relation to surrounding agricultural fields.

4. DESKTOP ASSESSMENT

**It should be noted that the desktop results presented in this section were sourced from various databases such as the Agricultural Geo-referenced Information System (AGIS) and Soil and Terrain (SOTER) database. Thus, inaccuracies may exist in the data presented. The data however gives useful information of the surrounding soils.*

The following data is applicable to the investigation area, according to various data sources including but not limited to the Agricultural Geo-referenced Information System (AGIS).

- The Mean Annual Precipitation (MAP) is estimated to range between 401 - 600 mm per annum. These conditions have a moderate yield potential for a limited range of adapted crops but planting date options are limited for supporting rain fed agriculture;
- The mean annual evaporation ranges between 1801 - 2000 mm per annum. The high evaporation rates pose risks to plant yield due possible plant permanent wilting resulting in plant desiccation and lack of adequate soil moisture;
- According to the Council of Geoscience Geological map of South Africa (2001), the investigation area is dominated by the mudstone formation;
- The Landform type occurring within the investigation area is classified as Plain, which means the terrain is suitable to allow agricultural activities;
- The Land type data associated with the investigation is the Bc30 type.
- The Soil and Terrain (SOTER) database indicates that the investigation area is characterised by Eutric Cambisols and Calcic Luvisols. These soils are characterised by sandy red and yellow brown soils underlain by calcic or plinthic horizons. These soils are typically well suited for agriculture;
- Soil depth associated with the investigation area is less than 750 mm, this depth is suitable for most cultivated crops;
- In terms of the desktop land capability the investigation area is characterised by marginal potential arable capability under the Arable Class IV classification.
- According to the AGIS database, the soil medium occurring on the investigation area is neither alkaline or sodic, this indicates soils are not affected by high concentration of salts
- According to the AGIS database (Grazing capacity, 1993), the livestock grazing capacity potential for the investigation area is not considered viable for grazing as it is transformed rangeland due to the cultivation practices;
- According to the database, soils with beneficial water retaining characteristics without the risk of waterlogging are present within the investigation area;
- The soil pH of soil occurring within the investigation area are slightly acidic to neutral with pH range of 6.5 - 7.4 which means that most nutrients will be available for plant uptake; as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);
- Historical land use associated with the investigation area is cultivated land;
- The predicted soil loss for the investigation area is considered very low, indicating the associated soils are not susceptible to erosion; and
- the investigation area is located within an area of high agricultural significance.

5. SITE CONDITIONS

Upon the site visit conducted in March 2022, the following observations were made:

- The investigation area is located along a flat terrain utilised for sunflower cultivation;
- A 50 m x 70 m fenced gas extraction well; and
- No residential areas were observed in the immediate vicinity of the gas extraction well.

Figure 2: Images depicting landuses associated with the investigation area.

6. SOIL AND LAND CAPABILITY CONSIDERATIONS

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 1 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas, Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, as illustrated in Table 1 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating to provide a land potential value. The anticipated impacts of the proposed land use on soil resources, land use and land capability were assessed to inform decision making and defining the necessary mitigation measures.

The majority of the soils within the investigation area can be broadly classified as soils ideal for arable agriculture (with minor limitations). These ideal soils include the soils of Bainsvlei/Avalon forms. These soil forms are characterised by the presence of a water table below the 1200 mm depth, facilitating the storage and release of water. The weak apedal structure of the sub-soil and the loamy texture allows for deep root penetration and thus favourable for the majority of cultivated crops. The land potential within the investigation area, considering the soils, terrain quality and climatic conditions (potential low rainfall and very high temperatures during the growing season) can be classified as Good potential land. Table 1 below presents the summary of the dominant soil forms as well as their respective land capability and land potential. Whereas Figure 4, 5 and 6 depict the soils occurring within the investigation area, the spatial distribution of the dominant soil forms and land potential respectively.

Table 1: Identified soil forms within the investigation area and their respective land capability.

Soil Form	Land capability	Land Potential	Area (ha)
Avalon	Arable (Class II)	Good Potential (L3)	0.35

Figure 3: Photograph representing the dominant soils associated with the investigation area.

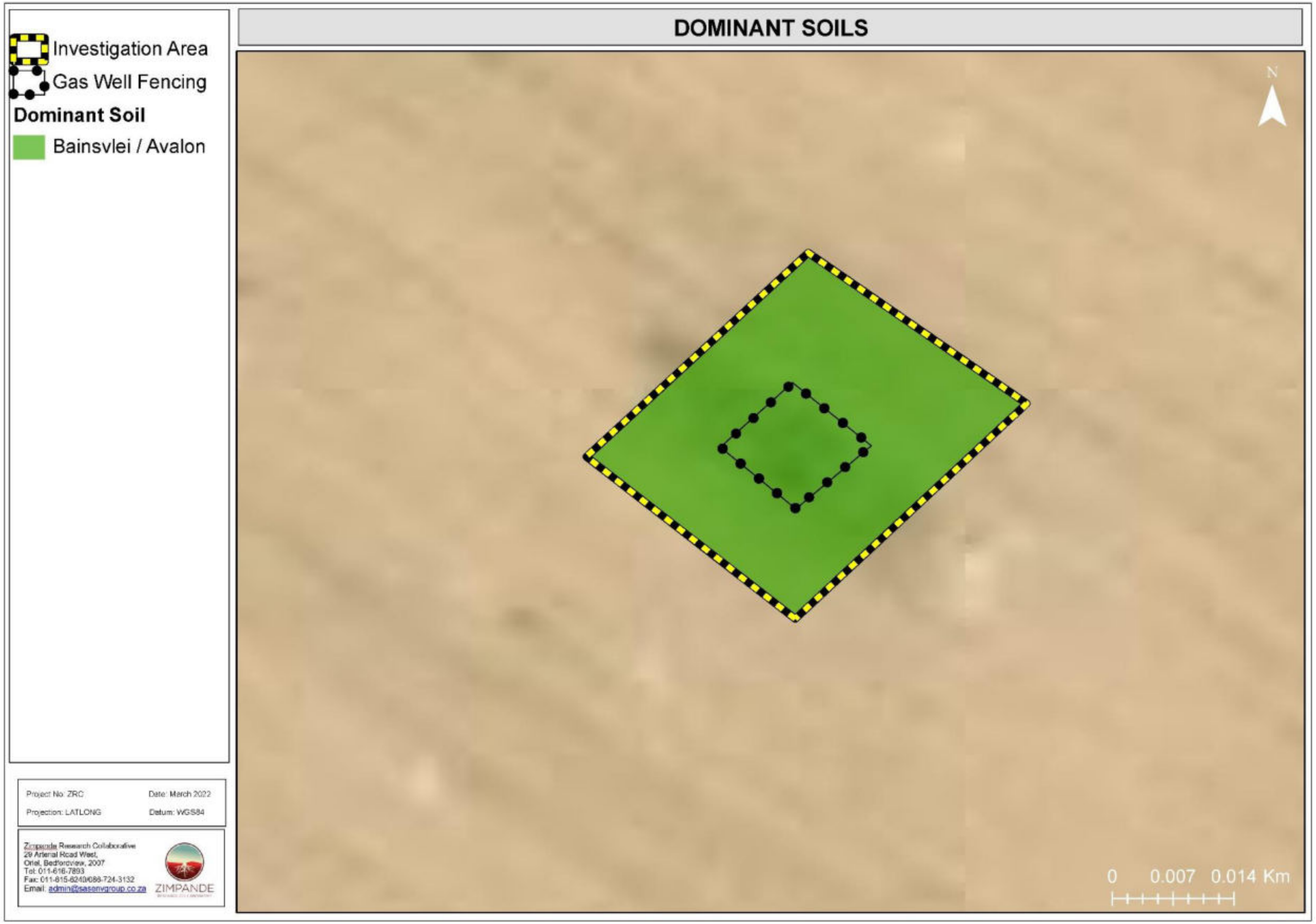

Figure 4: Dominant soils associated with the investigation area.

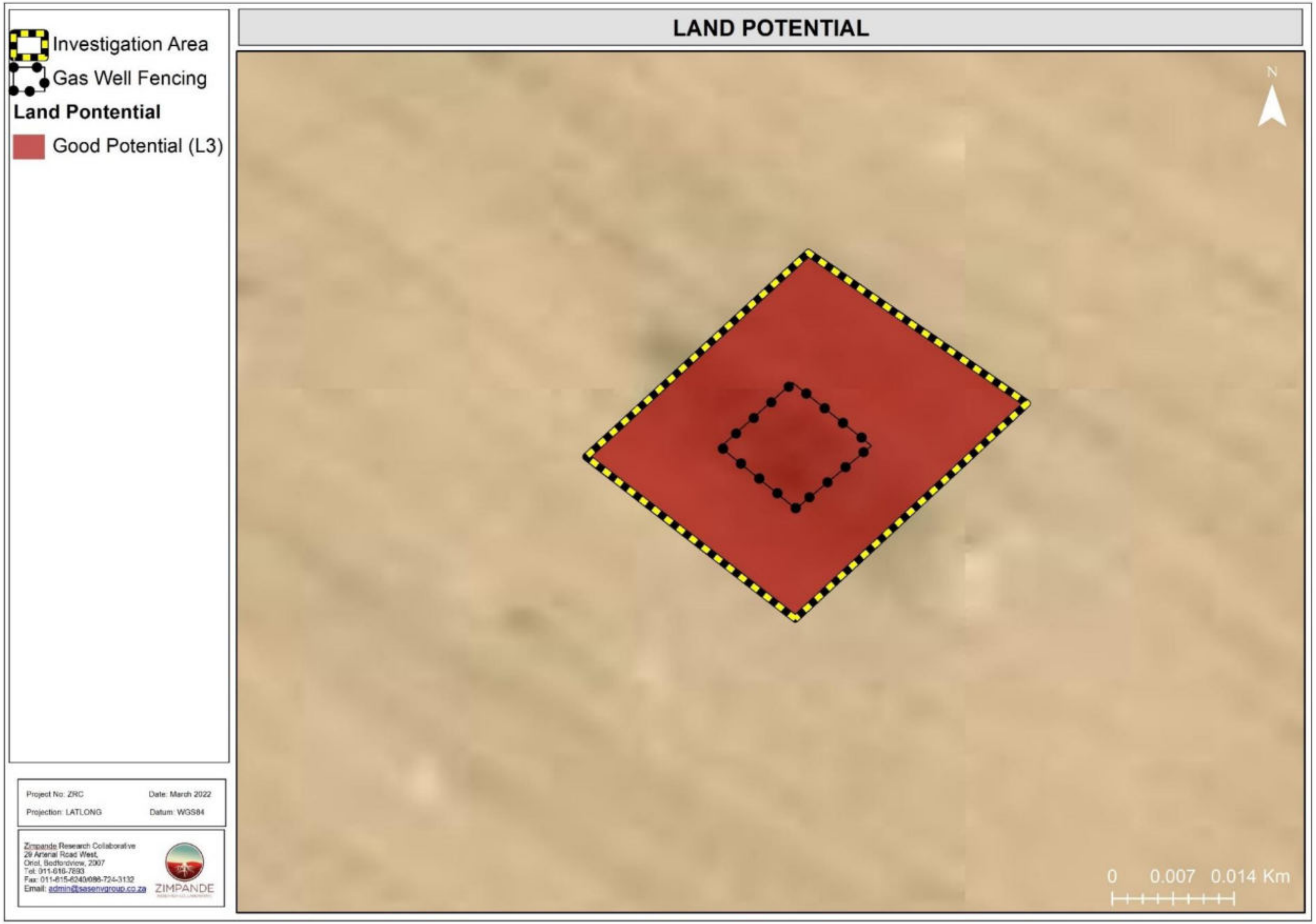

Figure 5: Land Potential associated with the investigation area.

7. BUSINESS CASE, OPPORTUNITIES, CONSTRAINTS, AND IMPACT STATEMENT APPLICABLE TO THE GAS WELL EXTRACTION AREA.

The gas well extraction fence has an area of 50 m x 70 m (0.35 ha) and the impact can be considered Very Low to negligible from a soil, land use and land capability point of view. The mixed gases contained within the gas chambers associated with the gas well are more likely to impact on human health and thus appropriate air quality monitoring techniques should be applied whenever the well is in use to guard against impacting on human health and wellbeing as stated in the Bill of Rights included in the Constitution of South Africa (DEAT, 2005).

8. REFERENCES

Agricultural Geo-referenced Information System (AGIS) database. www.agis.agric.za

Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983).

Council of GeoScience (CGS)., 2001.Geological survey (South Africa). Pretoria, South Africa.

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Land Type Survey Staff, 1976-2006. Land type Survey Database. ARC-ISCW, Pretoria.

National Department of Agriculture, 2002. Development and Application of a Land Capability Classification System for South Africa

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Smith, B. , 2006. The Farming Handbook. Netherlands & South Africa: University of KwaZulu Natal Press & CTA.

Soil Classification Working Group, 2018. Soil classification. A Natural and Anthropogenic System for South Africa. Mem. agric. nat. Resource. S. Afr. No. 15. Dept. Agric. Dev., Pretoria.

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APPENDIX A: ASSESSMENT METHODOLOGY

Desktop Screening

Prior to commencement of the field assessment, a background study, including a literature review, was conducted in order to collect the pre-determined soil and land capability data in the vicinity of the investigated area Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were used for the assessment.

Soil Classification and Sampling

A soil survey was conducted from March 2022 by a qualified soil specialist, at which time the identified soils within the infrastructure areas and associated access roads were classified into soil forms according to the Soil Classification Working Group for South Africa (2018). Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table **A1** below; with Classes I to III classified as prime agricultural land that is well suitable for annual cultivated crops. Whereas, Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table **A2** below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures.

Table A1: Land Capability Classification (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC	IC		
IV	W	F	LG	MG	IG	LC				
V	W		LG	MG						**Grazing land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**

W- Wildlife	MG- Moderate grazing	MC- Moderate cultivation
F- Forestry	IG- Intensive grazing	IC- Intensive cultivation
LG- Light grazing	LC- Light cultivation	VIC- Very intensive cultivation

Table A2: Climate Capability Classification (Scotney et al., 1987)

Climate Capability Class	Limitation Rating	Description
C1	None to slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated area. The classification of land potential and knowledge of the geographical distribution within an area of interest. This is of importance for making an informed decision about land use. **Table A3** below presents the land potential classes, whilst Table 4 presents description thereof, according to Guy and Smith (1998).

Table A3: Land Potential Classes (Guy and Smith, 1998)

Land Capability Class	Climate Capability Class							
	C1	C2	C3	C4	C5	C6	C7	C8
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table A4: The Land Capability Classes Description (Guy and Smith, 1998)

Land Potential	Description of Land Potential Class
L1	**Very high potential:** No limitations. Appropriate contour protection must be implemented and inspected.
L2	**High potential:** Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	**Good potential:** Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	**Moderate potential:** Moderately regular and/or severe to moderate limitations due to soil, slope, temperature or rainfall. Appropriate permission is required before ploughing virgin land.
L5	**Restricted potential:** Regular and/or moderate to severe limitations due to soil, slope, temperature or rainfall.
L6	**Very restricted potential:** Regular and/or severe limitations due to soil, slope, temperature or rainfall. Non-arable.
L7	**Low potential:** Severe limitations due to soil, slope, temperature or rainfall. Non-arable.
L8	**Very low potential:** Very severe limitations due to soil, slope, temperature or rainfall. Non-arable.

APPENDIX B: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden	M.Sc. (Environmental Management) (University of Johannesburg)
Braveman Mzila	B.Sc. (Hons) Environmental Hydrology University of KwaZulu-Natal
Tshiamo Setsipane	M.Sc. Soil Science (University of the Free State)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Zimpande Research Collaborative		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

----

Signature of the Specialist

1.(b) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Braveman Mzila, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

----

Signature of the Specialist

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Tshiamo Setsipane, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

Setsipane

Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource discipline lead, Managing member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland assessment short course Rhodes University	2016
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2013

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS OF WORK EXPERIENCE

South Africa – All Provinces

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments
- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments
- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plan
- Freshwater Offset Plan
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies
- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Soil and Land Capability Assessment
- Soil and Land Capability Assessment
- Soil Monitoring
- Soil Mapping

Visual Impact Assessment
- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments
- View Shed Analyses
- Visual Modelling

Legislative Requirements, Processes and Assessments
- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Joined SAS Environmental Group of Companies	2017

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Soil Science Society (SASSO)

Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of Kwazulu-Natal)	2013
BSc Hydrology and Soil Science (University of Kwazulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape, KwaZulu-Natal

KEY SPECIALIST DISCIPLINES

Hydropedological Assessments:

- Soil Survey
- Soil Delineation
- Hydrological hillslope classification
- Hydropedological loss Quantification
- Hydropedological impact assessment
- Scientific buffer determination

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural potential
- Agricultural Impact Assessments

The proposed developments are not anticipated to cause a significant impact in terms of soils, land use and land capability or from a hydropedological point of view provided that the mitigation measures outlined below can be considered.

From a soil and land capability point of view the key mitigation measure include:

- ➢ After clearing, the affected area shall be stabilised to prevent any erosion or sediment runoff. Stabilized areas shall be demarcated accordingly;

- Incremental clearing of ground cover should take place to avoid unnecessary exposed surfaces over long periods of time.
- Reasonable measures must be undertaken to ensure that any exposed areas are adequately protected against the wind and stormwater run-off;
- Top soil shall be removed separately and stockpiled separately from other soil base layers.
- Stockpiles should ideally be located to create the least visual impact and must be maintained to avoid erosion of the material;
- Stockpile height should be restricted to that which can deposited without additional traversing by earth moving equipment. A Maximum height of 3-4 m is therefore proposed, based on the ability of earth moving equipment to place material without travelling on the topsoil stockpile
- The stockpile should be treated with temporary soil stabilisation methods; such as the application of organic matter to promote soil aggregate formation, leading to an increased infiltration rate and moisture retention ability, thereby reducing soil erosion. Also, the use of lime to stabilise soil pH levels may become necessary;
- Topsoil must be treated with care, must not be buried or in any other way be rendered unsuitable for further use (e.g. by mixing with spoil/overburden) and precautions must be taken to prevent unnecessary handling and compaction;
- Reduce drop height of material to a minimum;
- Temporarily halt material handling in windy conditions, whenever possible;
- A speed limit of 30km/hour must be displayed and enforced through a fining system. All vehicle drivers using the access road and entering the site will be informed of the speed limit. This is to reduce dust emissions from moving trucks; and
- Compacted areas that are not required for access shall be scarified after use during decommissioning and rehabilitation.

Key mitigation measures from a hydropedological point of view include:

- All surface development footprint areas should remain within demarcated areas as far as possible and disturbance of soil profiles to be limited to what is essential;
- Excavation activities within the watercourses must be avoided as far as practically possible;
- The material of the pipe used in the construction of the proposed pipeline should be durable and not susceptible to leakages as the material may likely reach the wetland due to the occurrence of interflow soils;
- Water from clean water structures should be discharged back into the watercourse in an attenuated manner; and
- Implementation of strict erosion control measures to limit loss of soil and sedimentation of the watercourse within the proposed project;

We trust we have interpreted your requirements correctly. Please do not hesitate to contact us if there are aspects of our proposal that you would like to discuss further.

Yours Faithfully,

Digital Documentation Not Signed For Security Purposes

Stephen van Staden

APPENDIX 5

Palaeontological Impact Assessment

Palaeontological Impact Assessment for the proposed drilling of a well, AFO-024 (Well 1) on Farm Vogelrand 720, southeast of Hennenman, Free State Province

Desktop Study (Phase 1)

For

Prime Resources

20 March 2022

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf
Experience: 33 years research and lecturing in Palaeontology
25 years PIA studies and over 300 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Prime Resources, Johannesburg, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed drilling of a well for gas, AFO-024 (well 1) and access road on Farm Vogelrand 720, southeast of Hennenman and northwest of Ventersburg, Free State.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the moderately sensitive Quaternary sands and alluvium which are probably underlain by the highly sensitive rocks of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). The well site and access road are in ploughed fields so no fossils will be visible on the surface. There might be vertebrate fossils of the *Daptocephalus* Assemblage Zone. The footprint of the well is very small so unlikely to disturb any fossils. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once drilling activities have commenced. As far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

There is a proposal to remove gas from a well by using a blower (as opposed to fracking where a chemical cocktail is pumped into the ground). The site will be used for the location of a portable compression unit for the removal of gas from a well. The site is about 20m x 30m and will be accessed by a new track across the field to an existing farm road. Refer to Figure 1 below for a site layout plan.

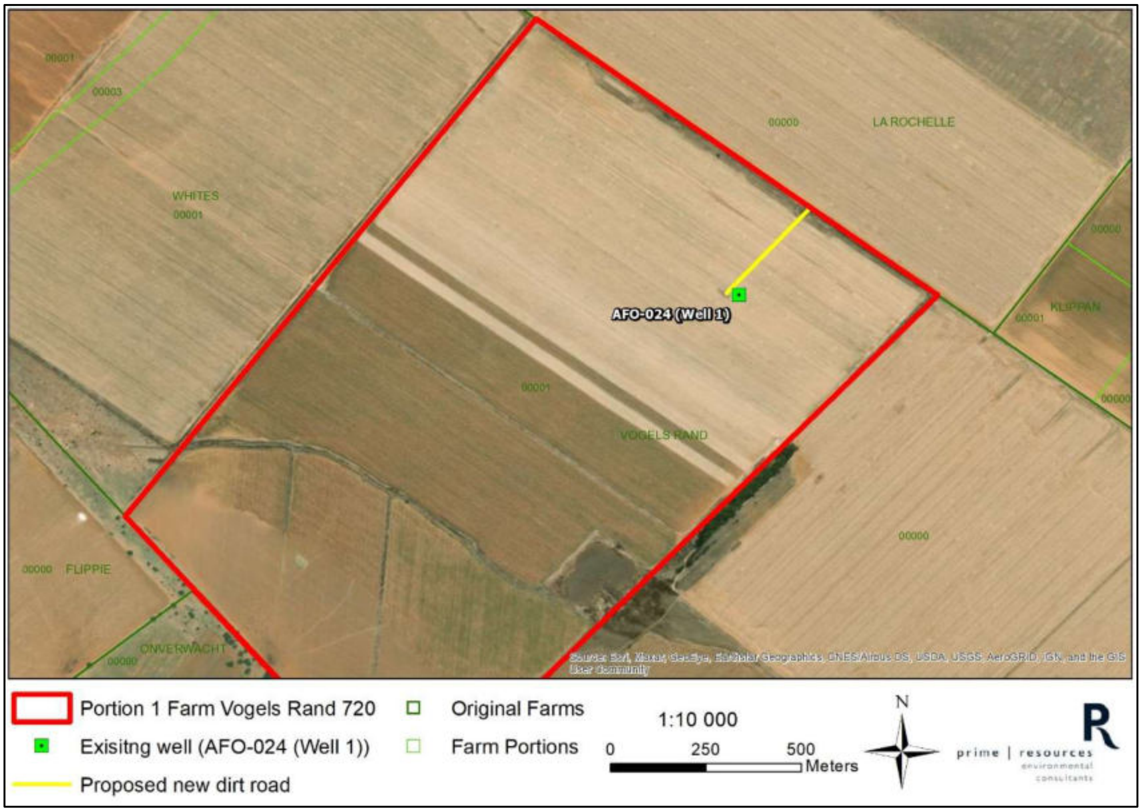

Figure 1: Site layout plan (Prime Resources, 2022)

The AFO-024 (Well 1) site is on Farm Vogelrand 720 about 14 m south southwest of Hennenman and about 12 km northwest of Ventersburg (Figures 1, 2), northern Free State.

A Palaeontological Impact Assessment was requested for the gas well project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

Figure 2: Google Earth map of the general area to show the relative land marks. The AFO-024 gas well project is shown by the yellow pin.

Figure 3: Google Earth Map of the proposed AFO-024 (well 1) location (within the yellow outline, and the access road to the site (lilac line).

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

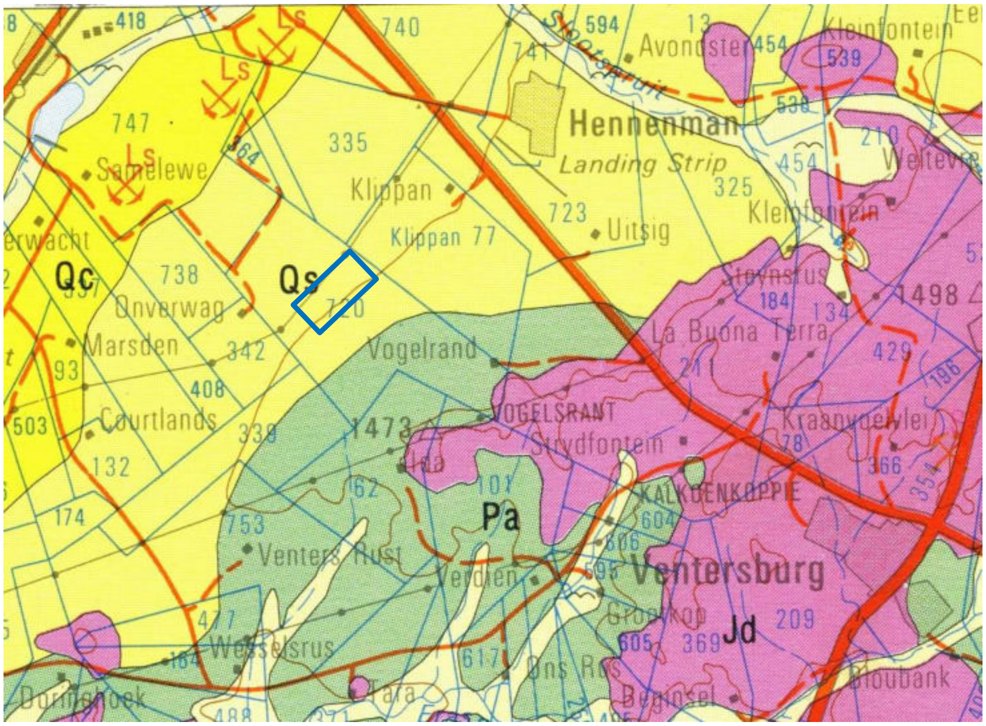

Figure 4: Geological map of the area around the AFO-024 gas well. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2826 Winburg.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary sand	Alluvium, aeolian sand	Neogene, ca 2.5 Ma to present
Qc	Quaternary sand and calcrete	Sand calcrete and surface limestone	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pa	Adelaide Subgroup, Beaufort Group, Karoo SG	Buff-white to white sandstone; mudstone, shale	Late Permian

The project lies in the north-western part of the main Karoo Basin where the sediments of Beaufort Group are exposed. They are overlain by the much younger Quaternary sands, alluvium and soils.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989; Isbell et al., 2012). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group. They comprise tillites, diamictites, mudstones, siltstones and sandstones that were deposited as the basin filled. This group has been divided into two formations with Elandsvlei Formation occurring throughout the basin and the upper Mbizane Formation occurring only in the Free State and KwaZulu Natal (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the Ecca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. All of these sediments have varying proportions of sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Overlying the Ecca Group are the rocks of the Beaufort Group that has been divided into the lower **Adelaide Subgroup** for the Upper Permian strata, and the Tarkastad Subgroup for the Early to Middle Triassic strata. As with the older Karoo sediments, the formations vary across the Karoo Basin.

In this part of the basin three formations are recognised in the Adelaide Subgroup, the basal Koonap Formation, Middleton Formation and thick upper Balfour Formation. The latter has been divided into five members, the lower four from the base up are the Oudeberg, Daggaboersnek, Ripplemead and Elandsberg Members. The topmost member, the Palingkloof Member, is in the earliest Triassic (Smith et al., 2020).

Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from the western part of the basin but are more uniform across the eastern part of the basin. Capping the Stormberg Group are the Drakensberg Group basalts and dykes that signalled the end of deposition in the Karoo basin. The Stormberg Group formations are the lower Molteno Formation shales, the Elliot Formation that has recently been divided into the lower and upper Elliot Formation, and the upper Clarens Formation.

Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

The **Quaternary Kalahari sands** form an extensive cover of much younger deposits over much of the Northern Cape Province and Botswana. Based on the early works of Leicester King, Partridge and Maud (1987, 2000) developed a model of three African Erosion Surfaces for southern Africa, from the Cretaceous to the Pliocene. During the Cretaceous Africa was very high, averaging about 2500-2000m above sea level but the rifting apart of Gondwanaland and formation of the Atlantic and Indian Oceans, coastal erosion was rapid and the escarpment rapidly receded about 120km inland along the east and south coasts, but only 50km along the west coast. The newly exposed surface was called the African Erosion Surface. Their model has been challenged and modified by a number of researchers (Burke, 2011; Braun et al., 2014) who propose that mantle plumes caused uplift of the continent during the late Cretaceous, followed by erosion and further uplift about 30-20 million years ago, The newer interpretations have been followed here.

Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.

There are numerous pans in the Kalahari, generally 3–4 km in diameter (Haddon and McCarthy, 2005). According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Ecca shales and sandstones (ibid).

Most pans in the Kalahari Basin are filled by a layer of clayey sand or calcareous clays and are flanked by lunette dunes formed as a result of deflation of the pan floor during arid periods (Lancaster, 1978a, b; Haddon and McCarthy, 2005). At some localities in the south western Kalahari spring-fed tufas have formed at the margins of pans during periods where groundwater discharge was high (Lancaster, 1986). These tufas may contain evidence of algal mats and stromatolites and may also be associated with calcified reed and root tubes (Lancaster, 1986). Many of the pans are characterised by diatomaceous earth, diatomite or kieselguhr, a white or grey, porous, light-weight, fine-grained sediment composed mainly of the fossilised skeletons of diatoms. Associated with some palaeo-pans and palaeo-springs are fossil bones, root casts, pollen and archaeological artefacts. Well-known sites are Florisbad and Deelpan in the Free State, Wonderkrater in Limpopo and Bosluispan in the Northern Cape.

The Tertiary calcretes can trap fossils and artefacts when associated with palaeo-pans or palaeo-springs (Partridge et al., 2006). Where deflation has occurred, for example along the west coast of South Africa, any trapped materials in the different levels can be concentrated in the depo-centre of the pan or dune and thus it can be challenging to interpret the deposit (Felix-Henningsen et al., 2003). Pans and calcrete occur in the Free State too, for example Deelpan and Florisbad (spring).

The aeolian sands of the Gordonia Formation do not preserve fossils because they have been transported and reworked. Conditions required for the preservation of organic material and formation of fossils are burial in a low energy, anoxic environment such as overbank deposits, lake muds or clays (Briggs and McMahon, 2016). Aeolian sands are high energy, well oxygenated environments. In some regions the sands may have covered pan or spring deposits and these can trap fossils, and more frequently archaeological artefacts. Usually these geomorphological features can be detected using satellite imagery. No such features are visible.

Exploration and research along the palaeo-rivers of Southern Africa, now only present as abandoned palaeochannels, or captured by the present day rivers, the Vaal and Orange Rivers in this case, the gravels and sands might include transported robust and fragmentary fossils. Examples of these are heavy bone fragments and silicified wood fragments, as well as diamonds (de Wit, 1999; de Wit et al., 2000).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The project site for development is in the Quaternary aeolian sands and soil (green).

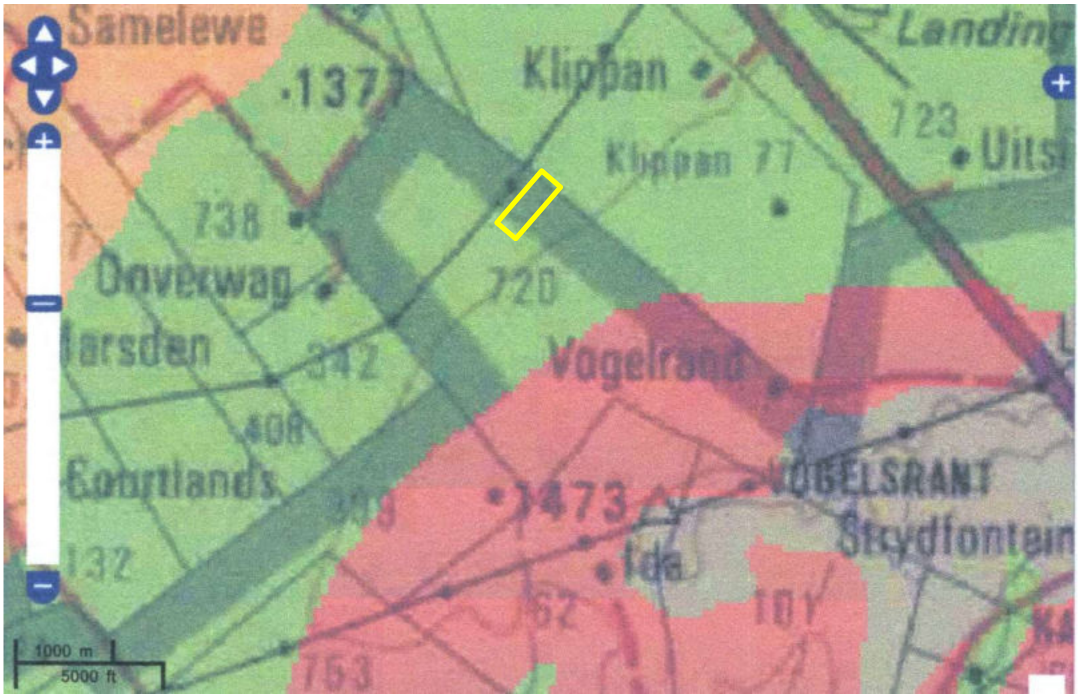

Figure 5: SAHRIS palaeosensitivity map for the site for the proposed AFO-024 gas well 1 shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as moderately sensitive (green) so a desktop study is required. It is close to the rocks of the Adelaide Subgroup which probably underlie the sands and alluvium.

Quaternary sands may have fragments of transported bone and silicified wood that are out of context, with their source unknown. The Adelaide Subgroup rocks are not distinguished by formations in the geological map (Figure 3) but more recent work by a team of palaeontologists has revised the Karoo Biostratigraphic zones (Smith et al., 2020) and the gas well site is most likely underlain by the *Daptocephalus* Assemblage Zone. This zone has a fauna that includes fish, amphibians, therapsids and rare plants and invertebrates. (Smith et al., 2020; Appendix A). Fossil plants from the Adelaide Subgroup are late Permian *Glossopteris* flora examples, including lycopods, sphenophytes, ferns and early gymnosperms (Anderson and Anderson, 1985; Plumstead, 1969).

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

Table 3a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 3b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils and sands do not preserve fossils; so far there are no records from the Adelaide Subgroup of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.

PART B: Assessment		
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be fossil vertebrates and plants below ground in the shales of the Adelaide Subgroup, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in the shales below ground because the well diameter is small. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the right age and type to contain fossils but the area is covered in deep cultivated soils. Since there is an extremely small chance that fossils from the nearby Adelaide Subgroup may occur below ground and may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

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, mudstones, shales and sands are typical for the country and might contain fossil plant, insect, invertebrate and vertebrate material. The sands and soils of the Quaternary period would not preserve fossils.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying deep soils and sands of the Quaternary. There is a very small chance that fossils may occur in the shales below ground of the late Permian Adelaide Subgroup so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once drilling of the well or construction of the access road have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, therefore, as far as the palaeontological is concerned, the project should be authorised.

7. References

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Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Lancaster, N., 1986. Pans in the southwestern Kalahari: a preliminary report.

Smith, R.M.H., Rubidge, B.S., Day, M.O., Botha, J., 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123, 131-140.

doi:10.25131/sajg.123.0009

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figures 5, 6). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the contractor/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

9. Appendix A – Examples of fossils from the Adelaide Subgroup

Figure 5: Photograph of some fossil bone exposed in the rock, as seen in the field. It is usually not possible to identify the animal until the bones have been prepared out of the roc matrix.

Figure 6: Photographs of a selection of fossil plats from the Beaufort *Glossopteris* flora.

Table 4: List of fossil plants and animals from the Adelaide Subgroup, Daptocephalus AZ (compiled from Anderson ad Anderson, 1985: Plumstead, 1969; Smith et al., 2020 and references therein)

Group/sG/Fm	Plant Group	*Genera*	Animal Group	Common Genera
Beaufort Gr Adelaide Subgroup Balfour Fm	Lycophyta	*Gregicaulis*	Amphibia	*Lydekkerina, Thabanchuia, Eolydekkerina, Micropholus, Broomulus*
Daptocephalus AZ	Sphenophyta	*Calamites*	Parareptila	*Saurodektes, Sauropareion, Procolphon, Colleta, Phonodus*
	Filicophyta	*Asterotheca Cladophlebis*	Eureptilia	*Protocuchus, Prolacerta*
	Incertae sedis	*Bergesia*	Anomodontia	*Lystrosaurus, Myosaurus*
	Peltaspermales	*Lepidopteris Dicroidium*	Therocephalia	*Tetracynodon, Scaloposaurus, Olivierosuchus, Ericiolacerta, Regiosaurus*

	Ginkgoales	*Ginkgoites Sphenobaiera*	Cynodontia	*Galesaurus, Progalesaurus, Thrinaxodon*
	Cycadales	*Pseudoctenis Nilsonia*		

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 2022

I) Personal details

Surname : **Bamford**
First names : **Marion Kathleen**
Present employment: Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
Telephone : +27 11 717 6690
Fax : +27 11 717 6694
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees
All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 45 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12-20 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor Open Science UK: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals
Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic, Leakey Foundation

x) Palaeontological Impact Assessments
Selected from the past five years only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells

- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for EnviroPro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe

xi) Research Output

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google scholar h-index = 35; -i10-index = 92
Conferences: numerous presentations at local and international conferences.

APPENDIX 6

Heritage Impact Assessment

Cultural Heritage Survey of the Proposed Gold Mine Operation by Gold One Africa Limited, Ventersburg Project, Lejweleputswa District Municipality, Free State

For

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December 2011
Version 1: Draft Report

Executive Summary

This report contains a comparative heritage impact assessment investigation in accordance with the provisions of Sections 38(1) and 38(3) of the *National Heritage Resources Act* (Act no 25 of 1999). This report focuses on the results from a cultural heritage survey that was conducted as a result of the proposed gold mining by Gold One Africa Ltd in an area south of Hennenman in the Free State.

Stone Age settlement

No Stone Age tools were noted and no manufacturing or basecamp site was identified.

Iron Age settlements

No Iron Age artefacts, structures, features or settlements were identified during the survey.

Graves

A total of 5 individual grave sites (including cemeteries) were recorded. Note that some graves do not have inscriptions and that in terms of Section 36(3) of the National Heritage Resources Act (Act no. 25 of 1999) graves without inscriptions are by default regarded as older than 60 years and are therefore protected by the Act. In the case of this survey this only holds if no descendants could be located to provide detailed information about the graves.

Although no impact is envisaged with the current mining plan any future impacts will result in mitigation measures which may entail full grave relocation. Such a relocation process must be undertaken by suitably qualified individuals with a proven track record. The relocation must also be undertaken in full cognisance of all relevant legislation, including the specific requirements of the National Heritage Resource Act (Act no. 25 of 1999). Furthermore, a concerted effort must also be made to identify all buried individuals and to contact their relatives and descendants. Other legislative measures which may be of relevance include the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), the Human Tissues Act (Act no. 65 of 1983, as amended), the Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws that may be in place.

Historical structures

Site 3 contains a historical house that dates to the 1910s and is associated with a period when the local farmer was involved in breeding race horses. Several outbuildings are associated with the houses. These historical structures are all older than 60 years and are therefore protected by the NHRA (Act no. 25 of 1999). A more recent house dating to the 1940s (still occupied) but which has been constantly altered and expanded is situated adjacent to the earlier house.

Description of and Impacts on Heritage Sites

Site No	Site Description	Impact
1	Cemetery	None (Peripheral)
2	Cemetery	None (Peripheral)
3	Historical farmhouse complex	Peripheral (Utilise)
4	Cemetery	None
5	Cemetery	None
HC1	Farmhouse complex	None
HC2	Farmhouse complex	None

Recommendations

Please refer to Table 3 for individual mitigations measures. Please take note that a Phase 2 Heritage Investigation entails the following aspects:

- Surveying and mapping of the site
- Compiling a detailed report of the affected sites
- Application for a permit from SAHRA

In terms of graves it usually entails a comprehensive social consultation and permit application process for the exhumation and reburial of the graves.

However, also note the following:

It should be kept in mind that archaeological deposits usually occur below ground level. Should archaeological artefacts or skeletal material be revealed in the area during development activities, such activities should be halted, and a university or museum notified in order for an investigation and evaluation of the find(s) to take place **(*cf.* NHRA (Act No. 25 of 1999)**, Section 36 (6)).

Definitions and abbreviations

Midden: Refuse that accumulates in a concentrated heap.
Stone Age: An archaeological term used to define a period of stone tool use and manufacture
Iron Age: An archaeological term used to define a period associated with domesticated livestock and grains, metal working and ceramic manufacture
NHRA: National Heritage Resources Act (Act no 25 of 1999)
SAHRA: South African Heritage Resources Agency
HIA: Heritage Impact Assessment

Contents

1. Introduction

The aim of this cultural heritage survey is to record and document cultural heritage remains consisting of visible archaeological and historical artefacts, structures (including graves) and settlements of cultural significance. Gold One Africa Ltd is currently undertaking a feasibility project for the establishment of a new gold mine in the Free State referred to as its Ventersburg Project. Extensive prospecting activities (drilling) have yielded results that might lead to the establishment of a new gold mine close to Hennenman in the Free State. The heritage survey was requested by Umhlaba Consulting CC on behalf of the client.

2. Objectives

The terms of reference of this survey are as follows:

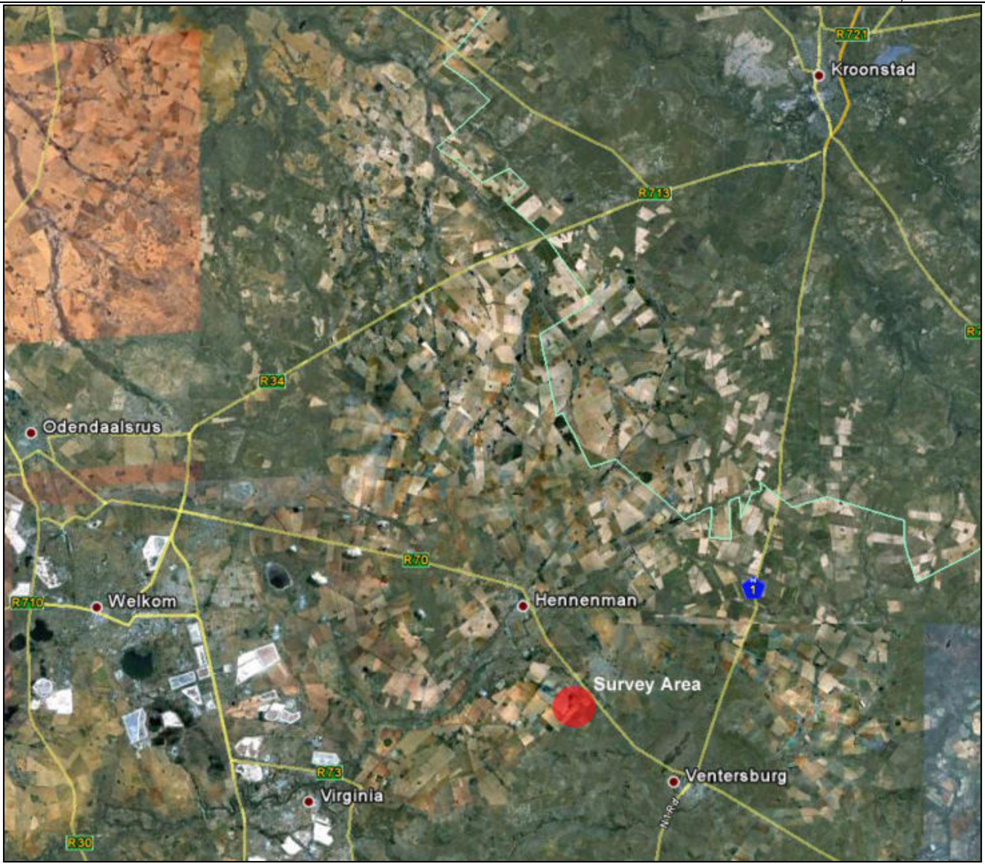
- Provide a detailed description of known archaeological and historical artefacts, structures (including graves), features and settlements
- Estimate the level of significance/importance of the these remains within the study area
- Assess any possible impact on the archaeological and historical remains within the area emanating from the proposed development activities
- Propose possible mitigation measures which will limit or prevent any impact provided that such action is necessitated by the development

3. Study Area

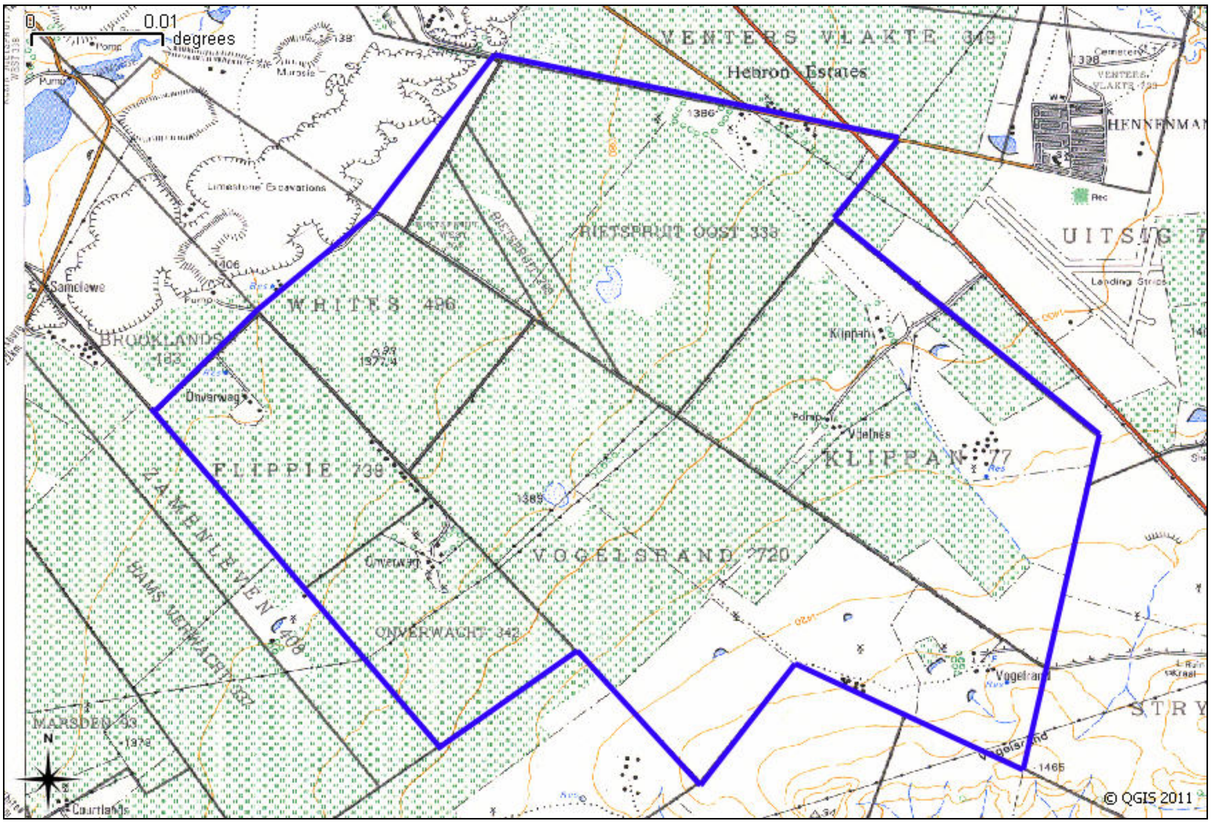
The survey area is situated halfway between Ventersburg and Hennenman and includes the following farms:

- Rietspruit Oost 338
- Rietspruit 299
- Rietspruit West 364
- Klippan 77
- Vogelsrand 720
- Onverwacht 342
- Flippie 738
- Whites 496

The area is characterised by inactive and active agricultural fields as well as other infrastructure developments associated with farming. As a result various dirt roads, fences, power lines, farm houses, sheds and worker accommodation occur in the area. The survey area is also generally open grassland with undulating hills and intermittent trees. Agricultural fields dominate the landscape.



Map 1: Regional context of the survey area



Map 2: Demarcation of the survey area

Figure 1: General view of the northern sections of the survey area

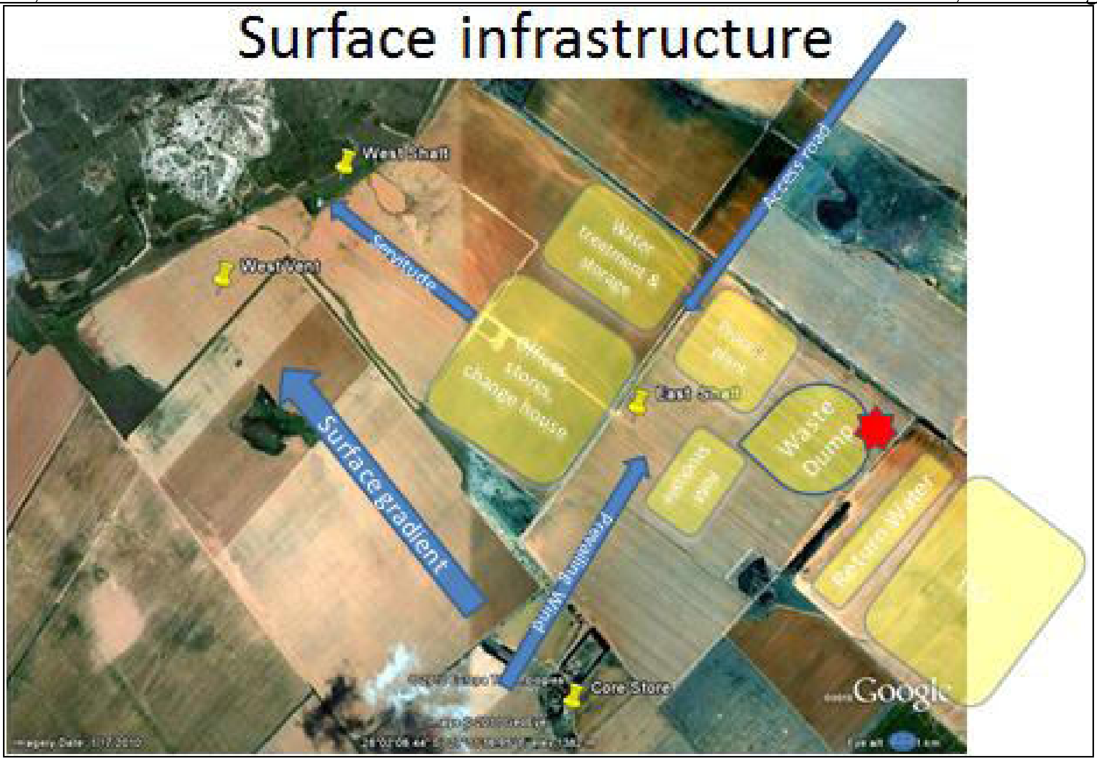
4. Proposed Project Activities

The proposed Ventersburg operation will be an underground gold mining operation. The waste rock from the mine will be deposited in a waste rock dump. Ore extracted from the mine will be processed at an onsite processing plant. In addition a tailing facility will be developed for the disposal of the waste from the processing plant.

The following activities are planned during the construction and operation of the Ventersburg mining operation:

- **Construction will include:**
  - Two access shafts (East and West shaft);
  - Two ventilation shafts;
  - Surface infrastructure (entire surface infrastructure area to be concrete fenced);
  - Tailings facility; and
  - Gold processing plant.

- **Operational activities:**
  - All surface activities to take place within fenced area;
  - Underground traditional gold mining methods will be implemented (drilling and blasting);
  - Production rate proposed at 80 000 tons per month;
  - Waste rock dump;
  - Tailing facility; and
  - Dewatering from the mine.



Map 3: Proposed infrastructure development

5. Legal Framework

- Archaeological remains can be defined as human-made objects, which reflect past ways of life, deposited on or in the ground.

- Heritage resources have lasting value in their own right and provide evidence of the origins of South African society and they are valuable, finite, non-renewable and irreplaceable.

- All archaeological remains, features, structures and artefacts older than 100 years and historic structures older than 60 years are protected by the relevant legislation, in this case the **National Heritage Resources Act (NHRA) (Act No. 25 of 1999, Section 34 & 35)**. The Act makes an archaeological impact assessment as part of an EIA and EMPR mandatory (see **Section 38**). No archaeological artefact, assemblage or settlement (site) may be moved or destroyed without the necessary approval from the **South African Heritage Resources Agency (SAHRA)**. Full cognisance is taken of this Act in making recommendations in this report.

- Cognisance will also be taken of the **Mineral and Petroleum Resources Development Act (Act No 28 of 2002)** and the **National Environmental Management Act (Act No 107 of 1998)** when making any recommendations.

- Human remains older than 60 are protected by the **NHRA**, with reference to **Section 36**. Human remains that are less than 60 years old are protected by the **Human Tissue Act (Act 65 of 1983 as amended)**.

- **Mitigation guidelines (The significance of the site):**

Rating the **significance of the impact** on a historical or archaeological site is linked to the significance of the site itself. If the significance of the site is rated high, the significance of the impact will also result in a high rating. The same rule applies if the significance rating of the site is low (also see Table 1).

Significance Rating	Action
Not protected	1. None
Low	2a. Recording and documentation (Phase 1) of site adequate; no further action required
	2b. Controlled sampling (shovel test pits, auguring), mapping and documentation (Phase 2 investigation); permit required for sampling and destruction
Medium	3. Excavation of representative sample, C^{14} dating, mapping and documentation (Phase 2 investigation); permit required for sampling and destruction [including 2a & 2b]
High	4a. Nomination for listing on Heritage Register (National, Provincial or Local) (Phase 2 & 3 investigation); site management plan; permit required if utilised for education or tourism 4b. Graves: Locate demonstrable descendants through social consulting; obtain permits from applicable legislation, ordinances and regional by-laws; exhumation and reinterment [including 2a, 2b & 3]

Table 1: Rating the significance of sites

- With reference to the evaluation of sites, the certainty of prediction is definite, unless stated otherwise.

- The guidelines as provided by the **NHRA (Act No. 25 of 1999)** in Section 3, with special reference to subsection 3, and the Australian ICOMOS (International Council on Monuments and Sites) Charter (also known as the Burra Charter) are used when determining the cultural significance or other special value of archaeological or historical sites.

- It should be kept in mind that archaeological deposits usually occur below ground level. Should archaeological artefacts or skeletal material be revealed in the area during development activities, such activities should be halted, and a university or museum notified in order for an investigation and evaluation of the find(s) to take place (***cf.*** **NHRA (Act No. 25 of 1999)**, Section 36 (6)).

- **Architectural significance:**
  - Does the site contain any important examples of a building type?
  - Are any of the buildings important examples of a style or period?
  - Do any of the buildings contain fine details and or reflect fine workmanship?
  - Are any of the buildings the work of a major architect or builder?

- Are the buildings important examples of an industrial, technological or engineering development?
- What is the integrity of the buildings?
- Are the buildings still utilised?
- Has the buildings been altered and are these alterations sympathetic to the original intent of the design?

- **Spatial significance of architecture:**
  - Is the site or any of the buildings a landmark in the city or town?
  - Does the plant contribute to the character of the neighbourhood/region?
  - Do the buildings contribute to the character of the street or square?
  - Is the place or building part of an important group of buildings?

- **Architecture**: **Levels of significance** are:
  - Protect
  - Highly significant
  - Possible significance
  - Least significance
  - No significance

- **Architecture: Levels of protection** are:

Retain and protect	Considered to be of high significance. The building or structure can be used as part of the development but must be suitably protected. Should not include major structural alterations. If the building is older than 60 years a modification permit is required from SAHRA.
Retain and re-use	Considered to be of moderate significance. The building or structure can be altered to be accommodated within the development plans. Structural alterations can be included. If the building is older than 60 years a modification permit is required from SAHRA.
Alter and re-use	Considered to be of low significance. The building or structure can be structurally altered or destruction can be considered following further documentation. If the building is older than 60 years a modification/destruction permit is required from SAHRA.
Can be demolished	Considered to be of negligible significance and can be demolished. If the building is older than 60 years a destruction permit is required from SAHRA.

Table 2: Level of protection of buildings/structures

- A copy of this report will be lodged with the **SAHRA** as stipulated by the National Heritage Resources Act (NHRA) (Act No. 25 of 1999), Section 38 (especially subsection 4).

- Note that the final decision for the approval of permits, or the removal or destruction of sites, structures and artefacts identified in this report, rests with the SAHRA (or relevant PHRA).

6. Study Approach/Methods

Regional maps and other geographical information were supplied by Umhlaba Consulting CC and Gold One Africa Ltd. Google images and topographic maps were also used to indicate the survey area and to plot heritage sites. The sites were localised on the 1:50 000 topographic map 2827AA.

6.1 Review of information/data

Additional information on the cultural heritage of the area was sourced from the following records:

- National Mapping Project by SAHRA (which lists heritage impact assessment reports submitted for South Africa)
- Maps and information documents supplied by the client

6.2 Site visit

The area was surveyed on 19 October 2011. The survey area was accessed by a network of dirt roads and agricultural areas. Specific areas were surveyed on foot using intensive pedestrian survey techniques. A local representative from the mine also facilitated access to the various farms and known sensitive areas.

6.3 Assessment of Impact

The criteria used to describe heritage resources and to provide a significance rating of recorded sites are listed in the NHRA (Act 25 of 1999) specifically Section 7(7) and Section 38). SAHRA also published various regulations including: Minimum standards: Archaeological and palaeontological components of impact assessment reports in 2006.

6.4 Assumptions, uncertainties and gaps in knowledge

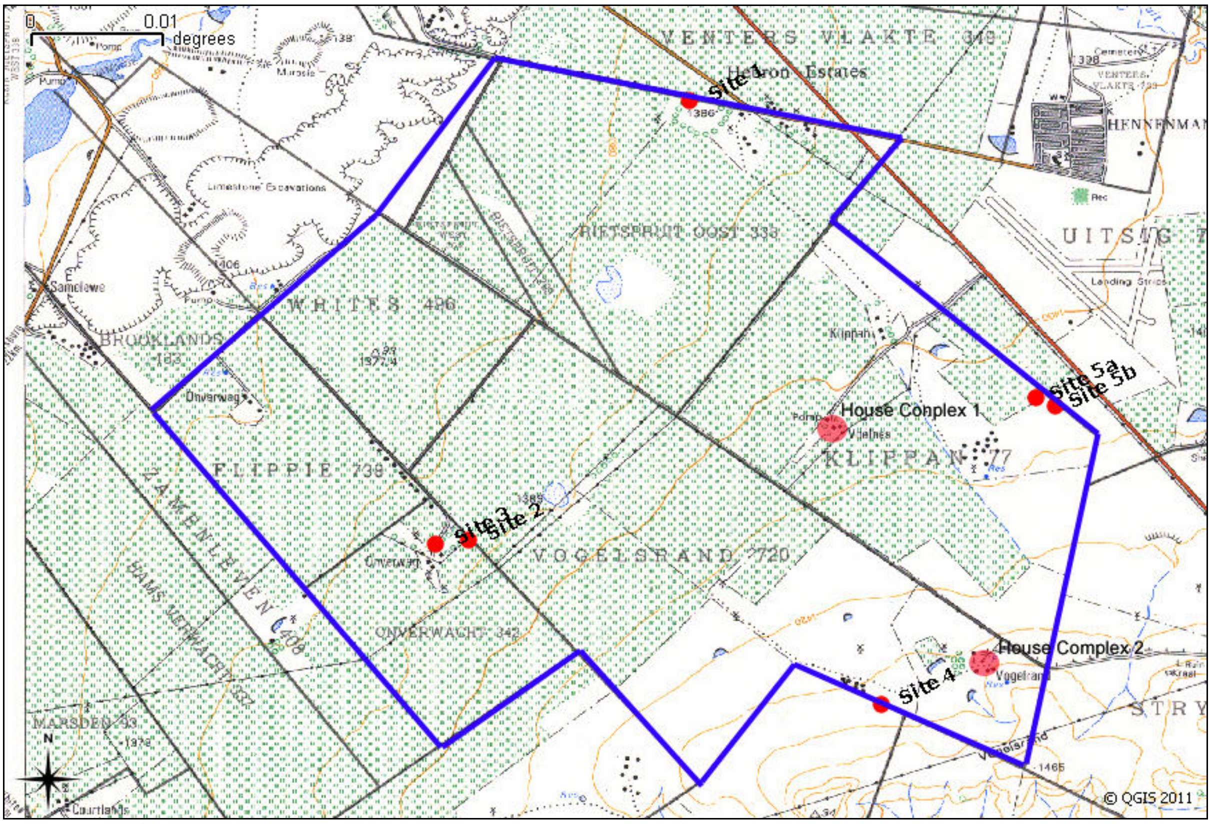
Although most areas were fenced, no severe physical restrictions were encountered. A major assumption for this study is that most of the agricultural fields have been worked for several generations and are severally disturbed and therefore highly unlikely to yield heritage features. However, care should be taken not to over generalise this aspects. Also note that due to the subterranean nature of cultural remains this report should not be construed as a record of all archaeological and historic sites in the area.

Please note that the funeral proceedings of one of the prominent members of the local farming community took place during the survey. As a result two main farm complexes could not be accessed and assessed. These are:

- House Complex 1 (HC1) on the farm Klippan 77; and
- House Complex 2 (HC2) on the farm Vogelsrand 720.

7. Description of Cultural Heritage Sites

A total of 7 cultural heritage sites were identified during the survey. Please note that although three farmhouse complexes were recorded (Site 3, House Complex 1 and 2) that are probably older than 60 years they are all still occupied with the resultant ongoing alterations and maintenance.



Map 4: Location of heritage sites within the survey area

7.1 Cemeteries and Individual Graves (see Appendix 2)

Sites 1, 2, 4, 5a and 5b all comprise cemeteries which contain a mixture of old and new graves. Most of the graves are either demarcated by packed stones, cement and brick or granite bases and headstones. The cemeteries are all partially fenced and relatives still seem live in the area (substantiated by cleared graves with recent offerings). A high significance rating (local level) has been awarded to these sites.

7.2 Historical Structures (see Appendix 2)

Sites 3, HC1 and HC2 comprise historical structures which are probably older than 60 years and are therefore protected by the NHRA (Act no. 25 of 1999). However is should be noted that extensive alterations and additions have been made to most of the original structures. As such most house structures have not retained their original heritage value, in fact it has been severely diminished. As a result all recorded farmhouse complexes received a low significance rating (local level), except for the farm house dating to the 1910s which forms part of Site 3 which was rated medium (provincial level). The house has also been severely altered, renovated and expanded with the result that it also lost most of its significance and heritage value.

7.4 Summary of Sites

Site No	Coordinates	Site Type	Statement of Significance	Impact	Proposed Mitigation
1	27.049787°E 28.012642°S	Cemetery	High (Local level)	Peripheral (None)	▪ Demarcated with palisade fence ▪ Install access gate ▪ Buffer zone: 60 metres
2	27.033052°E 28.045875°S	Cemetery	High (Local level)	Peripheral (None)	▪ Demarcated with palisade fence ▪ Install access gate ▪ Buffer zone: 60 metres
3	27.030616°E 28.046187°S	House Complex	Medium (Provincial level)	Peripheral (Utilized)	▪ Phase 2: Survey, mapping and archival research ▪ Permit from SAHRA
4	27.064269°E 28.058324°S	Cemetery	High (Local level)	None	▪ Demarcated with palisade fence ▪ Install access gate ▪ Buffer zone: 60 metres
5a 5b	27.076008°E 28.035122°S 27.077444°E 28.035709°S	Graves and Cemetery	High (Local level)	None	▪ Demarcated with palisade fence ▪ Access gate ▪ Buffer zone: 60 metres
HC1	29.111483°E 26.601773°S	House Complex	Low (Local level)	None	None
HC2	29.131425°E 26.604563°S	House Complex	Low (local level)	None	None

Table 3: Summary of sites with ratings, significance and mitigation measures

8. Management (Mitigation) Measures

Although no direct impact is envisaged on the heritage sites all the recorded cemeteries (Sites 1, 2, 4 and 5) should be fenced off with palisade fencing (with access gate). Furthermore a buffer zone of at least 60 metres should be observed as a precautionary measure to prevent any secondary or cumulative impacts on the graves.

The current proposed areas earmarked for mining activities will not affect the farmhouse complexes (Sites 3, HC1 and HC2). However structures associated with Site 3 might be utilised as site offices in the future. In case this materialises in the future the old farm house dating to the 1910s must be recorded, mapped and assessed by a conservation architect and a permit for any further renovations and alterations must be obtained from SAHRA.

9. Recommendations and Conclusions

Stone Age settlement

No Stone Age tools were noted and no manufacturing or basecamp site was identified.

Iron Age settlements

No Iron Age artefacts, structures, features or settlements were identified during the survey.

Graves

A total of 5 individual grave sites (including cemeteries) were recorded. Note that some graves do not have inscriptions and that in terms of Section 36(3) of the National Heritage Resources Act (Act no. 25 of 1999) graves without inscriptions are by default regarded as older than 60 years and are therefore protected by the Act. In the case of this survey this only holds if no descendants could be located to provide detailed information about the graves.

Although no impact is envisaged with the current mining plan any future impacts will result in mitigation measures which may entail full grave relocation. Such a relocation process must be undertaken by suitably qualified individuals with a proven track record. The relocation must also be undertaken in full cognisance of all relevant legislation, including the specific requirements of the National Heritage Resource Act (Act no. 25 of 1999). Furthermore, a concerted effort must also be made to identify all buried individuals and to contact their relatives and descendants. Other legislative measures which may be of relevance include the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925), the Human Tissues Act (Act no. 65 of 1983, as amended), the Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws that may be in place.

Also note that four categories of graves can be identified. These are:

- Graves younger than 60 years;
- Graves older than 60 years, but younger than 100 years;
- Graves older than 100 years; and
- Graves of victims of conflict or of individuals of royal descent.

Historical structures

Site 3 contains a historical house that dates to the 1910s and is associated with a period when the local farmer was involved in breeding race horses. Several outbuildings are associated with the houses. These historical structures are all older than 60 years and are therefore protected by the NHRA (Act no. 25 of 1999).

Recommendations

Please refer to Table 3 for individual mitigations measures. Please take note that a Phase 2 Heritage Investigation entails the following aspects:

- Surveying and mapping of the site
- Compiling a detailed report of the affected sites
- Application for a permit from SAHRA

In terms of graves it usually entails a comprehensive social consultation and permit application process for the exhumation and reburial of the graves.

However, also note the following:

It should be kept in mind that archaeological deposits usually occur below ground level. Should archaeological artefacts or skeletal material be revealed in the area during development activities, such activities should be halted, and a university or museum notified in order for an investigation and evaluation of the find(s) to take place **(*cf*. NHRA (Act No. 25 of 1999)**, Section 36 (6)).

References

Dreyer, C. 2004. *Archaeological and Historical Investigation of the Proposed Developments at Ventersburg, Free State.* An unpublished report on file at SAHRA as: 2004-SAHRA-0050.

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Addendum 1: Archaeological Sequence & Regional History

The table provides a general overview of the chronological sequence of the archaeological periods in South Africa.

PERIOD	APPROXIMATE DATE
Early Stone Age	More than c. 2 million years ago - c. 250 000 years ago
Middle Stone Age	c. 250 000 years ago – c. 25 000 years ago
Later Stone Age (Includes San Rock Art)	c. 25 000 years ago - c. AD 200 (up to historic times in certain areas)
Early Iron Age	c. AD 400 - c. AD 1025
Late Iron Age (Stonewalled sites)	c. AD 1025 - c. AD 1830 (c. AD 1640 - c. AD 1830)

Archaeological Context

Stone Age Sequence

Concentrations of Early Stone Age (ESA) sites are usually present on the flood-plains of perennial rivers and may date to over 2 million years ago. These ESA open sites may contain scatters of stone tools and manufacturing debris and secondly, large concentrated deposits ranging from pebble tool choppers to core tools such as handaxes and cleavers. The earliest hominins who made these stone tools, probably not always actively hunted, instead relying on the opportunistic scavenging of meat from carnivore fill sites.

Middle Stone Age (MSA) sites also occur on flood plains, but are also associated with caves and rock shelters (overhangs). Sites usually consist of large concentrations of knapped stone flakes such as scrapers, points and blades and associated manufacturing debris. Tools may have been hafted but organic materials, such as those used in hafting, seldom preserve. Limited drive-hunting activities are also associated with this period.

Sites dating to the Later Stone Age (LSA) are better preserved in rock shelters, although open sites with scatters of mainly stone tools can occur. Well-protected deposits in shelters allow for stable conditions that result in the preservation of organic materials such as wood, bone, hearths, ostrich eggshell beads and even bedding material. By using San (Bushman) ethnographic data a better understanding of this period is possible. South African rock art is also associated with the LSA.

Iron Age Sequence

In the northern regions of South Africa at least three settlement phases have been distinguished for early prehistoric agropastoralist settlements during the **Early Iron Age** (EIA). Diagnostic pottery assemblages can be used to infer group identities and to trace movements across the landscape. The first phase of the Early Iron Age, known as **Happy Rest** (named after the site where the ceramics were first identified), is representative of the Western Stream of migrations, and dates to AD 400 - AD 600. The second phase of **Diamant** is dated to AD 600 - AD 900 and was first recognized at the eponymous site of Diamant in the western Waterberg. The third phase, characterised by herringbone-decorated pottery of the **Eiland** tradition, is regarded as the final expression of the Early Iron Age (EIA) and occurs over large parts of the North West Province, Northern Province, Gauteng and Mpumalanga. This phase has been dated to about AD 900 - AD 1200. These sites are usually located on low-lying spurs close to water.

The **Late Iron Age** (LIA) settlements are characterised by stone-walled enclosures situated on defensive hilltops c. AD 1640 - AD 1830). This occupation phase has been linked to the arrival of ancestral Northern Sotho, Tswana and Ndebele (Nguni–speakers) in the northern regions of South Africa with associated sites dating between the sixteenth and seventeenth centuries AD. The terminal LIA is represented by late 18th/early 19th century settlements with multichrome Moloko pottery commonly attributed to the Sotho-Tswana. These settlements can in many instances be correlated with oral traditions on population movements during which African farming communities sought refuge in mountainous regions during the processes of disruption in the northern interior of South Africa, resulting from the so-called *difaqane* (or m*fecane*).

History of the region

Ventersburg is a small town in the Lejweleputswa District Municipality of the Free State province in South Africa. It was established on the farm Kromfontein which was owned by PA Venter who died in 1857. His son allowed a Reform Church to be established on the farm in 1864 and by 1871, the first plots of the original farm were sold. Ventersburg was declared as a town on 6 May 1873. The Dutch Reform Church was built in Ventersburg in 1891 but it was burnt down in 1900 by the British forces during the Boer War. The church was later re-built in 1912.

In 1903, Ventersburg became a municipality but on the 5 December 2000 it was incorporated into the Matjhabeng Local Municipality along with the city of Welkom and the towns of Allanridge, Hennenman, Odendaalsrus, and Virginia.

Hennenman is a small town also in the Lejweleputswa District Municipality of the Free State. The town is unusual in the district as its economy is based mainly on agriculture not gold. The town, which started out as a railway station, was previously called *Ventersburg Road*. The name was changed in 1927 to Hennenman Station after a prominent local farmer, Mr. P.F. Hennenman of the farm Swartpan. On the 5 December 2000, Hennenman was incorporated into the Matjhabeng Local Municipality with the city of Welkom and the towns of Allanridge, Odendaalsrus, Ventersburg and Virginia (see also Dreyer 2004).

Appendix 2

Site 1

A. GENERAL SITE DESCRIPTION		
The site comprises cemetery which consists of at least 52 graves with an east-west orientation with the headstones on the western side. Most of the graves are demarcated with packed stone/sand bases with no headstone. A few graves have granite bases and headstones. Although most graves have no inscriptions the following details were recorded: ▪ Toloki Joshua Moseme (Born: 12/04/1912, Died: 10/11/1968) ▪ Moselantje Jocobeth Motsumi (No dates) ▪ Stimela Adam Motsumi (No dates) ▪ No Name (Stone broken) (14/12/1879, Died: 10/05/1966 Unmarked graves are by default regarded as older than 60 years and are therefore protected by the NHRA (Act No 25 of 1999, section 36).		
B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.	√	
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class		√

of South Africa's natural or cultural places or objects.			
B2. REGIONAL CONTEXT			
Other similar sites in the regional landscape.			√
B3. CONDITION OF SITE			
Integrity of deposits/structures.	Stable, some headstones broken		
C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local	√		
Specific community	√		
D. FIELD REGISTER RATING			
National/Grade 1 [should be registered, retained]			
Provincial/Grade 2 [should be registered, retained]			
Local/Grade 3A [should be registered, mitigation not advised]			
Local/Grade 3B [High significance; mitigation, partly retained]			
Generally Protected A [High/Medium significance, mitigation]			√
Generally protected B [Medium significance, to be recorded]			
Generally Protected C [Low significance, no further action]			
E. GENERAL STATEMENT OF SITE SIGNIFICANCE			
Low			
Medium			
High			√
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT			
None			
Peripheral			√
Destruction			
Uncertain			

G. RECOMMENDED MITIGATION

The following is precautionary measures are recommended:

- Palisade fencing to demarcate and protect the cemetery
- Access gate
- Buffer zone of at least 60 metres

If future impacts are envisaged a Phase 2 investigation is recommended which includes:

- Exhumation and reburial
- Social consultation process

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- National Heritage Resources Act (Section 36 of Act no. 25 of 1999)
- Human Tissue Act (Act 65 of 1983 as amended)
- Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925)
- Ordinance on Excavations (Ordinance no. 12 of 1980)
- Local and regional provisions, laws and by-laws
- Permit from SAHRA

I. PHOTOGRAPHS

Figure 2: Some of the graves with granite bases and headstones

Figure 3: Some of the unmarked graves

Figure 4: Some of the unmarked graves demarcated with packed stones

Site 2

A. GENERAL SITE DESCRIPTION		
The site comprises cemetery which consists of at least 40 graves with an east-west orientation with the headstones on the western side. Most of the graves are demarcated with packed stone/sand bases with no headstone. A few graves have granite bases and headstones. Although most graves have no inscriptions the following details were recorded: ▪ Anacletta Motlabane (Born: 08/11/1926, Died: 06/05/1964) ▪ Jacob Makhetha (Born: 22/04/1910, Died: 21/01/1975) ▪ Maria Mmatumelo Mokhoabane (Born: 12/06/1944, Died: 07/03/1978) ▪ Elisa Mathata (Born: 19/02/1920, Died: 26/12/1977) ▪ Name faded (Died: 1948?) ▪ Selonyane Thakamakhooa (no date) ▪ Moses Gladstone Ntyoko (Born: 24/12/1930, Died: 21/06/2004) ▪ Mamokete Julia Ntyoko (Born: 20/10/1936, Died: 02/11/2004) ▪ Jwalane Adelina Manka (Born: 01/01/1904, Died: 01/03/1989) ▪ Nogate Sanah Ntshoko (Born: 01/01/1937, Died: 05/08/1988) Unmarked graves are by default regarded as older than 60 years and are therefore protected by the NHRA (Act No 25 of 1999, section 36).		
B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or		√

precolonial history.		
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.	√	
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√
B2. REGIONAL CONTEXT		
Other similar sites in the regional landscape.	√	
B3. CONDITION OF SITE		
Integrity of deposits/structures.	Stable, some headstone broken	

C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local	√		
Specific community	√		

D. FIELD REGISTER RATING	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	√
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	

E. GENERAL STATEMENT OF SITE SIGNIFICANCE	
Low	
Medium	
High	√

F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT	
None	
Peripheral	√
Destruction	
Uncertain	

G. RECOMMENDED MITIGATION

The following is precautionary measures are recommended:

- Palisade fencing to demarcate and protect the cemetery
- Access gate
- Buffer zone of at least 60 metres

If future impacts are envisaged a Phase 2 investigation is recommended which includes:

- Exhumation and reburial
- Social consultation process

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- National Heritage Resources Act (Section 36 of Act no. 25 of 1999)
- Human Tissue Act (Act 65 of 1983 as amended)
- Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925)
- Ordinance on Excavations (Ordinance no. 12 of 1980)
- Local and regional provisions, laws and by-laws
- Permit from SAHRA

I. PHOTOGRAPHS

Figure 5: Some of the demarcated graves in the cemetery

Site 3

A. GENERAL SITE DESCRIPTION		
The site comprises a historic farmhouse complex consisting of the following aspects: • An old multi-room brick house with corrugated iron roof and surrounding veranda (substantial midden situated in front of the house) dating to the 1910s • Associated outbuildings (especially old horse stables) • Modern house (occupied) built in the 1940s but renovated and altered through the years The old farm house is a good example of the early 20th century building style. However, the building has been substantially altered, expanded and renovated which diminishes the significance value of the building. Also internal roof trusses are missing and some of the outer walling is collapsing. The outside of the house has also been covered in a type of cement gladding. Most of the windows and doors have been altered and the veranda has been closed off with brick and cement infill.		
B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		√
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.	√	
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).		√
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√
B2. REGIONAL CONTEXT		

Other similar sites in the regional landscape.			√
B3. CONDITION OF SITE			
Integrity of deposits/structures.	1910s house: Unstable 1940s house: Occupied		
C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local		√	
Specific community		√	
D. FIELD REGISTER RATING			
National/Grade 1 [should be registered, retained]			
Provincial/Grade 2 [should be registered, retained]			
Local/Grade 3A [should be registered, mitigation not advised]			
Local/Grade 3B [High significance; mitigation, partly retained]			
Generally Protected A [High/Medium significance, mitigation]			√
Generally protected B [Medium significance, to be recorded]			
Generally Protected C [Low significance, no further action]			
E. GENERAL STATEMENT OF SITE SIGNIFICANCE			
Low			
Medium			√
High			
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT			
None			
Peripheral			√
Destruction			
Uncertain			
G. RECOMMENDED MITIGATION Phase 2 investigation is recommended: • Survey and mapping • Archival research for further background			
H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS • NHRA (Act 25 of 1999), Section 34 • Destruction permit from SAHRA			
I. PHOTOGRAPHS			

Figure 6: Old farm house dating to the 1910s with midden in the forefront

Figure 7: Alterations to the veranda pillars

Figure 8: Additions to the main house

Figure 9: Unstable condition of some of the outer walling

Figure 10: Associated structure, probably stables for the horses (notice alterations)

Figure 11: Adjacent farmhouse built in the mid 1940s (notice additions and alterations which continued until recently)

Site 4

A. GENERAL SITE DESCRIPTION

The site comprises cemetery which consists of at least 40 graves with an east-west orientation with the headstones on the western side. Most of the graves are demarcated with packed stone/sand bases with no headstone. A few graves have granite bases and headstones. Although most graves have no inscriptions the following details were recorded:

- Ntone Jonas Malunga (Born: 10/07/1904, Died: 02/12/1984)
- Lydia Ramabodu (Born: 18/02/19??, Died: 04/02/????)
- Ghely Pulani Ramabodu (No date?)
- Tomas Pheello (Died?: 02/01/1976)
- ? Mohapi Born: 1963, Died: 1969)
- Ntlantla Kompi (Born: 10/05/1998, Died: 06/01/1998)
- Mmalebone Berlina Kompi (Born: 19/12/1965, Died: 31/10/1998)
- Benak? Dipho (Died: 23/07/1932)

Unmarked graves are by default regarded as older than 60 years and are therefore protected by the NHRA (Act No 25 of 1999, section 36).

B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.	√	
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√

Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√
B2. REGIONAL CONTEXT		
Other similar sites in the regional landscape.	√	
B3. CONDITION OF SITE		
Integrity of deposits/structures.	Stable	

C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local	√		
Specific community	√		

D. FIELD REGISTER RATING	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	√
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	
E. GENERAL STATEMENT OF SITE SIGNIFICANCE	
Low	
Medium	
High	√
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT	
None	√
Peripheral	
Destruction	
Uncertain	

G. RECOMMENDED MITIGATION

The following is precautionary measures are recommended:

- Palisade fencing to demarcate and protect the cemetery
- Access gate
- Buffer zone of at least 60 metres

If future impacts are envisaged a Phase 2 investigation is recommended which includes:

- Exhumation and reburial
- Social consultation process

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- National Heritage Resources Act (Section 36 of Act no. 25 of 1999)
- Human Tissue Act (Act 65 of 1983 as amended)
- Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925)
- Ordinance on Excavations (Ordinance no. 12 of 1980)
- Local and regional provisions, laws and by-laws
- Permit from SAHRA

I. PHOTOGRAPHS

Figure 12: Some of the graves in the cemetery

Site 5

A. GENERAL SITE DESCRIPTION

The site comprises cemetery containing at least 40 graves and two separate graves situated a few metres to the north. All the graves have an east-west orientation with the headstones on the western side. Most of the graves are demarcated with packed stone/sand bases with no headstone. A few graves have granite bases and headstones.
Although most graves have no inscriptions the following details were recorded:

- Frans Mahlelehlele Thaele (Died: 1940)
- Annatletta Clotsi Makgauta (Born: 1884, Died: 1979)
- Sarah Mojapela Mohlouoa (Born: 1820, Died: 1964)
- Ntoko Samuel (Born: 01/10/1943, Died: 20/03/1991)
- Masabata Elma Mohlouoa (Born: 03/10/1976, Died: 23/03/1978)
- Kleinbooi Mohoalali (Died: 17/02/1978)
- Serame Mokoena (Died: 23/05/1995)

Unmarked graves are by default regarded as older than 60 years and are therefore protected by the NHRA (Act No 25 of 1999, section 36).

B. SITE EVALUATION

B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.	√	
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√

B2. REGIONAL CONTEXT		
Other similar sites in the regional landscape.	√	

B3. CONDITION OF SITE	
Integrity of deposits/structures.	Stable

C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local	√		
Specific community	√		

D. FIELD REGISTER RATING	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	√
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	

E. GENERAL STATEMENT OF SITE SIGNIFICANCE

Low	
Medium	
High	√
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT	
None	√
Peripheral	
Destruction	
Uncertain	

G. RECOMMENDED MITIGATION

The following is precautionary measures are recommended:

- Palisade fencing to demarcate and protect the cemetery
- Access gate
- Buffer zone of at least 60 metres

If future impacts are envisaged a Phase 2 investigation is recommended which includes:

- Exhumation and reburial
- Social consultation process

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- National Heritage Resources Act (Section 36 of Act no. 25 of 1999)
- Human Tissue Act (Act 65 of 1983 as amended)
- Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925)
- Ordinance on Excavations (Ordinance no. 12 of 1980)
- Local and regional provisions, laws and by-laws
- Permit from SAHRA

I. PHOTOGRAPHS

Figure 13: Some of the graves in the cemetery

Site 6 (House Complex 1)

A. GENERAL SITE DESCRIPTION The site comprises an extensive farmhouse complex with associated outbuildings. Although the site was not visited it is deduced from the regional history that some of the building date to the early 20th century and will therefore be older than 60 years. However, the structures are still occupied with the resultant maintenance and possible alterations and changes made to the original structures.		
B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√
It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		√
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√
B2. REGIONAL CONTEXT		
Other similar sites in the regional landscape.	√	
B3. CONDITION OF SITE		

Integrity of deposits/structures.	Occupied		
C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local			√
Specific community			√
D. FIELD REGISTER RATING			
National/Grade 1 [should be registered, retained]			
Provincial/Grade 2 [should be registered, retained]			
Local/Grade 3A [should be registered, mitigation not advised]			
Local/Grade 3B [High significance; mitigation, partly retained]			
Generally Protected A [High/Medium significance, mitigation]			
Generally protected B [Medium significance, to be recorded]			
Generally Protected C [Low significance, no further action]			√
E. GENERAL STATEMENT OF SITE SIGNIFICANCE			
Low			√
Medium			
High			
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT			
None			√
Peripheral			
Destruction			
Uncertain			
G. RECOMMENDED MITIGATION • None, sufficiently recorded as no impact it envisaged			
H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS • NHRA (Act 25 of 1999) • Destruction permit from SAHRA			
I. PHOTOGRAPHS			

Figure 14: Aerial view of the farmhouse complex

Site 7 (House Complex 2)

A. GENERAL SITE DESCRIPTION

The site comprises an extensive farmhouse complex with associated outbuildings. Although the site was not visited it is deduced from the regional history that some of the building date to the early 20th century and will therefore be older than 60 years. However, the structures are still occupied with the resultant maintenance and possible alterations and changes made to the original structures.

B. SITE EVALUATION		
B1. HERITAGE VALUE	**Yes**	**No**
Historic Value		
It has importance to the community or pattern of South Africa's history or precolonial history.		√
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.		√

It has significance relating to the history of slavery in South Africa.		√
Aesthetic Value		
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.		√
Scientific Value		
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		√
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		√
It has importance to the wider understanding of the temporal change of cultural landscapes, settlement patterns and human occupation.	√	
Social Value		
It has strong or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).	√	
Tourism Value		
It has significance through its contribution towards the promotion of a local sociocultural identity and can be developed as tourist destination.		√
Rarity Value		
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		√
Representative Value		
It is importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		√
B2. REGIONAL CONTEXT		
Other similar sites in the regional landscape.	√	
B3. CONDITION OF SITE		
Integrity of deposits/structures.	Occupied	

C. SPHERE OF SIGNIFICANCE	**High**	**Medium**	**Low**
International			√
National			√
Provincial			√
Local			√
Specific community			√

D. FIELD REGISTER RATING	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	
Generally protected B [Medium significance, to be recorded]	
Generally Protected C [Low significance, no further action]	√
E. GENERAL STATEMENT OF SITE SIGNIFICANCE	
Low	√
Medium	
High	
F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT	
None	√
Peripheral	

Destruction	
Uncertain	

G. RECOMMENDED MITIGATION

- None, sufficiently recorded as no impact it envisaged

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- NHRA (Act 25 of 1999)
- Destruction permit from SAHRA

I. PHOTOGRAPHS

Figure 15: Aerial view of the farmhouse complex

APPENDIX 7

Groundwater Impact Assessment Study

Gold One Africa Limited
Ventersburg Mine

Groundwater Impact Assessment Study

DATE:	**November 2012**
REVISION	FINAL
REFERENCE:	220_Ventersburg
COMPILED FOR:	Gold One International Limited Postnet Suite 115, Private Bag X17, Weltevreden Park, 1715
COMPILED BY:	*GROUNDWATER SQUARE* *Consulting Groundwater Specialists*

Executive Summary

Gold One Africa Ltd is currently evaluating the feasibility of a new gold mine near Hennenman in the Free State (referred to as the Ventersburg project). This groundwater study is an independent evaluation of the potential impacts on the groundwater system.

The following important aspects relate to the anticipated impact on the local groundwater system:

- The Twin Vertical Shaft System will have a localised impact:
    - A 100m influence zone on the shallow groundwater system is the most-likely scenario; maximum 200m;
    - Water encountered in the shallow Karoo aquifers (deeper than the natural groundwater level of 15m) will be reflective of the local background water quality. High Na-Cl concentrations will be observed in the deep Karoo aquifers;
- Groundwater conditions during Underground Mining:
    - No evidence could be found to contradict the *Groundwater Square* 2010 desk-study research of typical water inflow volumes and water quality in surrounding mines;
    - Peak inflow volumes of 3ML/d to 6ML/d are anticipated after year 4, when full production will have been reached;
    - The average anticipated saline water quality concentrations are: EC = 800mS/m, TDS = 5500mg/L, Cl = 2800mg/L and Na = 2000mg/L;
- *Bear GeoConsultants* made several recommendations on the construction activities in the Plant area. It is assumed that:
    - Potentially acid generating material in the ROM stockpile areas will be placed on lined areas;
    - All contaminated water will be stored in tanks or suitably lined (e.g. HDPE liners) dams;
- The Waste Rock Dump (WRD) and Tailings Storage Facility (TSF) are considered to be the mining activities with the highest potential of impacting the groundwater environment:
    - During the operational phase, the WRD will most-likely have a relatively small impact compared to the TSF:
        - It is likely that the natural clay in the area can be compacted sufficiently to a permeability coefficient of $5x10^{-9}$m/s, as a base layer for the WRD;
        - If the liner system of the TSF cannot be installed to a permeability coefficient of $<10^{-9}$m/s, and the phreatic surface in the tailings material maintained to a level significantly lower than the final dam height of 20m, alternative construction options should be considered, such as a liner system with an HDPE layer;
    - Seepage water from both the WRD and TSF are expected to become acidic over the long-term due to oxygen ingress. Consequently the designs of the capping systems will be important;
    - In view of the local land being purchased by Gold One, and the location of the surface infrastructure, it is anticipated that none of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of groundwater levels or groundwater quality. It is however clear that the spread of the contamination plume may cover a significant area of the groundwater system if high integrity liner systems and capping systems are not installed (especially relevant to the TSF);
    - Depending on the chosen liner- and capping systems, additional groundwater mitigation measures may have to be considered, such as groundwater abstraction and treatment (including practical implementation) to reduce the groundwater quality impact of the TSF.

The latest South African Waste Management Act should be studied to ascertain the responsibility of *Gold One* in terms of aquifer restoration; i.e. the degree to which contaminated groundwater systems should be "cleaned" after mining (e.g. pre-mining conditions).

Site specific water quality objectives (SSWQO) should be developed; based upon catchment water quality objectives, background groundwater quality and drinking water standards.

Several recommendations were made on:

- Mitigation measures to prevent contamination, reduce contamination and the disposal of excess water;
- Groundwater monitoring schedules, groundwater levels and groundwater quality analyses.

Table of Contents

1. INTRODUCTION

1.1. Background

Gold One Africa Ltd is currently evaluating the feasibility of a new gold mine near Hennenman in the Free State (referred to as the Ventersburg project). *Groundwater Square* submitted a pre-feasibility groundwater impact assessment report during December 2010 for this project.

On 11/02/2011, *Umhlaba* approached *Groundwater Square* on behalf of *Gold One* to provide a technical and financial proposal to conduct a groundwater assessment of the project infrastructure and operational activities. *Umhlaba* highlighted the following important project components:

- Identify current baseline groundwater conditions;
- Model the potential impact of the mining activities on groundwater;
- Compile management plan for potential dewatering of the mine;
- Propose applicable management measures to mitigate the potential groundwater impacts.

The planned *Ventersburg Gold Mine* is located between the towns of Hennenman and Ventersburg, in Free State Province. The mineral resource boundary is depicted in Figure 1.1 against a Google Earth aerial photograph of the surrounding region.

This groundwater study is an independent evaluation of the potential impacts on the groundwater system that can be expected/associated with the planned underground mining operations and mining infrastructure. The potential cumulative impact of/on/from the nearest current mining operations were taken into account. Future mining developments near *Ventersburg Gold Mine* need to take cognisance of this impact assessment report.

The general mine layout can be seen against a thematic depiction of the regional surface topography in Figure 1.2.

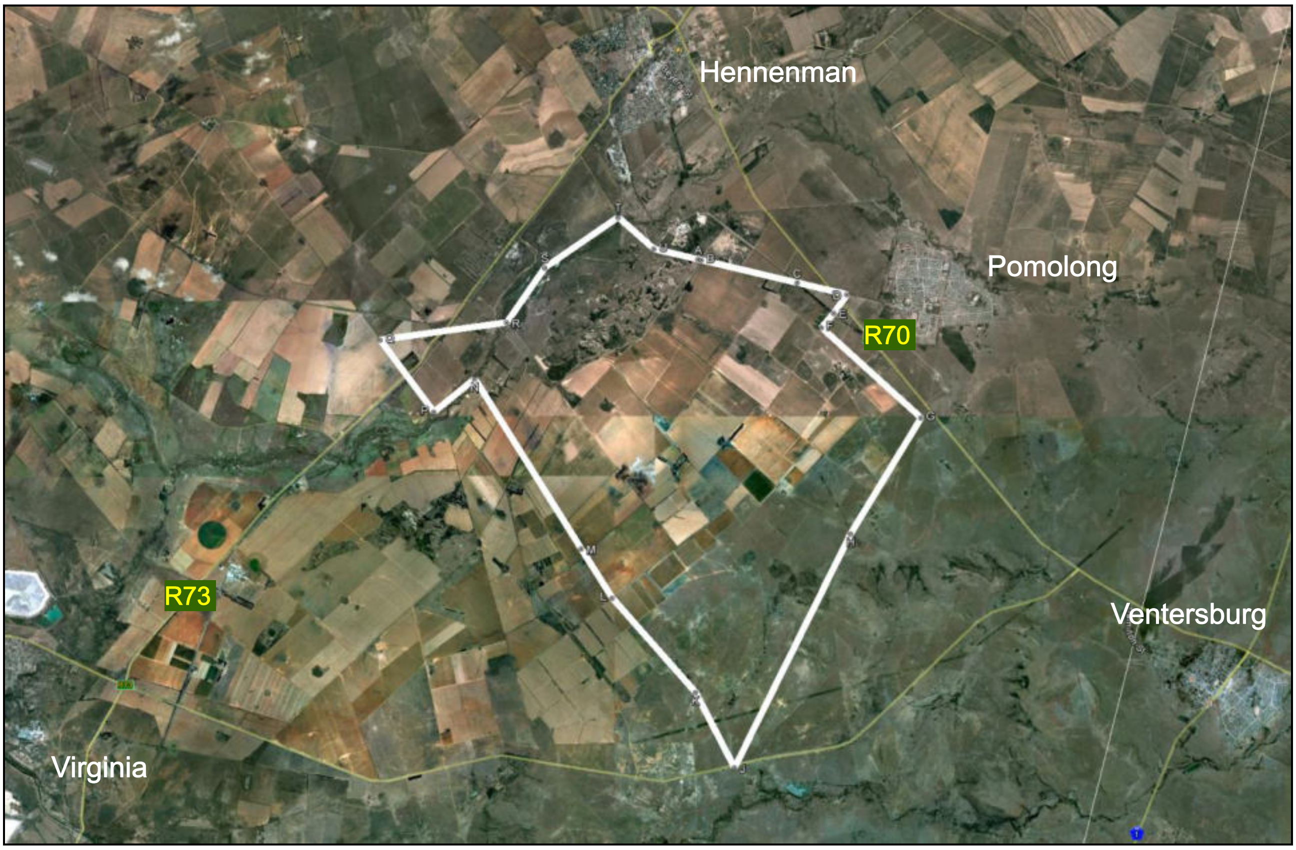


Figure 1.1 ***Regional view of mineral resource boundary, depicted against Google Earth aerial photograph***

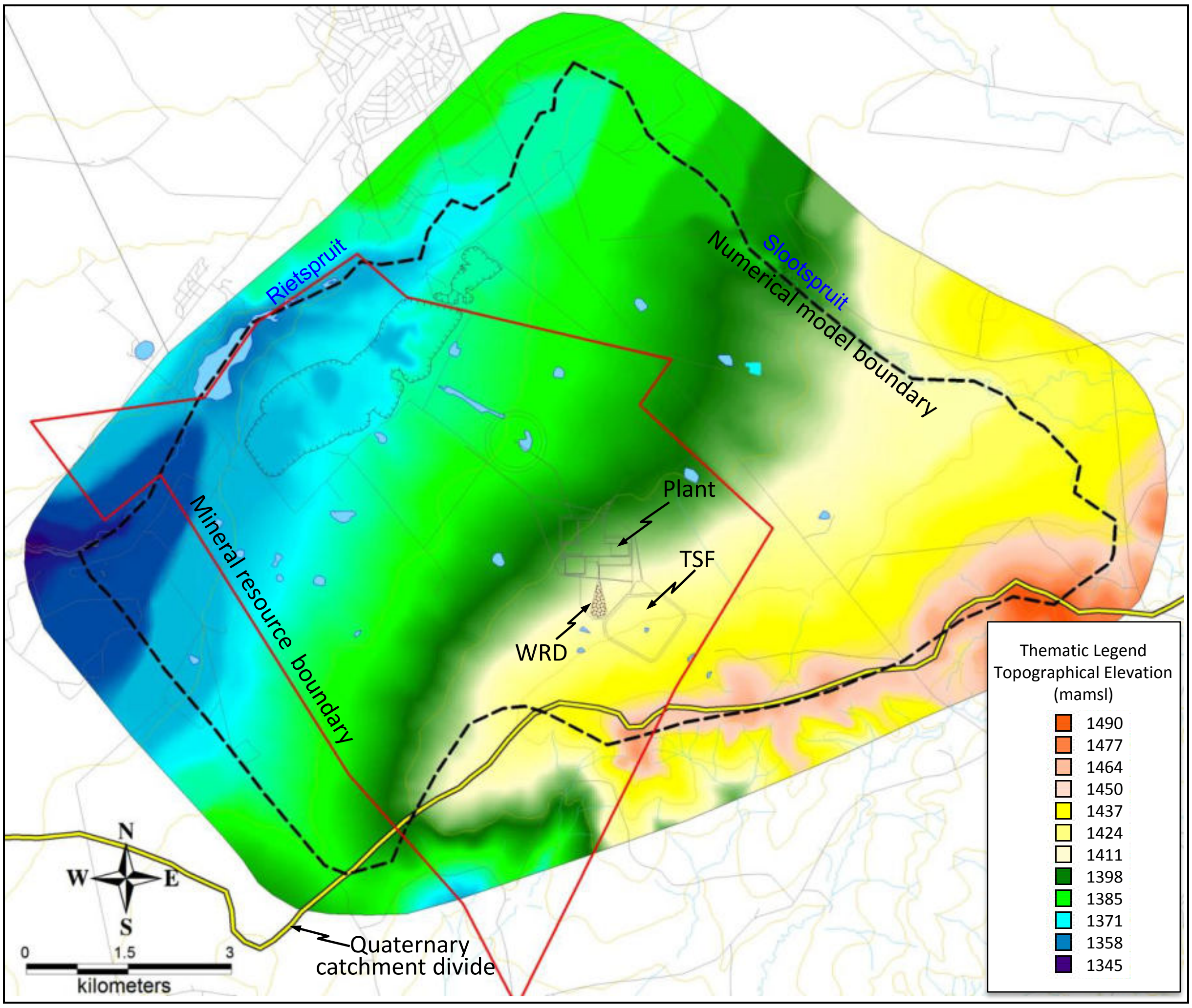


Figure 1.2 ***Regional view of study area depicted against thematic depiction of surface topography***

1.2. Description of Activities

The following mining information is of importance:

- The mining right area extends over some +/- 5400 hectares;
- As far as could be determined, no historical gold mines exist within the mine boundaries of the study area:
  - A limestone quarry is located on the project area >3km northeast of the plant along the edge of the Rietspruit;
  - Agricultural activities in the area include maize and game farming;
- The Free State Goldfields of the Witwatersrand constitute the neighbouring gold mining:
  - Harmony *Masimong Mine* underground operations are situated 17km to the west;
  - *Harmony Virginia* underground operations are situated 15km to the southwest;
- According to Turgis PFS report, the economical ore body consists of 2 separate economic zones of the same A Reef:
  - See mine layout Figure 1.3;
  - The sub-outcrops of the east and west ore bodies are about 1,500m apart horizontally:
    - The west ore body has a sub outcrop at 277m below surface extending down to 650m below surface;
    - The east ore body has a sub out crop at 340m below surface and extends down to 1,330m below surface;
    - The dip varies between 15° and 17°;
- The total mining area is estimated at:
  - Surface activities of ±200ha;
  - Underground mining area of ±500ha.

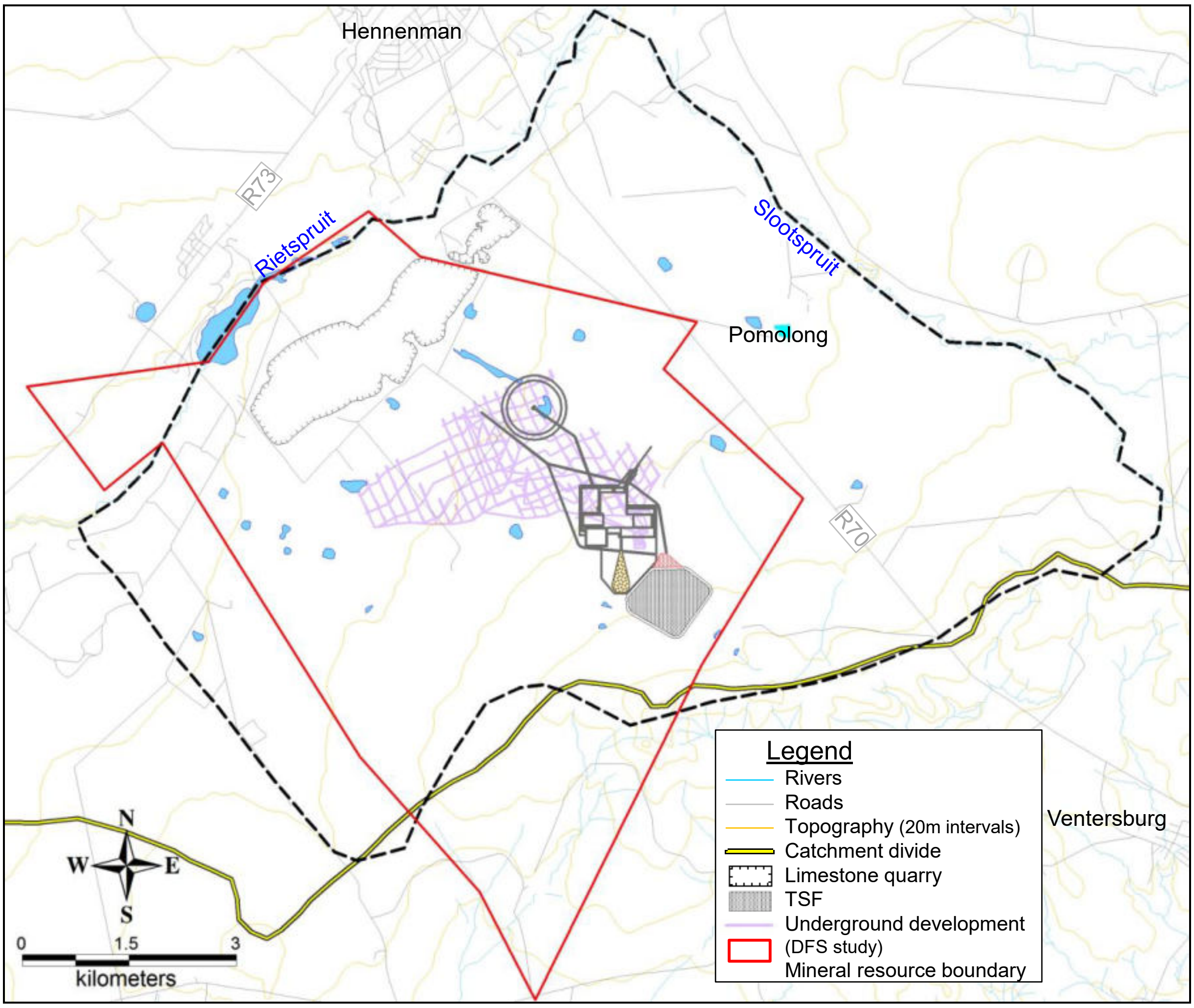


Figure 1.3 Mine layout (development according to DSF design)

The following important information relates to the impact assessments in Section 6 (see Figures 1.4 to 1.6):

- Underground mining:
  - Mine access is envisaged/proposed through:
    - The primary access system will be a twin vertical shaft system;
    - The secondary access will be a trackless mechanised development;
  - The primary development will take ±4years;
    - Including stopes, haulages, cross cuts, etc.;
    - Underground workshops etc.;
  - The planned production rate is 80,000 ROM ton/month with ±30,000ton/month waste;
- Ore stockpiles or silo's will be placed on surface;
- Waste Rock Dump (WRD):
  - The WRD will be positioned to the South of the Plant area directly north of the TSF;
  - Waste rock from the Karoo rock excavated during Shaft construction will be utilised for road building and Plant foundations;
  - Waste rock during mining will be placed on a Waste Rock Dump that will be lined to reduce the impact on the groundwater system (described in Section 6.5);
- Tailings Storage Facility (TSF):
  - The TSF will be positioned to the South of the Plant area and WRD;
  - A site selection process was undertaken of 3 potential locations to select/rank the most appropriate location for a TSF based on (see Figure 1.5):
    - Potential groundwater impacts;
    - TSF construction from an engineering perspective;
  - The base layer will be designed according to geochemical modelling, groundwater modelling and geotechnical analysis;

- The following design aspects are based on discussions with Fraser Alexander:
  - The TSF footprint area will be 70.7ha;
  - A Return Water Dam (RWD) (functioning as a Pollution Control Dam and Storm Water Dam) with silt trap of (3.1ha) and will be associated with the TSF;
  - The catchment paddocks will be 9.8ha;
- The following important design criteria relates to the phreatic water table inside the TSF:
  - The internal drainage system will be designed to prevent the phreatic surface from getting too close to the outer slope;
  - The dam will be developed at a rate slow enough for the material to drain to allow for sufficient consolidation;
  - The rate of rise will be approximately 1.8m/a at the end of life when the dam is 40m high. Consequently the phreatic level build up will be significantly lower than that because of the filter drains that will be installed;

- Gold processing plant and associated dams (see Figure 1.6):
  - Lined storm water and process water dams;
  - Water purification plant and associated dams;
- Administration buildings and change houses:
  - Sewage treatment plant;
  - Various workshops, storage/ lay-down yards and salvage yards;
  - General waste disposal sites;
  - Explosives storage (magazine) and handling areas;

The following general comments are applicable (based on comments by *Umhlaba Environmental*):

- All surface infrastructures will be located in the Ventersburg area. The entire area will be concrete fenced;
- Access will take place from the R70 approximately 4km south of the town of Hennenman.

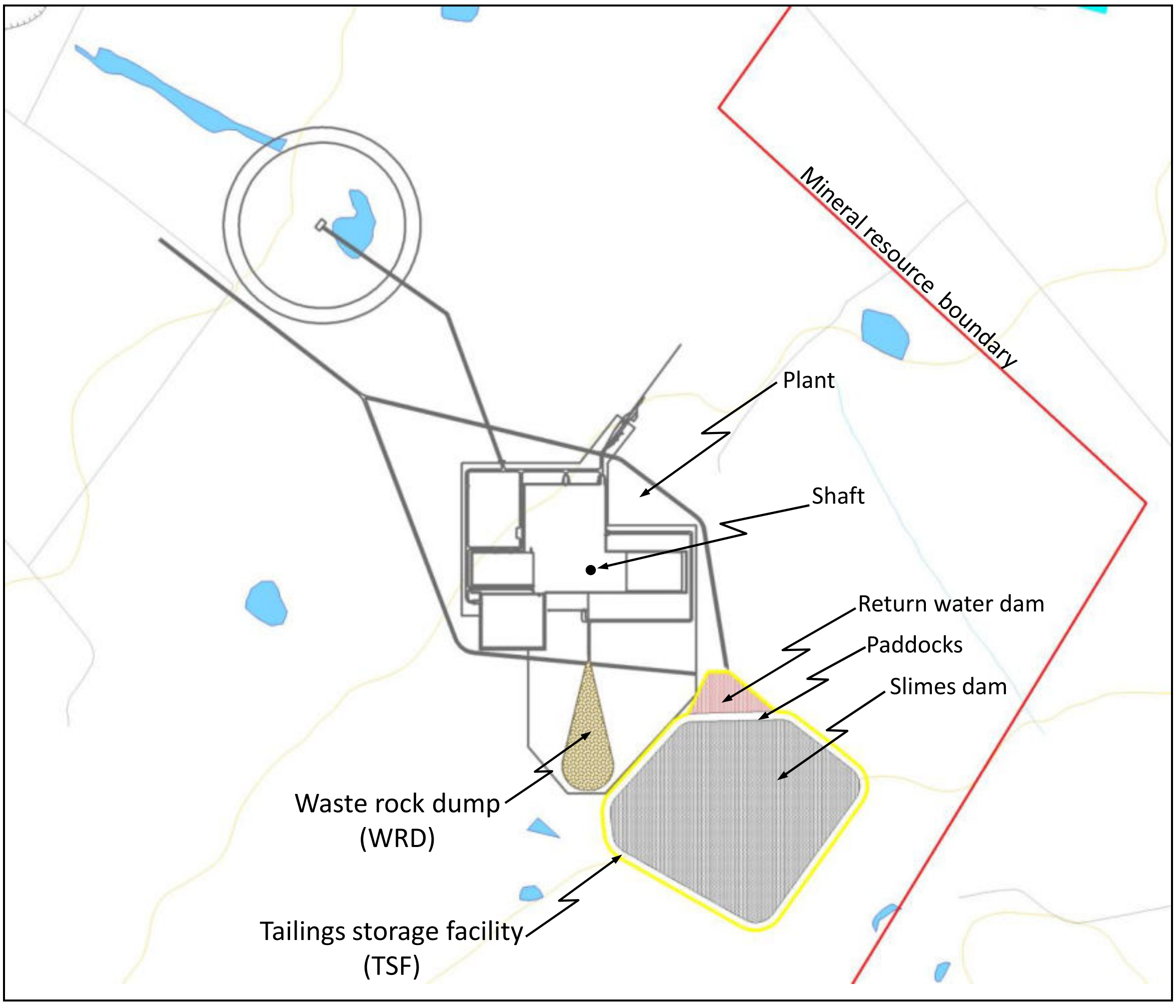


Figure 1.4 Plant, Tailings Storage Facility (TSF) and Waste Rock Dump (WRD) layout

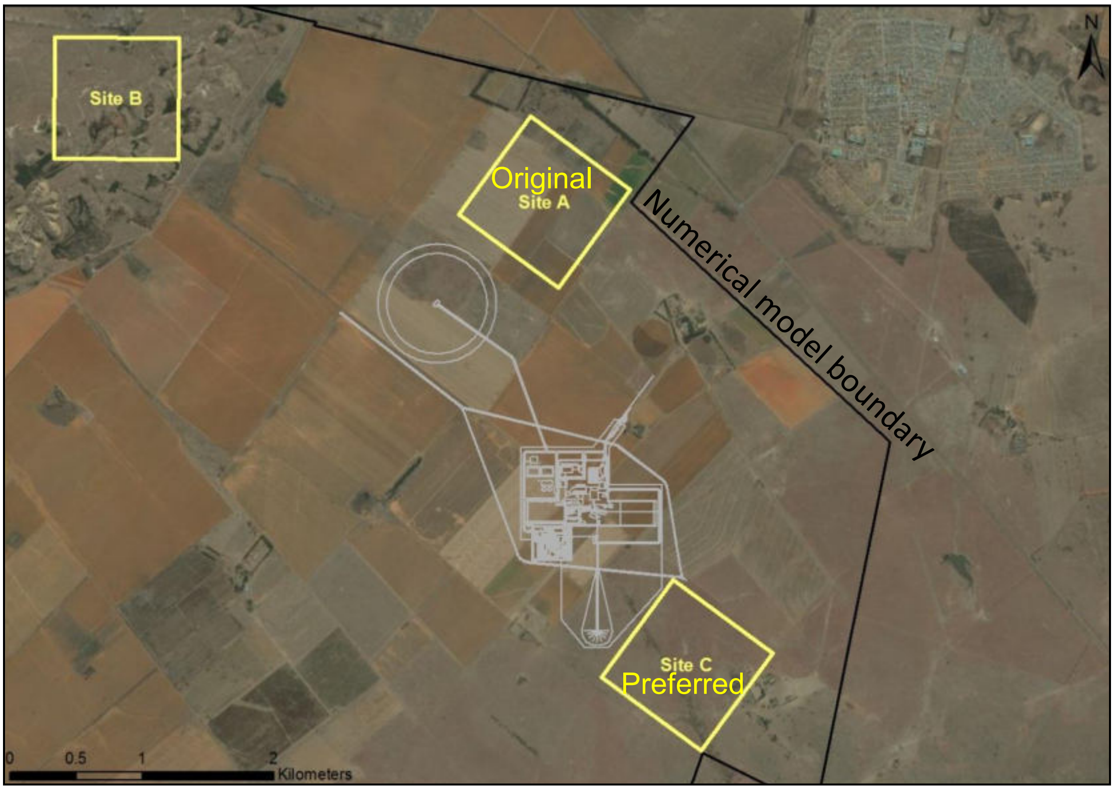


Figure 1.5 Tailings storage facility – site selection options

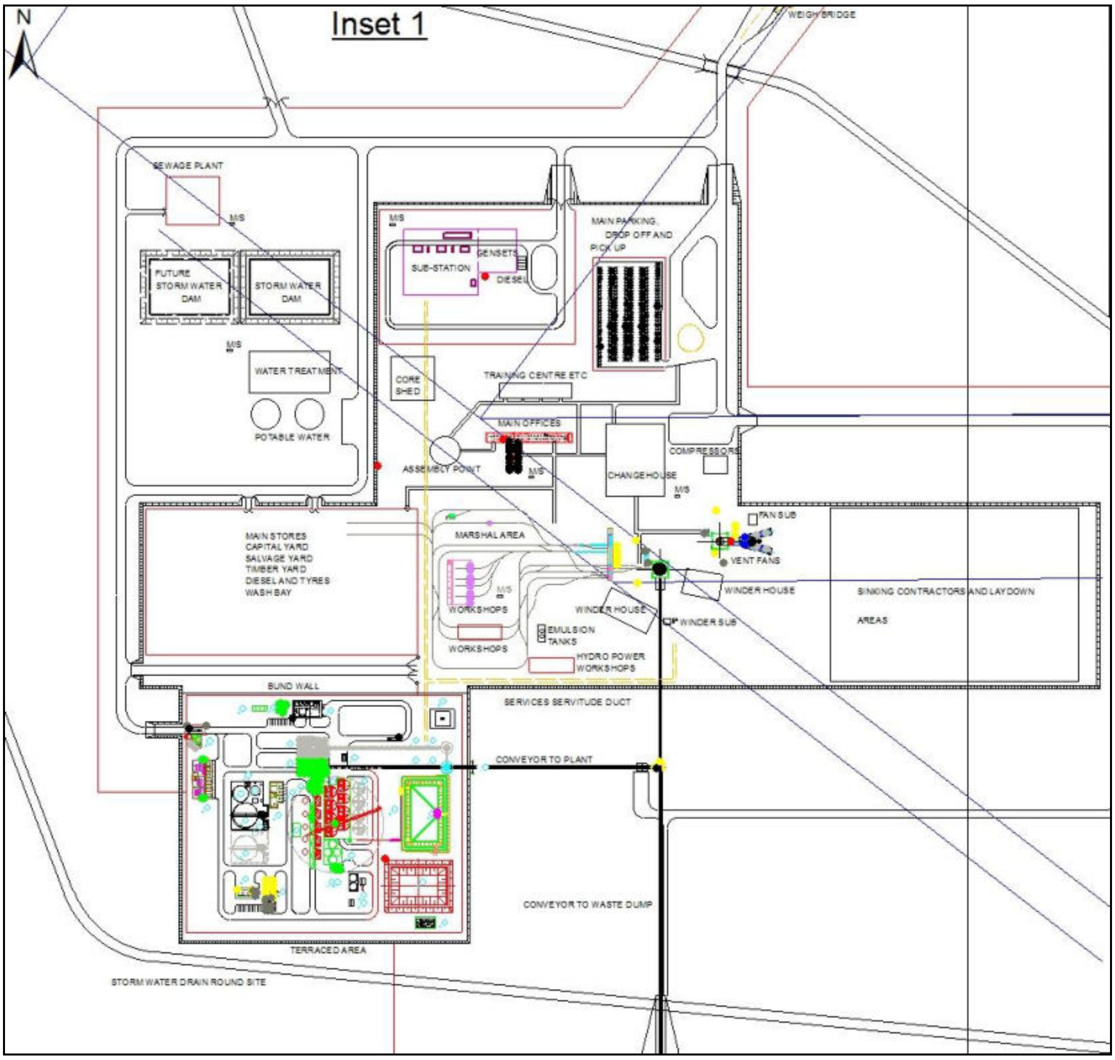


Figure 1.6 Site layout of Shaft Complex and Plant Area (Ref: Turgis, May 2012)

1.3. Study Approach

The main aims and objectives for this project can be summarised as follows:

- To determine the expected water quantity and quality in the underground mine;
- To identify all potential sources of groundwater contamination and associated:
    - Water quality;
    - Water volumes;
- Assist in the site selection process and design of the TSF and other potential sources of contamination;
- Identify treatment/mitigation requirements (e.g. the need to line the TSF with clay or HDPE);
- Establish an environmental critical level (ECL) if appropriate;
- To ensure appropriate and representative sampling protocols to determine:
    - Mineralogy at Ventersburg and surrounding areas;
    - Long-term geochemical behaviour of potential sources of contamination;
- Taking cognisance of the fact that no mining-related additional impacts on the local surface water system will be allowed by the authorities.

1.4. Terms of Reference / Scope of Study

In light of the information provided in Section 1, the following terms of reference were proposed by *Groundwater Square* on 26/02/2011:

- Project kick-off:
    - Start-up meeting, site visit and workshop;
    - Generate baseline infrastructure information and maps;
    - Collect baseline hydrogeology from previous reports and maps;
- Collect field data:
    - Perform limited geophysical survey (magnetic) to investigate the occurrence of dolerite dykes[*];
    - Drill hydrogeological boreholes (based on geophysics, structural geology and potential impacts)†:
    - Perform EC and temperature profiling on borehole water columns;
    - Perform water sampling of boreholes, springs and surface water;
    - Perform aquifer and borehole hydraulic testing:
        - Slug-tests on all newly drilled boreholes (where possible, boreholes surrounding the property might be included);
        - Yield tests, step-tests and long-term tests on a selection of boreholes[‡];
    - Update external users' survey:
    - Laboratory analysis for groundwater and surface water qualities (x25)[§]:
        - pH, EC, TDS, Ca, Mg, Na, K, Cl, SO_4, NO_3, T.Alk, Si, F, NH4, and ICP-scan;
- Data evaluation in the context of geological information provided by mine project geologist:
    - Computerise and output field data;
    - Analyse/interpret field test data;
    - Interpret/describe aquifer conditions/hydraulic attributes;
- Perform geochemical evaluation of waste and reef material :
    - Obtain samples from the geological drilling programme;
    - Obtain water and soil samples from surrounding Free State Gold Mine tailings storage facilities
    - ABA analyses, total leachable cations, anions and metal extraction will be done at different paste and oxidized levels;
    - Salt balances will be performed for the status-quo situation and for long term quality predictions;
    - Utilise the latest DWAF best practice guidelines;

[*] Additional surveys were performed due to the relocation of site infrastructure during the design phase.

† Due to the number of boreholes already in place and field conditions 5 shallow boreholes were drilled; associated with certain water supply boreholes drilled by Gold One.

‡ Not performed due to information collected from boreholes already in place.

§ Additional inorganic and various isotope samples were collected during the sampling of the deep Wits aquifer.

- Groundwater modelling assessment:
  - Compile conceptual model of regional groundwater movement;
  - Compile and calibrate 1st order regional numerical 3D model;
  - Compile and calibrate detailed numerical 3D models to quantify/assess individual impacts;
  - Incorporate geochemical assessment data in numerical models, to enable prediction of contaminant movement;
- Groundwater impact calculations:
  - Identify and describe impacts on the groundwater situation;
  - Calculate impacts on the groundwater situation with available information, analytical equations and numerical modelling;
  - Propose mitigation measures;
  - Identify data gaps and focus areas for additional research if required;
- Integrate groundwater and surface water balance data;
- Attend project meetings;
- Compile report.

The following additional comments are important:

- Several discussions were held with project engineers and engineering subcontractors to ensure proper information exchange and integration between different disciplines;
- A dedicated effort was made to work with a subcontractor (*Ground Water Practitioners*) to sample representative water qualities of the Wits formation.

Disclaimer – The current state of knowledge and impact assessments was presented as accurately as possible using available information and new information generated during field surveys. *Groundwater Square* exercised due care and diligence in gathering and evaluating relevant information. *Groundwater Square* will not accept any liability in the event of encountering unexpected aquifer conditions during mining operations. Any unauthorized dissemination or reuse of the groundwater specialist impact assessment report will be at the user's sole risk and with the condition that *Groundwater Square* will not accept any liability for any and all claims for losses or damages and expenses arising out of or resulting from such unauthorized disclosure or reuse.

2. SETTING

The *Ventersburg Gold Mine* is located in the Free State Province to the east of the Witwatersrand Free State Goldfields between the towns of Hennenman and Ventersburg (±12km west of Ventersburg, immediately south of Hennenman and ±48 km southwest of Kroonstad) adjacent to the R70 (see Figure 1.1).

The nearest gold mining operations are ±15km to the east (Harmony Gold's operations of Merriespruit 1 and 3, Harmony 2 and Masimong). The regional setting of the proposed mine is indicated in Figures 2.1 and 2.3.

The proposed mining area falls within the boundaries of the Matjhabeng Local Municipality of the Lejweleputswa District Council; one of the municipalities in the Middle Vaal and Upper Orange WMA's that discharges wastewater (Hennenman Waste Water Treatments Works – Water Use Authorisation Exemption) directly into the Vaal River System.

2.1. Hydrological Setting

The *Ventersburg Gold* reserve is situated within quaternary catchment C42J, with natural drainage primarily to the northwest. See quaternary catchment boundary to the south in Figure 2.1.

The following comments are relevant:

- The area is drained by the Rietspruit (west-flowing to the north of study area) downstream of its confluence with the Slootspruit (north-flowing to the east of study area):
  - The Rietspruit joins the Sand River at Virginia some 12km southwest of the proposed mine between Harmony 2 and Merriespruit 2 (both Harmony Gold operations);
  - The Rietspruit originates along the side slope of the surface water divide between quaternary catchment area C42J and C60F ±25 km northeast of the proposed mine;

   - Approximately 6.7km downstream from the proposed mine, the Rietspruit is joined by a tributary that originates close to Harmony Gold's Masimong workings;
- Quaternary catchment area C42J of the Sand Sub-catchment (C42F-L) form part of the Middle Vaal Water Management Area (WMA):
   - The Middle Vaal WMA is integrally linked to both the Upper WMA and Lower WMA;
   - All surface water has been developed to its potential (i.e. being fully utilised);
   - Given the existing impacts of municipalities (predominantly sewage) and gold mines downstream of the site, it is essential that no additional impacts be introduced to the surface water environment by the Gold One operation.

2.2. Meteorological Conditions

According to Midgley (1994), meteorological conditions can be summarised:

- Quaternary catchment C42J has a mean annual precipitation (MAP) of 530mm/a:
   - It is bounded by quaternary catchments C42H (MAP=540mm/a) to the south;
   - A MAP of 530mm/a applied to all relevant calculations in this study;
- The mean annual evaporation (MAE) varies between 1500mm/a and 1700mm/a;

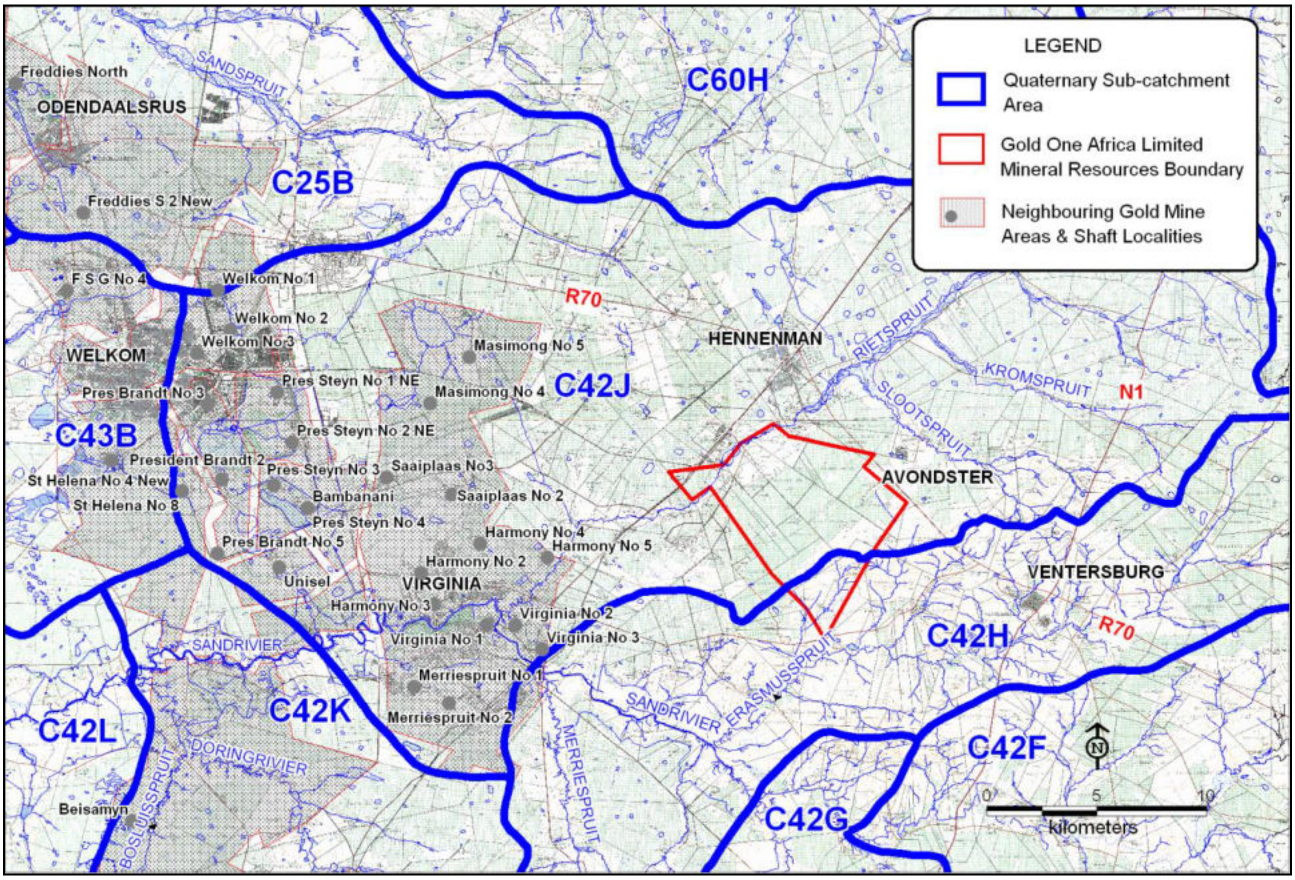


Figure 2.1 ***Mine boundary in relation to major surface rivers/spruits and quaternary catchment boundary***

2.3. Topographical Setting

As can be seen in Figure 1.2, surface topographical elevations range between 1350mamsl (in the low-lying regions of the Rietspruit) and 1490mamsl (around the southern and south-eastern extent on the quaternary catchment divide). In the vicinity of the Plant and TSF, surface topographical elevations range between 1400mamsl and 1430mamsl.

The topography slopes towards the Rietspruit at gradients ranging between 0.6% and 1.5%.

2.4. Geological Setting

It is not the purpose of this report to provide a detailed geological description. However, certain important aspects are mentioned with respect to the hydrogeological evaluation. General geological information was supplied by the Gold One project geologist (Mr. S Buys – referring to Allsopp, et al. 1986, Johnson et al., 2006, Steenekamp, 1990 and McCarthy, 2006):

- The study area is located in the southern part of the Witwatersrand Basin of South Africa near the towns of Virginia and Welkom in the Free State Province and forms part of the Welkom Goldfields;
- The Witwatersrand Supergroup (2.8Ga) is overlain by rocks of the Ventersdorp Supergroup (2.7Ga) and Karoo Supergroup (302-180Ma):
    - The Witwatersrand Supergroup has two subdivisions, the West Rand and Central Rand Groups of which the latter – relevant to the study area – is the youngest, and therefore shallowest;
    - The Central rand group has shale to quartzite ratio of 12:1. It was deposited in fluvial deltaic environments;
    - The A-Reef at the Ventersburg Project is located in the upper part of the Central Rand Group;
- The Witwatersrand Basin is divided into two sections by the north-south striking De Bron Fault (see illustration in Figure 2.2). This major structure has a vertical displacement of about 1500m in the region of Bambanani, as well as a lateral shift of 4km. This lateral shift allows a reconstruction of the orebodies of Unisel to the west of the De Bron and Merriespruit to the east:
    - A number of other major faults (Stuurmanspan, Dagbreek, Arrarat and Eureka) are situated parallel to the De Bron Fault;
    - The Virginia sub-basin consists of the Harmony gold mines (Harmony original, old Virginia, old Saaiplaas, old Erfdeel and old Merriespruit), which are all interconnected – the De Bron Fault marks its western boundary. The absence of economical reef horizons, form the eastern boundary of this sub-basin;
- The following constitutes a typical stratigraphic section through the study area:
    - Rocks of the Karoo Sequence are typically 270m to 300m thick:
        - Most of the study area is underlain by sandstone and shale from the Ecca Group (Vryheid and Volksrust formations) and Beaufort Group of the Karoo Supergroup;
        - A Dwyka glacial valley occurs in the western limit of the study area, where the Karoo is 370m to 395m thick;
        - The sediments of the Ecca Group are collectively known and described as the Ecca Shale Formation;
        - The Vryheid Formation was deposited in a deltaic environment. The lower part of the formation consists of carbonaceous shale and dark-grey siltstone. Sequences of sandstone and siltstone are found to the top;
        - The Volksrust Formation consists of grey to black shale with siltstone and mostly fine to medium grained sandstone lenses. A fine-grained upward fining lithology is found;
        - Coal is found in the Vryheid and Volksrust Formations but only to the north and northeast of the Ventersburg area towards Kroonstad, Sasolburg and Vereeniging;
        - No economic gold occurrences are found in any of the Karoo Supergroup rocks;
    - Andesitic lavas of the Ventersdorp Supergroup (Klipriviersberg Group) underlie the Karoo Supergroup:
        - The age difference between the Ventersdorp and Karoo Supergroups is approximately 2000 million years;
        - It consists of a succession of lavas and poorly sorted conglomerates with inter-bedded fine sediments;
    - Rocks of the Central Rand Group (Witwatersrand Supergroup) underlie the Ventersdorp lavas:
        - These rocks are mostly conglomerates and sandstone with minor shale inter-beds with a sandstone shale ratio of 12:6;
        - The deepest holes in the Ventersburg Project area intersected the Welkom Formation consisting of informal members termed Upper footwall 1 to 4, the UF1-4 (SACS Task Group for the Witwatersrand Supergroup, 2006);
        - The Welkom Formation is made up of argillaceous quartzites, some coarse grained polymictic grits and in places small pebble conglomerates (SPC). Vein quartz, chert, quartz porphyries and chloritic schist are the main constituents and the core of the UF quartzites has a light greenish colour. This green tint is very important to distinguish between the much younger Eldorado Formation and the underlying footwall succession;

- The basic surface geology in a 10km radius around the proposed mine are depicted in Figure 2.3:
  - It primarily consists of sand, limestone, dolerite, sandstone/siltstone/shale/mudstone;
  - Deposits of secondary limestone occur around Hennenman on the lower part of the Beaufort Series and have been exploited for many years (e.g. Whites 496, Brookland 433 and Portland 23).
- According to the Turgis Pre-Feasibility Study report, the economical ore body consists of 2 separate economic zones of the same A Reef:
  - The sub-outcrops of the east and west ore bodies are about 1,500m apart horizontally:
    - The west ore body has a sub outcrop at 277m below surface extending down to 650 m below surface;
    - The east ore body has a sub out crop at 340m below surface and extends down to 1,330m below surface;
  - The ore body dip varies between 15° and 17°.
  - The graben structure, on which the bulk of the project area is located, is bounded to the west by the north-northeast trending Virginia Fault with considerable downward displacement to the east.

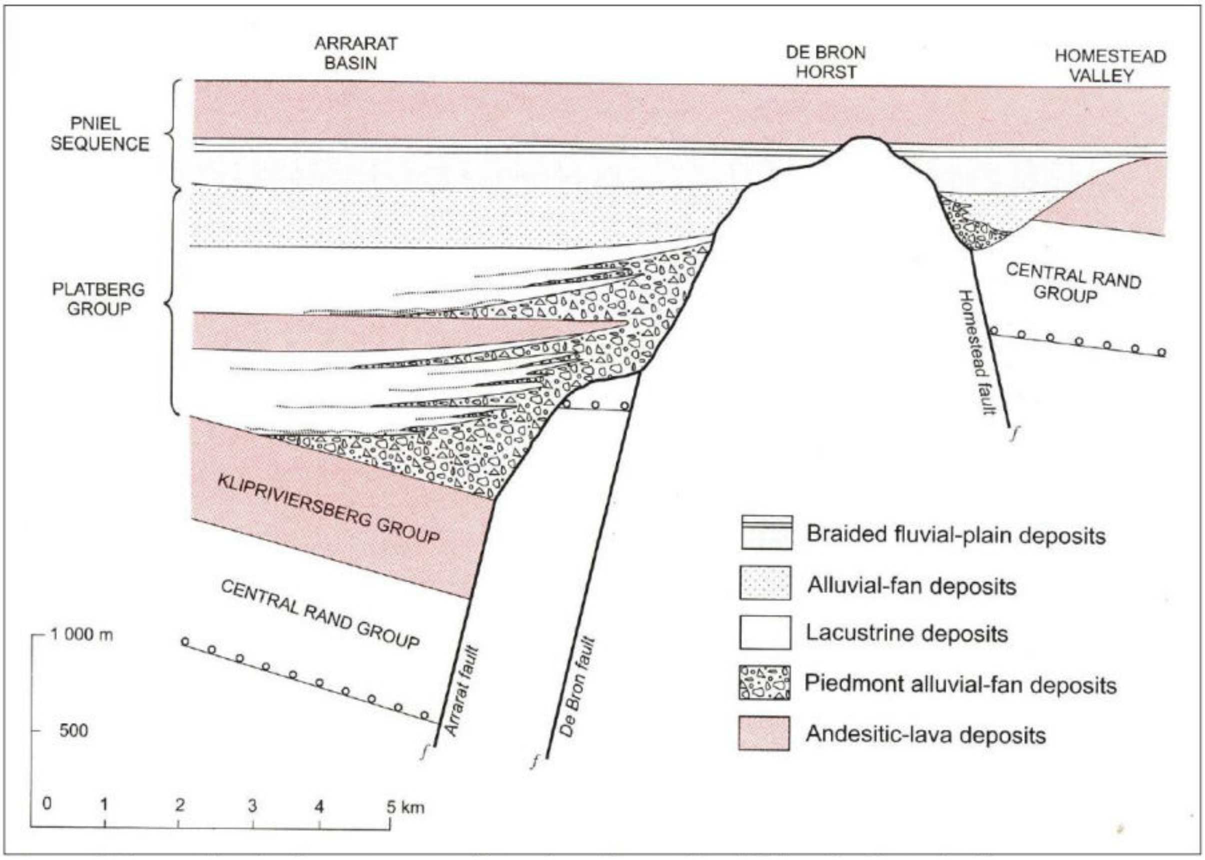


Figure 2.2 Illustrative cross-section of north-south striking De Bron fault

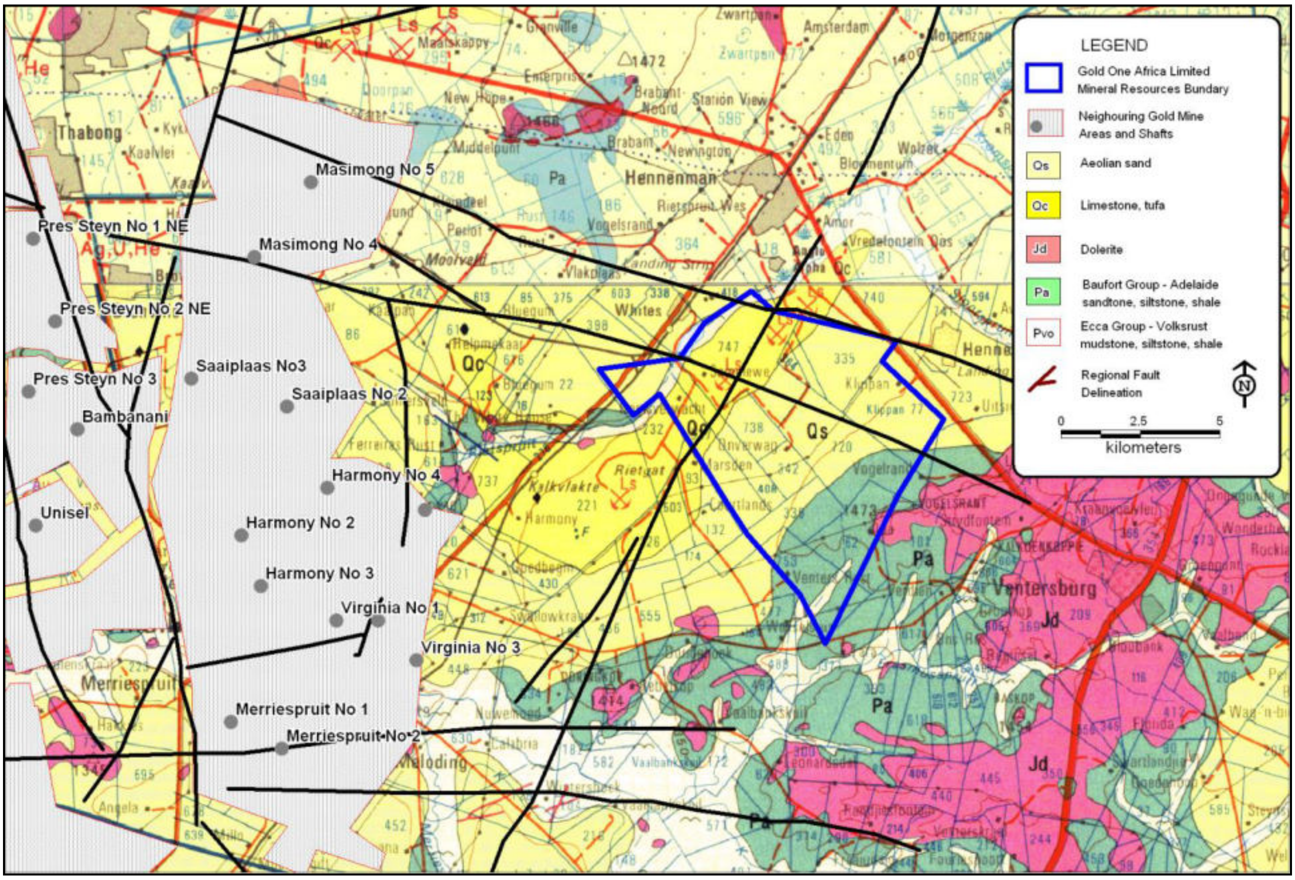


Figure 2.3 Regional geology (Council for Geoscience) – Note 2010 mine layout information

3. DATA COLLECTED

3.1. Hydrocensus

A hydrocensus of groundwater use in the area was undertaken in 2010. The locations of boreholes and surface water points are indicated in Figure 3.1. This information was verified and upgraded during June 2012 for this assessment, within a 2km radius of the proposed mining activities.

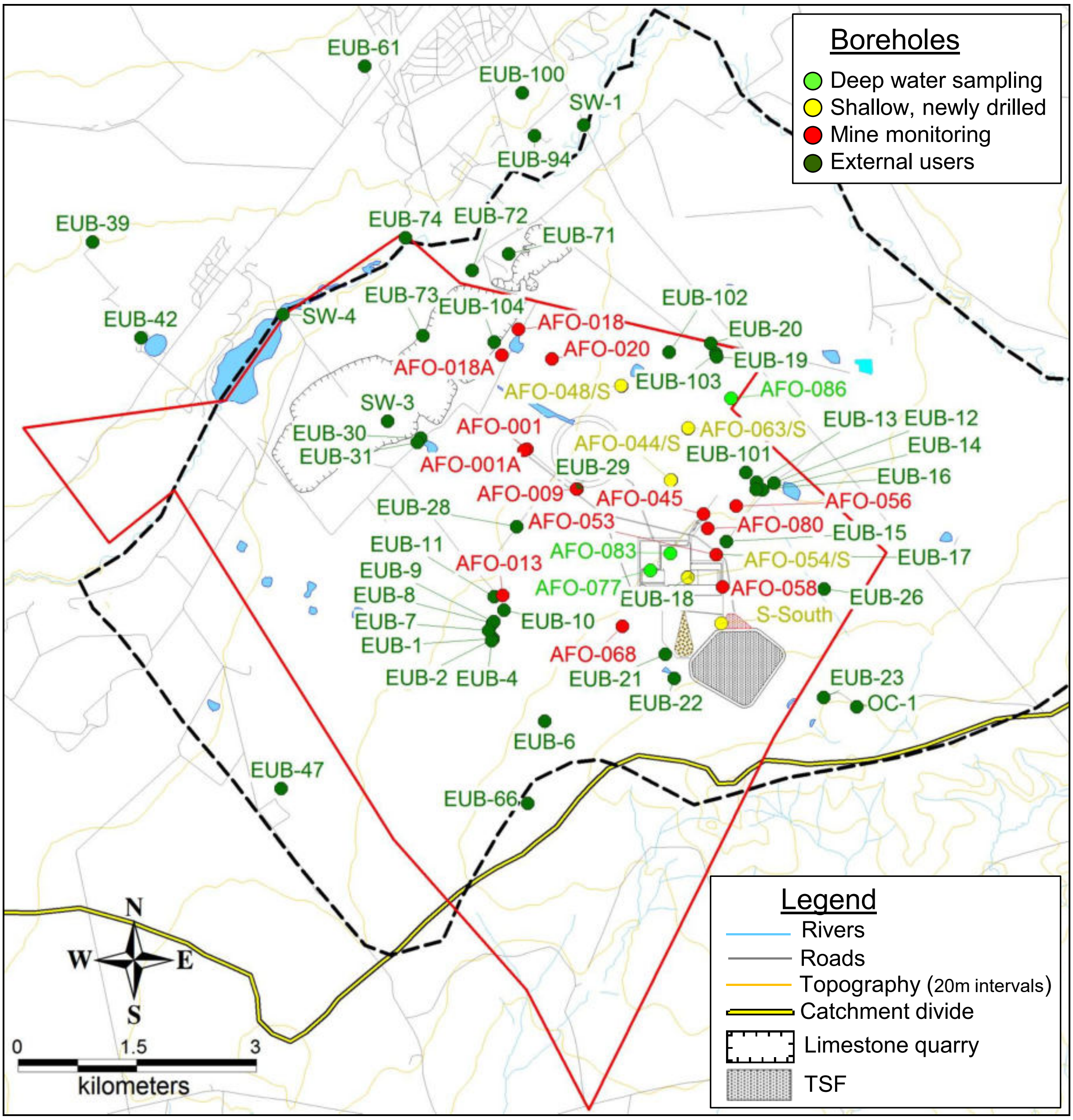


Figure 3.1 2012 Hydrocensus borehole localities in relation to proposed mining downstream of site

The following comments relate to owner/location/water-related information (summarised in Tables 3.1A-C) and groundwater quality results (attached as Appendix-3):

- Borehole depths ranged between 15m and 100m deep (typically between 35m and 40m deep);
- Groundwater levels varied between 3.3m and 29m deep (average 10m deep). There appears to be some correlation between the depth to the groundwater table and the borehole depth. This may be attributed to these boreholes being located at higher topographical elevations, where the groundwater table is expected to be deeper;
- Borehole yields were specified by the owners as ranging between 0.3L/s and 20L/s. 66% of borehole yield were <5L/s. A representative yield of 2L/s was calculated;

- The typical borehole yield suggested by the 1:500 000 hydrogeological map series of South Africa, Sheet 2736 (Kroonstad, 2000) is 0.1L/s to 0.5L/s. Yields of 0.5L/s to 2L/s can be expected in the aquifers 10km to the northwest. The hydrocensus data therefore recorded borehole yields that were higher than expected from previous DWA groundwater studies;
- A summary of the background groundwater quality profile is presented in Table 4.1, Section 4.4.

Table 3.1A Hydrocensus - Owner Information

BH Nr	Name of Owner	Address	Contact Person	Phone Numbers	Farm Name	Farm Number	Portion Number
EUB-1	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-2	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
SW-3	Oranje Mynbou en Vervoer EDMS Bpk	PO Box 158, Hennenman, 9445		05776 320115	Whites	747	
EUB-4	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-6	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-8	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-9	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-10	PJ Coetzer	P O Box 107, Hennenman, 9445	PJ Coetzer	082 809 7203	Onverwacht	342	
EUB-14	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Klippan	77	
EUB-16	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Klippan	77	
EUB-17	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Klippan	77	P3 (Voelnes)
EUB-18	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Vogelsrand	720	
EUB-20	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Rietspruit-Oost	335	
EUB-21	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Vogelsrand	720	
EUB-25	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Strydfontein		
EUB-28	AM Theron	PO Box 173, hennenman,9445	Wynand Theron	072 450 1344	Vogelsrand	720	P1
EUB-29	TP & MM Boerdey	PO Box 212, hennenman,9445	Wynand Theron	072 450 1344	Vogelsrand	720	P1
EUB-30	TP & MM Boerdey	PO Box 212, hennenman,9445	Wynand Theron	072 450 1344	Whites	747	P1
EUB-39	AM Theron	PO Box 173, hennenman,9445	Wynand Theron	072 450 1344	Tiepie	752	
EUB-42	AM Theron	PO Box 173, hennenman,9445	Wynand Theron	072 450 1344	Tiepie	752	
EUB-45	WR Oosthuizen	PO Box 26, Hennenman, 9445	Ras Oosdthuizen	082 850 6136	Courtlands	132	
EUB-47	WR Oosthuizen	PO Box 26, Hennenman, 9445	Ras Oosdthuizen	082 850 6136	Courtlands	132	
EUB-48	WR Oosthuizen	PO Box 26, Hennenman, 9445	Ras Oosdthuizen	082 850 6136	Courtlands	132	
EUB-50	WR Oosthuizen	PO Box 26, Hennenman, 9445	Ras Oosdthuizen	082 850 6136	Marsden	93	
EUB-51	WR Oosthuizen	PO Box 26, Hennenman, 9445	Ras Oosdthuizen	082 850 6136	Courtlands	132	
EUB-54	Whites Golf Club		Nellus Loots	082 772 9972	Whites		
EUB-57	Whites Golf Club		Nellus Loots	082 772 9972	Whites		
EUB-60	J Conradie	PO Box 527, Hennenman, 9445	J Conradie	074 904 0429	Vredefontein		Hennenman Ext.13
EUB-61	J Conradie	PO Box 527, Hennenman, 9445	J Conradie	074 904 0429	Vredefontein		Hennenman Ext.13
EUB-64	PW du Plooy	PO Box 113, Ventersburg, 9450	Piet du Plooy	082 371 0637	Ida	62	P1
EUB-65	PW du Plooy	PO Box 113, Ventersburg, 9450	Piet du Plooy	082 371 0637	Ballyedikin	339	P1
EUB-71	Oranje Mynbou en Vervoer EDMS Bpk	PO Box 158, Hennenman, 9445		05776 320115	Ventersvlakte	740	Remainder
EUB-76	MPA du Plooy	PO Box 176, Ventersburg, 9450	Thys du Plooy	083 390 0796	Lewenslus	753	P1
EUB-77	MPA du Plooy	PO Box 176, Ventersburg, 9450	Thys du Plooy	083 390 0796	Barnards Deel	477	
EUB-85	Dr Jaco de Villiers		Dr Jaco de Villiers	083 629 4724	Rietspruit West	364	
EUB-86	Dr Jaco de Villiers		Dr Jaco de Villiers	083 629 4724	Rietspruit West	364	
EUB-88	Salvador Buonadonna	PO Box 45, Hennenman, 9445	Salvador Buonadonna	082 555 1516	Verwacht Hams	337	
EUB-89	Salvador Buonadonna	PO Box 45, Hennenman, 9445	Salvador Buonadonna	082 555 1516	Verwacht Hams	337	
EUB-94	JH Erasmus	PO Box 267, Ventersburg, 9450	Frans erasmus	072 849 8730	Schoolplaats Zuid	71	
EUB-95	JH Erasmus	PO Box 267, Ventersburg, 9450	Frans erasmus	072 849 8730	Schoolplaats Zuid	71	
EUB-100	JH Erasmus	PO Box 267, Ventersburg, 9450	Frans erasmus	072 849 8730	Schoolplaats Zuid	71	
EUB-101	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	Klippan	77	
EUB-102	GC Vogel	P O Box 174, Hennenman, 9445	Frikkie Vogel	083 4494535	La Rochelle	760	

Table 3.1B Hydrocensus – Location information

BH Nr	Drainage Region	GPS Long (WGS 84)	GPS Lat (WGS 84)	Elevation (m)	Topography	Site Type	Information Source	Site Status	Site Purpose	User Consumer	User Application	Equipment
EUB-1	C42J	28.04804	27.03019	1394.00	S	B	F	G	P	N	AD	S
EUB-2	C42J	28.04810	27.03019	1388.00	S	B	F	G	P	N	AS	S
SW-3	C42J	28.02330	27.01670	1374.00	S	B	F	U	P	N	AD	N
EUB-4	C42J	28.04829	27.02999	1401.00	S	B	F	U	P	N		N
EUB-6	C42J	28.05742	27.03681	1409.00	S	B	F	G	P	N	AS	S
EUB-8	C42J	28.04627	27.03013	1395.00	S	B	F	G	P	N	AS	S
EUB-9	C42J	28.04610	27.03029	1389.00	S	B	F	G	P	N	TM	S
EUB-10	C42J	28.04479	27.03161	1392.00	S	B	F	U	P	N		N
EUB-14	C42J	28.03108	27.06469	1408.00	S	B	F	G	P	N	AD	S
EUB-16	C42J	28.03104	27.06390	1401.00	S	B	F	U	P	N		N
EUB-17	C42J	28.03849	27.05876	1408.00	S	B	F	U	P	N	TM	N
EUB-18	C42J	28.04103	27.05512	1410.00	S	B	F	G	P	N	TM	S
EUB-20	C42J	28.01438	27.05806	1399.00	S	B	F	G	P	N	AD	W
EUB-21	C42J	28.04980	27.05229	1426.00	S	B	F	G	P	N	AS	W
EUB-25	C42J	28.05372	27.08132	1439.00	S	B	F	U	P	N		W
EUB-28	C42J	28.03529	27.03322	1387.00	S	B	F	U	P	N		N
EUB-29	C42J	28.03099	27.04092	1391.00	S	B	F	U	P	N		N
EUB-30	C42J	28.02519	27.02094	1376.00	S	B	F	G	P	N	AS	M
EUB-39	C42J	28.00286	26.97892	1389.00	S	B	F	G	P	N	AS	W
EUB-42	C42J	28.01379	26.98508	1373.00	S	B	F	G	P	N	AD	M
EUB-45	C42J	28.06490	27.00268	1377.00	S	B	F	U	P	N		N
EUB-47	C42J	28.06513	27.00305	1380.00	S	B	F	G	P	N	AD	S
EUB-48	C42J	28.06468	27.00332	1379.00	S	B	F	G	P	N	AI	S
EUB-50	C42J	28.05918	27.00432	1378.00	S	B	F	G	P	N	AD	S
EUB-51	C42J	28.06437	27.00848	1383.00	S	B	F	G	P	N	AI	S
EUB-54	C42J	28.01183	26.98842	1378.00	S	B	F	U	P	N		N
EUB-57	C42J	28.00940	26.99122	1381.00	S	B	F	U	P	N		N
EUB-60	C42J	27.98261	27.01413	1398.00	S	B	F	U	P	N		S
EUB-61	C42J	27.98286	27.01372	1399.00	S	B	F	G	P	N	DA	S
EUB-64	C42H	28.07263	27.05177	1412.00	S	B	F	G	P	N	AS	W
EUB-65	C42J	28.06102	27.04207	1427.00	S	B	F	G	P	N	AS	W
EUB-71	C42J	28.00419	27.03219	1382.00	S	B	F	G	P	N	AD	S
EUB-76	C42H	28.08217	27.02883	1397.00	S	B	F	G	P	N	AD	W
EUB-77	C42H	28.09480	27.01921	1393.00	S	B	F	G	P	N	AS	W
EUB-85	C42J	27.98383	27.00151	1399.00	S	B	F	G	P	N	AS	W
EUB-86	C42J	27.98953	26.99558	1398.00	S	B	F	G	P	N	AS	W
EUB-88	C42J	28.03365	26.99363	1359.00	S	B	F	U	P	N		N
EUB-89	C42J	28.03383	26.99389	1364.00	S	B	F	U	P	N		N
EUB-94	C42J	27.99073	27.03548	1376.00	S	B	F	G	P	N	DA	S
EUB-95	C42J	27.98941	27.03700	1376.00	S	B	F	G	P	N	AD	S
EUB-100	C42J	27.98588	27.03391	1380.00	S	B	F		P	N	AS	W
EUB-101	C42J	28.02911	27.06259	1402.00	S	B	F	G	P	N	AD	S
EUB-102	C42J	28.01540	27.05273	1394.00	S	B	F	G	P	N	AS	S

Site Type: B - Borehole, D - Dug well, F - Fountain, T - Tunnel/shaft/drain,
Info Source: G - Geologist/technician/operator's record,
Site Status: D - Destroyed, G - In use, U - Unused,
Site Purpose: E – Exploration, O - Observation, P - Production(water supply),
User Consumer: N - Non-urban,
User Application: AD – Agricultural and domestic use, AS – Agricultural – stock watering only, DA – Domestic – all purposes, TM – Industrial – mining,
Equipment: C – Centrifugal pump, H – Hand pump, M – Mono-type pump, N – No equipment, P – Piston pump, S – Submersible pump, W – Windpump,

Table 3.1C Hydrocensus – Water related information

BH Nr	Collar Height (m)	Depth (m)	Yield (L/s)	Date	Time	Water level (m)	Comments: P=People; LSU=Large Stock; SSU=Small Stock; D=Dairy; G=Garden; N=Nursery
EUB-1	0.15	40.00	3.16	20101108	1510	16.19	1.1Kw sub, pump 5000l/h x 4 hours per day, P=39, 215ha + 223ha dryland
EUB-2	0.10	45.00		20101108	1520	7.33	1.1Kw sub pump 5000l/h x 8 to 10 hours per day, G=1, LSU=136, SSU=17
SW-3	0.24			20101111	1240	3.70	AFO030, sealed
EUB-4	0.90	48.00	0.83	20101108	1525	12.57	Not equipped, standby borehole
EUB-6	0.15	86.00		20101108	1530	20.32	0.75Kw sub, pump 3000l/h 2 times per day to 2 x 5000L tanks with portable generator, LSUP=136, SSU=17
EUB-8	0.36	45.00	3.16	20101108	1600	10.95	1.1Kw sub pump, standby, pump 5000l/h when needed to 2 x 5000L tanks and concrete dam, G=1, LSU=136, SSU=17
EUB-9	0.63	50.00	3.16	20101108	1605	10.64	Used for exploration drilling water supply
EUB-10	0.26	76.00	0.83	20101108	1535	14.08	Not equipped, standby borehole
EUB-14	0.10			20101109	1000	12.66	pump rate = 8000l/h, pump every day, P=4, G=1, D=1, LSU=350, SSU=700, 7ha pivot irrigation, 1200ha dryland
EUB-16	0.00	35		20120614	1040	24.96	Pump removed, open hole
EUB-17	0.50	84	0.83	20101109	1050	14.53	53 Waterhole - Water for exploration drilling
EUB-18	0.52			20101109	1100	15.81	AFO-40 - Water hole for exploration drilling, sub with portable generator
EUB-20	0.25			20101109	1300	10.68	pump rate = 4000l/h, reservoir = 39000L dam, P=4, G=1, LSU=350, SSU=700
EUB-21	0.17	35		20120614	1215	15.851	LSU=350, SSU=700
EUB-25	0.36			20101109	1645	17.81	219ha grazing, LSU=350, SSU=700, windmill broken
EUB-28	0.00			20101108	1610	6.26	Open hole underneath broken windmill
EUB-29	0.74			20101109	1120	5.96	AFO-09 - Water hole for exploration drilling
EUB-30	0.40	21.22	3.97	20120613	0845	5.82	LSU=400 periodically, pump being repaired, sample @ 20m
EUB-39	0.48		2.08	20101110	1140	7.29	LSU=400 periodically
EUB-42		40	3.97	20101110	1200		House & LSU=400 periodically
EUB-45	0.46					5.15	5m away from EUB-43, open hole
EUB-47		50	8.61	20101110	1420	5.83	Pumping roughly 1.0l/s mainly household use
EUB-48	0.18	50	8.61			5.34	In Vegetable garden
EUB-50	0.31			20101110	1500	3.30	Bees, SSU=300, next to road
EUB-51	0.00	50	8.33	20101110	1530	5.69	
EUB-54	0.15			20101110	1600	8.24	Open hole not in use
EUB-57	0.19	97	0.44	20101110	1630	9.5	Newly drilled hole, not equipped
EUB-60	0.05			20101110	1700	14.52	Not connected
EUB-61	0.50			20101110	1730		75mm Submersible, Houses=2, P=5, 22ha propertry
EUB-64	0.21	35		20101111	0830	5.29	Pumping, LSU=250, SSU=200
EUB-65	0.08	35				28.97	Not pumping, LSU=250, SSU=200
EUB-71	0.18	20		20101111	1200	6.33	Workshop, Lodge + Houses=11, P=50, 500 units of game, 16 species, pump 24h per day, overflow to old lime quarry dam
EUB-76	0.10	40	0.56	20101111	1415	7.07	P=40, LSU=150
EUB-77	0.20	40	0.28	20101111	1445	14.27	Not pumping, LSU=150
EUB-85	0.40	15		20101111	1630	8.14	Varying amount of SSU seasonal
EUB-86	0.40	15		20101111	1645	4.60	Varying amount of SSU seasonal
EUB-88	0.32			20101111	0820	8.46	Open hole not in use
EUB-89	0.00			20101111	0830	8.09	Open hole not in use
EUB-94	0.15	30		20101112	1140		House + garden, was contaminated 8 years ago by 9000L diesel spil
EUB-95	0.25	30		20101112	1155	6.00	Irrigate 6ha lusern, LSU =300
EUB-100	0.17	30	5.56	20101112	1210	9.19	Busy fixing windmill, LSU=300
EUB-101	0.28			20120614	1100	16.65	pump rate = 8000l/h, pump every day, P=4, G=1, D=1, LSU=350, SSU=700, 7ha pivot irrigation, 1200ha dryland
EUB-102				20120614	1215	15.81	Sub with poratble generator, pumping, pump 0.75l/s to concrete dam, LSU=350, SSU=700

3.2. Hydrogeological Boreholes

The following borehole information was assessed (summarised in Tables 3.1-3.2 and depicted in Figures 3.1-3.2):

- Existing private boreholes, which were identified during the 2 hydro-censuses ("EUB" numbers);
- Gold One drilled the following boreholes:
  - Air percussion holes are drilled to the depth of the Wits Formation (known as "Pilot Holes") before continuing deeper with core drilling:
    - Groundwater samples were obtained during drilling in 2 such holes (AFO-080 and AFO-086) to provide an indication of the water quality in the deeper aquifers;
  - Dedicated water sampling holes into the Wits Formation were drilled to retrieve representative samples of the water quality to be encountered during mining (AFO-077 and AFO-083);
  - Some percussion holes in the Karoo aquifer are utilised as "water holes" to supply water to the exploration drilling rigs ("AFO" numbers);
  - A total of 5x shallow boreholes, ("AFOs" numbers; 6m deep – associated with a selection of "water holes" – refer to hydrogeological borehole logs attached as Appendix 1) were drilled:
    - To determine the piezometric head distribution in the shallow aquifer (e.g. upward or downward);
    - To determine if a shallow "perched" groundwater table exists.

Table 3.2 Pertinent hydrogeological information

Borehole	Coordinate (WGS84)			Borehole information			Water quality (mg/L)				
	Y	X	Z (mamsl)	Depth (m)	Groundwater level (mbs)	Hydraulic conductivity (m/d)	EC (mS/m)	Ca	Na	Cl	SO4
AFO-001	-3393	3101373	1380	56	5.15	6.84E-01	75	19	147	21	24
AFO-001A	-3357	3101387	1380	56	4.75	1.23E+00	67	56	73	14	32
AFO-009	-4023	3101876	1387	60	6.08						
AFO-013	-3090	3103221	1387	37	6.62	1.82E+00	103	106	93	133	32
AFO-018	-3288	3099859	1383	56	5.51	1.49E-01	63	65	40	18	14
AFO-020	-3711	3100235	1386	54	5.02	4.32E+00	68	65	47	29	30
AFO-044	-5210	3101764	1390	73	5.61	9.50E-01	115	82	83	172	67
AFO-044S	-5206	3101463	1390	12			139	65	147	307	123
AFO-045	-5619	3102190	1397	60	9.32	2.06E+01	77	63	60	61	29
AFO-048	-4586	3100575	1385	60	6.61	5.72E+00	74	67	50	40	26
AFO-048S	-4581	3100573	1387	12			58	49	36	30	36
AFO-053	-5778	3102708	1390	77	14.25	3.00E-01	73	67	52	18	28
AFO-054	-5419	3102992	1397		19.83						
AFO-054S	-5422	310299	1406	12							
AFO-056	-6031	3102089	1399	60	9.29	8.09E-01	58	44	35	27	14
AFO-063	-5427	3101110	1391	60	6.46	1.03E+00	60	49	55	39	19
AFO-063S	-5426	3101105	1394	12			65	49	53	44	76
AFO-068	-4596	3103610	1404	36	14.16		80	69	50	22	32
AFO-077 [*]	-4949	3102903	1401	696			546	112	936	1678	<5
AFO-080 (354m)	-5670	3102373	1399	402			762	21	1936	2797	1
AFO-080 (402m)	-5670	3102373	1399	402			651	20	1668	2494	3
AFO-083	-5200	3102690	1350	546			128	13	303	139	<5
AFO-086	-5965	3100730	1350				569	29	979	1793	<5
EUB-1	-296	3103765	1394	40	8.99		84	74	99	42	56
EUB-100	-3335	3096877	1380	30							
EUB-2	-2968	3103772	1388	45	9.02		84	74	99	42	56
EUB-21	-5140	3103961	1426	35	15.851		95	91	93	73	38
EUB-30	-2059	3101233	1376	40	5.82		60	75	34	11	35
EUB-6	-3618	3104805	1409	86	16.49		127	96	157	82	129
EUB-9	-2978	3103550	1389	50	8.75		80	74	94	39	38

[*] Maximum concentration recorded during second deep sampling exercise (November 2012)

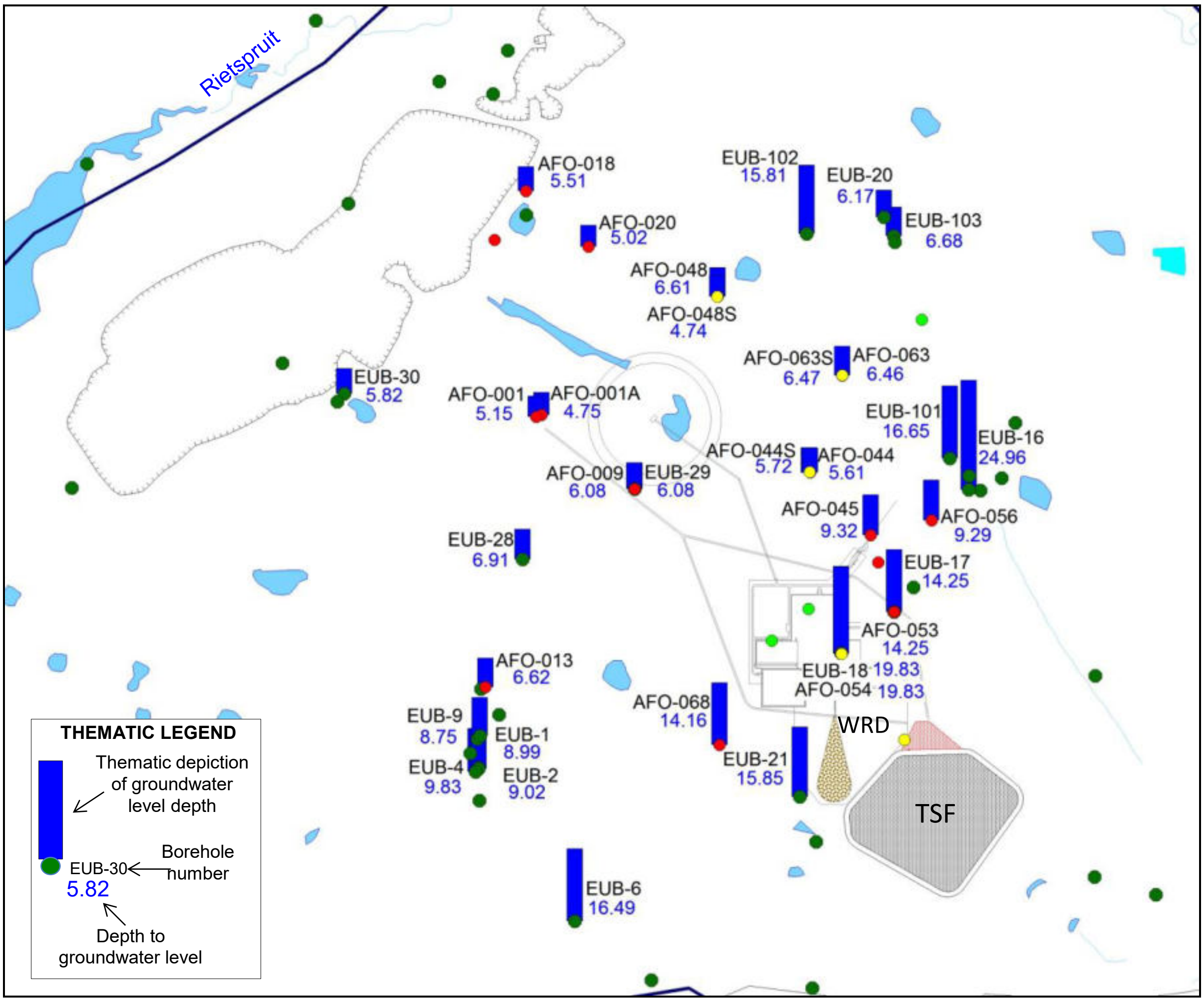


Figure 3.2 Thematic depiction of depth to groundwater level (m)

Several factors were considered in evaluating boreholes information, including:

- Geology;
- Depth of borehole; i.e. aquifer intercepted;
- Borehole location in relation to proposed mining activities;
- Direction of groundwater flow and distance to surface water bodies;
- Topographical elevation and depth to groundwater table;
- Geochemical sampling and statistical distribution;

Pertinent hydrogeological information is listed in Table 3.2. Groundwater level depths listed in Table 3.2 and Appendix 2, depicted in Appendix 4 and thematically depicted in Figure 3.2. The major cations and anions summarised as Piper- Durov- and Expanded Durov plots in Figures 4.4A-C.

3.3. Double-Ring Infiltrometer Tests

It was important to determine the hydraulic conductivity of soils in the vicinity of the TSF (original locality in north-east, known as Site Alternative-A) and the Plant area. Double-ring infiltrometer tests were performed in 6 locations as summarised in Table 3.3 during July 2012. The diameters of the inner and outer rings were respectively 800cm and 1200cm.

It was determined that the soils are very permeable compared clay horizon immediately below the soil profile (see Section 3.4).

No additional infiltrometer tests were performed in the final location of the TSF (TSF Alternative-C). The results of nearby Test 4 and Test 6 were believed to be indicative of the conditions at TSF Alternative-C with the exception that more gravel and boulders would be found to the south. The soil profile will be removed prior to constructing the TSF.

Table 3.3 Pertinent information relating to double-ring infiltrometer tests

Test	GPS #	Longitude	Latitude	Infiltration rate (m/d)	Description
Test 1	WP54	27.0472	-28.0188	0.164	Northwest of TSF Alternative-A
Test 2	WP56	27.0553	-28.0236	0.250	Footprint of TSF Alternative-A
Test 3	WP61	27.0558	-28.0408	0.075	Plant area, northeast of Rock Dump, north of TSF Alternative-C
Test 4	WP62	27.0554	-28.0195	1.743	Footprint of TSF Alternative-A
Test 5	WP63	27.0534	-28.0295	0.912	South of TSF Alternative-A
Test 6	WP64	27.0598	-28.046	0.327	East of Rock Dump, north of TSF Alternative-C

3.4. Analysis of Clay Profile

Bear GeoConsultants performed 2 investigations (July 2012 and October 2012) into the geotechnical properties of the study area. It is important to note that these investigations were performed on the assumption that the TSF would be located at the original site (Site-A) to the north-west of the Plant area.

Findings of July 2012 *Bear GeoConsultants* investigation:

- Most of the site is blanketed by a layer of sandy and clayey transported soil of a variable nature and thickness:
  - Alluvium soils transported by rivers and aeolian soils transported by wind;
  - This top section of the profile is usually separated from the underlying residual soil profile by a layer of gravel, often referred to as the pebble marker;
- The residual soil horizon, forming a clay horizon (below the transported horizon), can be divided into two sub-horizons:
  - A reworked residual horizon where macro structure (joints, bedding) and micro structure (mineral grain boundaries) have been destroyed by biotic action;
  - A residual horizon where the macro and micro structure inherited from the parent rock remains intact and visible;
- No evidence of groundwater seepage was observed;
- Recommendations were made with regard to construction activities, including:
  - Removal of soil and clay profile to construct heavy structures;
  - Utilising the clay profile (which is relatively impermeable) during the construction of the TSF;
  - Potentially utilising hardpan calcrete (which underlies the clay profile) in the construction of the TSF starter walls;
  - Calcrete would also be suitable in the construction of roads and terraces on site, and possibly in the construction of pavements.

From a groundwater prospective, *Groundwater Square* concluded the following:

- All clay occurs as either silty clay or sandy clay; almost always with abundant calcareous concretions or some form of secondary substance (e.g. mudstone fragments, gravel, pockets of sand, etc);
- Empirical equations were utilised on the particle size grading (i.e. percentage clay/salt/sand/gravel) to deduce the permeability of the clay:
  - Unless compacted (for which no tests were performed at that stage), the in-situ permeability would not be ideal;
  - *Bear GeoConsultants* were of the opinion that the permeability could be reduced significantly by compacting the clay, especially in view of the fact that it is a very plastic material. It was recommended that:
    - Clay from the plant area (that has to be removed for the foundations) can potentially be utilised underneath the tailings facility;
    - This should replace the calcrete taken out below the tailings facility which is to be utilised for road and terrace construction;

- In view of the fact that empirical equations are better suited to determine the permeability of soils with a higher sand content compared to materials with a high clay content, it was recommended that:
    - Appropriate laboratory testing be performed on representative clay samples at appropriate Proctor densities;
    - As the final position of the tailings facility were not yet determined at that stage, test pits were excavated in the original location of the TSF (Site-A);

Findings of October 2012 *Bear GeoConsultants* investigation:

- Five test pits were excavated in the original TSF area (Site-A) to examine the permeability and strength of the underlying clay rich horizons. Although the TSF has subsequently moved to the south east of the current area, the results of the tests are still likely to give a reasonable idea of whether the clay in the area in general will be suitable for forming a clay liner below the TSF;
- Samples from tests pits were submitted to a soils laboratory to determine several physical and hydraulic parameters, including Falling Head Permeability Tests on samples compacted to 93% mod AASHTO to obtain the coefficient of permeability. Table 3.4 serves as a summary of the results;
- It was concluded that the clayey soils in the area are reasonably impervious (when compacted) as a liner for the envisaged TSF;
- Significant sandy horizons occur within some portions of the site (e.g. 1.3m of sandy aeolian soil overlay the clay horizon, in 1 test-pit). Elsewhere the sandy overburden is insignificant but should be removed to stockpile for use as topsoil.

From a groundwater prospective, *Groundwater Square* concluded the following:

- Although the lowest permeability of 2.1×10^{-10}m/s, is ideal for constructing a relatively impermeable base foundation for the TSF, the higher values of 8.6×10^{-9}m/s and $1.7e^{-8}$m/s are not ideal;
- Statistically the following averages were determined:
    - Mean = 7.4×10^{-9}m/s;
    - Harmonic mean = 7.7×10^{-10}m/s;
    - Geometric mean = 3.2×10^{-9}m/s.

Table 3.4 Summary of soil laboratory permeability tests

Sample	Hole [*]	Depth (m)	Description	Coefficient of permeability (m/s)
K754	TP 1	1.50m - 2.50m [1m thick from total thickness of 2.1m]	Brown mottled orange brown and black, firm, shattered(?), sandy CLAY. Reworked residual sandstone?	2.1E-10
K755	TP 2	1.80m - 2.50m [0.7m thick from total thickness of 1.3m]	Grey mottled orange brown, stiff, shattered and slickensided, sandy clay. Reworked residual sandstone.	3.6E-09
K756	TP 3	1.80m - 2.90m [1.1m thick from total thickness of 1.1m]	Orange brown mottled grey brown, stiff, shattered, clayey sand. Reworked residual sandstone.	8.6E-09
K757	TP 5	2.00m - 2.80m [0.8m thick from total thickness of 1.1m]	Orange brown mottled grey, stiff, shattered and slickensided, slightly sandy clay. Reworked residual mudstone.	1.7E-08

[*] TP-4 were not tested

3.5. Deep Groundwater Sampling

The long-term water quality that will be encountered during mining is one of the most important considerations of the project. High water treatment costs may be incurred due to the fact that contaminated water cannot be discharged to the surface water environment.

Water quality sampling from the Wits was undertaken as summarised in Table 3.5 (also see Table 3.2). The laboratory water quality analyses are included as Appendix 3. It is believed that the water quality that can be expected during mining (from the Wits) could be determined to a high degree of certainty.

Dedicated boreholes were drilled for water sampling. Pilot holes were drilled with air percussion through the Karoo aquifer into the top-most section of the Wits aquifer. Where water and gas problems were encountered, an attempt was made to seal the fissures. Steel casing was installed into this section of boreholes. Drilling to the final depth of each hole were performed with diamond core drilling of 99mm diameter. Drilling fluids were flushed out of the hole with the core drilling rig.

The following important comments relate to the borehole sampling in the Wits aquifer:

- Sampling was undertaken by *Ground Water Practitioners*;
- Sampling of borehole AFO-077 (first attempt) from 4 sampling zones:
  - The borehole core was inspected and 4 fissure zones were selected, each 30m thick (Zone-1: 570m-600m, Zone-2: 510m-540m, Zone-3: 470m-500m, Zone-4: 403m-433m);
  - Prior to sampling, injection tests were performed in all 4 zones to ensure that the fissures were open and would yield water during pumping;
  - The top-most Zone was sampled first (packers were inflated at depths 403m and 433m to prevent upward flow of water from below and downward flow of water from above, while pumping from between the packers). Unfortunately the pump burned out (assumed to be related to a drop in groundwater level to below the pump intake) and sampling could not continue;
  - Due to the specialised nature of the pump, the supplier indicated that it would take many weeks to build a new pump. Consequently an alternative sampling methodology had to be considered;
  - It was decided to use nitrogen gas to force water from between the packers in each zone. First 1000L of water was forced out between the packers (inclusive of water in pipes – estimated at <600L), followed by a resting period of 6hrs. During the second blow-out, 60L to 70L was removed from between the packers, followed by an overnight recovery period. During the third/final phase, ±40L was removed from the hole after which a sample was collected. This practise was followed for all 4 zones;
- The specialised borehole pump could be manufactured prior to the sampling of boreholes AFO-083 and AFO-077;
- Sampling of borehole AFO-083:
  - Only 1 sampling zone of 139m thick was selected (packer depth = 363m, casing depth = 360m, pump depth = 502m, total depth of hole = 546m):
  - The pumping rate mostly varied between 110L/h to 180L/h (average 140L/h);
  - The borehole initially contained 1.5m^3 above the pump (diameter = 98mm, groundwater level = 300m, pump = 502m). Approximately 3.3m^3 was pumped out by the time the packer was set (inflated);
  - The borehole contained 1m^3 between the packer and pump (diameter = 98mm, packer = 363m, pump = 502m). After the packer was set, ±22m^3 was pumped out, which equates to 22 borehole volumes;
  - The test was stopped after 14days when it was deduced that the water quality (observed in terms of EC) would not become reflective of the Wits aquifers (see Table 3.5). It was concluded that water from the shallow Karoo aquifers were influencing the pumped water quality in some manner (e.g. downward flow through fissures around the borehole, or water introduced during drilling and borehole flushing prior to testing);
- Sampling of borehole AFO-077 (second sample attempt):
  - Only 1 sampling zone of 351m thick was selected (packer depth = 222m, pump depth = 573m, total depth of hole = 696m):
  - The pumping rate was 160L/h on average for the first day after which the packer was inflated to prevent any water from the Karoo aquifer from flowing down the hole to the sampling zone. The borehole initially contained 2m^3 above the pump (diameter = 98mm, groundwater level = 300m, pump = 573m). Approximately 3.4m^3 was pumped out by the time the packer was set;
  - The water below the packer was then pumped out for another 50hours (the pumping rate was increased to 500L/h for most of the test). The borehole contained 2.6m^3 between the packer and pump (diameter = 98mm, packer = 222m, pump = 573m). After the packer was set, ±18.5m^3 was pumped out, which equates to 7 borehole volumes;
  - It was observed that the water quality (observed in terms of EC) stabilised soon after the packer was inflated (thus preventing water from the Karoo aquifer to flow down the borehole). The EC readings during the 74hours are depicted in Figure 3.3;
- Field measurements:
  - Field readings of pH, EC, TDS and temperature were recorded with 2 field instruments (i.e. 2

measurements of each parameter). It is possible that the readings were not 100% accurate due to the high concentrations during sampling of borehole AFO-077 (second sampling attempt). However the relative concentrations are important;
    - Continuous temperature- and pressure readings were collected with transducers which were installed with each packer and below the pump;
    - The pressure readings (measured in bars) provided valuable information on the water level fluctuations in boreholes during pumping, water level recovering and inflating/deflating of packers;
    - The average temperature readings during testing are included in Table 3.5. Based on discussions with RHDHV, rock temperatures can be estimated with the formula [20 + depth x 0.014]:
        - At depths of 502m and 573m (pump depths in boreholes AFO-083 and AFO-077 [second test]) the temperature would equate to 27 degrees C and 28 degrees C respectively. Slightly lower temperature readings were obtained than expected;
        - At a depth of 600m (Zone-1 [570m to 600m deep], the deepest zone during the first sampling attempt of borehole AFO-077) the temperature would equate to 28.4 degrees C , which is slightly higher than measured;
- Deep Karoo water was sampled in 2 pilot holes during air percussion drilling, as summarised in Table 3.5. This provided valuable information because these aquifers were also exposed to marine water during formation (i.e. high in Na-Cl).

Detailed water quality analyses of the samples listed in Table 3.5 are presented in Appendix 3. Both filtered and unfiltered results were analysed for the second sampling attempt of borehole AFO-077. The main differences relate to Fe and Al concentrations, which may be of interest to the Water Purification Plant engineers.

The following comments relate the average anticipated water quality during mining:

- The sampling results of AFO-077 (second sampling attempt) were more reliable than the first 2 tests. The EC measurement at the end of the pumping was 30% lower than the maximum reading during the 74 period. This is believed to be an indication that the concentrations may be higher;
- In light of the long-term average TDS at Beatrix Mine and the anticipated concentrations determined from the groundwater pre-feasibility study (Ref:GW2_220, December 2010), the proposed <u>average</u> concentrations in Table 3.5 are presented with a high degree of confidence. “Pockets” of much higher concentrations can be anticipated.

Isotope samples were collected and submitted to Ithemba Laboratory for the analysis of Deuterium, Oxygen-18, Tritium and Carbon-14. The only results received at the time of the compilation of this report were Tritium analysis of the AFO-077 (first sampling attempt), which indicated that the water was older than 45years. No conclusions can be reached afore all analyses are completed.

Table 3.5 Pertinent hydrogeological information

	Borehole	**EC mS/m**	**TDS mg/L**	**Cl mg/L**	**Na mg/L**	**Temperature Degrees C**	**Date**
WITS	AFO-077 (highest of the four zones)	130	659	267	217	[*] 28.5 – 30.3 (Avg = 29.5)	1/10/2012
	AFO-077 (2nd sample = attached results)	546	3286	1678	936	20 – 25 (avg = 23)	9/10/2012
	AFO-83	114	730	97	268	20 – 25 (avg = 23)	29/10/2012
Karoo	AFO-080 (sampled during air percussion drilling)	762 651	5002 4379	2796 2493	1935 1667		13/6/2012
	AFO-086 (sampled during air percussion drilling)	569	3034	1793	979		17/9/2012
Beatrix	Average according to RHDHV		3200				
Original regional study – minimum Original regional study – maximum			2000 >4000				
Anticipated average concentrations		**800**	**5500**	**2800**	**2000**		

[*] Zone-1 (570m to 600m below surface)

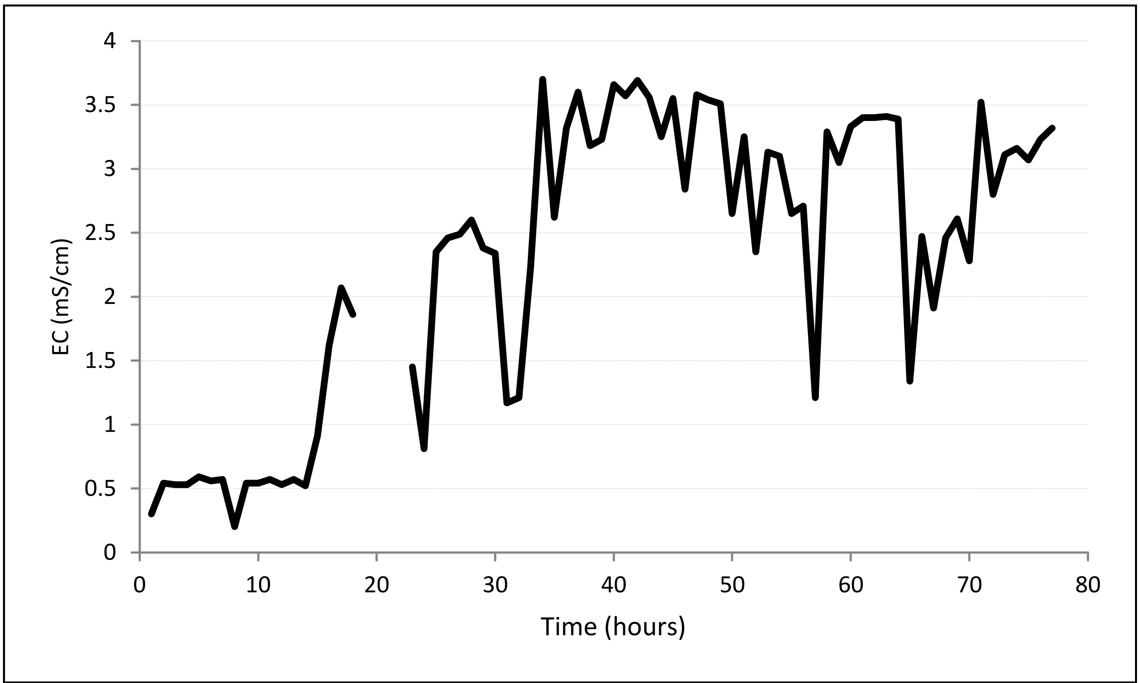


Figure 3.3 ***EC field readings during pumping from deep borehole AFO-077 (second sample)***

3.6. Geophysical Traversing

Geophysical traversing (magnetic) was performed on the original location of the TSF (site alternative Site-A) and the final choice for the TSF (site alternative Site-C). The spacing between readings were typically <2m and the traverse lines were typically spaced 20m to 50m apart (100m in the some areas, in the case of Site-C).

The following was concluded:

- No definite geological structure could be identified that would constitute a preferential groundwater flow zone (i.e. no fatal flaws);
- Similar magnetic readings (nTesla) were recorded at both sites;
- The magnetic anomalies of the regional aeromag survey (November 2010) could not be identified.

Given the lower contaminant risks presented by the Plant (in terms of preferential groundwater flow) no geophysical traversing was performed in the Plant area.

3.7. CN Water Quality Guidelines

Internet research was conducted on CN water quality guidelines, both internationally (e.g. Equator Principles, WHO) and locally in South Africa to assist in the decision making regarding the necessity to construct a CN destruction plant. Nothing comprehensive could be found dedicated to tailings facilities.

3.8. Geochemical Sampling

In order to determine the potential water quality expected to emanate from the Tailings Storage Facility (TSF), Waste Rock Dump (WRD) and other potential sources of contamination, a geochemical sampling exercise was undertaken. Geochemical samples of different lithological facies were taken from geological boreholes in the study area. A total of 15 samples were taken from 6 boreholes (VENCO001 to 011 and VENCH001 to 004) as summarised in Table 3.6). The A-reef sample was collected from the Ventersburg bulk sampling program (variability testing sample with both high and low grade ore) before leaching but after milling (VENMET002; Table 3.6). One tailings sample was also collected after leaching (VENMET001; Table 3.5).

Since the project is located in the Free State Goldfields and the mineralogy of the TSF is expected to be similar, tailings material (FGS001 to 003; Table 3.5) and leachate (7 water samples; Table 3.7) from toe drains and return water dams (RWD) were collected at various gold mines in the area.

The results of the ABA analyses, leaching qualities and geochemical modelling are presented and discussed in Section 5.

Table 3.6 Soil and core samples collected for geochemical analysis

Sample Type	Sample ID	Sample Description	Stratigraphy	Depth (m)	BH_ID
Core	VENCO_001	Ventersdorp Lavas	Ventersdorp Supergroup	380	AFO084
Core	VENCO_002	Ventersdorp Lavas	Ventersdorp Supergroup	246	AFO030A
Core	VENCO_003	Eldorado Intrusive	Intrusive	326	AFO069
Core	VENCO_004	HW_Eldorado	CR_Mondeor Formation	543	AFO084
Core	VENCO_005	HW_Eldorado	CR_Mondeor Formation	794	AFO084
Core	VENCO_007	HW_Eldorado Basal Conglomerate (VS5)	CR_Mondeor Formation	648	AFO079 Defl 3
Core	VENCO_008	HW_10m above A Reef	CR_Kimberley Formation	458	AFO070
Core	VENCO_009	FW_Big Pebble Marker	CR_Kimberley Formation	652	AFO079 Defl 3
Core	VENCO_010	FW_Big Pebble Marker	CR_Kimberley Formation	486	AFO070
Core	VENCO_011	FW Development Spes Bona (50m below A Reef)	CR_Kimberley Formation	510	AFO070
Soil	VENCH_001	Karoo (Ecca) Shale	Karoo Supergroup	0-300	AFO080
Chips	VENCH_002	Dyke	Intrusive	248	AFO080
Chips	VENCH_003	Gold Seam	Karoo Supergroup	366	AFO080
Chips	VENCH_004	Dolerite Sill	Intrusive	390	AFO080
Tailings	FGS_001	Welkom Tailings			
Tailings	FGS_002	Masimong Tailings			
Tailings	FGS_003	Masimong Tailings			
Tailings	VENMET_01	Ventersburg A Reef Tailings	CR_Kimberley Reef		Multiple
Pulp	VENTMET_02	Ventersburg A Reef	CR_Kimberley Reef		Multiple

FW = Footwall, HW = Hang wall and CR = Central Rand Group of the Witwatersrand Supergroup

Table 3.7 Water samples collected for tailings leachate across the Free State Goldfield

Sample ID	Location	Mine
FG_TSF02	Wetland off R73	Welkom
FG_TSF03	From pipe discharging into Solution Trench	President Steyn South
FG_TSF04	Reclaimed Dump Solution Trench	Virginia
FG_TSF05	RWD – pump station	Virginia
FG_TSF06	RWD	St Helena
FG_TSF07	RWD	Welkom
FG_TSF08	Dam	President Steyn North

4. CONCEPTUAL MODEL

4.1. Aquifer Parameters

The Karoo aquifer descriptions in Tables 4.1 and 4.2 are based on several sources of information as discussed in Section 3. The shallow soil/clay/calcrete profile was assessed through double-ring infiltrometer tests, shallow boreholes, geophysical traversing and the geotechnical investigations by Bear GeoConsultants (July 2012 and October 2012). The shallow and deeper Karoo aquifers were assessed through the study of hydrocensus information, geophysical traversing and boreholes drilled by Gold One (including "water holes" used for water supply during drilling, as well as pilot holes drilled through the Karoo aquifers). Cognisance was taken of the typical groundwater conditions that can be expected in the Karoo environment, especially in the Free State Gold Fields.

The following aspects are important:

- Regionally speaking, it is well-known that:
  - The Karoo aquifers are separated from the gold-bearing reefs by thick impermeable strata;
  - During mining, no measurable dewatering impact is observed in the shallow Karoo aquifers;
  - Whilst the groundwater quality of the Wits aquifers and deepest Karoo aquifers are expected to be of poor quality, the unimpacted shallow Karoo aquifers are of good quality when compared to drinking water standards;
- Due to historical mining activities the groundwater level in the Wits aquifer is substantially lower than in the Karoo aquifer:
  - Groundwater levels in the Karoo aquifers vary between 0m (e.g. around rivers and pans) and 30m deep (in the higher lying regions). Groundwater levels are 10m to 15m deep where the surface infrastructure will be located;
  - Pressure readings during the deep water sampling (see Section 3.5) indicated that the groundwater in the Wits aquifer is approximately 300m below surface;
- There appears to be some correlation between the depth to the groundwater table and the borehole depth. This may be attributed to these boreholes being located at higher topographical elevations, where the groundwater table is expected to be deeper;
- During the hydrocensus it was determined that borehole yields ranged between 0.3L/s and 20L/s. A representative yield of 2L/s was calculated:
  - The high-yielding boreholes drilled by Gold One for water supply, confirmed this deduction;
  - Borehole yields in the study area are higher than the ranges suggested by the 1:500 000 hydrogeological map series of South Africa, Sheet 2736 (Kroonstad, 2000);
  - Borehole yields were an important consideration in assigning hydraulic conductivity values to the Layers of the numerical model;
- Water-strikes in the shallow zone aquifer range between 18m and 42m below surface. Drill cuttings from air percussion "pilot" boreholes and cores indicate highly weathered to weathered strata up to approximately 18m deep and variations of lightly weathered, fractured and fresh strata between 18m and approximately 42m below surface;
- No major continuous zones of preferential flow were identified in the area where surface activities will be placed.

Table 4.1 Aquifer layers – description

Aquifer	Average depth	Description	Comment
Aquifer-1	0m to 50m (50m thick)	Shallow weathered zone aquifer, which includes the soil profile	Unconfined to semi-confined conditions. Groundwater levels are shallower after wet rainfall periods or in close proximity to drainage/rivers/streams. Deepest water strikes and depth of hydrogeological weathering used as indicator of zone bottom.
Aquifer-2	50m to 80m (30m thick)	Deep fractured aquifer	Observations have shown that the potential for the Karoo aquifer to transmit water is largely restricted at depths exceeding 60m to 80m below surface.
Aquifer-3	>80m	Deep non-fractured aquifer	Almost all fractures are believed closed. However, groundwater can be intersected at geological contacts.

Table 4.2 Aquifer layer – hydraulic parameters [*]

Aquifer Layer	Numerical model layer	Thickness / Depth (m)	Hydraulic conductivity (m/d) [m/s]	Longitudinal dispersivity [**]	Rainfall Recharge (m/d) {mm/a} [%of MAP]
Aquifer-1 (50m)	Layer-1: Soil	2.5m / 2.5m	(0.01) [$1.2x10^{-7}$]	20	($2.9x10^{-5}$) {10.6} [2]
	Layer-2: Clay	2.5m / 5m	(0.0005) [$5.8x10^{-9}$]	20	
	Layer-3: Highly weathered aquifer	5m / 10m	(0.05) [$5.8x10^{-7}$]	20	
	Layer-4:	20m / 30m	(0.7) [$8.1x10^{-6}$]	50	
	Layer-5:	20m / 50m	(0.07) [$8.1x10^{-7}$]	20	
Aquifer-2 (30m)	Layer-6:	30m / 80m	(0.001) [$1.2x10^{-8}$]	5	
Aquifer -3 (120m)	Layer-7:	40m / 120m	(0.0001) [$1.2x10^{-9}$]	1	
	Layer-8:	180m / 300m	($1x10^{-5}$) [$1.2x10^{-10}$]	1	

[*] Storativity and porosity values are expected to be 0.05 and 0.08 respectively.
[**] Transversal dispersivity was assumed 10% of the longitudinal dispersivity.

A two-dimensional view (top-view) of the numerical model grid, which consists of six layers, is depicted in Figures 4.1A-B (the model domain is depicted in Figures 1.2 and 1.3). Rivers/spruits serve as hydraulic boundaries to the local groundwater flow system. Aquifers discharge into these non-perennial streams (i.e. base-flow), especially during the rainy season when groundwater levels rise due to rainfall recharge. Boundary conditions as employed in the numerical groundwater flow and transport model are summarised in Table 4.4. The size of the model domain was chosen sufficiently large to ensure that the model boundaries did not influence model accuracy.

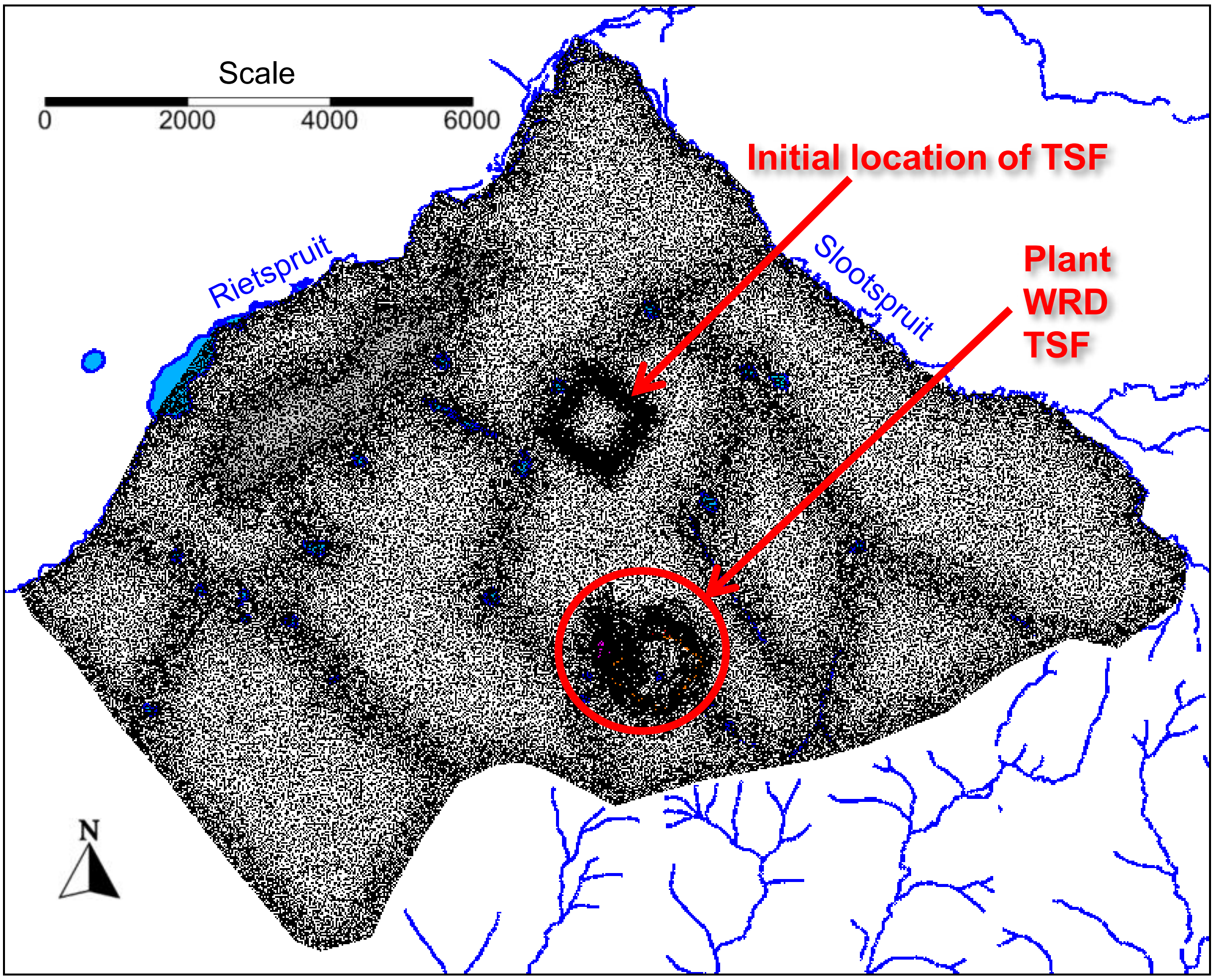


Figure 4.1A Model grid – full view

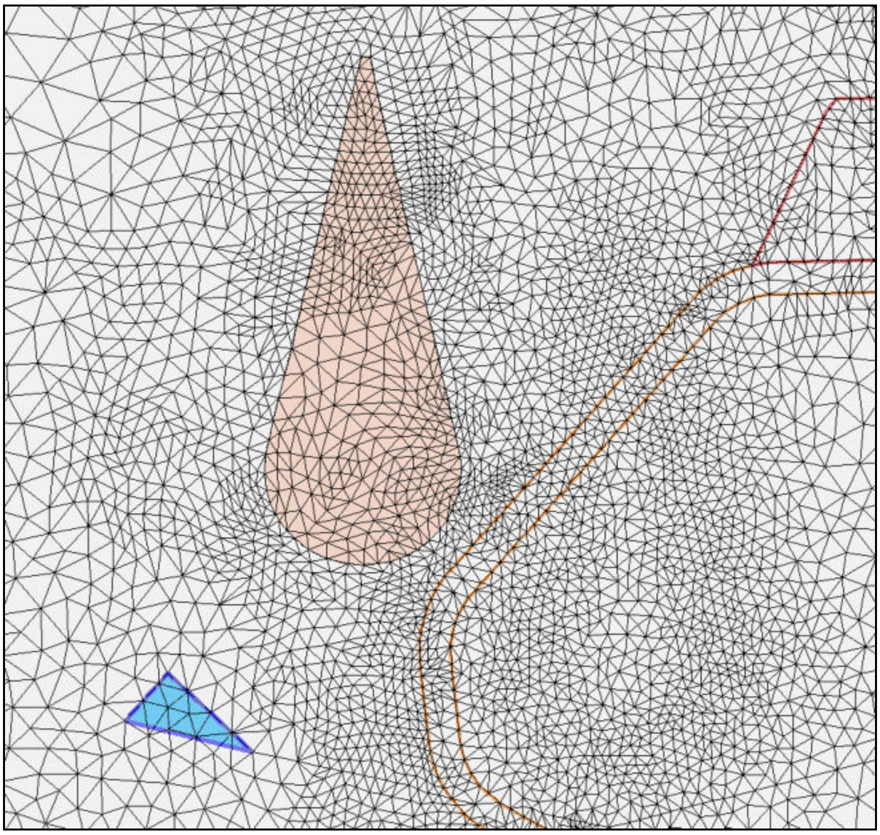


Figure 4.1B Model grid – zoom view around WRD and TSF

The calibration of the numerical groundwater flow model (model parameters: hydraulic conductivity and recharge) was achieved by simulating the observed groundwater levels through the optimum combination of rainfall recharge and aquifer permeability. The groundwater level calibration graph is included as Figure 4.2.

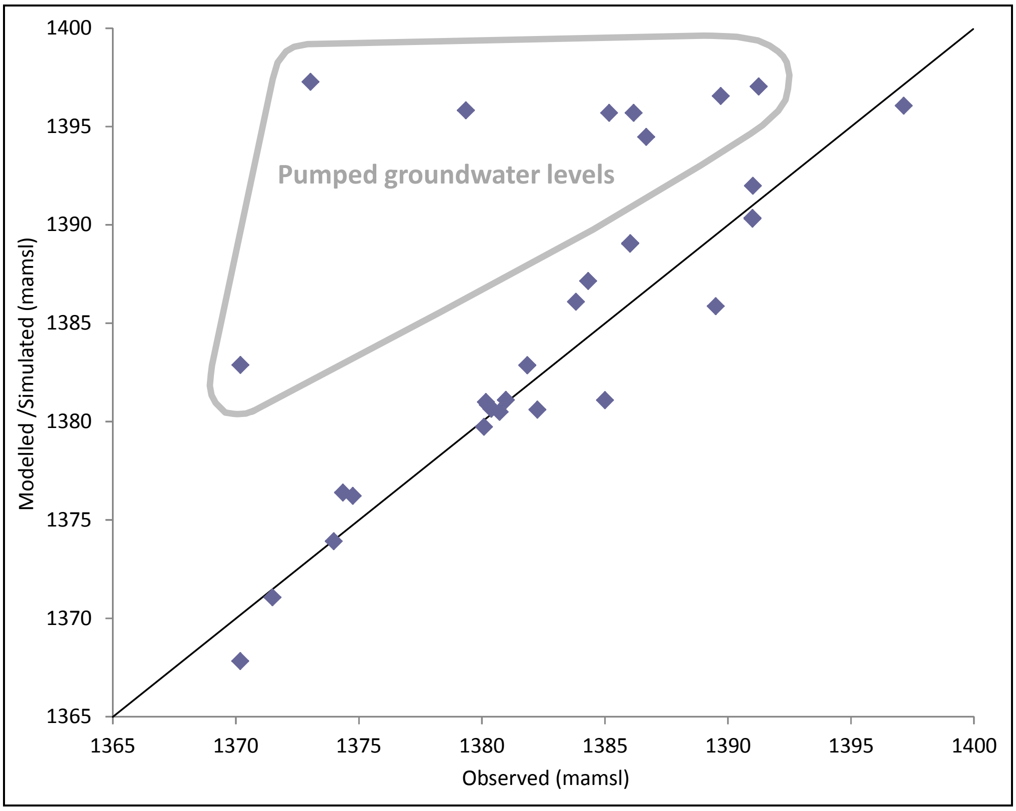


Figure 4.2 Modelled/simulated groundwater levels vs. observed groundwater levels

Table 4.4 Numerical model boundaries

Boundary	Boundary type	Comment
South and west	No-flow	Perpendicular to groundwater flow or along topographical highs
North and east	Seepage face	Seepage to surface if groundwater should rise above the stream/riverbed elevation/surface
Several internal rivers/streams/low-lying areas [*]		

[*] Especially relevant in close proximity to TSF, WRD and Plant

4.2. Groundwater Levels and Groundwater Flow

Groundwater levels are depicted in Figure 3.3, and partially addressed in Section 3. The groundwater elevations and flow directions as determined through numerical flow modelling are depicted in Figure 4.3.

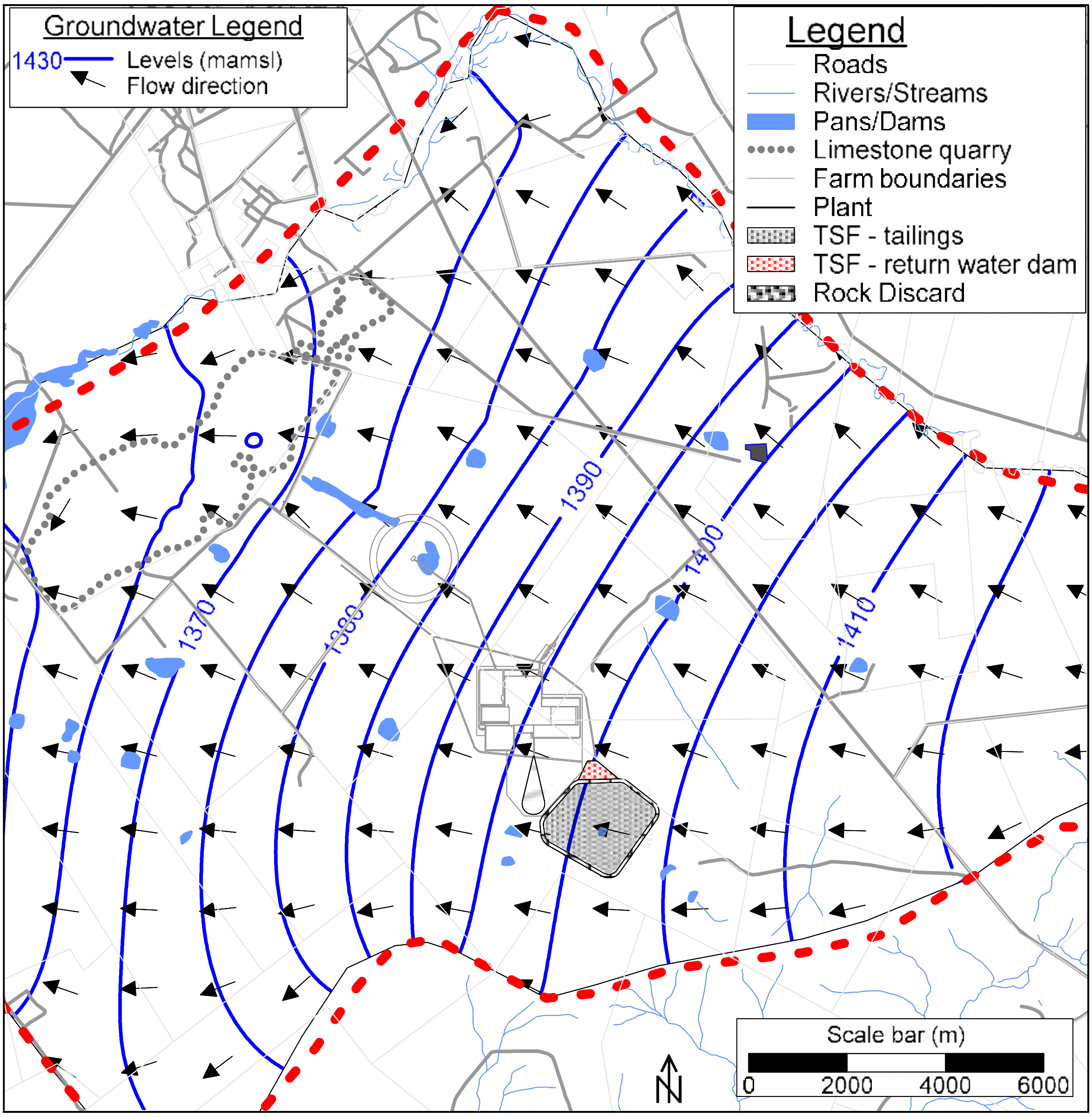


Figure 4.3 Numerically simulated pre-mining groundwater level elevations (mamsl) and groundwater flow directions

4.3. Groundwater Quality

The groundwater quality database (consisting of recently drilled hydrogeological boreholes and hydrocensus information) was scrutinised to compile a background groundwater quality profile; see Table 4.5.

All laboratory water quality results are included as Appendix 3. Major cations and anions are hydro-chemically summarised as Piper-, Durov- and Expanded Durov plots in Figures 4.4A-C for hydrocensus boreholes, monitoring boreholes (drilled by Gold One), deep groundwater samples and surface water monitoring localities.

The following comments are relevant to the shallow Karoo aquifers which are being utilised for water supply for domestic/farm use:

- All elemental concentrations in groundwater samples collected from the hydrogeological drilling and hydrocensus, fall within the indicated background quality range:
  - The background groundwater quality marginally exceeds the South African National Standards (SANS-241) for Domestic Use (2006) for NO_3. It does not represent a health hazard to adults, but Methaemoglobinaemia may occur in infants;
  - Elevated water qualities were observed in a few boreholes (e.g. AFO-044, AFO-044S and EUB-06); especially EC, TDS, Na, Cl and SO_4:
    - No evidence could be found of surface activities which could impact the groundwater quality in the vicinity of these boreholes;
    - Na and Cl concentrations are especially relevant due to the high concentrations expected in the Wits aquifer where gold mining will take place;
    - The Cl concentration in 1 borehole exceeds the class one guideline concentration;
  - It is expected that agricultural activities had a marginal influence on the natural background groundwater quality:
    - This usually applies to Na, Cl and NO_3;
    - The SAR diagram included as Figure 4.5 (also the Durov diagrams included in Figures 4.4A-C), indicates that the possibility for Sodium Adsorption is low, but that Electrical Conductivity generally exceed 75mg/L;
- Based on the Expanded Durov diagram, the dominant anions and cations are:
  - In the shallow Karoo aquifers: Alkalinity and Mg.

The following comments are relevant to the deeper Karoo and Wits aquifers:

- Compared to the shallow Karoo aquifers, the water quality of the deeper Karoo aquifer (i.e. immediately above the Wits – sampled from boreholes AFO-086 and AFO-080) reflected much higher concentrations:
  - These elemental concentrations exceed the indicated SANS-241 drinking water standards in almost all instances:
  - See results listed in Appendix 3;
- The water quality of the Wits aquifers could be confirmed with a high degree of certainty as discussed in Section 3.5;
- Based on the Expanded Durov diagram, the dominant anions and cations are:
  - In the shallow Karoo aquifers: Mg and Alkalinity;
  - In the deep Karoo and Wits aquifers: Na and Cl.

Isotope samples were collected and submitted to Ithemba laboratory for the analysis of Deuterium, Oxygen-18, Tritium and Carbon-14. The only results received at the time of the compilation of this report were Tritium analysis of the AFO-077 (first sampling attempt), which indicated that the water was older than 45years. No conclusions can be reached afore all analyses are completed.

During the mining phase, the following elements will indicate the impact of mining and gold processing on the groundwater environment:

- Na-Cl-type water will be pumped from the underground gold mine;
- SO_4 will indicate contamination due to mining-related activities on surface (e.g. gold process and tailings deposition).

Table 4.5 Background inorganic groundwater quality in Karoo aquifers

	Background Water Quality			**SANS 241 - 2006 Domestic Water**	
	Shallow Karoo aquifers		**Deep Karoo and Wits aquifers**	**Class 1 (Recommended Operational Limit)**	**Class II (Max Allowance for Limited Duration)**
	Typical/ Mostly	**Also observed**			
pH	6.6-8.8		7.0 – 9.5	5.0 - 9.5	4.0 - 10.0
EC (mS/m)	45-110	100-130 AFO-044S = 139	800 (700 – 1000)	<150	150 - 370
TDS (mg/L)	270-660	EUB-6 = 824	5500 (3500 – 6000)	<1000	1000 - 2400
Ca (mg/L)	20-106		<30	<150	150 - 300
Mg (mg/L)	<55		<5	<70	70 - 100
Na (mg/L)	<100	115-160	2000 (1700 – 2500)	<200	200 - 400
K (mg/L)	<20		<20	<50	50 - 100
Cl (mg/L)	<80	130-170 [*] AFO-044S = 307	2800 (2000 – 3500)	<200	200 - 600
T.Alk. (mg/L)	200-425				
SO_4 (mg/L)	<75	AFO-044S = 122 EUB-6 = 128	<5	<400	400 - 600
NO_3 - N (mg/L)	<10	11-20	<1	<10	10 - 20
F (mg/L)	<1			<1.0	1.0 - 1.5
Fe (mg/L)	<0.2	Outlier = 0.66		< 0.2	0.2 - 2.0
Mn (mg/L)	<0.03	Outliers = 0.45 & 0.47		< 0.1	0.1 - 1.0
Al (mg/L)	<0.3	Outliers = 0.38 & 0.62		<0.3	0.3-0.5

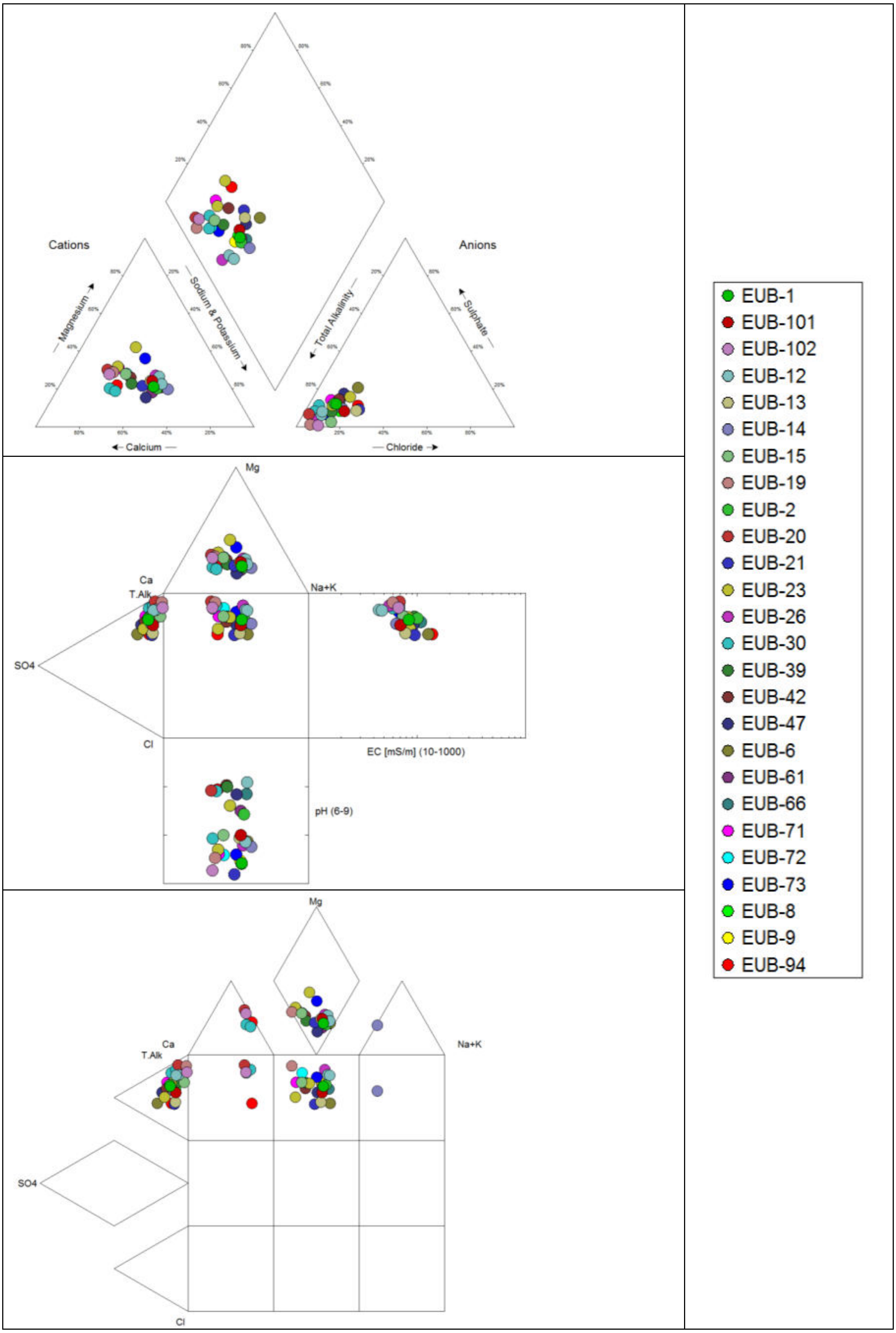


Figure 4.4A ***Piper/Durov/Expanded Durov plots of groundwater quality – hydrocensus localities***

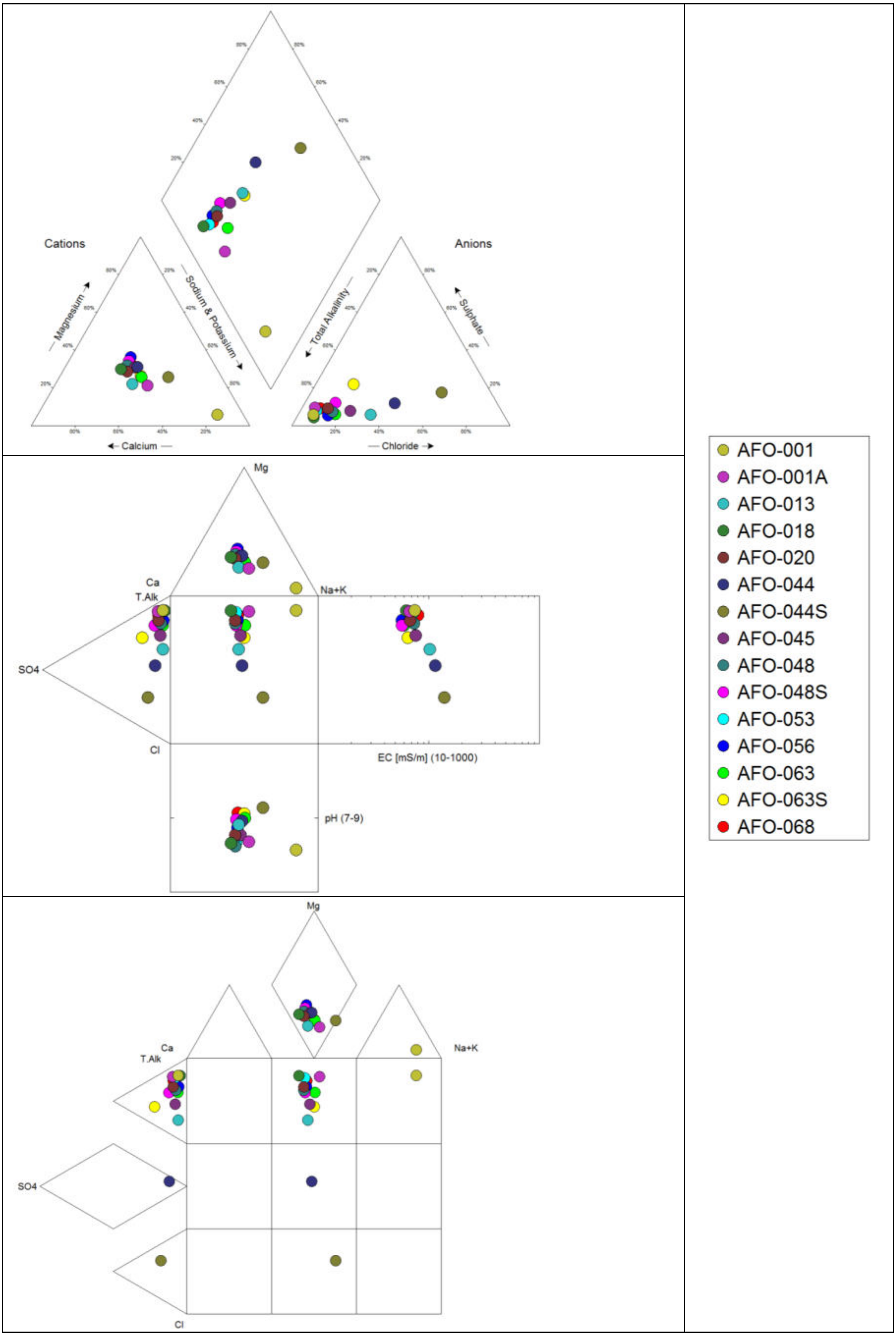


Figure 4.4B Piper/Durov/Expanded Durov plots of groundwater quality – monitoring boreholes

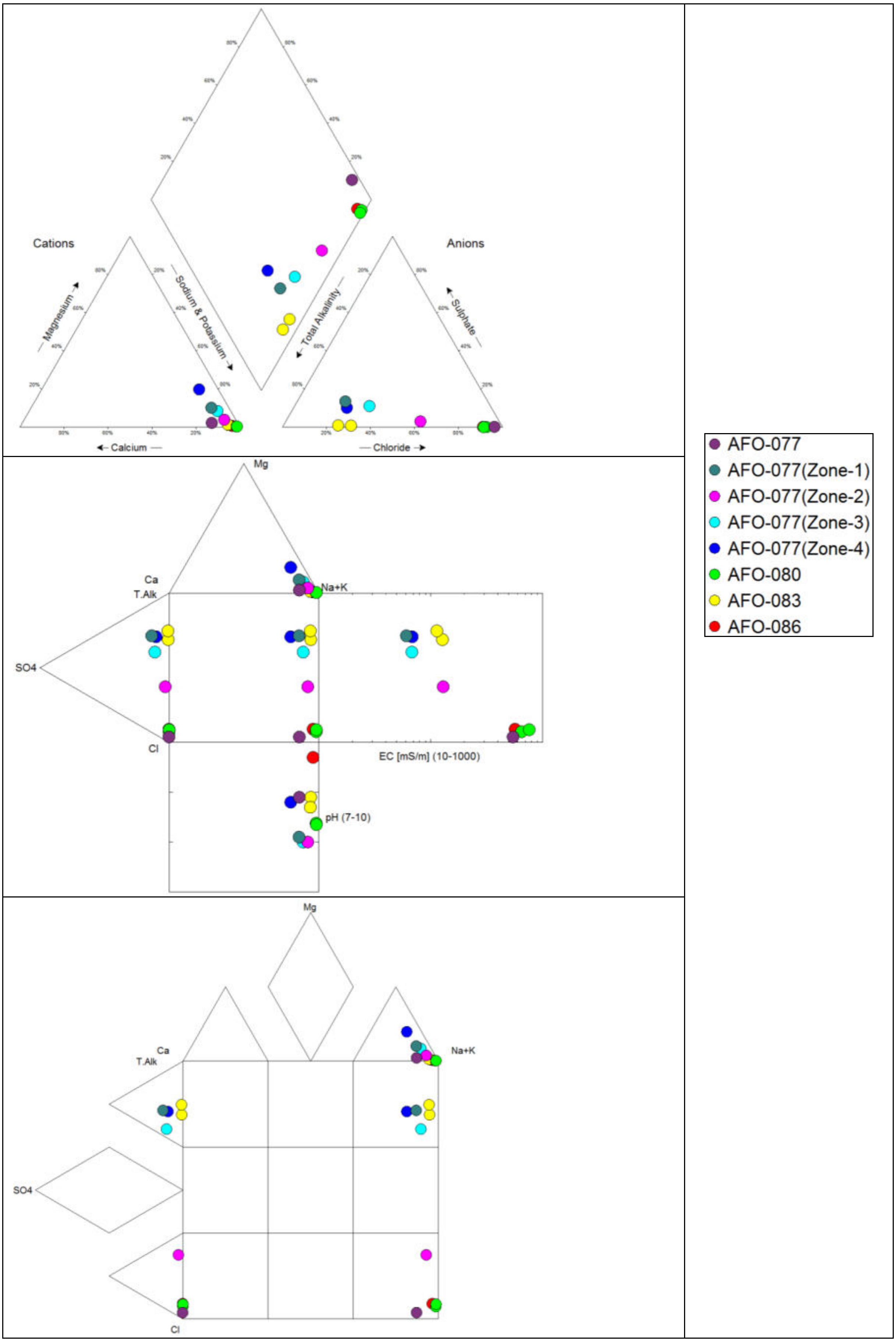


Figure 4.4C Piper/Durov/Expanded Durov plots of groundwater quality – deep water sampling boreholes (see summary in Table 3.5)

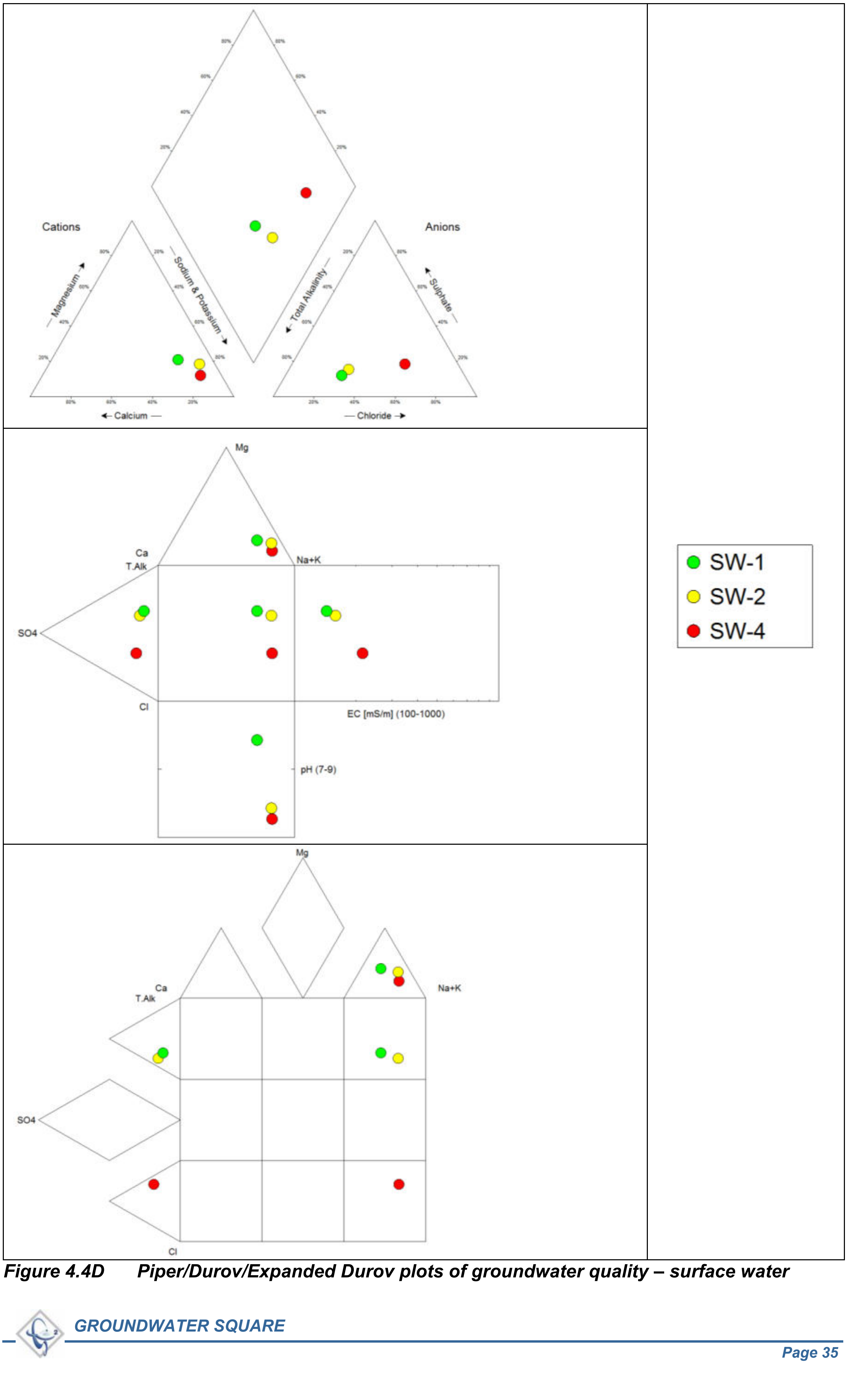


Figure 4.4D Piper/Durov/Expanded Durov plots of groundwater quality – surface water

localities

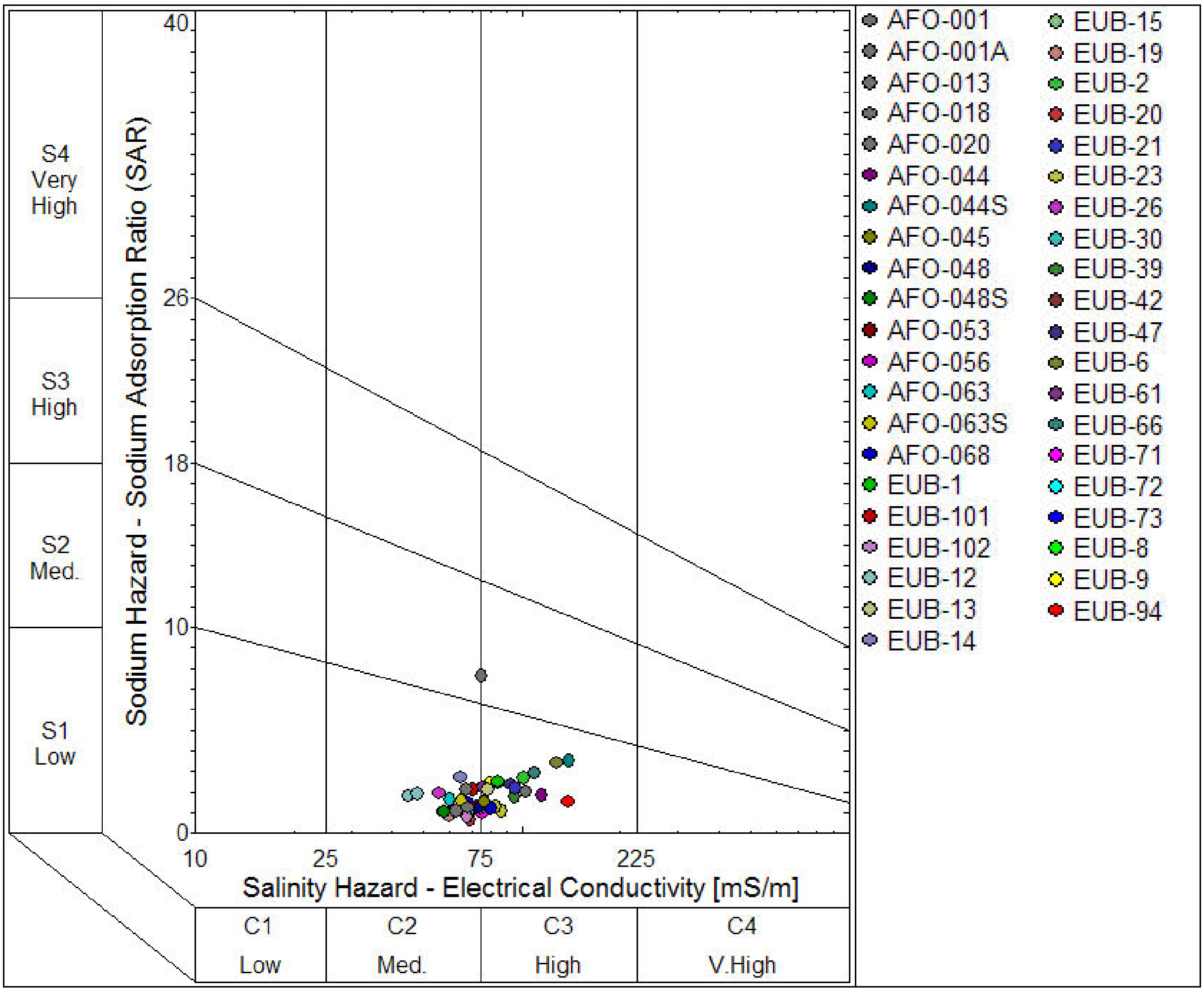


Figure 4.5 Sodium Adsorption Ration (SAR) diagram – groundwater localities

5. GEOCHEMISTRY

Groundwater Square appointed *Geostratum* to perform an environmental geochemical assessment (in collaboration with Environmental Geologist, Vanessa Vermaak, who performed sampling and data collection) of the *Ventersdorp Gold Mine*, *Gold One (Pty) Ltd*. The primary objective of the assignment was to:

- Collect and submit samples to the various testing laboratories;
- Interpret analytical results to determine first order potential for acidic mine drainage;
- Identify metals that may be present in drainage from the mine residue dumps; and
- Perform geochemical modelling in order to predict future seepage qualities from the mine residue dumps.

Mitigation measures were proposed based on the modelling results.

5.1. Analytical Results and Interpretation

Sampling

An elaborate sampling programme was performed. The programme included the collection of samples from existing tailings and tailings dam water/seepage (from surrounding mines), as well as waste rocks from both the Wits (hanging and foot wall - HW and FW) and the Karoo and Ventersdorp Stratigraphic Super Groups (from Gold One drilling). A description of the samples is given in Tables 5.1A-D.

The following samples were collected:

- 4 Karoo waste rock samples (1 shale, 1 coal, 1 dolerite sill, 1 dolerite dyke);
- 2 Ventersdorp lava waste rock samples;
- 9 Witwatersrand samples (1 dolerite intrusive, 8 HW and FW quartzites/conglomerates);
- 5 Tailings samples including 2 prepared pulp samples from various boreholes in the project area;
- 3 In-situ soil samples and 1 calcrete sample;
- 7 Tailings water/seepage samples.

The following comments relate to the representativeness of sampling and quality control:

- The complete litho-stratigraphical profile was sampled down to (but excluding) the mined Wits ore;
- The sampled boreholes (waste rock sampling) are spaced across the planned mining area;
- Tailings were sampled from two adjacent mines (Masimong and Welkom Operations). These tailings were not recently deposited. The tailings from these two sites had a %S lower than the Ventersdorp laboratory prepared pulp;
- It was assumed that the 2 Ventersdorp prepared pulp samples are representative of the feed and the tailings material respectively. It is however uncertain whether the tailings material would not be more oxidized in an actual processing plant than during laboratory preparation. Some assumptions were made in the geochemical modelling in order to address this uncertainty;
- For quality control purposes 4 of the 24 samples (17%) were analysed in duplicate for acid-base accounting (ABA).

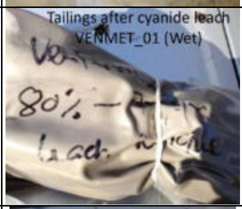
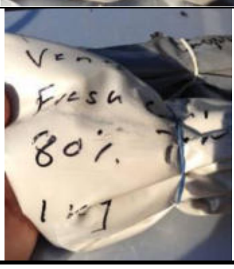
Table 5.1A Description of waste rock samples submitted for geochemical testing

Sample ID	Sample	Sample Type	Borehole ID	Stratigraphy	Depth (m)	*	Waste/Rock Type
VENCH_001	-	Rock chips from percussion drilling	AFO080	Karoo (Ecca) Shale	0-300		Waste Rock Karoo
VENCH_002	-	Rock chips from percussion drilling	AFO080	Dyke	248		Waste Rock Karoo
VENCH_003	-	Rock chips from percussion drilling	AFO080	Coal Seam	366		Waste Rock Karoo
VENCH_004	-	Rock chips from percussion drilling	AFO080	Dolerite Sill	390		Waste Rock Karoo
VENCO_001		Core from diamond drilling	AFO084	Ventersdorp Lavas	380		Waste Rock Ventersdorp
VENCO_002		Core from diamond drilling	AFO030A	Ventersdorp Lavas	246		Waste Rock Ventersdorp
VENCO_003		Core from diamond drilling	AFO069	Eldorado Intrusive	326		Waste Rock Hanging Wall/Foot Wall
VENCO_004		Core from diamond drilling	AFO084	HW_Eldorado	543		Waste Rock Hanging Wall/Foot Wall
VENCO_005		Core from diamond drilling	AFO084	HW_Eldorado	794		Waste Rock Hanging Wall/Foot Wall

Sample ID	Sample	Sample Type	Borehole ID	Stratigraphy	Depth (m)	*	Waste/Rock Type
VENCO_006		Core from diamond drilling	AFO079 Defl 3	HW_Eldorado Basal Congl (VS5)	644		Waste Rock Hanging Wall/Foot Wall
VENCO_007		Core from diamond drilling	AFO079 Defl 3	HW_Eldorado Basal Congl (VS5)	648		Waste Rock Hanging Wall/Foot Wall
VENCO_008		Core from diamond drilling	AFO070	HW_10m above A Reef	458		Waste Rock Hanging Wall/Foot Wall
VENCO_009		Core from diamond drilling	AFO079 Defl 3	FW_Big Pebble Marker	652		Waste Rock Hanging Wall/Foot Wall
VENCO_010		Core from diamond drilling	AFO070	FW_Big Pebble Marker	486		Waste Rock Hanging Wall/Foot Wall
VENCO_011		Core from diamond drilling	AFO070	FW Development_Spes Bona (50m below A Reef)	510		Waste Rock Hanging Wall/Foot Wall

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.1B Description of tailings and metallurgical pulp samples submitted for geochemical testing

Sample ID	Sample	Sample Type	Sampling Site/Borehole ID	Rock Type	Depth (m)	*	Location
FGS_001		Tailings	Tailings Dam	Welkom Tailings (dry)	Surface		Tailings Welkom Operations
FGS_002		Tailings	Tailings Dam	Masimong Tailings dam (dry)	Surface		Tailings Masimong
FGS_003		Tailings	Tailings Dam	Masimong Tailings dam (dry)	Surface		Tailings Masimong
VENMET_01		Pulp	Multiple boreholes	Ventersburg Tailings after cyanide leach (wet)	-		Pulp Ventersdorp Metallurgy
VENMET_02		Pulp	Multiple boreholes	Ventersburg (Reef) Pulp after milling (dry)	-		Pulp Ventersdorp Metallurgy

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.1C Description of soil samples

Sample ID	Sample Type	Sampling Site/Borehole ID	Depth (m)	*	Description (Bear GeoConsultants)
TP1	Clay	In-situ	1.6-2.6		Very moist, brown mottled orange brown and black, firm, shattered sandy CLAY. Reworked residual sandstone? Traces of ferruginous concretions and scattered calcareous nodules.
TP3	Sand	In-situ	1.8-2.8		Moist, orange brown mottled grey brown, stiff, shattered, clayey SAND. Reworked residual sandstone?
TP5	Clay	In-situ	2-2.8		Slightly moist, orange brown mottled grey, stiff, shattered and slickensided, slightly sandy CLAY. Reworked residual mudstone. Becomes less clayey with depth.
Calcrete Waste	Calcrete	In-situ	-		-

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

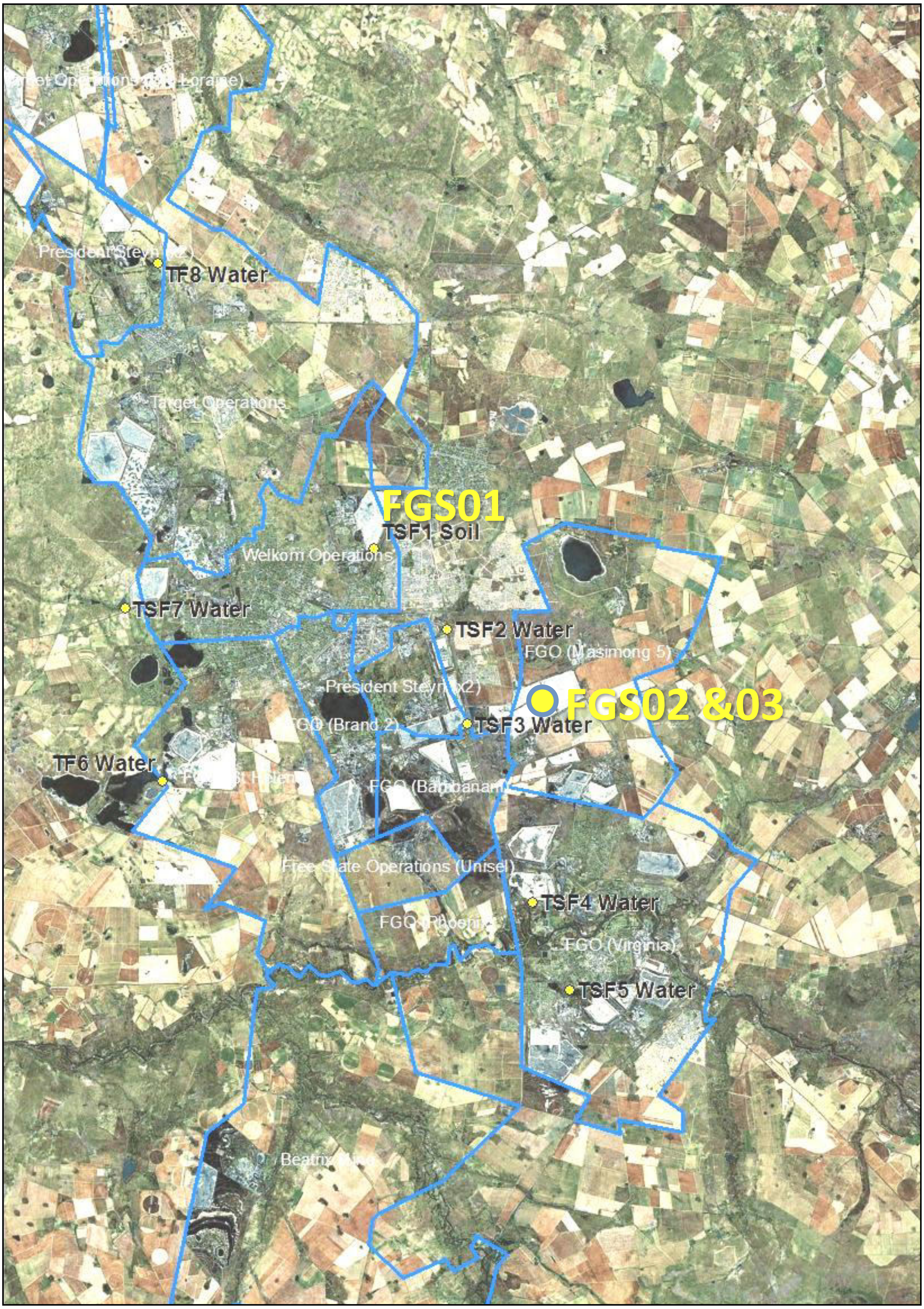
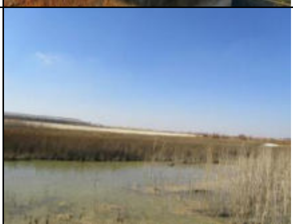


Figure 5.1 Location of tailings water sampling points

Table 5.1D Description of tailings water/seepage

Sample ID	Sample	Sample Type	Sampling Site/Borehole ID	*	Location
TSFO2		Tailings seepage	Wetland. Surface water.		Wetland off R73, Welkom Operations
TSFO3	 	Tailings seepage	Trench. Surface Water.		President Steyn North. Pipe discharging into solution trench.
TSFO4		Tailings seepage	Trench. Surface Water.		Virginia Operations. Reclaimed dump solution trench.
TSFO5		Tailings return water	RWD. Surface water.		Virginia Operations. Return water dam pump station.
TSFO6		Tailings return water	RWD. Surface water.		St Helena operations. Return water dam.
TSFO7		Tailings return water	RWD. Surface water.		Welkom operations. Return water dam.
TSFO8		Dam	Surface Water.		President Steyn North. Return water dam.

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Mineralogical and total element analyses:

The mineralogical and total element compositions for a selection of samples were determined by means of X-ray Diffraction (XRD) and X-ray fluorescence (XRF) respectively. The results are reported in Tables 5.2A-D.

The following pertains to the XRD method:

- The samples were prepared for XRD analysis using a back loading preparation method. They were analysed with a PANalytical X'Pert Pro powder diffractometer with X'Celerator detector and variable divergence and fixed receiving slits with Fe filtered Co-K radiation. The phases were identified using X'Pert Highscore plus software;
- Amorphous phases were not taken into account in the quantification;
- Trace minerals at concentrations below ±1% are often not detected by means of XRD testing on whole rock samples as the error might become larger than the analyses reported;
- The weight percentages of the minerals were determined using the Rietveld method (Autoquan Program).

The following comments relate to the mineralogy and total elemental composition of the samples:

- SiO_2 is elevated above the Average Upper Crust (AUC) of Rudnick and Gao (2003) in the Wits Hanging and Footwalls, the tailings, and some soils. The elevation in the Wits, tailings and pulp can be contributed to the fact that these rocks are mostly quartzites or conglomerates with quartz as a dominant mineral;
- In the Wits HW/FW and tailings and pulp samples, quartz is the dominant mineral with muscovite, pyrophyllite, pyrite and chlorite only present as minor minerals. Calcite is present in one pulp and one HW/FW sample (Venmet 2 and Venco_011). Resultantly, these sample predominantly comprises of SiO_2 with Al_2O_3 and Fe_2O_3 mostly higher than the sum of the base oxides (CaO, MgO, Na_2O and K_2O) but still lower than the AUC;
- Al_2O_3 and TiO_2 are elevated above the AUC in the Karoo and in the soil samples. The TiO_2 in the Karoo dolerite is due to the presence of ilmenite ($FeTiO_3$). In the shale and coal the Ti is mostly related to the presence of rutile, anatase or Al-silicates like kaolinite. In the latter Ti, as a trace element, may often replaces the Al;
- The 3 clay/sand soil samples predominantly comprises of SiO_2 and Al_2O_3, with some Fe_2O_3. The phases in these samples comprise of quartz as a dominant mineral with muscovite, microcline, kaolinite, enstatite, diopside and chlorite all as minor minerals. These soils were all formed in-situ. According to the soil description the three soil samples originate from underlying sandstones;
- MgO and CaO are elevated above the AUC in the dolerite, V. lava and in the calcrete samples. The elevation in these rocks could be attributed to the presence of Ca and Mg minerals like chlorite, Ca-plagioclase, dolomite and calcite. The Eldorado intrusion was identified by the geologist in the field as a dolerite as it is very similar in texture as the dolerite in the area. It is altered to chlorite with some calcite, dolomite and quartz. This is because of carbonatisation and chlorinitisation that took place during alternation whereby chlorite, carbonates and quartz are formed, for example:
    - Diopside + $2CO_2$(g) ↔ dolomite + 2quartz (balanced)
    - Ca-plagioclase + diopside + CO_2(g) + H_2O ↔ calcite + Mg-chlorite + quartz (not balanced)
- The Eldorado intrusion is mineralogical however similar in composition to the one Ventersdorp lava sample tested with chlorite, calcite and quartz present in both samples at almost the same quantities. However, the intrusion has hornblende instead of muscovite which is present in the lava. The major oxides in these samples are also very similar; with the exception of the intrusion having a lower Si but higher Mg content than the lava;
- P_2O_5 is elevated above the AUC in the Karoo and calcrete samples. The P may often be related to traces of apatite ($Ca_5(PO_4)_3(F,OH,Cl)$) in these samples;
- As is elevated above the AUC in the coal and in all the Wits HW/FW and tailings samples. The As could be correlated to the sulphur in these samples (arsenopyrite or as traces in pyrite);
- In the Venmet Pulp samples trace elements that are at least 2 times elevated above the AUC in both samples includes As, Co, Cr, Ni, Pb, Th and U. In the Wits HW/FW samples the above trace elements (with also Cu and Zn) were often elevated above the AUC;
- Elevation above the AUC is however not an indication of the leachability of the trace elements and metals with meteoric water under field conditions. The leachability was assessed through leaching tests.

Table 5.2A Description of minerals present

Mineral	*	Formula	Mineral type/group	Sub-group
Anatase		TiO_2	Oxide mineral	Rutile Group
Calcite		$CaCO_3$	Anhydrous Carbonate	Calcite Group
Chlorite		$(Mg,Fe)_5Al(AlSi_3O_{10})(OH)_8$	Phyllosilicate. 2:1 layers with brucite inbetween	Chlorite group
Diopside		$CaMgSi_2O_6$	Inosilicate	Ca clinopyroxene
Dolomite		$CaMg(CO_3)_2$	Anhydrous Carbonate	Calcite Group
Enstatite		$Mg_2Si_2O_6$	Inosilicate	Orthopyroxenes
Gypsum		$Ca(SO_4)(H_2O)_2$	Hydrated Sulfate	
Halite		$NaCl$	Anhydrous and Hydrated Halides	Halite Group
Hornblende		$Ca_2[Mg_4(Al,Fe^{3+})]Si_7AlO_{22}(OH)_2$	Inosilicate	Calcic Amphiboles
Illite		$(K,H_3O)(Al,Mg,Fe)_2(Si,Al)_4O_{10}[(OH)_2,(H_2O)]$	Phyllosilicate	Mica Group (Hydromica subgroup)
Jarosite		$KFe_3(SO_4)_2(OH)_6$	Anhydrous Sulfates	Alunite Group (Jarosite subgroup)
Kaolinite		$Al_2Si_2O_5(OH)_4$	Phyllosilicate 1:1 layer	Phyllosilicate
Magnetite		Fe_3O_4	Multiple Oxide	Spinel group
Microcline		$KAlSi_3O_8$	Tectosilicate	K(Na,Ba) feldspar subgroup
Muscovite		$KAl_2((OH)_2AlSi_3O_{10})$	Phyllosilicate 2:1 layer	Mica Group (Muscovite subgroup)
Palygorskite		$(Mg,Al)_2Si_4O_{10}(OH)\cdot 4(H_2O)$	Phyllosilicate Modulated Layers	Palygorskite-sepiolite group (Palygorskite subgroup)
Plagioclase		$(Na,Ca)(Si,Al)_4O_8$	Tectosilicate	Plagioclase series
Pyrophyllite		$Al(Si_2O_5)(OH)$	Phyllosilicate 2:1 layer	Pyrophyllite-talc group
Pyrite		FeS_2	Sulfides	Pyrite group
Quartz		SiO_2	Tectosilicate	Tectosilicate
Rutile		TiO_2	Oxide mineral	Rutile Group
Smectite		$CaMg_2AlSi_4(OH)_2\cdot H_2O$	Phyllosilicate 2:1 clay	Smectite group

* Mineral Type: Grey = Fe/Al/Ti-Oxides and hydroxides, Blue = Carbonates and Chlorides, Yellow = Sulphides and Sulphates, Pink = Phyllosilicates, Green = Ino- and Tectosilicates

Table 5.2B X-ray diffraction results (weight %)

Sample ID	VENCH_001	VENCH_002	VENCH_003	VENCO_001	VENCO_003	VENCO_004	VENCO_006	VENCO_008	VENCO_009	VENCO_011	FGS_001	FGS_002	VENMET 01	VENMET 02	TP1 1.5-2.5m	TP3 1.8-2.9m	TP5 2.0-2.8m	Calcrete
Waste/ Rock Type *	Shale	Dolerite	Coal	Lava	Dolerite ?	HW/FW	HW/ FW	HW/ FW	HW/ FW	HW/ FW	Tailings	Tailings	Pulp	Pulp	Clay	Sand	Clay	Calcrete
Anatase	-	-	3.19	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-
(Error)	-	-	0.26	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-
Calcite	1.36	2.19	1.28	15.05	7.98	-	-	-	-	0.51	-	-	-	0.29	-	-	-	6.03
(Error)	0.33	0.36	0.39	0.45	0.51	-	-	-	-	0.17	-	-	-	0.11	-	-	-	0.33
Chlorite	6.57	4.57	-	39.25	43.51	4.46	5.16	2.45	-	-	4.45	4.27	1.48	1.48	3.27	6.77	3.74	-
(Error)	0.63	0.75	-	0.69	1.02	0.29	0.39	0.29	-	-	0.57	0.51	0.29	0.3	0.54	0.66	0.72	-
Diopside	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.14	2.01	2.06	-
(Error)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.42	0.39	0.48	-
Dolomite	-	-	-	-	2.48	-	-	-	-	-	-	-	-	-	-	-	-	-
(Error)	-	-	-	-	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-
Enstatite	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.85	1.82	2.57	-
(Error)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.39	0.36	0.42	-
Gypsum	-	-	-	-	-	-	-	-	-	-	-	1.9	-	-	-	-	-	-
(Error)	-	-	-	-	-	-	-	-	-	-	-	0.28	-	-	-	-	-	-
Halite	-	-	-	-	-	-	-	-	-	-	2.34	-	-	-	-	-	-	-
(Error)	-	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-
Hornblende	-	-	-	-	22.58	-	-	-	-	-	-	-	-	-	-	-	-	-
(Error)	-	-	-	-	0.81	-	-	-	-	-	-	-	-	-	-	-	-	-
Illite	-	-	-	-	-	-	-	-	-	-	-	-	-	-				11.7
(Error)	-	-	-	-	-	-	-	-	-	-	-	-	-	-				0.9
Jarosite	-	-	-	-	-	-	-	-	-	-	0.33	-	-	-	-	-	-	-
(Error)	-	-	-	-	-	-	-	-	-	-	0.23	-	-	-	-	-	-	-
Kaolinite	-	-	44.34	-	-	-	-	-	2.25	1.19	-	-	-	-	7.44	8.18	9.58	-
(Error)	-	-	1.11	-	-	-	-	-	0.39	0.39	-	-	-	-	0.63	0.66	0.69	-
Magnetite	-	-	-	-	-	-	-	-	1.15	-	-	-	-	0.04	-	-	-	-
(Error)	-	-	-	-	-	-	-	-	0.14	-	-	-	-	0.13	-	-	-	-
Microcline	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.08	9.8	6.73	9.79
(Error)	-	-	-	-	-	-	-	-	0.14	-	-	-	-	-	0.78	2.07	0.72	0.63
Muscovite	10.06	10.3	25.28	9.4	-	9.44	1.09	11.99	11.12	32.4	18.18	8.68	6.55	4.03	8.65	7.31	12.12	-
(Error)	0.81	1.08	1.14	0.63	-	0.36	0.29	0.39	0.48	0.66	0.6	0.39	0.42	0.33	0.69	0.69	0.72	-
Palygorskite	-	-	9.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sample ID	VENCH_001	VENCH_002	VENCH_003	VENCO_001	VENCO_003	VENCO_004	VENCO_006	VENCO_008	VENCO_009	VENCO_011	FGS_001	FGS_002	VENMET 01	VENMET 02	TP1 1.5-2.5m	TP3 1.8-2.9m	TP5 2.0-2.8m	Calcrete
Waste/ Rock Type *	Shale	Dolerite	Coal	Lava	Dolerite ?	HW/FW	HW/FW	HW/FW	HW/FW	HW/FW	Tailings	Tailings	Pulp	Pulp	Clay	Sand	Clay	Calcrete
(Error)	-	-	1.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plagioclase	9.54	79.56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.3
(Error)	1.11	1.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.57
Pyrophyllite	-	-	-	-	-	3.16	-	4.35	4.47	6.47	9.66	6.31	3.38	3.03	-	-	-	-
(Error)	-	-	-	-	-	0.48	-	0.48	0.63	0.6	0.63	0.48	0.54	0.39	-	-	-	-
Pyrite	-	-	3.73	-	-	-	5.78	0.24	4.26	-	-	-	3.44	3.75	-	-	-	-
(Error)	-	-	0.3	-	-	-	0.15	0.07	0.13	-	-	-	0.09	0.1	-	-	-	-
Quartz	34.72	3.38	10.6	36.31	23.45	82.93	87.97	80.97	76.75	58.23	65.05	78.83	85.14	87.37	68.57	64.12	63.19	41.51
(Error)	1.26	0.42	0.96	0.66	0.93	0.48	0.99	0.51	0.72	0.69	0.78	0.69	0.66	0.51	1.08	1.77	1.11	0.84
Rutile	-	-	1.9	-	-	-	-	-	-	0.99	-	-	-	-	-	-	-	-
(Error)	-	-	0.25	-	-	-	-	-	-	0.19	-	-	-	-	-	-	-	-
Smectite	37.76	-	-	-	-	-	-	-	-	-	-	-	-	-	trace?	trace?	trace?	25.67
(Error)	1.65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.11

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.2C XRF majors element results (ppm

Sample ID	VENCH_001	VENCH_002	VENCH_003	VENCO_001	VENCO_003	VENCO_004	VENCO_006	VENCO_008	VENCO_009	VENCO_011	Average Upper Crust (Rudnick and Gao, 2003)
Waste/ Rock Type *	Shale	Dolerite	Coal	Lava	Dolerite?	HW/FW	HW/FW	HW/FW	HW/FW	HW/FW	
SiO_2	61.9	51.82	37.8	50.31	45.24	90.1	82.37	91.69	80.95	83.9	66.6
TiO_2	0.71	0.79	1.09	0.56	0.47	0.28	0.58	0.26	0.26	0.34	0.64
Al_2O_3	16.54	16.02	25.34	10.9	10	4.66	1.81	4.63	4.81	10.54	15.4
Fe_2O_3	6.49	10.59	3.35	11.8	12.13	2.48	9.87	1.38	8.37	0.76	11.2
MnO	0.1	0.16	<0.09	0.14	0.21	<0.09	<0.09	<0.09	<0.09	<0.09	0.1
MgO	1.82	6.8	0.53	4.18	14.05	0.57	0.46	0.25	<0.12	<0.12	2.48
CaO	1.7	9.73	0.94	6.41	6.65	<0.06	<0.06	<0.06	<0.06	0.2	3.59
Na_2O	1.41	2.39	0.78	<0.04	0.07	0.12	<0.04	0.08	0.19	0.05	3.27
K_2O	2.26	0.83	1.46	0.86	0.05	0.81	0.13	0.95	0.74	2.17	2.8
P_2O_5	0.32	0.15	0.28	0.07	0.08	<0.02	0.07	<0.02	<0.02	<0.02	0.15
Cr_2O_3	<0.04	<0.04	<0.04	<0.04	0.39	<0.04	0.17	<0.04	0.06	<0.04	See trace
SO_3	<0.35	<0.35	1.77	7.87	2.08	<0.35	0.58	<0.35	<0.35	<0.35	-
LOI	6.75	0.77	26.89	7.86	8.96	1.11	4.22	0.9	4.56	1.84	-
Total	100.25	100.21	100.26	100.98	100.39	100.19	100.28	100.36	100.18	99.99	-
H_2O-	3.62	0.43	1.57	0.07	0.36	0.08	0.06	0.06	4.81	0.19	-

Sample ID	FGS_001	FGS_002	VENMET 01	VENMET 02	TP1 1.5-2.5m	TP3 1.8-2.9m	TP5 2.0-2.8m	Calcrete	Average Upper Crust (Rudnick and Gao, 2003)
Waste/ Rock Type *	Tailings	Tailings	Pulp	Pulp	Clay	Sand	Clay	Calcrete	
SiO_2	70.62	79.71	87.34	88.09	69.82	71.7	66.29	64.76	66.6
TiO_2	0.42	0.28	0.21	0.23	0.77	0.7	0.76	0.76	0.64
Al_2O_3	12.51	6.31	3.03	2.69	16.13	15.93	17.91	11.99	15.4
Fe_2O_3	3.47	3.66	5.59	5.44	7.73	5.42	6.65	5.87	11.2
MnO	<0.09	<0.09	<0.09	<0.09	0.16	0.08	0.09	0.08	0.1
MgO	1.05	0.74	0.22	0.21	0.5	0.66	1.29	2.55	2.48
CaO	0.19	0.72	0.14	<0.06	0.15	0.42	0.55	5.08	3.59
Na_2O	1.76	0.24	0.08	0.11	0.63	0.39	0.39	1.04	3.27
K_2O	1.36	0.52	0.49	0.49	1.6	1.56	1.61	1.85	2.8
P_2O_5	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01	0.27	0.15
Cr_2O_3	0.05	<0.04	0.07	0.09	0.06	0.04	0.05	0.11	See trace
SO_3	2.83	1.74	<0.35	<0.35	<0.01	0.1	0.09	0.08	-
LOI	6.05	6.13	2.64	2.64	4.1	4.12	5.38	5.44	-
Total	100.35	100.12	99.97	100.13	101.65	101.12	101.06	99.88	-
H_2O-	1.82	1.74	0.06	0.07	1.5	1.7	3.15	4.28	-

*** Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage**

Table 5.2D XRF trace element results (ppm)

Sample ID	VENCH_001	VENCH_002	VENCH_003	VENCO_001	VENCO_003	VENCO_004	VENCO_006	VENCO_008	VENCO_009	VENCO_011	VEN MET 01	VEN MET 02	FGS_001	FGS_002	TP1 1.5-2.5m	TP3 1.8-2.9m	TP5 2.0-2.8m	Calcrete	Average Upper Crust (Rudnick and Gao, 2003))
Waste/Rock Type *	Shale	Dolerite	Coal	Lava	Dolerite?	HW/FW	HW/FW	HW/FW	HW/FW	HW/FW	Pulp	Pulp	Tailings	Tailings	Clay	Sand	Clay	Calcrete	
As	<16.9	<16.9	21.4	<16.9	<16.9	<16.9	100	20	79.8	20.6	75.9	87.8	204	209	<5.00	<5.00	<5.00	<5.00	4.8
Ba	686	243	1767	179	<43.5	153	<43.5	194	112	462	128	131	267	128	588	428	382	572	628
Bi	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<1.00	<5.00	<1.00	<5.00	0.16
Br	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	20.3	4.39	<1.00	0.99	0.99	1.12	1.6
Cd	<2.9	<2.9	<2.9	3.31	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<5.00	<5.00	<5.00	<1.00	0.09
Ce	128	49.2	218	57.1	5.37	86.5	312	61.5	86	55.2	56.5	89.7	99	55	186	5.95	26.8	<5.00	63
Cl	1210	111	112	19.2	<3	48.7	<3	31.2	32.2	61.7	<3	<3	8.13	4017	392	362	377	483	370
Co	48.1	115	<3	192	142	<3	105	<3	82.6	<3	77.6	81.6	54.1	92.4	<5.00	<5.00	<5.00	<5.00	17.3
Cr	39.8	246	27.1	141	3137	54.9	1103	179	144	151	426	665	394	225	387	289	342	723	92
Cs	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	<2.8	1.21	1.5	1.02	<5.00	4.9
Cu	<63	78.1	<63	<63	<63	<63	67.2	<63	<63	73.9	<63	<63	106	81.8	71.9	33.7	36.3	20.1	28
Ga	<19.4	<19.4	24.8	<19.4	<19.4	20.5	24.4	23.5	25.3	25.1	23.9	24.3	<19.4	<19.4	1.85	8.07	11.9	23.3	17.5
Ge	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<6.4	<1.00	1.39	1.18	2.16	1.4
Hf	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	<11.2	8.33	8.43	7.52	6.37	5.3
Hg	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<5.00	<5.00	<5.00	<5.00	0.05
La	<54	64.4	<54	<54	<54	<54	122	<54	<54	<54	<54	<54	<54	<54	<5.00	<5.00	<5.00	<5.00	31
Lu	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	1.97	<1.8	<1.8	<1.8	<1.8	1.11	1.41	1.25	1.57	0.31
Mo	2.27	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2	2.64	<2.2	3.29	<2.2	4.57	<2.2	<2.2	17.3	12.8	14.4	15.2	1.1
Nb	11.9	3.06	27.4	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	6.63	5.07	5.07	4.12	12
Nd	47.6	26.1	76.3	26.6	12.4	31.7	104	23.5	31.3	21.9	21.7	32.7	38.6	23.2	65.7	41.7	39.6	28.8	27
Ni	57.3	108	29.5	141	789	46.1	152	30.5	71	44.2	71.5	84.5	106	123	83.4	48.1	76.4	50.2	47
Pb	<70.5	<70.5	<70.5	86	<70.5	<70.5	101	<70.5	<70.5	<70.5	84.6	84.8	178	<70.5	36.9	19.4	25.7	19	17
Rb	130	22.9	50.6	49.9	<11.4	24.9	<11.4	31.1	21.7	84.4	13.8	14.5	45.7	16.5	71.6	69.5	82.9	87.6	82
Sb	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	3.22	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<2.9	<5.00	<1.00	<5.00	<5.00	0.4
Sc	17.8	11.6	17	16.4	13.3	10.8	9.58	12.3	12	15.6	11.7	10.2	13.6	12.1	9.42	11.3	11.1	23.6	14
Se	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<5.00	<5.00	<5.00	<1.00	0.09
Sm	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	<14.6	4.93	6.9	5.38	7.71	4.7
Sn	22.1	10.4	8.62	10.4	14	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	<2.4	4.34	7.88	<1.00	<5.00	2.1
Sr	136	136	615	126	48	24.5	<15.5	24.5	20.2	69.5	20.4	20.1	57.5	30.4	52.9	48.5	64.6	137	320
Ta	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<4.9	<1.00	2.12	1.85	3.02	0.9
Te	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	<11.6	3.49	4.57	4.33	8.77	-
Th	<19.8	<19.8	27.8	<19.8	<19.8	<19.8	49.4	<19.8	<19.8	<19.8	24	21.6	26.6	<19.8	7.57	11.4	11.5	12.1	10.5
Tl	<19.8	<16.9	21.4	<19.8	<19.8	<19.8	<19.8	<19.8	<19.8	<19.8	<19.8	<19.8	204	<19.8	<1.00	<1.00	<5.00	<1.00	0.9
U	<12.8	<12.8	<12.8	<12.8	<12.8	<12.8	132	<12.8	51.8	<12.8	121	128	81.5	107	<5.00	<5.00	<5.00	<5.00	2.7
V	141	191	215	167	139	45.5	65.6	43	47	64.7	<39.9	40.4	114	68.4	191	132	168	171	97
W	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	<5.6	3.84	3.55	3.77	2.89	1.9
Y	35.6	18.9	50.7	<14.2	<14.2	<14.2	17.1	<14.2	<14.2	<14.2	<14.2	<14.2	15.2	14.3	28.6	16.4	23.1	20.7	21
Yb	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	<15.5	9.49	10.5	8.96	12	2
Zn	87.6	<81.6	<81.6	<81.6	<81.6	96.8	190	<81.6	<81.6	<81.6	<81.6	<81.6	124	119	19.2	31	52.5	47	67
Zr	167	<46.8	324	54	<46.8	92.4	543	141	105	108	125	106	76.6	82.5	326	312	270	256	193

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Acid Base Accounting and Net-acid generation test

The following comments relate to the ABA and the NAG test:

- ABA Terminology and Screening Methods:
  - Acid-base Accounting (ABA) is a static test where the net potential of the rock to produce acidic drainage is assessed. The %S, the Acid Potential (AP), the Neutralization Potential (NP) and the Net Neutralization Potential (NNP) of the rock material are determined in this test, as an important first order assessment of the potential leachate that could be expected from the rock material;
  - AP is determined by multiplying the %S with a factor of 31.25. The unit of AP is kg $CaCO_3$/t rock and indicates the theoretical amount of calcite neutralized by the acid produced;
  - The NP (Neutralization Potential) is determined by treating a sample with a known excess of standardized hydrochloric or sulfuric acid (the sample and acid are heated to insure reaction completion) and then back-titrated with standardized sodium hydroxide in order to determine the amount of unconsumed acid. NP is also expressed as kg $CaCO_3$/t rock as to represent the amount of calcite theoretically available to neutralize the acidic drainage;
  - NNP is determined by subtracting AP from NP. Therefore, a rock with NNP<0kg $CaCO_3$/t will have a net potential for acidic drainage and a rock with NNP>0kg $CaCO_3$/t rock will have a net potential for the neutralization of acidic drainage. Due to the uncertainty related to the exposure of the carbonate minerals or the pyrite for reaction, the interpretation of whether a rock will actually be net acid generating or neutralizing is more complex. Research has shown that a range from -20kg $CaCO_3$/t to 20kg $CaCO_3$/t exists, which is defined as a “grey” area in determining the net acid generation or neutralization potential of a rock. Material with a NNP above this range is classified as *Rock Type IV - No Potential for Acid Generation* and with a NNP below this range as *Rock Type I - Likely Acid Generating*;
  - In an attempt to classify the rock in terms of its net potential for acid production or neutralization, further screening criteria can be used. The screening methods in Table 5.3A, as proposed by Price (1997), use the NP:AP ratio to classify the rock in terms of its potential for acid generation. Soregaroli and Lawrence (1998) further states that samples with less than 0.3% sulphide sulphur are regarded as having insufficient oxidisable sulphides to sustain long term acid generation. Material with a %S below 0.3% is therefore classified as *Rock Type IV - No Potential for Acid Generation,* material with a %S of 0.1% - 0.2% as *Rock Type III - Low Potential Acid Generating,* material with a %S of 0.2% - 0.3% as *Rock Type II - Possibly Acid Generating,* and material with a %S of above 0.3%, as *Rock Type I - Likely Acid Generating*;
- NAG Test Terminology and Screening Methods:
  - In the Net-acid Generating (NAG) test hydrogen peroxide (H_2O_2) is used to oxidize sulphide minerals in order to predict the acid generation potential of the sample;
  - The NAG test provides a direct assessment of the potential for a material to produce acid after a period of exposure (to a strong oxidant) and weathering. The test can be used to refine the results of the ABA predictions;
  - In general, the static NAG test involves the addition of 250 ml of 15% H_2O_2 to 2.5 g of sample in a 500 ml wide mouth conical flask, or equivalent. The sample is covered with a watch glass, and placed in a fumehood or well-ventilated area. Once "boiling" or effervescing ceases, the solution is allowed to cool to room temperature and the final pH (NAG pH) is determined. A quantitative estimation of the amount of net acidity remaining (the NAG capacity) in the sample is determined by titrating it with NaOH to pH 4.5 (and/or pH 7.0) to obtain the NAG Value;
  - In order to determine the acid generation potential of a sample, the screening method given in Table 5.3B of Miller et al. (1997) is used;
- ABA and NAG tests were performed by *Waterlab*. The results are listed in Tables 5.3C and 5.3F respectively. A summary of the ABA results for the various lithologies is presented in Tables 5.3D-E. Sulphur speciation results of tailings are provided in Table 5.3G. The following comments relate to the ABA results:
  - Figure 5.2 summarises the classification of the samples in terms of %S and NP/AP;
  - The NP/AP indicates the potential for the rock to generate acid drainage, whereas the %S indicates whether this drainage will be over the long term;
  - The total S% (as determined by Leco analyser) was used to determine the Acid Potential (AP) of the rock. This might be an overestimation in some cases as only sulphides produces acid upon oxidation;
  - The coal seam is the only sample from the Karoo and Ventersdorp waste rock that has a %S of above 0.3 as well as a NP/AP < 1, classifying the rock as potentially acid producing over the long-term. The one Ventersdorp lava sample that has a S% of 0.53 has a large NP and no

net potential to generate acid over the long-term (NP/AP >4);

- All Wits Hanging and Footwall rocks (except the Eldorado intrusion) as well as the Tailings/pulp samples have a %S > 0.3, a resultant high acidification potential, and almost no neutralisation potential. The NP/AP for these samples is < 1 and most often 0. These samples could therefore be classified as having a long-term potential to generate acid drainage;
- A statistical presentation of the net potential of the material to generate acid mine drainage is provided in Table 5.3E. The following aspects are important:
  - 17%, 34% and 50% of the Karoo and Ventersdorp lava samples have respectively a large, a low, and no potential to generate acid mine drainage. On average, the waste rock of the Karoo/Ventersdorp lava will probably generate a low salt load;
  - 67%, 11%, and 22% of the Wits Hanging and Footwall samples have respectively a large, low and no potential to generate acid mine drainage. On average, the waste rock of the Wits Hanging and Footwall will probably generate a high salt load;
  - 100% of the tailings/pulp samples have a large potential to generate acid mine drainage. On average, the tailings will probably generate a high salt load;
- The Welkom and Masimong tailings are highly oxidised and most of the %S originates from sulphate sulphur and not sulphide sulphur as depicted in the sulphur speciation results in Table 5.3G. Most sulphates do not generate acid (e.g. gypsum). Therefore, the acid generation potential of these samples is actually much lower than determined with the ABA test. The NAG test however indicated that these samples have of lower acid generating capacity. These samples were however taken from old tailings that is already oxidised (and probably already produced some acid drainage). Unoxidised tailings deeper in these dams may however still have more sulphides than sulphates. It will therefore not be correct to assume that these samples are representative of the specific tailings dams that were sampled;
- The NAG test confirmed the ABA results. The shale and the Eldorado intrusions were classifying as non-acid producing. All Hanging and Footwall rock, as well as tailings/pulp were classify as acid generating;

Table 5.3A Screening methods using the NP:AP ratio (Price, 1997)

Potential for Acid Generation	NP:AP screening criteria	Comments
Rock Type I. Likely Acid Generating.	< 1:1	Likely AMD generating.
Rock Type II. Possibly Acid Generating.	1:1 – 2:1	Possibly AMD generating if NP is insufficiently reactive or is depleted at a faster rate than sulphides.
Rock Type III. Low Potential for Acid Generation.	2:1 – 4:1	Not potentially AMD generating unless significant preferential exposure of sulphides along fracture planes, or extremely reactive sulphides in combination with insufficient reactive NP.
Rock Type IV. No Potential for Acid Generation.	>4:1	No further AMD testing required unless materials are to be used as a source of alkalinity.

Table 5.3B NAG test screening method (edited from Miller et al., 1997)

Rock Type	NAG pH	NAG Value (H_2SO_4 kg/t)	NNP ($CaCO_3$ kg/t)
Rock Type Ia. High Capacity Acid Forming.	< 4	> 10	Negative
Rock Type Ib. Lower Capacity Acid Forming.	< 4	≤ 10	-
Uncertain, possibly Ib.	< 4	> 10	Positive
Uncertain.	≥ 4	0	Negative (Reassess mineralogy)*
Rock Type IV. Non-acid Forming.	≥ 4	0	Positive

* If non- or low acid forming sulphides is dominant then Rock Type IV.

Table 5.3C Acid-base accounting (ABA) results

Sample ID	Waste/Rock Type	*	Paste pH	Total (%S)	AP ($CaCO_3$ kg/t)	NP ($CaCO_3$ kg/t)	NNP ($CaCO_3$ kg/t)	NP/AP	Rock Type NNP	Rock Type (%S)	Rock Type NP/AP
VENCH_001	Karoo (Ecca) Shale		8.8	0.19	5.94	6.95	1.01	1.17	Uncertain	II	II
VENCH_002	Dyke		9.4	0.02	0.63	1.19	0.56	1.90	Uncertain	IV	II
VENCH_003	Coal Seam		9.0	1.86	58.13	9.35	-48.78	0.16	I	I	I
VENCH_004	Dolerite Sill		9.2	0.03	0.94	9.78	8.84	10.43	Uncertain	IV	IV
VENCO_001	Ventersdorp Lavas		5.9	0.53	16.56	72.00	55.16	4.33	IV	I	IV
VENCO_002	Ventersdorp Lavas		7.0	0.07	2.19	39.60	37.42	18.10	IV	IV	IV
VENCO_003	Eldorado Intrusive		7.8	0.01	0.31	36.37	36.05	116.37	IV	IV	IV
VENCO_004	HW_Eldorado		6.9	0.41	12.81	0.00	-12.81	0.00	Uncertain	I	I
VENCO_005	HW_Eldorado		7.2	0.07	2.19	0.00	-2.19	0.00	Uncertain	IV	I
VENCO_006	HW_Eldorado		3.9	6.69	209.06	0.00	-209.06	0.00	I	I	I
VENCO_007	HW_Eldorado		7.8	0.29	9.06	0.00	-9.06	0.00	Uncertain	II	I
VENCO_008	HW_10m above A Reef		8.0	0.30	9.38	0.00	-9.38	0.00	Uncertain	I	I
VENCO_009	FW_Big Pebble Marker		6.0	6.49	202.81	0.00	-202.81	0.00	I	I	I
VENCO_010	FW_Big Pebble Marker		4.3	0.75	23.44	0.00	-23.44	0.00	I	I	I
VENCO_010D	FW_Big Pebble Marker		4.4	0.75	23.44	0.00	-23.44	0.00	I	I	I
VENCO_011	FW Developm_Spes Bona		6.1	0.42	13.13	0.00	-13.13	0.00	Uncertain	I	I
FGS001	Tailings Welkom		4.8	0.49	15.31	8.59	-6.73	0.56	Uncertain	I	I
FGS001D	Tailings Welkom		4.8	0.49	15.31	9.60	-5.72	0.63	Uncertain	I	I
FGS_002	Tailings Masimong		3.47	1.70	53.19	0.00	-53.19	0.00	I	I	I
FGS_003	Tailings Masimong		3.68	0.46	14.36	0.00	-14.36	0.00	Uncertain	I	I
FGS_003D	Tailings Masimong		3.62	0.46	14.36	0.00	-14.36	0.00	Uncertain	I	I
VENMET 01	Pulp Venmet		5.41	3.39	106.05	4.00	-102.30	0.04	I	I	I
VENMET 02	Pulp Venmet		5.09	3.43	107.16	0.25	-106.91	0.00	I	I	I
VENMET02D	Pulp Venmet		4.83	3.43	107.16	0.00	-107.16	0.00	I	I	I

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.3D Acid-base accounting (ABA) results - average for various lithologies

Lithology	Number of samples	Total %S	AP (CaCO3 kg/t)	NP (CaCO3 kg/t)	NNP (CaCO3 kg/t)	NP/AP	Rock Type NNP	Rock Type %S	Rock Type NP/AP
Waste Rock Ventersdorp	2	0.30	9.38	56	46.29	5.94	IV	I	IV
Waste Rock HW/FW	9	1.71	53.58	4.04	-49.54	0.08	I	I	I
Tailings	5	1.89	59.22	2.52	-56.70	0.04	I	I	I

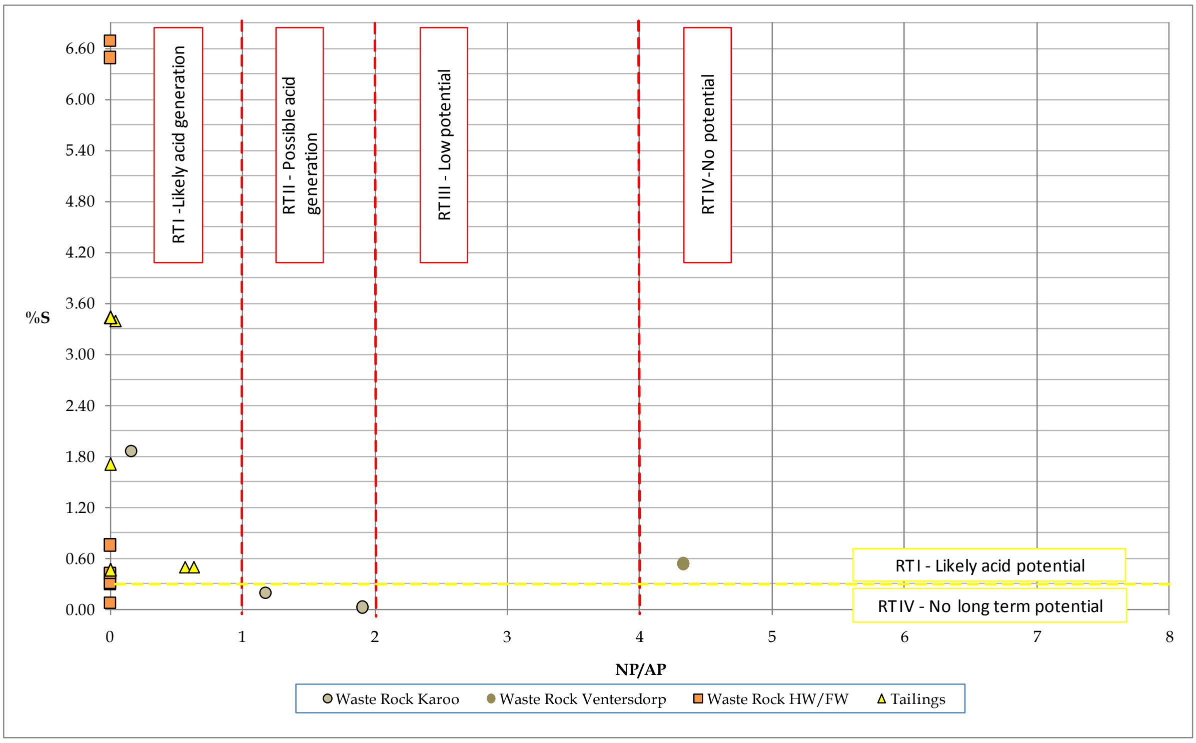


Figure 5.2 Classification of samples in terms of %S and NP/AP (only samples with NP/AP <8 is shown)

Table 5.3E Potential for various lithologies to generate acidic drainage

Criteria	Number of samples	Rock Type (%S) Rock Type (NP/AP) I or II	Rock Type (%S) I Rock Type (NP/AP) III or IV	%S 0.1 - 0.3 Rock Type (NP/AP) I or II	%S 0.1 - 0.3 Rock Type (NP/AP) III or IV	%S <0.1 Rock Type (NP/AP) I or II	%S <0.1 Rock Type (NP/AP) III or IV
Waste Rock Ventersdorp/Karoo	6	17	17	17	0	17	33
Waste Rock HW/FW	9	67	0	11	0	11	11
Tailings /Pulp	5	100	0	0	0	0	0
Potential for acid mine drainage		Likely/possibly acid generating. High salt load.	Low to medium potential for acid generation. Medium salt load.	Low potential for acid generation. Low to medium salt load.	Very low potential for acid generation. Very low to low salt load.	No potential for acidic drainage. Very low/no salt load.	No potential for acidic drainage. Very low/no salt load.

Table 5.3F Net acid generation (NAG) test results

Sample ID	*	Waste/Rock Type	NAG pH: (H_2O_2)	NAG (H_2SO_4 kg/t)	NNP ($CaCO_3$ kg/t)	Rock Type
VENCH_001		Shale	7.8	<0.01	1.01	IV
VENCH_003		Coal	2.7	13.33	-48.78	1a
VENCO_003		Eldorado	8.3	<0.01	36.05	IV
VENCO_004		HW_Eldorado	2.8	9.80	8.84	1b
VENCO_006		HW_Eldorado	2.2	49.00	-209.06	1a
VENCO_009		FW_Big Pebble Marker	2	54.68	-202.81	1a
FGS 001		Welkom Tailings	3.8	0.59	-6.73	1b
FGS 001D		Welkom Tailings	3.5	0.98	-5.72	1b
FGS_002		Masimong Tailings	3.2	7.84	-53.19	1b
VENMET 01		Tailings	2.1	60.76	-102.30	1a
VENMET 02		Tailings	2.1	49.39	-106.91	1a
VENMET 02		Tailings	2	48.61	-107.16	1a

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.3G Sulphur speciation results

Sample ID	Waste/Rock Type	*	Sulphur Speciation		
			Total Sulphur (%) (LECO)	Sulphate (SO_4^{2-}) Sulphur (%)	Sulphide (S^{2-}) Sulphur (%)
FGS_001	Welkom Tailings		0.49	0.48	<0.01
FGS_002	Masimong Tailings		1.7	1.69	<0.01
VENMET 01	Pulp		3.39	<0.01	2.79
VENMET 02	Pulp		3.43	<0.01	2.54

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Cation-Exchange Capacity of Soils:

Soil samples were collected from the future TSF area from the geotechnical drilling. XRD, XRF and test for the Cation-Exchange Capacity (CEC) were performed on the soils. The CEC data are presented in Table 5.4. The following observations are important:

- The 3 clay/sand soil samples predominantly comprises of SiO_2 and Al_2O_3, with some Fe_2O_3. The phases in these samples comprise of quartz as a dominant mineral with muscovite, microcline, kaolinite, enstatite, diopside and chlorite all as minor minerals. These soils were all formed in-situ. The soil description indicates that it originates from underlying sandstones;
- Ca and Mg are elevated in the calcrete due to the presence of especially dolomite and calcite;
- No kaolinite but 25% smectite was detected by means of XRD in the calcrete sample. In the 3 clay and sand samples kaolinite is present between 7% - 10% and only traces of smectite may be present;
- The CEC is the total cations that can be adsorbed by a soil. From the CEC results it is shown that the calcrete has a 30% - 50% higher CEC than the clay and sand. Smectite (as montmirrilonite) has a CEC of roughly 120cmol/kg. As the calcrete contains about 25% smectite the theoretical CEC must be 30cmol/kg, close to the measured 27cmol/kg measured.
- From the XRD results it is clear that calcrete would be a good basement layer to place beneath the outer rim of the tailings dam where acidification might be expected – this is a recommended mitigation measures. The smectite in the calcrete would be able to 1) adsorb metals in seepage and the calcite to 2) neutralise at least some acidic seepage. However, the thickness of the calcrete and additional calcitic lime that may be required must be calculated from an updated geochemical model.

Table 5.4 CEC results of selected soils and calcrete (meq/100g)

Sample ID	*	Waste/Rock Type	Na	K	Ca	Mg	S-Value	T-Value (CEC)
TP1		Clay	2.984	0.520	8.908	5.219	17.632	18.305
TP2		Sand	1.763	0.630	13.962	7.155	23.510	18.459
TP3		Clay	0.084	0.531	6.005	3.353	9.973	12.600
TP5		Clay	1.579	0.681	8.498	7.840	18.597	18.917
Calcrete waste		Calcrete	0.815	0.602	23.633	5.992	31.041	27.185

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Peroxide Leaching Test:

The samples were leached with a hydrogen peroxide solution. The static peroxide extraction test is based on the principle that sulphuric acid is produced from the oxidation reaction of pyrite, which may mobilize chemicals from the rock.

A rock/water ratio of 1:100 was used where 2.5 g of the sample was reacted with 250 ml of 15% hydrogen peroxide. System parameters and anions measured in the leachate are listed in Table 5.5A, with the ICP scan for metals listed in Table 5.5B.

From the data the following observations could be made:

- Leaching tests identify the elements that will leach out of waste but do not reflect the site-specific concentration of these elements in actual seepage since a different 1) water/rock ratio and 2) contact time will be present in the field. Kinetic leach testing often give a better quantification than static leach tests of the chemicals that may potentially leach out of the rock;

- It is also important to note that the peroxide extraction simulates extreme conditions where all the pyrite is oxidised at once, which will never happen under field conditions. Under field conditions 1) not all pyrite will be oxidised as some minerals are physically shielded by the rock matrix, and 2) oxidation will occur over a long period of time;
- SO_4 showed a significant increase upon reaction with peroxide. The elevation of SO_4 is a direct result of the pyrite oxidation. A positive correlation is present between the %S and the SO_4 extracted from the rock as shown in Figure 5.3. The coal seams have the largest resultant extracted SO_4 with some carbonaceous shale samples also having a significant SO_4 in leachate.
- NO_3 and F also leached out at marginal to elevated concentrations in some samples. NO_3 leached out from all the samples except sandstone. F leached out at marginal concentration from two coal samples; and
- Very few metals actually leached out at significant concentrations despite the harsh test conditions. Mn leached out at marginal concentrations from only one sample whereas Sb leached out from all samples. Al leached out at marginal to non-compliant concentrations from 4 of the 8 samples. Fe leached at non-compliant concentrations from only1 sample.

Table 5.5A System parameters and major anions in peroxide extraction test

Sample ID	Description/ Rock Type	*	pH (value)	EC (mS/m)	TDS (mg/l)	Total Alkalinity (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)	Cl (mg/l)	F (mg/l)
VENCH_001	Shale		7.8	22.1	148	36	42	<0.2	8	0.4
VENCH_003	Coal		3	122	817	<5	377	<0.2	<5	<0.2
VENCO_001	Ventersdorp Lavas		7.5	29.6	198	16	114	<0.2	<5	<0.2
VENCO_003	Eldorado Intrusive		8.5	9.6	64	32	<5	<0.2	<5	<0.2
VENCO_004	HW_Eldorado		2.9	69.7	467	<5	136	<0.2	<5	<0.2
VENCO_006	HW_Eldorado		2.2	310	2 077	<5	687	<0.2	<5	<0.2
VENCO_009	HW_Eldorado		2.2	334	2 238	<5	630	<0.2	<5	<0.2
FGS_001	Tailings		4.2	61.7	413	<5	73	0.3	136	0.2
FGS_002	Tailings		3.3	86	576	<5	308	<0.2	50	<0.2
VENMET 1	Tailings		2.1	366	2 452	<5	717	<0.2	<5	<0.2
VENMET 2	Tailings		2.2	304	2 037	<5	572	<0.2	<5	<0.2
SANS 241:2011	0-50% of limit		6 - 8.4	<85	<600	-	<250	<5.5	<150	<0.75
	50-100% of limit		5-6; 8.4-9.7	85-170	600-1200	-	250-500	5.5-11	150-300	0.75-1.5
	Above limit		<5 ; >9.7	>170	>1200	-	>500	>11	>300	>1.5

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

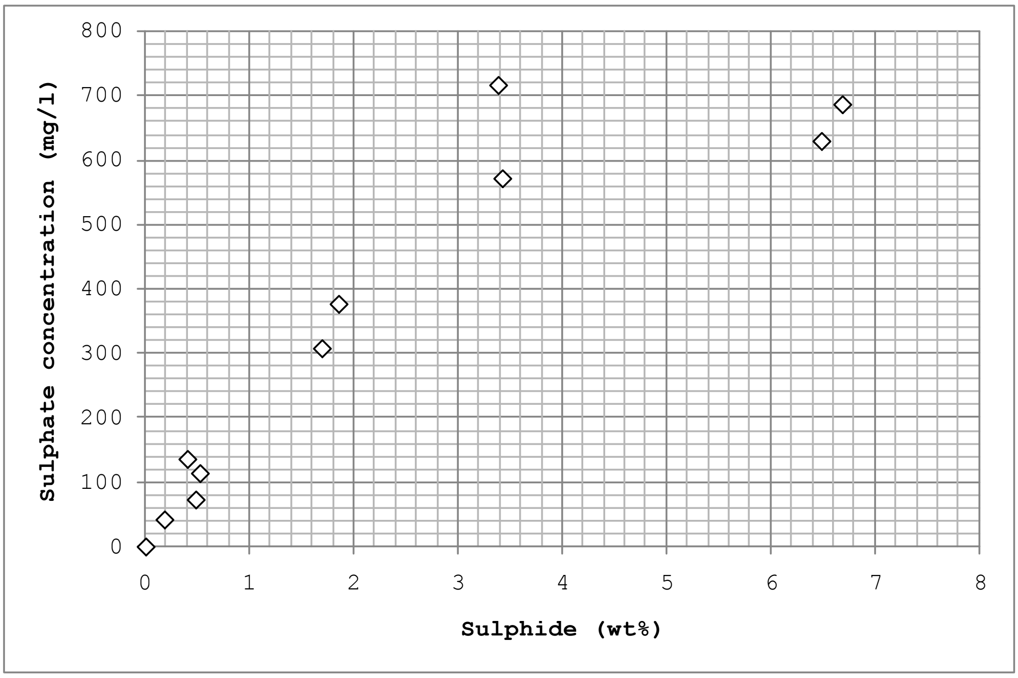


Figure 5.3 Correlation between SO_4 leached and rock sulphide content

Table 5.5B ICP results of peroxide extraction test

Sample ID	VENCH_001	VENCH_003	VENCO_001	VENCO_003	VENCO_004	VENCO_006	VENCO_009	FGS_001	FGS_002	VEN MET 01	VEN MET 02	SANS 241: 2011		
Rock Type	Shale	Coal	Lava	Dolerite?	HW/FW	HW/FW	HW/FW	Tailings	Tailings	Pulp	Pulp	0-50% of limit	50-100% of limit	Above limit
Ag	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Al	1.84	10	0.24	1.54	4.46	15	4.37	0.584	19	7.37	4.94	<0.15	0.15-0.3	>0.3
As	0.062	<0.010	0.042	<0.010	<0.010	0.034	0.031	<0.010	0.026	<0.010	<0.010	<0.005	0.005-0.01	>0.01
B	0.19	0.408	<0.025	1.6	0.163	0.299	0.251	0.112	0.12	0.167	0.148	-	-	-
Ba	0.421	<0.025	<0.025	0.087	<0.025	<0.025	<0.025	0.197	<0.025	<0.025	<0.025	-	-	-
Be	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Bi	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Ca	5	43	52	16	<2	<2	<2	10	53	11	<2	-	-	-
Cd	0.013	<0.005	0.007	<0.005	<0.005	0.009	0.008	0.016	0.013	<0.005	<0.005	<0.0015	0.0015-0.003	>0.003
Co	<0.025	<0.025	<0.025	<0.025	0.133	0.531	0.53	0.138	0.481	0.675	0.513	<0.25	0.25-0.5	>0.5
Cr	<0.025	<0.025	<0.025	0.457	<0.025	0.325	<0.025	<0.025	0.078	0.204	0.291	<0.025	0.025-0.05	>0.05
Cu	<0.025	0.101	<0.025	<0.025	0.218	0.544	0.237	0.154	0.372	0.308	0.357	<1	1 - 2	>2
Fe	1.78	81	<0.025	3.71	0.628	89	65	0.039	0.129	65	52	<1	1 - 2	>2
K	3	5.2	<1.0	<1.0	2.8	1	1.8	2.9	<1.0	2.6	1.1	-	-	-
Li	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Mg	<2	5	<2	4	3	8	<2	17	32	4	3	-	-	-
Mn	0.034	1.11	<0.025	0.059	0.357	0.591	0.27	1.56	2.77	0.64	0.357	<0.25	0.25-0.5	>0.5
Mo	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Na	39	24	<2	3	<2	<2	<2	58	5	2	<2	<100	100-200	>200
Ni	<0.025	0.149	<0.025	0.039	0.226	0.992	0.701	0.266	0.94	0.822	0.631	<0.035	0.035-0.07	>0.07
P	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Pb	<0.020	<0.020	0.036	<0.020	0.166	0.634	0.108	<0.020	<0.020	0.7	0.489	<0.005	0.005-0.01	>0.01
Sb	<0.010	<0.010	<0.010	0.012	0.036	0.088	<0.010	<0.010	0.111	0.012	0.027	<0.01	0.01-0.02	>0.02
Se	<0.020	<0.020	<0.020	<0.020	0.025	<0.020	0.021	<0.020	0.021	<0.020	<0.020	<0.005	0.005-0.01	>0.01
Si	7.1	8.2	0.8	12.9	3.7	8.3	2.1	1.5	1.78	4.9	2.9	-	-	
Sn	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Sr	0.079	0.53	0.263	0.079	0.043	<0.025	<0.025	0.145	<0.025	0.033	<0.025	-	-	-
Ti	0.043	<0.025	<0.025	0.035	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
V	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	0.049	<0.025	<0.025	<0.025	<0.1	0.1-0.2	>0.2
W	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	
Zn	<0.025	0.724	<0.025	<0.025	0.996	1.67	0.396	0.686	1.21	1.04	0.832	<2.5	2.5-5.0	>5
Zr	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Tailings Water/Seepage Quality:

Tailings water/seepage was collected from surrounding tailings dams. A detailed description of the samples is provided in Table 1D. A map of the sampling locations is included as Figure 5.1. System parameters and anions measured in the samples are listed in Table 5.6A, with ICP results of metals listed in Table 5.6B. Diagrams which indicated anion dominance and association are included as Figures 5.4A-E.

The following important aspects were observed:

- TSF05 - 08 are dominated by SO_4 and Cl as anions. Na and Ca are the dominant cations in these samples (see Figures 5.4A and B);
- Lower SO_4 and Cl concentrations were determined from TSF02 - 04 compared to TSF05-08. It is possible that the TSF02 - 04 sample is not tailings water/seepage, or the water was mixed with cleaner water (e.g. rainwater);
- A correlation was noted between the major cation (Ca, Mg and Na) concentrations and higher TDS concentrations (see Figure 5.4C). However the same correlation does not exist with lower pH values (see Figure 5.4D);
- In contrast to the cations, most metals show a strong dependency on pH (see Figure 5.4E). Based on the findings of similar projects, it was determined that the water/seepage quality from Wits gold tailings dams are generally as follows:
  - SO_4 in seepage from tailings dams typically ranges between 1500mg/L to 4500mg/L;
  - Na content is high in tailings operational water and in seepage water due to the addition of

NaCN in the plant. However, KCN or $Ca(CN)_2$ may also be used;
- Elevated Ca concentrations can be expected due to the addition of lime (CaOH) in the gold processing plant. Lime also helps to prevent the formation of HCN during cyanidation;
- Depending on the method used in the cyanide destruction additional chemicals may be introduced to the tailings water. The cyanide destruction may result in elevated N-species, carbonate and chloride in the tailings water - this will however depend on the CN destruction methodology;
- The pH in process water will often be above pH 8 due to the addition of lime in the plant. However, the pH in seepage water typically ranges between pH 6 - 8 due to short term acidification of the tailings water by 1) pyrite oxidation and 2) natural equilibrium with the atmospheric CO_2-buffer. The pH may drop to below pH 4.5 in older dams.

Table 5.6A System parameters and anions, Th and U in tailings water/seepage

Sample ID	Description / Rock Type	*	pH (value)	EC (mS/m)	TDS (mg/l)	Total Alkalinity (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)	Cl (mg/l)	F (mg/l)	Thorium as Th (Dissolved)	Uranium as U (Dissolved)	%Balancing
TSF02	Tailings seepage		7.9	69.6	442	112	123	<0.2	77	0.4	<0.001	<0.010	97.6
TSF03	Tailings seepage		8	21.2	140	76	9	0.4	14	0.3	<0.001	<0.010	99.8
TSF04	Tailings seepage		8.5	58.1	358	96	53	6.7	71	0.3	<0.001	<0.010	99.9
TSF05	Tailings seepage		7.2	129	874	36	288	0.3	195	0.3	<0.001	<0.010	96.5
TSF06	Tailings seepage		6.9	443	3 044	96	831	1.1	766	0.3	<0.001	0.349	92.7
TSF07	Tailings seepage		4	1087	9 118	<5	3508	1	1950	<0.2	<0.001	7	95.2
TSF08	Tailings seepage		8.2	679	4 444	148	859	0.7	1610	1	<0.001	0.537	95.4
SANS 241:2011	0-50% of limit		6 - 8.4	<85	<600	-	<250	<5.5	<150	<0.75	-	-	-
	50-100% of limit		5-6; 8.4-9.7	85-170	600-1200	-	250-500	5.5-11	150-300	0.75-1.5	-	-	-
	Above limit		<5 ; >9.7	>170	>1200	-	>500	>11	>300	>1.5	-	-	-

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

Table 5.6B ICP results of tailings water/seepage

Sample ID	TSF02	TSF03	TSF04	TSF05	TSF06	TSF07	TSF08	SANS 241: 2011		
Description *	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	0-50% of limit	50-100% of limit	Above limit
Ag	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Al	<0.100	<0.100	<0.100	0.171	1.190	121.000	0.129	<0.15	0.15-0.3	>0.3
As	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	0.005-0.01	>0.01
B	0.103	<0.025	0.039	0.053	0.664	0.530	1.180	-	-	-
Ba	0.067	0.040	<0.025	0.044	<0.025	0.059	0.227	-	-	-
Be	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Bi	0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Ca	47	17	36	111	246	655	292	-	-	-
Cd	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.0015	0.0015-0.003	>0.003
Co	<0.025	<0.025	<0.025	0.227	0.252	6.230	<0.025	<0.25	0.25-0.5	>0.5
Cr	<0.025	<0.025	<0.025	<0.025	<0.025	0.083	<0.025	<0.025	0.025-0.05	>0.05
Cu	<0.025	<0.025	<0.025	<0.025	0.098	2.140	<0.025	<1	1-2	>2
Fe	<0.025	<0.025	<0.025	<0.025	<0.025	0.334	<0.025	<1	1-2	>2
K	8.5	5.4	11.3	6.5	27.0	24.0	34.0	-	-	-
Li	<0.025	<0.025	<0.025	<0.025	0.154	0.334	0.274	-	-	-

Sample ID	TSF02	TSF03	TSF04	TSF05	TSF06	TSF07	TSF08	SANS 241: 2011		
Description *	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	Tailings seepage	0-50% of limit	50-100% of limit	Above limit
Mg	21	6	12	43	76	267	90	-	-	-
Mn	<0.025	<0.025	0.189	3.150	2.010	22.000	0.032	<0.25	0.25-0.5	>0.5
Mo	<0.025	<0.025	<0.025	<0.025	<0.025	0.131	<0.025	-	-	-
Na	54	15	56	89	649	1440	1146	<100	100-200	>200
Ni	<0.025	<0.025	0.043	0.422	0.446	8.920	<0.025	<0.035	0.035-0.07	>0.07
P	0.779	0.998	4.520	0.599	0.712	0.833	0.875	-	-	-
Pb	0.031	0.032	0.042	0.027	0.040	0.037	0.025	<0.005	0.005-0.01	>0.01
S	55.000	4.500	26.000	143.000	412.000	1429.000	447.000			
Sb	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.01	0.01-0.02	>0.02
Se	0.034	0.041	0.038	0.037	0.041	0.036	0.037	<0.005	0.005-0.01	>0.01
Si	<0.2	1.800	2.500	0.700	0.600	2.100	<0.2	-	-	-
Sn	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
Sr	0.209	0.143	0.225	0.722	1.660	2.780	4.300	-	-	-
Ti	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-
V	<0.025	0.026	<0.025	<0.025	<0.025	<0.025	<0.025	<0.1	0.1-0.2	>0.2
W	<0.025	<0.025	<0.025	<0.025	<0.025	0.082	<0.025	-	-	-
Zn	0.077	0.058	0.144	0.438	0.964	41.000	0.069	<2.5	2.5-5.0	>5
Zr	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	-	-	-

* Green = Waste Rock Ventersburg/Karoo, Orange = Waste Rock HW/FW, Yellow = Tailings/Pulp, Brown = Soil, Blue = Tailings Seepage

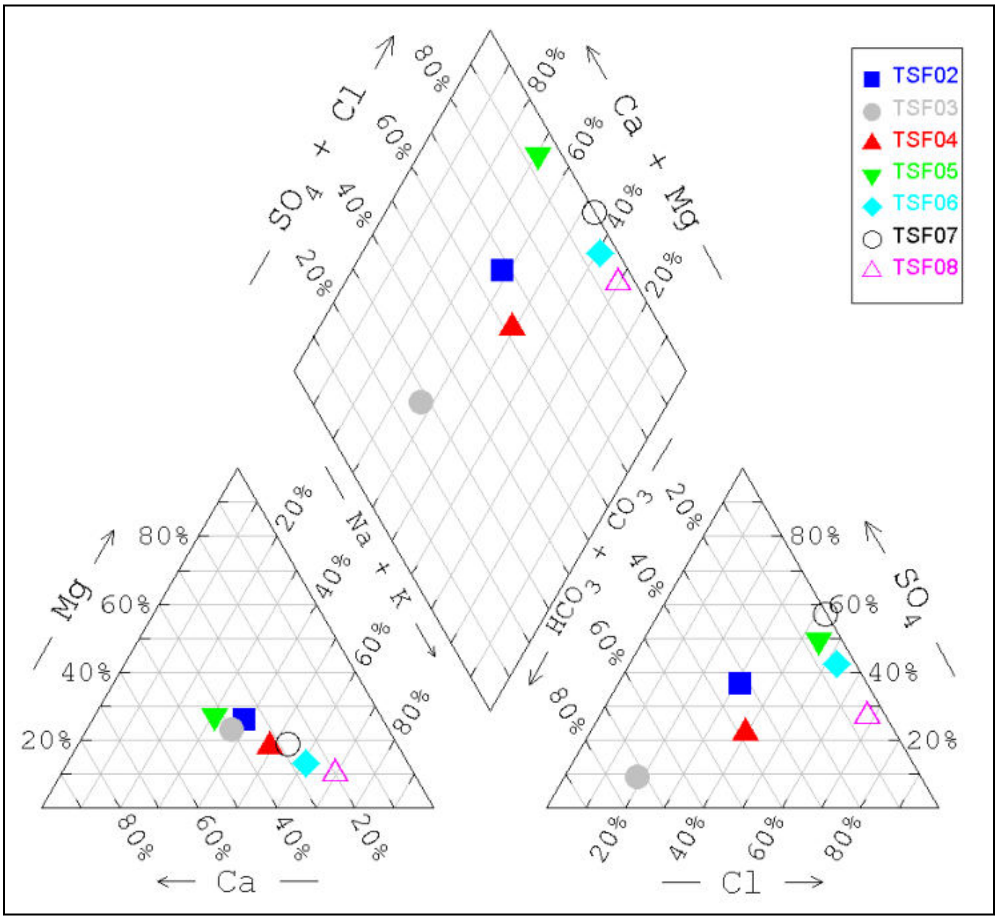


Figure 5.4A Piper diagram of tailings water/seepage

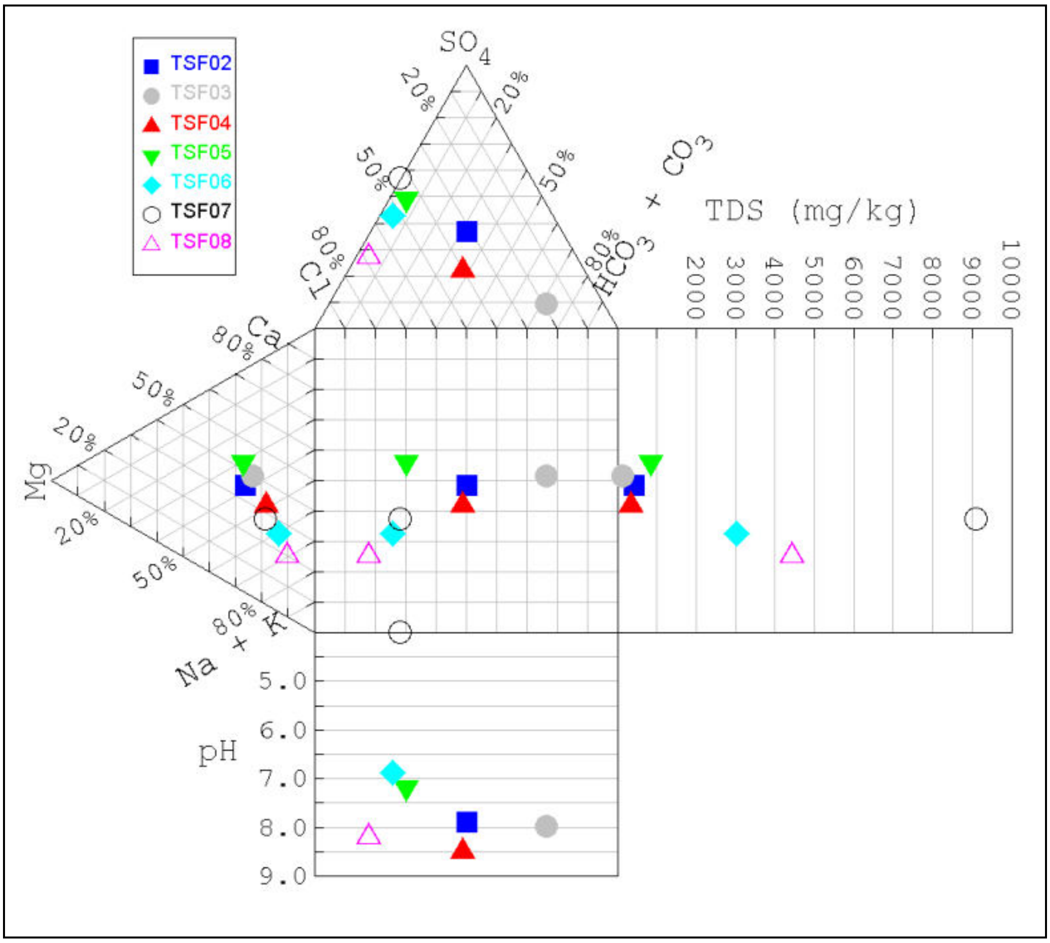


Figure 5.4B Extended Durov plot of tailings water/seepage

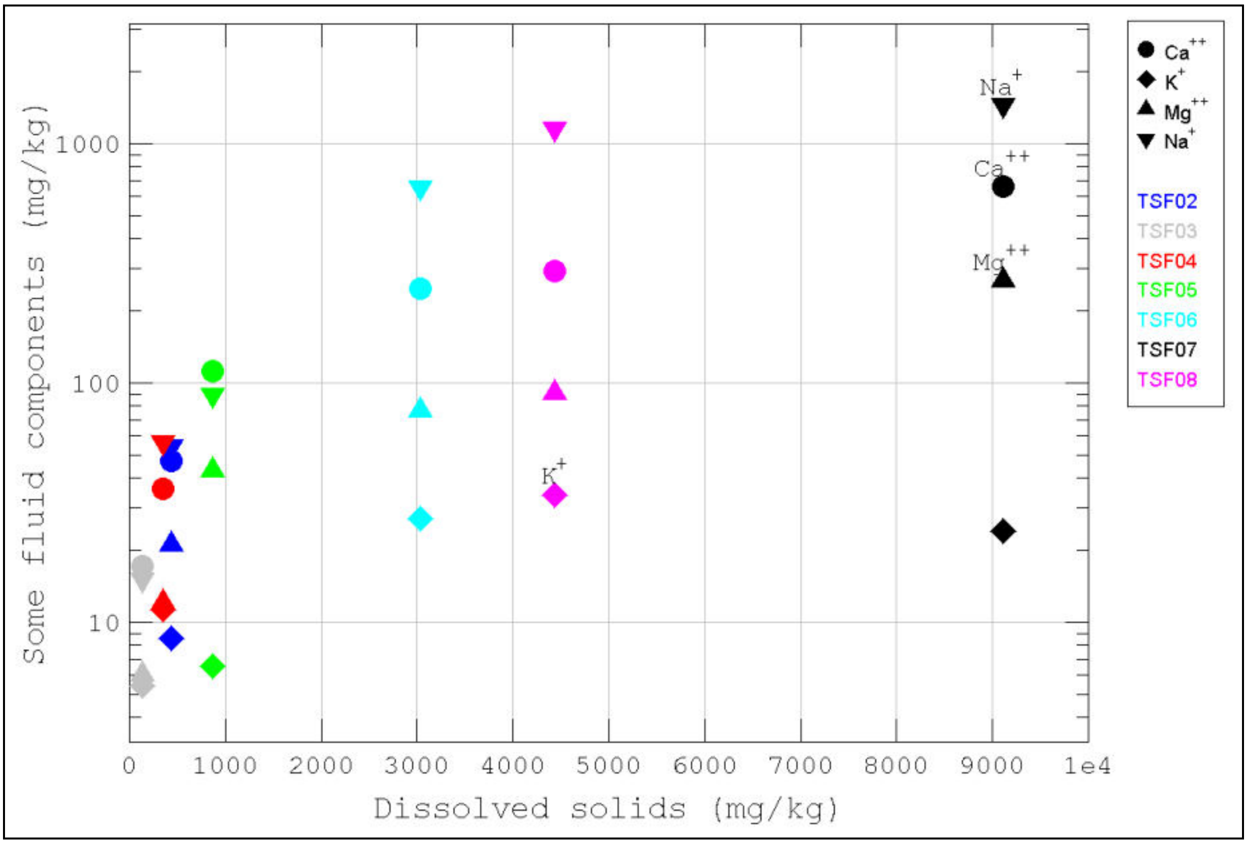


Figure 5.4C Major cations vs. TDS in tailings water/seepage

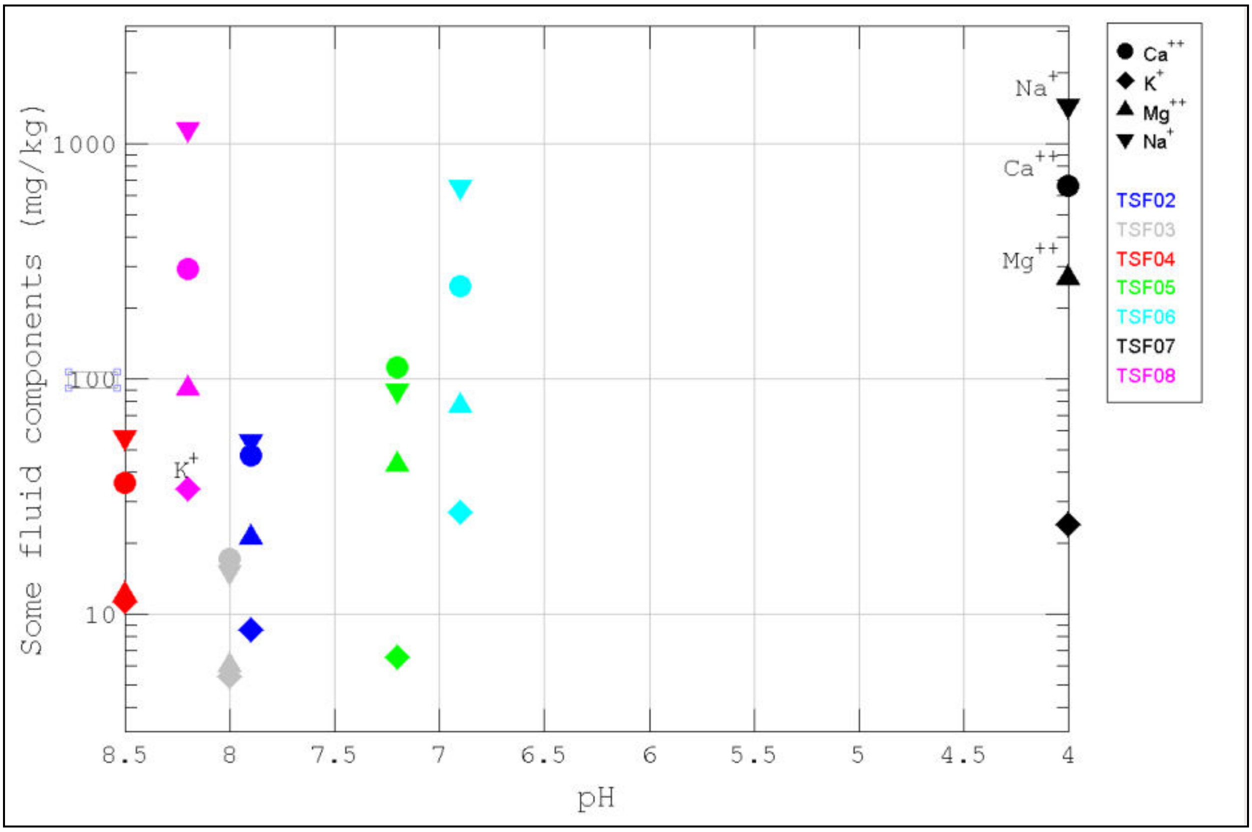


Figure 5.4D Major cations vs. pH in tailings water/seepage

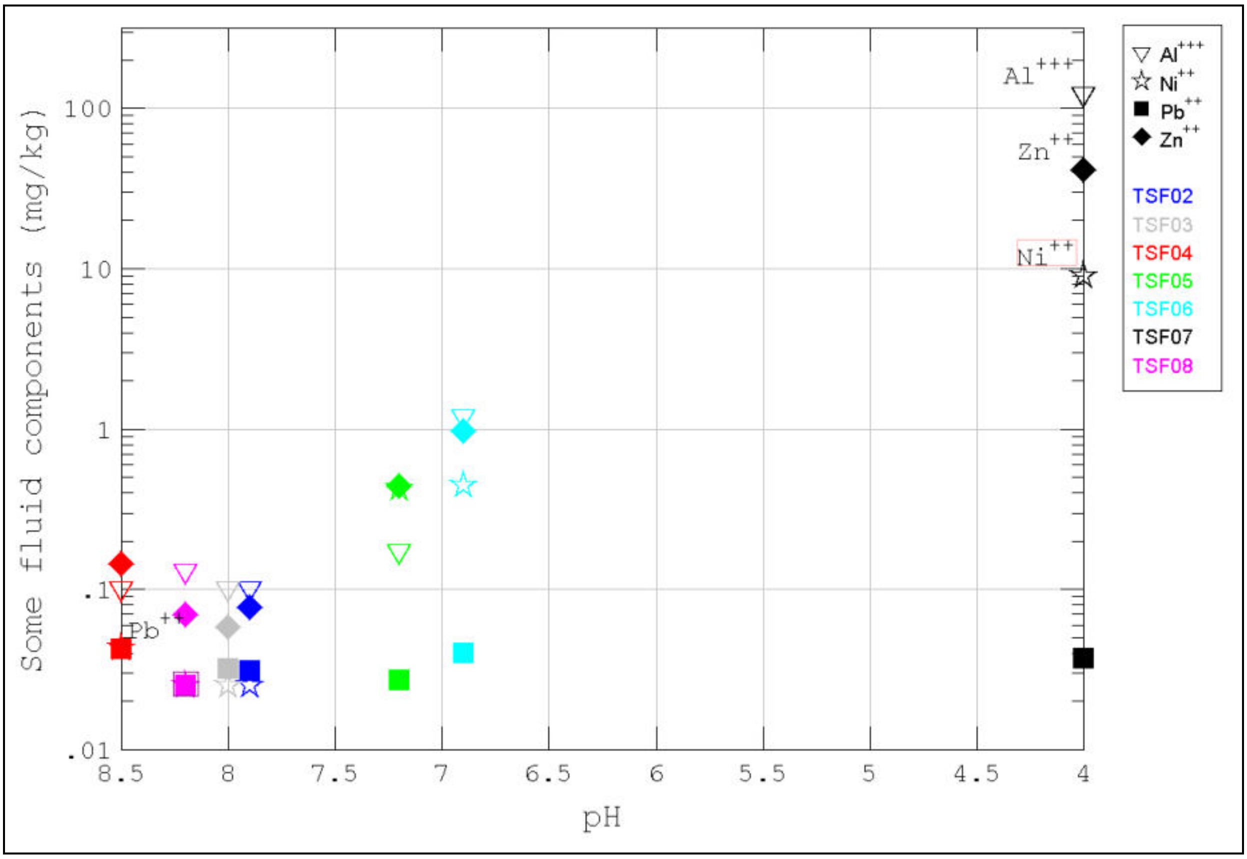


Figure 5.4E Selected metals vs. pH in tailings water/seepage

5.2. Conceptual Geochemical Model

The geochemical processes at the Tailings Storage Facility (TSF) and Waste Rock Dump (WRD) are discussed:

- A conceptual model of the physico-chemical processes is presented in Figure 5.5A:
  - During the operational phase, tailings will be wet and oxygen infiltration will be limited mostly to some of the walls. Generally, the tailings water and seepage water quality will be similar to that of the operational water quality;
  - After closure the piezometric level in the Tailings Dam will lower with the result that more oxygen will infiltrate into the upper few metres of the unsaturated zone. The outer part of the Dam will become unsaturated and the deeper part will remain saturated or partially saturated for several decades after closure;
  - During both the operational and post-closure phases the WRD will be unsaturated. The waste rock have large pores which will be easy drainable in contrast to the tailings. Oxygen will infiltrate the dump through both the processes of diffusion (differences in concentration) and advection (differences in air pressure). Oxygen diffusion into the unsaturated zone will be limited by the consumption of oxygen in the residue dump while advection will be controlled by differences in temperature within and outside the dump;
  - Consumption of oxygen will lead to a gradient in oxygen fugacity in the material that initiates oxygen diffusion (flow from high concentration to low concentration). The oxygen concentration will be at its highest in material directly in contact with the atmosphere and due to its consumption the oxygen concentration will gradually become depleted within only a few meters;
  - Initially only the upper part of the waste material will be situated in the oxidation zone. The oxidation zone will shift deeper into the material as sulphide minerals are depleted. The temperature in the material will eventually rise due to the oxidation of sulphides. Temperature differences will result in differences in gas pressure that initiate the process of oxygen advection. Advection is however minimal in fine material (tailings) and more relevant in coarse material (e.g. waste rock);
- A conceptual model of the presence of the oxic and anoxic zone in the tailings is presented in Figure 5.5B:
  - The unsaturated zone will comprise of an outer oxic and deeper anoxic zone depending on the depth of oxygen diffusion into the Tailings Dam;
  - Pyrite oxidation will only take place in the oxic zone and the interstitial water in the upper part of the unsaturated zone will have a much higher SO_4 concentration than the saturated water deeper in the Dam;
  - Due to differences in oxygen content and pyrite oxidation rate in the tailings dam, as well as the slow water flow in the Tailings Dam, the actual water quality in the tailings dam will differ in several parts of the Dam;
  - The water quality on the outer rim of the Tailings Dam and the inner saturated part will be slightly different. The outer rim will include the unsaturated zone and the contact zone with the saturated zone. The water quality in the outer rim will have a much higher SO_4 content and will eventually become acidic. Seepage water at the toe of the TSF will become more and more representative of the water in the outer rim;
  - Tailings Dam water in the inner saturated part will not be acidic and will have a much lower SO_4 concentration. The SO_4 concentration here will mostly be determined by gypsum saturation at about 2500mg/l. Seepage to the underlying aquifer will mostly be that of the inner saturated part for the first few decades. However, this zone will decrease over time until it is limited only to the very central part of the TSF footprint. In the long-term, the outer rim will significantly influence the seepage water quality to the groundwater system;
  - The increasing outer rim (including the unsaturated zone, with the oxic and anoxic subzones, and the contact zone with the saturated part) and the decreasing inner saturated part is illustrated in Figure 5.5B;
- A conceptual model of the presence of the oxic and anoxic zone in the WRD is depicted in Figure 5.5C:
  - The unsaturated zone will comprise of an outer oxic and deeper anoxic zone depending on the depth of oxygen infiltration into the Dump as illustrated in Figure 5.5C;
  - Pyrite oxidation will only take place in the oxic zone and the interstitial water in the upper part of the unsaturated zone will have a much higher SO_4 concentration than the saturated water deeper in the Dump;

- The following observations relate to the geochemical reactions in mine, waste rock and tailings material:
  - Waste material will consist of a solid, water and gas phase. Without 1 of 3 phases no AMD production and drainage are possible. The solid phase (tailings/waste rock) is the reactive part of the 3 phases and contains sulphide minerals that reacts spontaneously with oxygen and water;
  - Upon oxidation, pyrite will react with the infiltrating oxygen and water to produce Fe^{3+}, SO_4^{2-} and acidity as follows:

    pyrite + $3.5H_2O + 3.75O_2(aq) \Rightarrow Fe(OH)_3(ppd) + 2SO_4^{2-} + 4H^+$
  - Water serves as the transport medium for the products of acid mine drainage (AMD) as it percolates through the waste material. The water phase also serves as the medium in which dissolution of neutralizing minerals can take place. The acid produced by the pyrite will be consumed by calcite (or the lime in fresh tailings) if present:

    2calcite + $4H^+ \Rightarrow 2Ca^{2+} + 2CO_2(g) + 2H_2O$
  - Together with SO_4 the Ca^{2+} produced will form gypsum as follows:

    pyrite + 2calcite + $5.5H_2O + 3.75O_2(aq) \Rightarrow Fe(OH)_3(ppd)$ + 2gypsum + $2CO_2(g)$
  - If all the carbonate minerals are depleted then the seepage from the mine material generally becomes acidic. Silicate minerals can also consume some of the acidity. However, silicate minerals react too slowly to prevent acidification in material with a significant potential to generate acidic drainage;
  - More metals will also be leached out at elevated concentrations in acidic seepage, when the final stage of AMD have been reached.

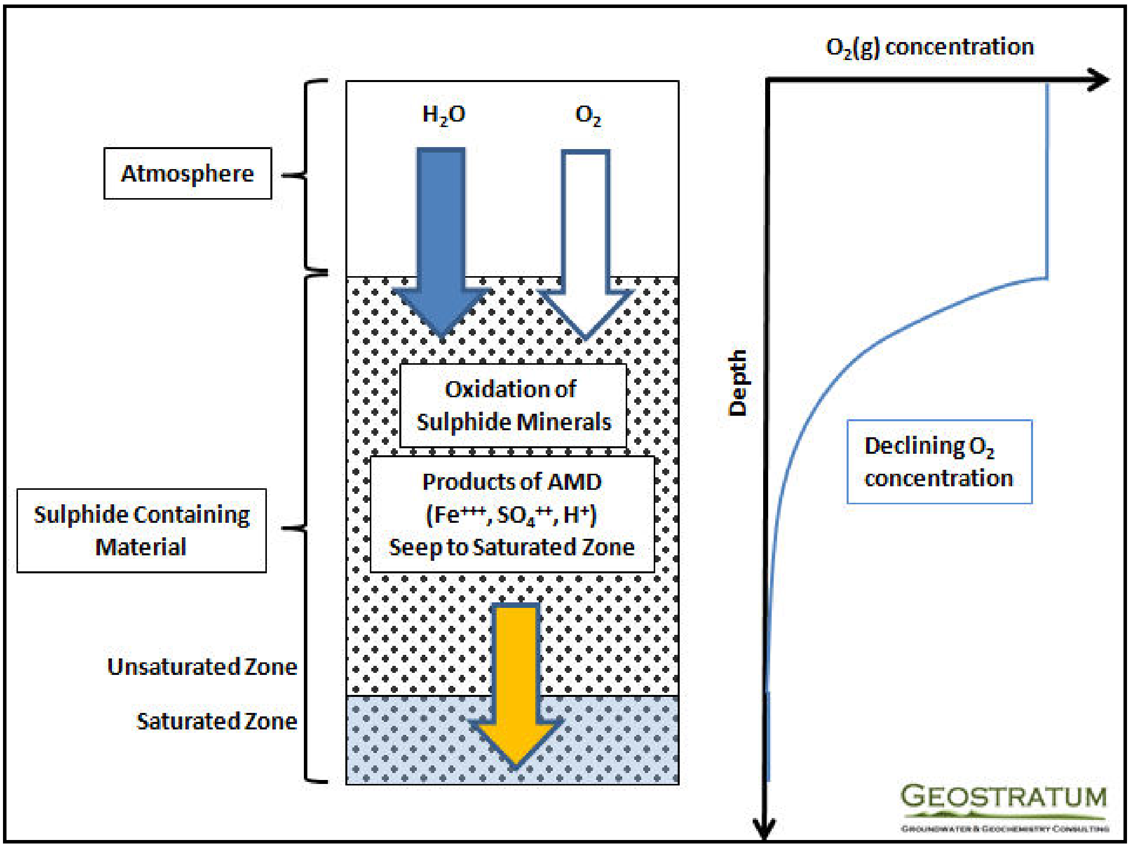


Figure 5.5A Conceptual model of physico-chemical process in the unsaturated zone

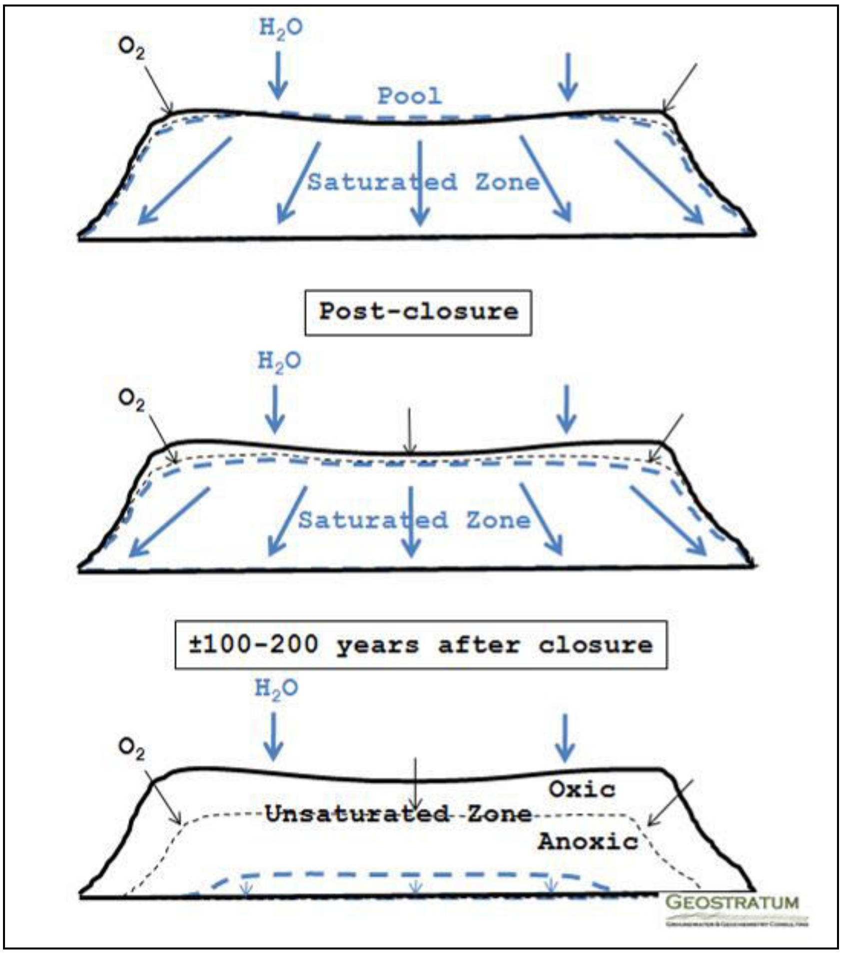


Figure 5.5B *Conceptual model of the tailings dam illustrating the presence of the oxic and anoxic zones*

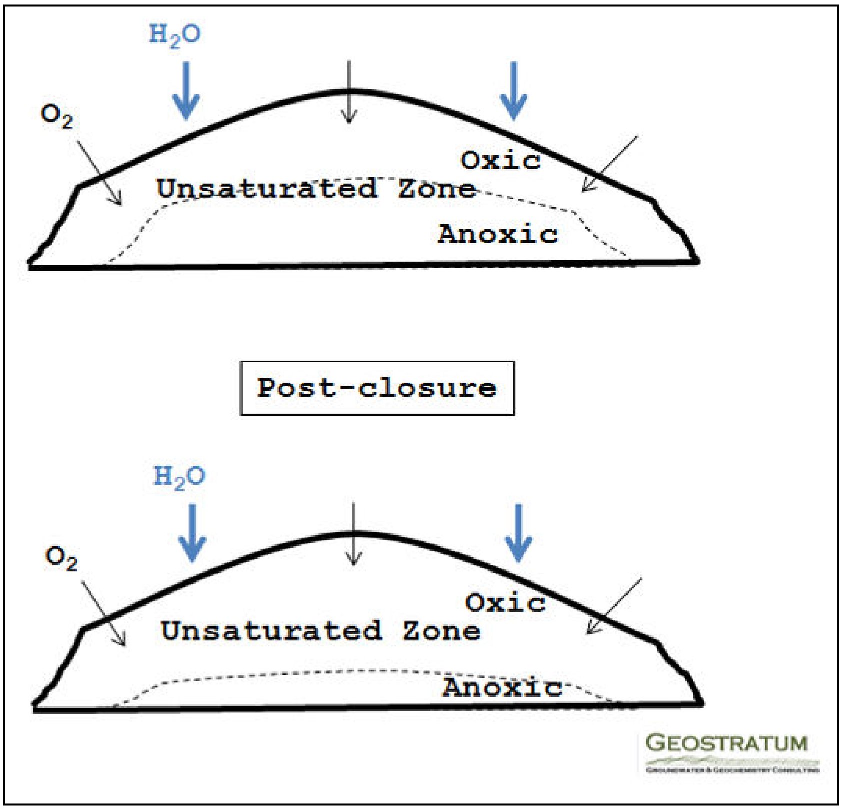


Figure 5.5C *Conceptual model of the waste rock dump illustrating the presence of the oxic and anoxic zones*

5.3. Geochemical Model Conclusions

Introduction

The primary objective of the geochemical modelling was to estimate the future seepage water quality of the mine residue dumps at the *Gold One Africa Ltd* Ventersdorp Gold Mine project. The modelling results will be valuable in identifying water management measures.

Analytical results cannot be used directly to establish the changes in the leachate quality from the mine over time. Due to the complexity in the interaction between the solid, water and gas phases, numerical modelling was used to predict the Acid Rock Drainage (ARD).

The oxygen diffusion into the residue mine waste was modelled using an edited version of PYROX. The code models 1) the diffusion of oxygen through the unsaturated zone, 2) the oxygen consumed by mineral oxidation, and 3) the subsequent sulphate, iron and acidity production.

The interaction between the mineral-, water- and the gas phases was modelled using the Geochemist's Workbench Professional. This model solves the hydro-chemical and mineral reactions with the equilibrium model and the kinetic rate law for mineral dissolution. The Geochemist's Workbench is a set of interactive software tools for solving problems in aqueous geochemistry.

Modelling Scenarios

Four models were compiled as summarised in Table 5.7A:

- Model A modelled the oxygen diffusion into the post-closure TSF;
- Model B modelled the oxygen diffusion into the WRD;
- Model C assessed the seepage water quality of the post-closure TSF;
- Model D assessed the seepage water quality of the WRD.

The following comments relate to the model sensitivity to material/design parameters:

- Sulphide/sulphate content of the tailings:
  - Whether the sulphur in the tailings is due to sulphides or sulphates may have a significant influence on the acid generation potential of the tailings as sulphates generally does not generate acid;
  - It seems unlikely that all %S in the future tailings will be related to the sulphide (pyrite) content as with the tested pulp samples (Venmet 01 and 02). Generally, sulphides are subdued to severe conditions during gold processing (both physically and chemically, e.g. milling, aeration, oxidants) with the result that some of the sulphides will oxidise and be present as sulphates;
  - Sulphides are often deliberately oxidised in gold plants 1) to release any gold traces and 2) to make the gold cyanidation process more efficient. Aeration (prior to the introduction of cyanide) of the ore in water at high pH can render elements such as iron and sulphur less reactive to cyanide, and therefore result in more efficient gold cyanidation; and
  - A model scenario was therefore created for the tailings with 50 wt% of the %S as sulphides and the remainder as sulphates in order to test the sensitivity of the model for variation in the sulphide/sulphate content.
- Soil capping:
  - A soil capping is one of the mitigation measures investigated. A soil capping will result in less water and oxygen that will infiltrate the Tailings Dam and WRD. With less oxygen infiltration, less pyrite oxidation will occur and therefore the soil capping will also have an effect on the seepage quality from these sites;
  - In order to test the sensitivity of the model for variation in soil cover compared to no cover, model scenarios were therefore created where 1m soil cover is placed upon the residue dumps. A loamy soil was used in the model as clay is not an effective cover due to cracks that may form during drying.

The %S and NP of the tailings/waste rock used for the models are provided in Table 5.7B. The following scenario variants were created/designed in consideration of the model parameter sensitivities:

- Model A, Scenario 1 and 2 - Oxygen diffusion into the post-closure TSF with no soil layer and with a 1m thick soil layer respectively;

- Model B, Scenario 1 and 2 - Oxygen diffusion into the WRD with no soil layer and with a 1m thick soil layer respectively;
- Model C, Scenario 1 - Average tailings composition with no mitigation;
- Model C, Scenario 2 - Tailings with 50 wt% of the %S as sulphides with remainder as sulphates;
- Model C, Scenario 3 - As Scenario 2 but the tailings dam covered with 1m thick loamy soil layer;
- Model D, Scenario 1 - The average WRD with no mitigation; and
- Model D, Scenario 2 - As Scenario D1 but the WRD covered with 1m thick loamy soil layer.

The following comments relate to model input and assumptions:

- Sample representativeness:
  - Pulp was prepared from various ore samples for metallurgical testing;
    - It was assumed that samples was representative of the ore body and that rock would be thoroughly mixed or that water will be in contact with all rock materials;
- Pyrite and carbonate mineral content:
  - Weighted average %S and NP are summarised in Table 5.7B;
  - The carbonate mineral content was calculated from the measured NP values;
  - The pyrite content was calculated from the weighted %S, assuming that all sulphur is present as pyrite for all the waste rock scenarios. However, the tailings were also modelled where 50 wt% of the %S is present as sulphides and the remainder as sulphates.

Table 5.7A Description of geochemical model scenarios

Model Scenario	Site	Material
Model A Scenario 1	Tailings Dam	Average tailings with no soil cover
Model A Scenario 2	Tailings Dam	Average tailings with 1m loamy soil cover
Model B Scenario 1	Waste Rock Dump	Average waste rock with no soil cover
Model B Scenario 2	Waste Rock Dump	Average waste rock with 1m loamy soil cover
Model C Scenario1	Tailings Dam	Average tailings with no soil cover
Model C Scenario 2	Tailings Dam	Tailings with 50% of sulphides oxidised and dam with no soil cover
Model C Scenario 3	Tailings Dam	Tailings with 50% of sulphides oxidised and dam with 1m loamy soil cover
Model D Scenario1	Waste Rock Dump	Average waste rock with no soil cover
Model D Scenario 2	Waste Rock Dump	Average waste rock with 1m loamy soil cover

Table 5.7B Weighted average %S and NP used in numerical model

Model Scenario	Description	Total (%S)	AP $CaCO_3$ (kg/t)	NP $CaCO_3$ (kg/t)	NNP $CaCO_3$ (kg/t)	NP/AP	Rock Type NNP	Rock Type (%S)	Rock Type NP/AP
Model A1 - A2	Tailings oxygen diffusion model	0.23	-	-	-	-	-	-	-
Model B1 - B2	Waste rock oxygen diffusion model	0.23	-	-	-	-	-	-	-
Model C1	Tailings geochem model	3.39	106.05	4.00	-102.30	0.04	I	I	I
Model C2 - C3	Tailings geochem model	1.70	53.03	4.00	-49.03	0.08	I	I	I
Model D1 & D2	Waste rock geochem model	1.71	53.58	4.04	-49.54	0.08	I	I	I

Models Scenarios A and Output – Oxygen Diffusion

The vertical oxygen diffusion profile for the average pyrite content is depicted in Figure 5.6A-D. The following were concluded:

- The oxygen concentration will decrease downwards in the unsaturated zone because of consumption by pyrite and because of resistance to diffusion by the material. In the tailings dam there will be much more resistance to diffusion because of the smaller pore sizes and larger water contents. The waste rock dam has larger pores and oxygen will reach much deeper depths;
- The oxygen infiltration becomes slower over time and will eventually reach a pseudo-steady state. Significant oxygen infiltration will only occur in the unsaturated zone;

- The depth of oxygen diffusion in the tailings will be between 5m - 10m from Year 1 - 200 (at O_2 of 0.1%); average dam height is 40m. With installation of a soil cover the infiltration will be between 4m - 8m;
- The depth of oxygen diffusion in the waste rock will be between 8m - 16m from Year 1 - 200 (at O_2 of 0.1%); average dump height is 20m. With installation of a soil cover the infiltration will be between 7m - 12m;
- The oxygen content of the unsaturated zone over time was used for further modelling.

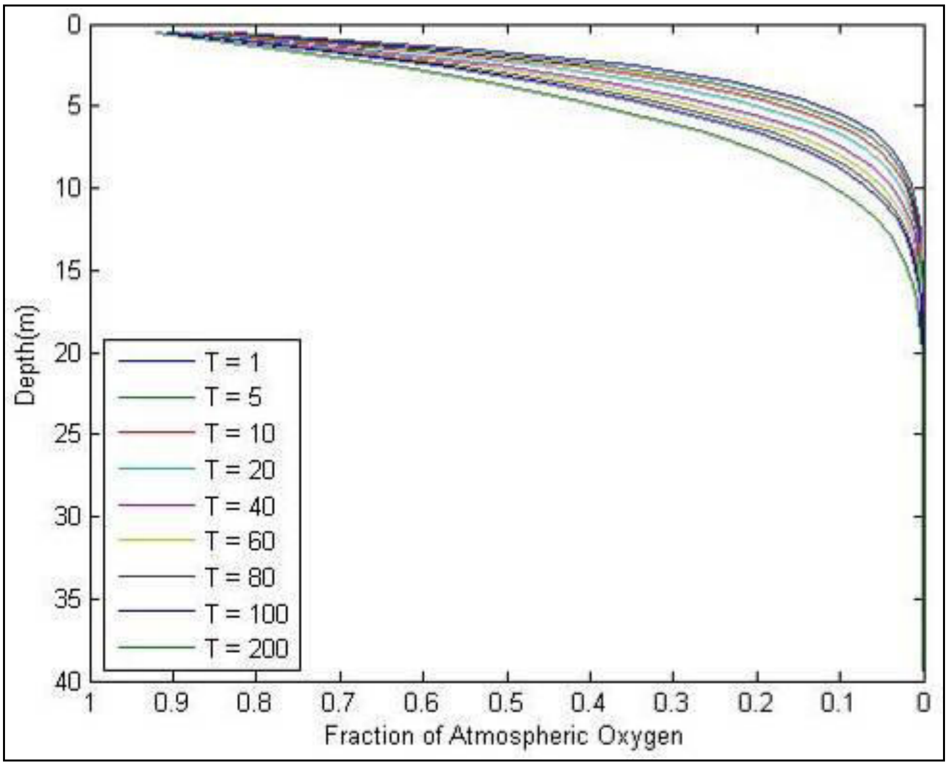


Figure 5.6 Model A1 - Oxygen infiltration in post-closure TSF – no soil cover

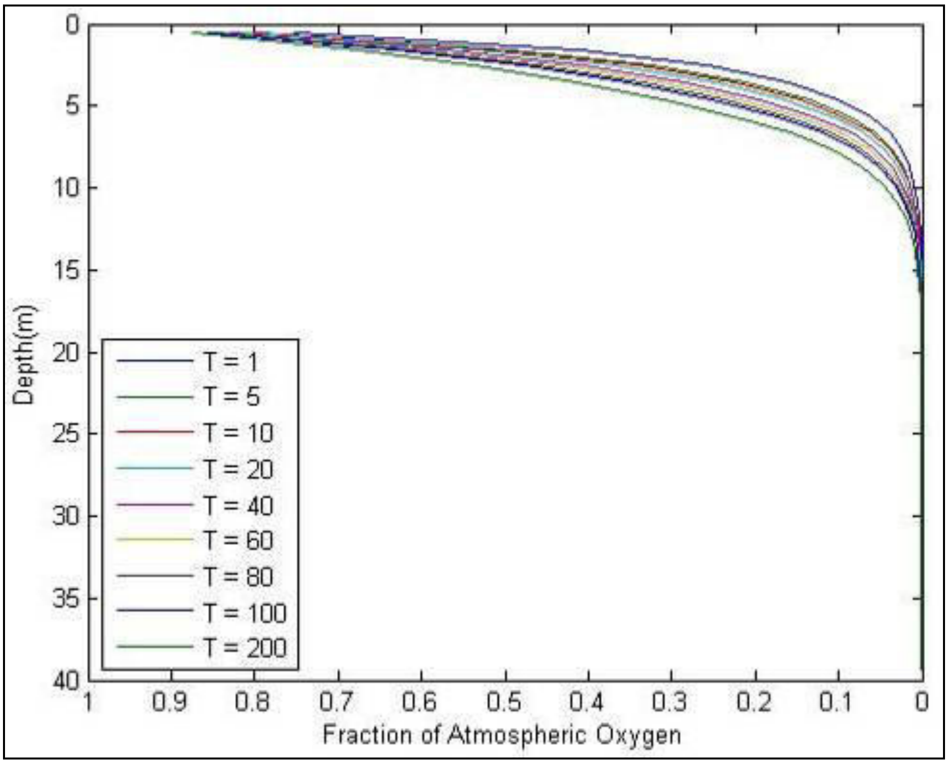


Figure 5.6B Model A2 - Oxygen infiltration in post-closure TSF – 1m thick loam soil cover

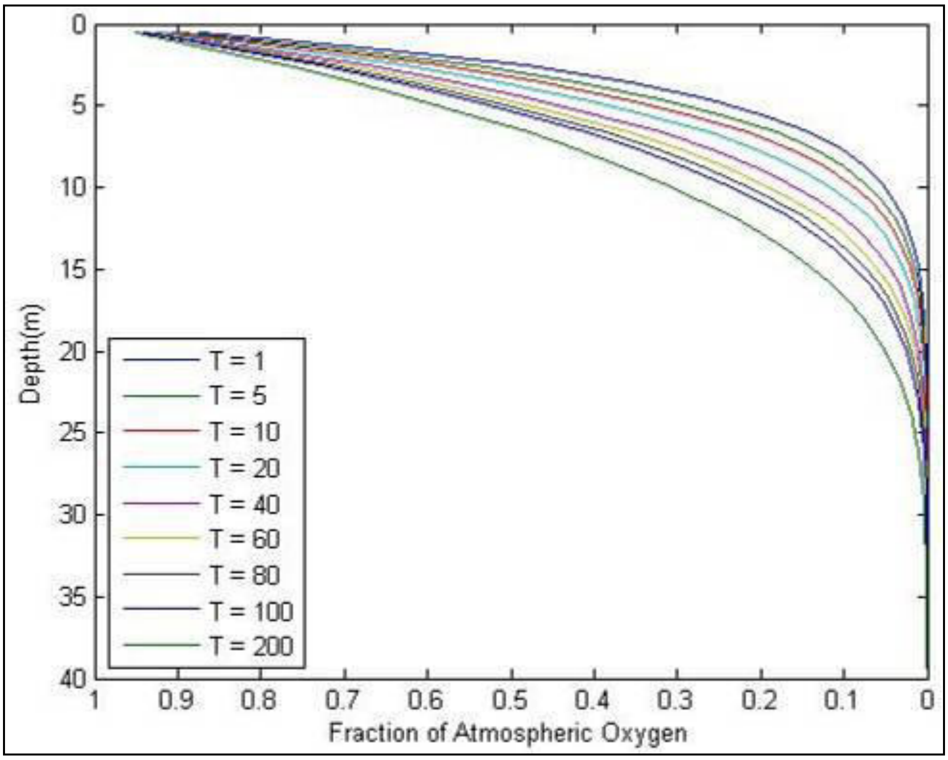


Figure 5.6C *Model B1 - Oxygen infiltration in post-closure WRD – no soil cover*

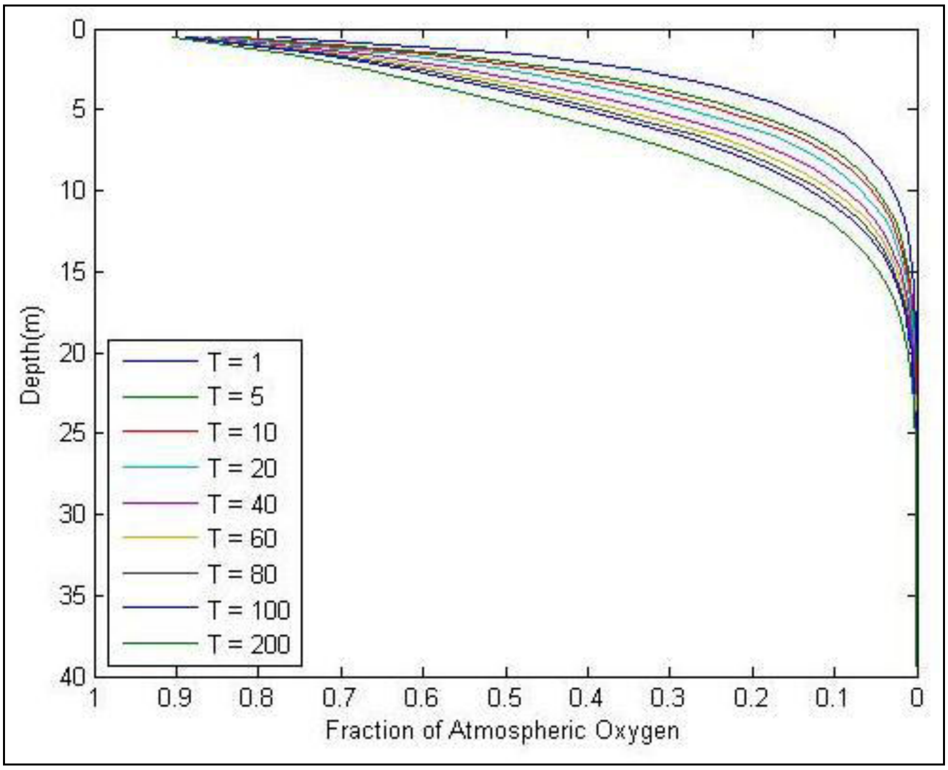


Figure 5.6D *Model B2 - Oxygen infiltration in post-closure WRD – 1m thick loam soil cover*

Model Scenarios Output – C1, C2 and C3

The geochemically simulated water quality trends for Model Scenarios C1 and C2 are presented in Figures 5.7A-C:

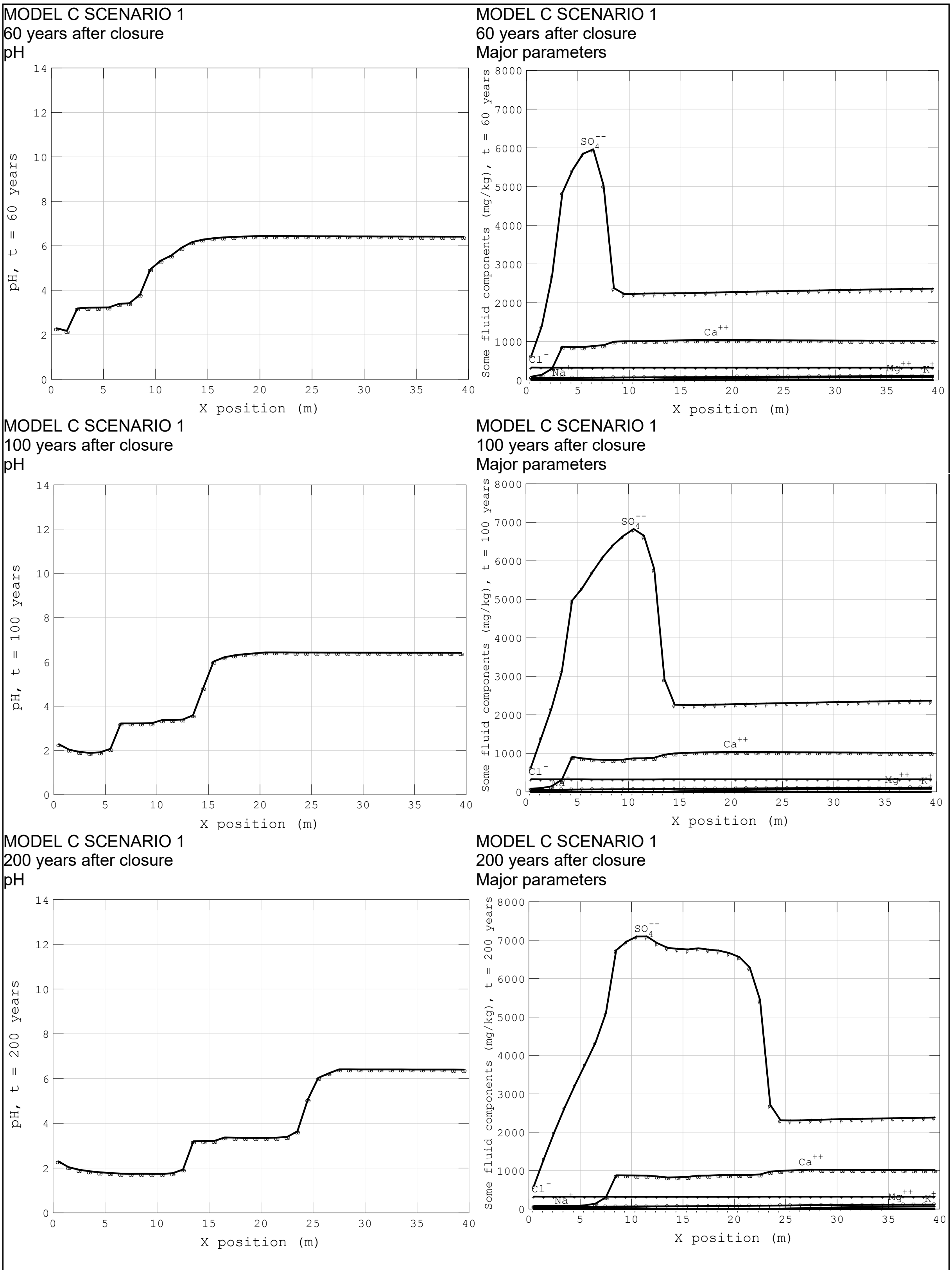


***Figure 5.7A** Trends in pH and major parameters (all %S attributed to pyrite; x-axis represents the depth into the Tailings Dam)*

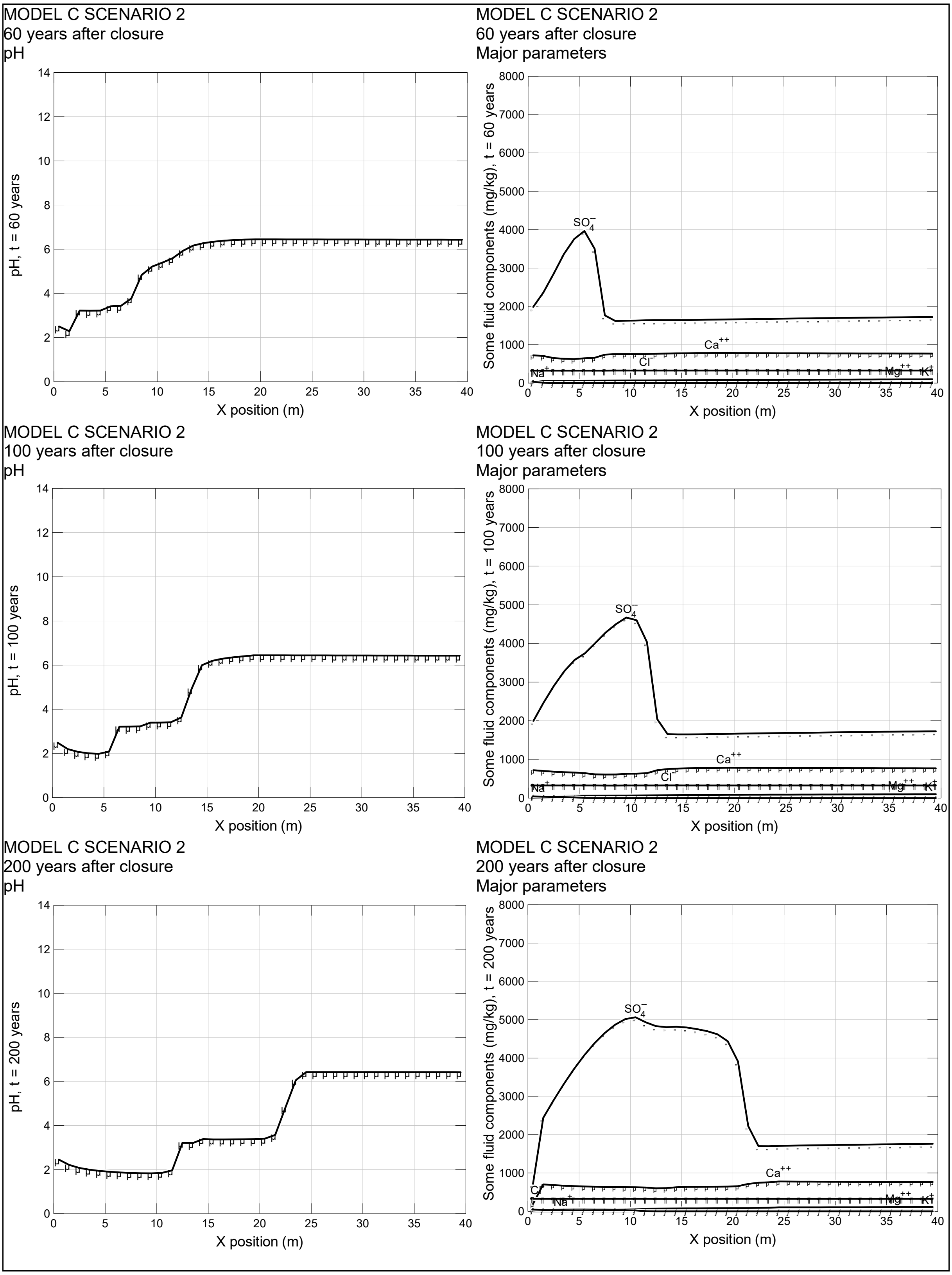


Figure 5.7B Trends in pH and major parameters (50% of %S attributed to pyrite; 50% of %S attributed to gypsum; x-axis represents the depth into the Tailings Dam)

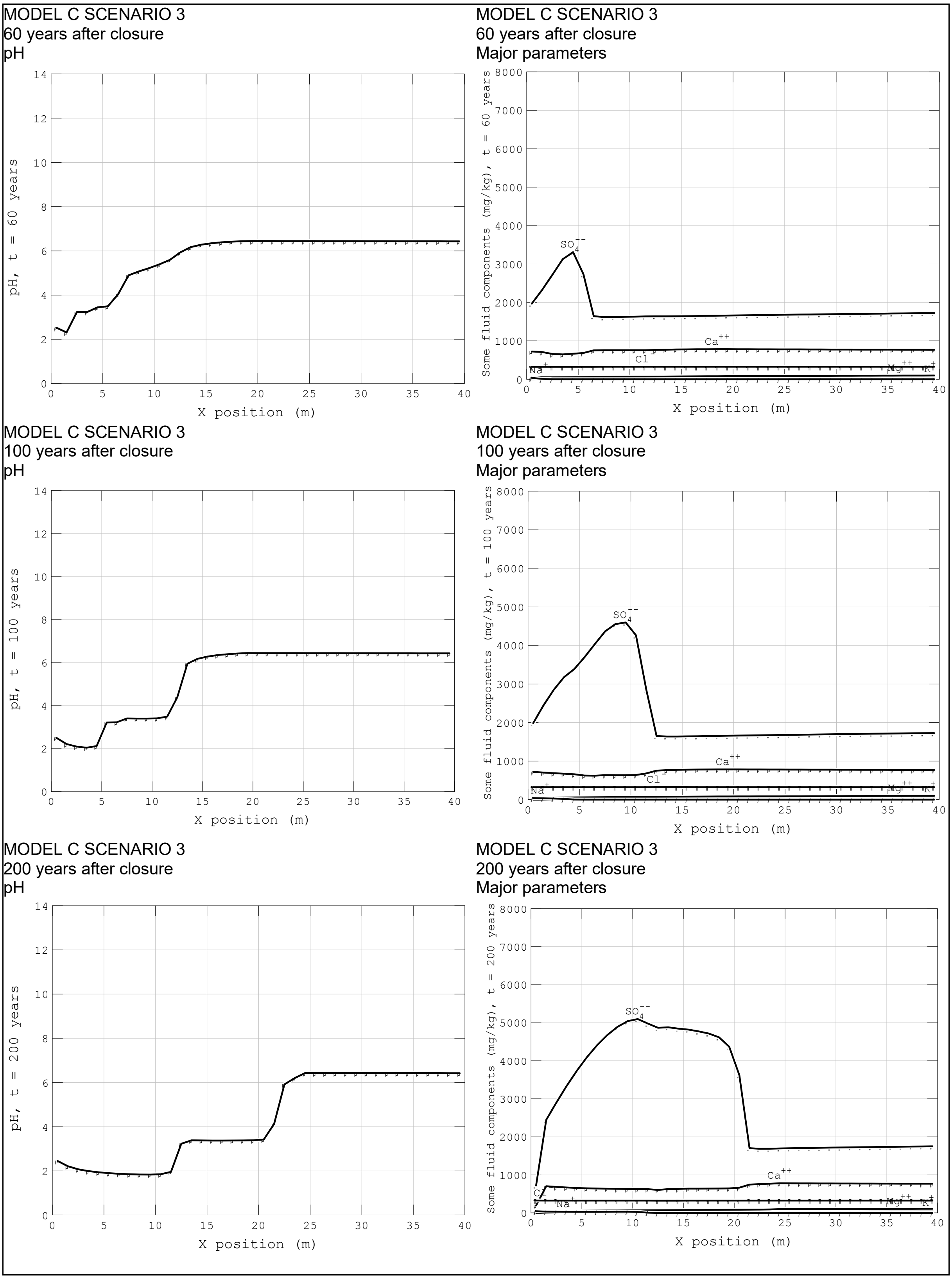


***Figure 5.7C** Trends in pH and major parameters (50% of %S attributed to pyrite; 50% of %S attributed to gypsum; 1m thick loam soil cover; x-axis represents the depth into the Tailings Dam)*

Model Scenarios Output – D1 and D2

The geochemically simulated water quality trends for Model Scenarios D1 and D2 are depicted in Figures 5.7D-E:

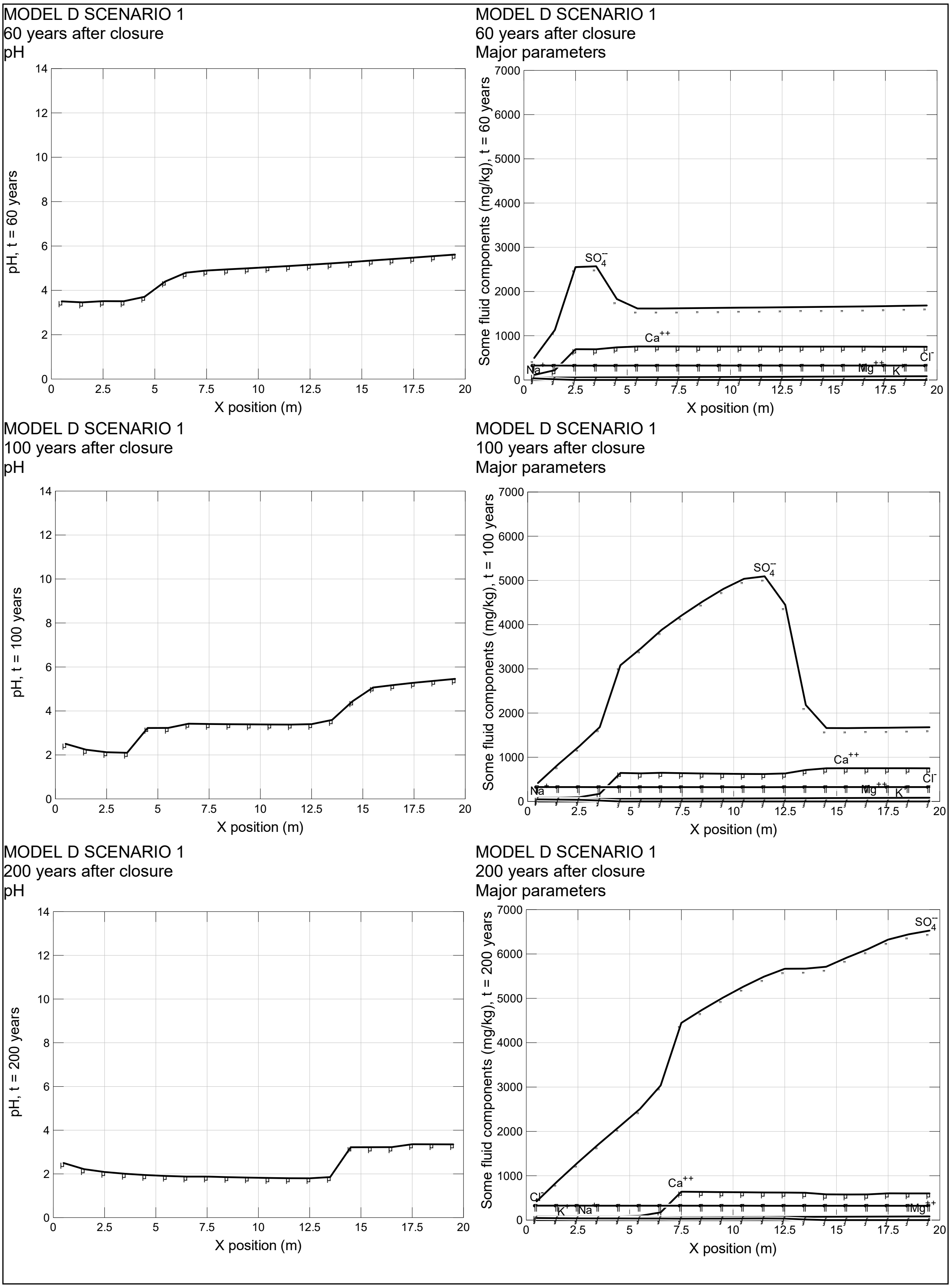


Figure 5.7D Trends in pH and major parameters (x-axis represents the depth in the WRD)

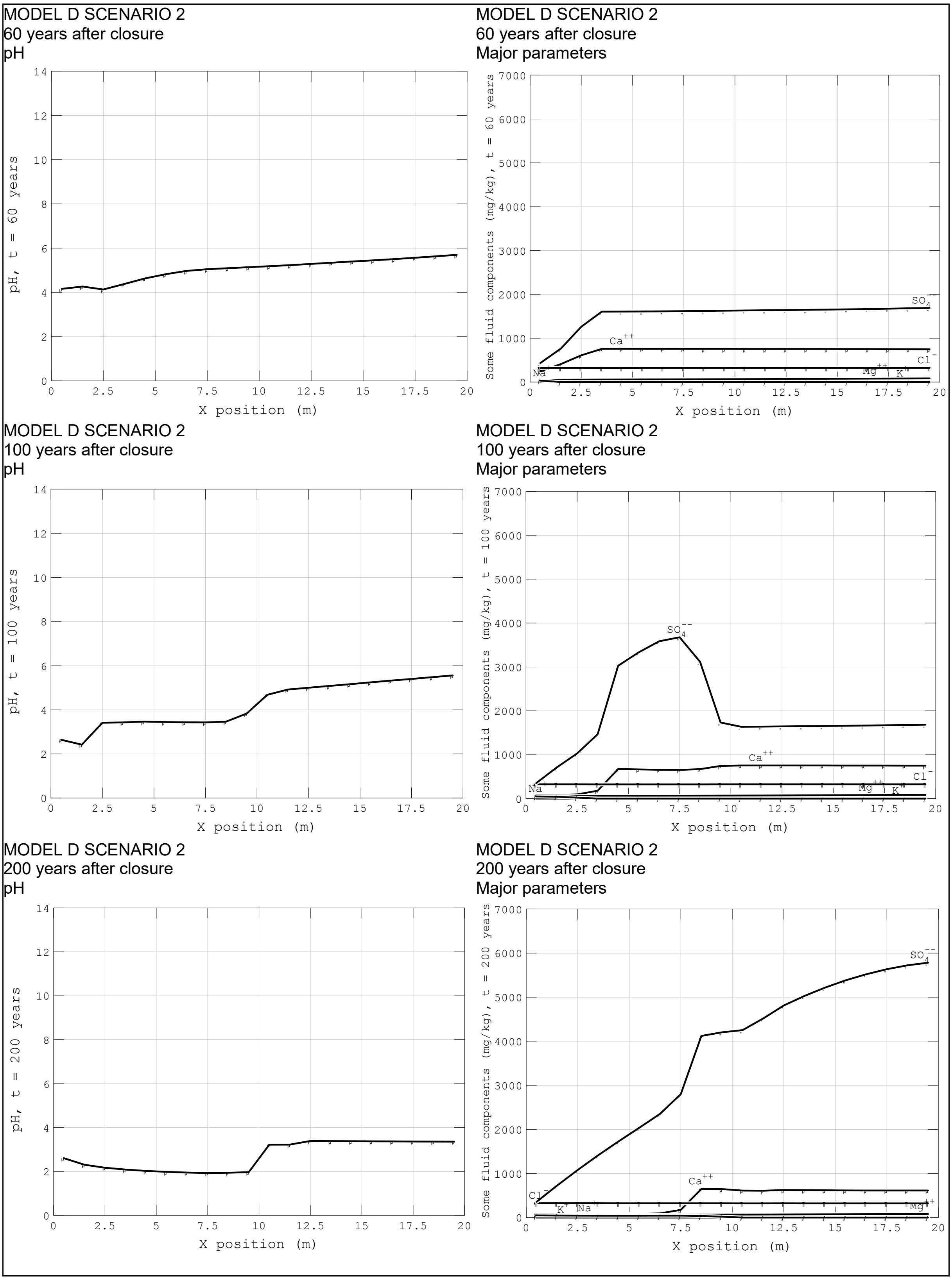


Figure 5.7E Trends in pH and major parameters (x-axis represents the depth in the WRD)

Seepage Water Quality Predictions

The geochemically simulated water quality trends are summarized in Tables 5.8A-B:

Table 5.8A Estimated water quality in the oxidised zone

Model Scenario	Year	pH	SO_4	TDS
C1 Tailings Dam	20	4.5 - 7.0	1000 - 2500	1500 - 3700
	60	2.0 - 7.0	700 - 6000	1100 - 8600
	100	2.0 - 7.0	700 - 7000	1100 - 10000
	200	2.0 - 7.0	700 - 7000	1100 - 10000
Model Scenario	Year	pH	SO_4	TDS
C2 Tailings Dam 50:50 S/SO_4	20	4.5 - 7.0	1700	2500
	60	2.0 - 7.0	2000 - 4000	3000 - 5800
	100	2.0 - 7.0	2000 - 4700	3000 - 6800
	200	2.0 - 7.0	700 - 5000	1100 - 7200
Model Scenario	Year	pH	SO_4	TDS
C3 Tailings Dam 50:50 S/SO_4 1m Cover	20	4.5 -7.0	1700	2500
	60	2.0 -7.0	2000 - 3500	3000 - 5100
	100	2.0 -7.0	2000 - 4500	3000 - 6500
	200	2.0 -7.0	700 - 5000	1100 - 7200
Model Scenario	Year	pH	SO_4	TDS
D1 Waste Rock Dump	20	4.5 - 6.0	500 - 2500	880 - 3700
	60	3.5 - 5.0	500 - 2500	880 - 3700
	100	2.0 - 3.5	500 - 5000	880 -7200
	200	2.0 - 3.5	500 - 6500	880 - 9300
Model Scenario	Year	pH	SO_4	TDS
D2 Waste Rock Dump 1m Cover	20	5.0 - 7.0	500 - 1700	880 - 2600
	60	4.0 - 5.0	500 - 1700	880 - 2600
	100	2.5 - 4.0	500 - 3500	880 - 5100
	200	2.0 - 3.5	500 - 5800	880 - 8300

Table 5.8B Estimated seepage quality from the deeper un-oxidised material

Model	Year	pH	TDS	SO_4	Ca	Mg	Na	K	Cl
TSF	0 - 200	6 - 7	2500 - 4500	1500 -2500	500-1000	100-300	250-1000	20 - 40	500-2000
WRD	0 - 150	5 - 7	2500 - 4000	1500 - 2000	500-1000	100-300	50 -100	20 - 40	20 - 100

Table 5.8C Approximate progress of outer rim containing also the oxic zone

Model Scenario	Year 60	Year 100	Year 200
C1	8	13	23
C2	7	12	22
C3	6	12	22
D1	4	13	20
D2	3	9	20

The following were concluded:

- Depth of oxidation:
  - The depth of oxygen diffusion in the tailings will be between 5m - 10m from Year 1 - 200 (at O_2 of 0.1%); average dam height is 40m. With installation of a soil cover, oxygen infiltration will be between 4m - 8m;
  - The depth of oxygen diffusion in the waste rock will be between 8 - 16m from Year 1 - 200 (at O_2 of 0.1%); average dump height is 20m. With installation of a soil cover, oxygen infiltration will be between 7m - 12m;
- Tailings Dam - Major parameters (Scenarios C1, C2 and C3):
  - Pyrite oxidation will only take place in the oxic zone and the interstitial water in the upper part of the unsaturated zone will have a much higher SO_4 concentration than the saturated water deeper in the Dam;
  - In the Tailings Dam, the water quality at the outer rim of the Dam and the deeper saturated part will differ. The water quality in the outer rim (including the unsaturated zone and the upper contact zone with the saturated zone) will have a much higher SO_4 content and will eventually become acidic;

- The seepage water quality at the toe of the TSF will first be dominated by water from the deeper saturated part but will gradually become more and more representative of the water quality at the outer rim post-closure;
- Tailings Dam water in the inner saturated part will not be acidic and will have a much lower SO_4 concentration. SO_4 concentration here will be predominantly determined by gypsum saturation at about 2500mg/L. Typical concentrations of cations are given in Table 5.8B;
- Seepage to the underlying aquifer will reflect the inner saturated part for the first few decades. However, this zone will decrease over time. Consequently seepage to the groundwater will gradually reflect the quality of the outer rim;
- Figure 5.7A depicts the SO_4 concentration in the Tailings Dam 60years, 100years and 200years after closure. The oxic zone is only a few meters deep (5m - 10m) but due to transport the whole outer rim of the Dam becomes acidic with higher dissolved solids. At 60years the outer rim is only 8m deep but at 200years it is 23m deep. The SO_4 concentration in the outer rim increases from about 2 500mg/L after closure to approximately 6 000mg/L after 60years and 7 000mg/L after 200years. The SO_4 concentrations in the inner saturated part is estimated at 2 500mg/L over all times as it is mostly limited by gypsum saturation;
- If it is assumed that 50 wt% of the sulphur in the tailings could be attributed to gypsum instead of pyrite, it is anticipated that the SO_4 concentration in the outer rim will increase from 1 500mg/L after closure to approximately 4 000mg/L after 60years and 5 000mg/L after 200years. The SO_4 concentrations in the inner saturated part is estimated at 1 500mg/L over all times as it is mostly limited by gypsum saturation;
- If the tailings dam is covered with a 1m thick loamy soil then slightly less oxygen will infiltrate the dam as shown in Figure 5.6B. However, due to the high sulphide content of the tailings the slight decrease in oxygen content is not enough to prevent acidification in the outer rim, or have a significant decrease in the tailings water quality. It is estimated that the soil cover will effect the water in the outer rim to have slightly lower SO_4 concentration of approximately 500mg/L - 1000mg/L and the depth of the outer rim will progress only slightly slower. These will however have little effect over the long-term;

* <u>Tailings Dam - Changes in pH and metal concentrations (Scenarios C1, C2 and C3):</u>
  - The pH will be near-neutral in the deeper saturated parts of the tailings dam;
  - In the outer rim, the pH will only be slightly acidic during the first 20years - 40years at pH 4.5. After about 60years the pH will be below pH 4.5;
  - The following metals were detected in neutral tailings water/seepage: Al, Mn, Ni, Pb and Se;
  - The following metals will be elevated above the SANS 241:2011 Water Standard in acidic tailings seepage/interstitial water elevation in: Al, Co, Cr, Cu, Mn, Ni, Pb, Se, U and Zn;
* <u>Tailings Dam - Conclusions (Scenario C1, C2 and C3):</u>
  - Overall, seepage over the largest part of the footprint (the central part) will be close to gypsum saturation at 1 500mg/L - 2 500mg/L. This part will not be acidic but will decrease in size over time. The outer rim of the tailings dam (both vertical and horizontal) will have a higher SO_4 concentration that will range between 1500mg/L - 7000mg/L over time. Seepage from this part will also be acidic. Because of the high sulphide content of the tailings, a soil cover will have a notable but modest effect on the seepage quality over the long-term. <u>The effect of the soil cover may however become significant if more sulphides could be oxidised at the plant (and less is present in the tailings dam</u>);
  - Several metals will be present in acidic seepage from the tailings dam, which may include: Al, Co, Cr, Cu, Mn, Ni, Pb, Se, U and Zn. These metals will be elevated above most water standards;
* <u>Waste Rock Dump - Major parameters (Scenarios D1 and D2):</u>
  - The unsaturated zone will comprise of an outer oxic and deeper anoxic zone depending on the depth of oxygen infiltration into the residue dump;
  - Pyrite oxidation will only take place in the oxic zone and the interstitial water in the upper part of the unsaturated zone will have a much higher SO_4 concentration than the saturated water deeper in the dump;
  - After 60years the outer rim is only 8m deep but at 200years it is 22m deep. The SO_4 concentration in the outer rim is expected to increase from about 2 500mg/L after closure to approximately 6 000mg/L after 60years and 7 000mg/L after 200years. The water in the deeper anoxic part is at about 2 500mg/L during all times due to being mostly limited by gypsum saturation;
  - If the WRD is covered with a 1m thick loamy soil, less oxygen will infiltrate the dump. The soil cover will be more effective on the waste rock dump than on the tailings dam. However, because of the high sulphide content of the waste rock the decrease in oxygen content is not expected to be enough to prevent acidification in the outer rim or have a significant influence

on water quality. With the soil cover, the SO_4 concentration are expected to be lower at concentrations ranging between 500mg/L - 1000mg/L. Acidification will be slightly delayed, and the depth of the oxygen zone at the outer rim will progress slower;

- Waste Rock Dump - Changes in pH and metal concentrations (Scenarios D1 and D2):
  - pH will be slightly acidic at the outer rim during the first 20years - 40years at pH 4.5. After 60years the pH will be below pH 4.5;
  - The following metals were detected in neutral tailings water/seepage: Al, Mn, Ni, Pb and Se;
  - The following metals will be elevated above the SANS 241:2011 Water Standard in acidic tailings seepage/interstitial water elevation: Al, Co, Cr, Cu, Mn, Ni, Pb, Se, U and Zn;
- Waste Rock Dump - Conclusions (Scenarios D1 and D2):
  - Overall, seepage over the largest part of the footprint will have a high SO_4 concentration that will range between 1500mg/L - 7000mg/L over time. Seepage from the WRD is expected to eventually become acidic. Because of the high sulphide content of the waste rock, a soil cover will have a notable but modest effect on the seepage quality over the long-term;
  - Several metals will be present in acidic seepage from the waste rock dump, which may include: Al, Co, Cr, Cu, Mn, Ni, Pb, Se, U and Zn. These metals will be elevated above most water standards.

Model validation

The following comments are important with respect to validating the geochemical model:

- Sample representativeness:
  - Sufficient samples of the Wits waste rock were collected to study the variability in geochemical parameters;
  - Only one prepared pulp sample of the tailings were made available. This may not be sufficient. In this sample all sulphur was present as sulphides. Actual tailings from the future mine must be tested and the geochemical model must be updated;
- Mineral kinetics:
  - The pyrite oxidation rate was determined from kinetic column tests performed on similar material in previous studies. The calibrated surface area was in good agreement with literature values;
  - No attempt was made to model any microbial activity. It is assumed that microbial activity could be ignored during near neutral conditions. The modelled concentrations were however in good agreement with tailings water measurements of surrounding mines;
- Predicted mine water quality:
  - The TSF is still in planning phase and no measurements were therefore possible to validate the predicted post-closure tailings water qualities;
  - The modelled concentrations were however in good agreement with tailings water/seepage from other slimes dams in the area. However, the tailings water/seepage samples were not correlated with the status of the other dams (e.g. age) or the tailings geochemical properties;

It can therefore be concluded that additional tailings samples would be required from the operational plant in order to update the model. It is recommended that the geochemical model be updated during the life of the mine in order to calibrate and validate its results and to construct an effective closure plan.

6. IMPACT ASSESMENT

6.1. Identification of Potential Impacts

As far as could be determined, no historical mining exists within the *Gold One* Mineral Resource Boundary.

Gold mining may potentially impact on the groundwater systems in terms of:

- Water volume/quantity, i.e.:
  - Taking water from the groundwater system/resource;
  - Introducing water to the groundwater system/resource;
- Water quality, i.e.:
  - Deteriorating the water quality of the groundwater system/resource;
  - Improving the water quality of the groundwater system/resource.

All possible impacts, however unlikely, are summarised in Table 6.1. Management measures are discussed in Section 7. The emphasis of this study was on the mining-related impacts, with conceptual management measures/guidelines proposed for relevant aspects.

Site specific water quality objectives (SSWQO) will be developed; based upon catchment water quality objectives, background groundwater quality and drinking water standards.

Table 6.1 Identification of potential groundwater related impacts

Aspect	Water Volume		Water Quality		Possible Manifestation	Assessment	Management Measures
	In	Out	Improve	Deteriorate			
Shaft system	-	Possible	-	Possible	Aquifer, rivers/spruits, wetlands and private groundwater users	Section 6.2	Section 7.2
Mining	Possible	Possible	Possible	Possible		Section 6.3	Section 7.3
Plant area	Possible	-	-	Possible		Section 6.4	Section 7.4
Tailing storage facility and Waste rock dump	Possible	-	-	Possible		Section 6.5	Section 7.5

6.2. Assessment of Potential Impacts Associated with Shaft System

Discussion

The Shaft System will consist of (see Figure 1.4, 1.6 and 6.1):

- The primary access system will be a twin vertical shaft system;
- The secondary access will be trackless mechanised development;
- The final recommended configuration is a shallow shaft system to just below the reef horizon with which a trackless footwall decline and a chairlift system for access to the working levels:
  - The vertical shaft system comprises a man-, material- and rock hoisting shaft 570m in depth and a ventilation shaft with a brattice wall for second egress and ventilation 480m in depth;
  - The decline will run at 8 degrees, 50m below the reef for approximately 4,600m.

The potential impact on the groundwater system is summarised in Table 6.2.

Table 6.2 Identification of potential impacts relating to the Shaft system

Aspect	Water Volume		Water Quality		Possible Manifestation	Management Measures
	In	Out	Improve	Deteriorate		
Shaft system	-	Possible	-	Possible	Aquifer, rivers/spruits, wetlands and private groundwater users	Section 7.2

Based on the geological log of exploration borehole AFO-054, the overburden at the Shaft location is 13m thick. The groundwater levels in exploration borehole AFO-054 and neighbouring exploration borehole AFO-053 were measured as 18.64m (12/09/2012) and 14.25 (11/06/2012) deep respectively. This depth to the groundwater table was also noted in nearby external users' boreholes as depicted in Figure 3.2. The depth to the groundwater table is therefore slightly deeper than the overburden. Below the groundwater table, the typical Karoo rock can be described as "weathered", gradually becoming more competent with depth:

Groundwater will seep into the Shaft system as a function of the aquifer hydraulic characteristics and the degree to which water-yielding fissures/fractures can be successfully grouted. Currently the shallow Karoo aquifers are uncontaminated (see water background water quality profile in Table 4.5), while the water quality in the Wits aquifers (and the Karoo aquifers immediately above) contain high levels of Na-Cl.

During initial construction, any groundwater seepage into the excavation, which cannot be grouted successfully, will be pumped to ensure dry working conditions. This will result in a localised dewatering cone developing in the immediate vicinity of the Vertical Shafts.

The FEFLOW finite element numerical groundwater modelling software package developed by WASY Institute for Water Resource Planning in Berlin, Germany, was used to calculate the extent of the dewatering and likely volumes that might flow into the initial excavation for scenarios where shafts are grouted and not grouted. A 7-layered model as described in Section 4 (see aquifer parameters listed in Table 4.1) was constructed.

<u>Results – Construction/Mining Phase</u>

The following results relate to the rate of groundwater inflow into the Vertical Shafts, as well as groundwater levels around the Shaft System:

- Initially groundwater seepage will probably be encountered 4m-8m below surface, towards the bottom of a clay profile as perched water, followed by water intersections in weathered/fractured rock at depths 14m to 18m deep;
- The clay is underlain by a shallow weathered zone aquifer, typically consisting of weathered/fractured sandstone to depths of approximately 50m;
- If no fissures are grouted, significant volumes of water will be encountered in the Shafts:
  - Certain fractures/fissures may yield water volumes of up to 2.5L/s, maximum 5L/s for short periods (days), after which time:
    - Slightly lower inflows will most-likely continue indefinitely for fissures which are >30m below surface;
    - Fissures above 30m deep, will eventually dry out, but flow again after the rainfall season;
  - However, below 50m deep, the likelihood of encountering high yielding fractures decreases;
  - High yielding fissures can be expected on the geological contact with the Wits;
  - The total groundwater inflow to the Shafts may potentially be as much as 2ML/d (>20L/s) if water-yielding fissures are intercepted. The highest yielding borehole identified during the hydrocensus, yielded 20L/s according to the owner;
- Grouting of high yielding fractures is a common and sensible practice, which will result in small volumes of groundwater seeping into the Shafts:
  - Groundwater inflow into the Shafts will vary as a function of depth and time;
  - A likely groundwater inflow rate of 2L/s is expected;
- The following conclusions were reached about the radius of influence on groundwater levels around the Shafts (assuming that major water-bearing fissures can be grouted successfully):
  - Under conditions of 2L/s entering the Shafts (likely situation) the cone of dewatering will not extend beyond 100m from the Shafts;
  - Under conditions of 4L/s entering the Shafts the cone of dewatering will most-likely not extend beyond 200m to 300m from the Shafts;
  - Any dewatering of the aquifers will be localised:
    - The 100m influence zone depicted in Figure 6.1, is therefore presented as the most-likely scenario;
    - The 200m influence zone depicted in Figure 6.1, is therefore presented as a worst-case scenario;

- None of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of:
  - Groundwater levels;
  - Groundwater quality (groundwater flow will be toward the Shafts);
- If no grouting is done, the zone of influence may extend several hundred metres.

The following comments relate to the quality/salt-load of groundwater inflow into the Shaft System:

- Groundwater flow into the Shafts is expected to be as follows:
  - The shallow Karoo aquifer (<100m deep) will be of similar quality to the prevalent background groundwater quality in the area, as listed in Section 4.4 (Table 4.5), e.g.:
    - EC < 110mS/m, TDS < 660mg/L,
    - Na < 100mg/L, Cl < 80mg/L;
    - SO_4 < 75mg/L;
  - Higher concentrations can be expected in the deeper Karoo aquifers (>200m), e.g.:
    - EC > 550mS/m, TDS > 3000mg/L,
    - Na > 1000mg/L, Cl > 1500mg/L;
    - SO_4 < 20mg/L;
  - The highest concentrations can be expected in the deeper Wits quartzites (i.e. deeper that 296m below surface , according to exploration borehole AFO-054):
    - The predominantly Na-Cl type water qualities are discussed in Section 6.3.

<u>Results – Post-Mining Phase</u>

The rate of groundwater inflow into the Shaft System during the mining phase will continue after mine closure. Provisional information suggests that the groundwater levels in the Wits aquifer is approximately 300m deeper than for the Karoo aquifers. Consequently, a decision needs to be taken on whether the Shaft System should be sealed above the Wits quartzites. The following aspects are important:

- If the Shaft System is not sealed above the Wits quartzites:
  - Seepage water from the Karoo aquifers will flow into the Wits aquifer where uncontaminated water from the Karoo aquifer will mix with highly saline Na-Cl type water from the Wits aquifer to form a mixing zone:
    - The depth of this mixing zone will initially be 300m below surface;
    - It is not known with certainty if this mixing zone will start to rise into the Karoo aquifer over the long-term (decades to centuries – the timescale is also uncertain);
  - If the mixing zone establishes within the Karoo aquifers, the potential to contaminate the surrounding Karoo aquifers with Na-Cl type water over the long-term is possible;
- It is therefore presumed that, groundwater studies conducted toward the end of mining will determine if the vertical Shafts should be sealed within the Karoo aquifers (i.e. at shallower depth than 296m below surface):
  - The construction considerations for such a seal will be researched/evaluated by suitably qualified engineers;
  - The groundwater table within the Shafts will then continue to rise relatively quickly (within a few years - even at low seepage rate of 2L/s) to establish at a level which will most-likely be very similar to the surrounding groundwater table;
  - The groundwater level influence zone indicated in Figure 6.1 will re-establish to pre-mining conditions soon afterwards;
  - The Shafts through the Karoo aquifers are not expected to impact negatively on the surrounding groundwater quality.

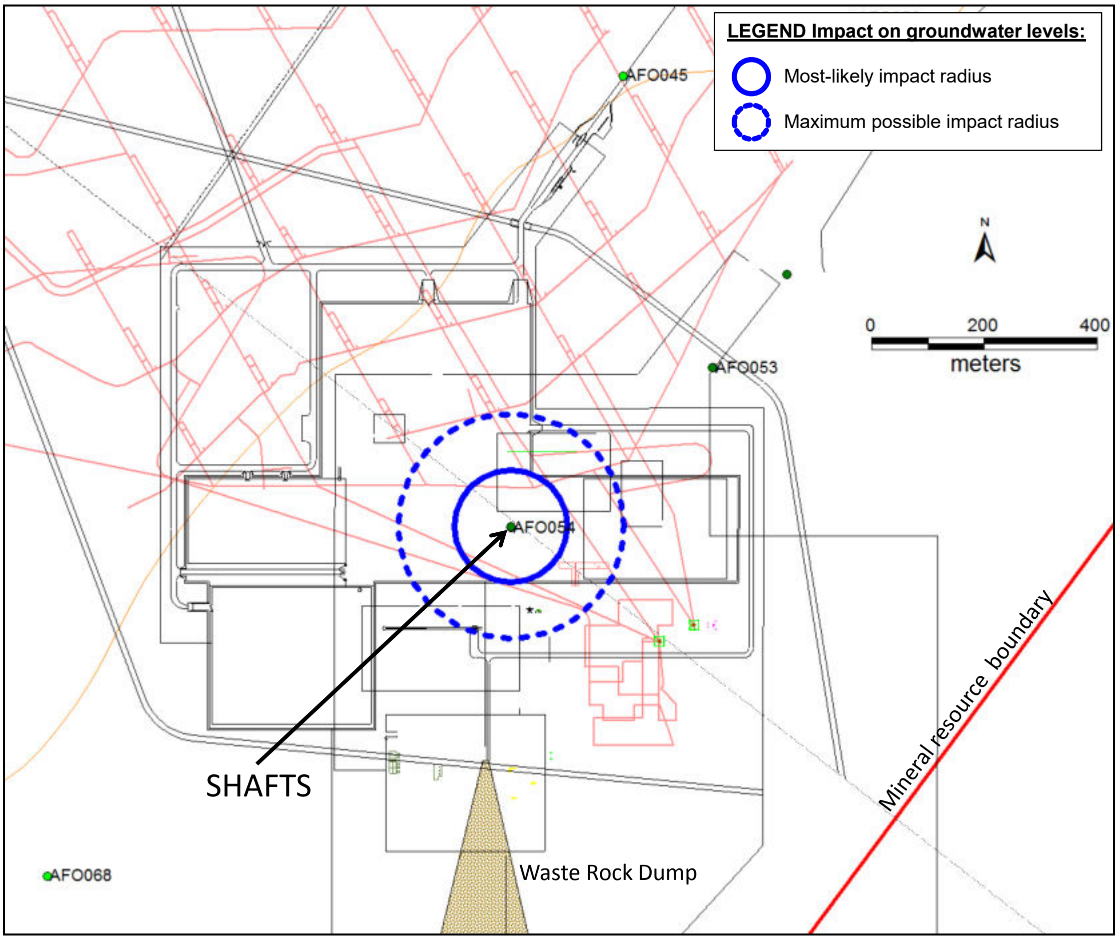


Figure 6.1 Potential impact of Shafts on groundwater levels

6.3. Assessment of Potential Impacts Associated with Underground Mining

Discussion

The location of underground mining, in relation to surface activities, is indicated in Figure 1.3. The primary development time of the underground mine is estimated at ±4years. The planned production rate is 80,000ton/month run-of-mine (ROM). Approximately 30,000ton/month of waste rock will be generated. Conventional stope layouts will be used at a 60m level interval, while cross-cuts are planned at 165m intervals. To minimise electrical energy requirements, the main powering system will be hydropower with limited compressed air for methane control and refuge bays.

Whilst the Mine might impact on groundwater levels in its immediate vicinity (surroundings and depth), the potential also had to be investigated that the Mine will decant after closure. Consequently, the potential impacts of mine water on the local groundwater system and rivers needed to be considered. See summary in Table 6.3 (extracted from Table 6.1).

Table 6.3 Identification of potential impacts relating to underground mining

Aspect	Water Volume		Water Quality		Possible Manifestation	Management Measures
	In	Out	Improve	Deteriorate		
Mining	Possible	Possible	Possible	Possible	Aquifer, rivers/spruits, wetlands and private groundwater users	Section 7.3

The expected water quality during mining was a significant factor in the financial viability of mining this gold resource, due to the cost involved in treating mine water in the event of having to discharge the water.

Given the technical difficulties, magnitude (and cost) of hydraulic testing at this depth, it would be very difficult to determine the local conditions during mining. Deep groundwater sampling was undertaken in 2 boreholes drilled into the Wits aquifer and 2 pilot percussion holes into the deep Karoo aquifer (as explained in Section 3.5) to determine the expected mine water quality in the Wits.

Results – Construction/Mining Phase

The following conditions are expected:

- Groundwater volumes:
  - The estimated mine water balance is based on the pre-feasibility groundwater assessment (Ref:GW2_220, December 2010):
  - Considering the situation at neighbouring mines, it was estimated that between 3ML/d and 6ML/d will have to be pumped from the underground;
  - Figure 6.2 was compiled to illustrate the water inflows into the underground workings during mining over time:
    - At the commencement of mining, groundwater inflow volumes were estimated at between 1ML/d and 3ML/d;
    - The steep rise in the expected water inflows over the first years is due to the fact that mining will commence near an east-west water fault, followed by mine development away from the fault for 2km;
    - Peak inflow volumes are expected after 4years when full production should be achieved;
  - Additional factors influencing the shape of the water volume curve, include:
    - The establishment of “water pillars” which would reduce water flowing to mining areas;
    - Water can be stored in mined-out areas during the latter stages of mining;
- Groundwater levels:
  - Groundwater level elevations were determined in both “water holes” drilled to date, for the purpose of obtaining water samples from the Wits aquifer (AFO-077 and AFO-083):
    - The depth to the groundwater table could be determined with pressure transducers as approximately 300m below surface;
    - The volume of seepage water from the overlying Karoo aquifers, is believed to be insignificant (i.e. having an insignificant influence on the Wits water table);
    - As far as could be determined, the water table re-established to this depth after pumping as well as when water was injected;
  - During the drilling of geological exploration boreholes, it was found that almost all boreholes would “take” water (i.e. additional water had to be added during the drilling process):
    - This observation is in support of a deeper groundwater table in the deepest aquifers (including the Wits aquifer);
- Groundwater quality:
  - No additional information was collected since 2010 which would contradict the 2010 findings;
  - Groundwater flow into the mine is expected to have a Na-Cl character;
  - The following average mine water quality is anticipated:
    - EC = 800mS/m (ranging 500mS/m to 1000mS/m);
    - TDS = 5500mg/L (ranging 3000mg/L to 6000mg/L);
    - Cl = 2800mg/L (ranging 2000mg/L to 3500mg/L);
    - Na = 2000mg/L (ranging 1500mg/L to 2500mg/L);
- None of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of groundwater levels of groundwater quality.

Results – Post-Mining Phase

After mining the mine will flood completely. The groundwater table in the Wits quartzites is expected to rise to a maximum level of 300m below surface (possibly deeper). This will most-likely be the situation for several decades after mining, possibly for much longer.

The most important aspect to consider is whether an Environmental Critical Level (ECL) will have to be established. If the Shaft system is not sealed, the saline mixing zone will develop between uncontaminated Karoo aquifers and Na-Cl water from the Wits aquifer. This issue is discussed in more detail in Section 6.2.

It can be argued that the current groundwater table in the Wits quartzite aquifer (and for the period immediately after mining) is 300m below surface, thus not posing a long-term risk (i.e. not requiring the establishment/management of an ECL). However, the benefits of installing a seal are clear:

- It is highly unlikely that a mixing zone will establish in the mined-out area and the shaft system, thus reducing the risk of contaminating the shallow Karoo aquifers (i.e. in the event that the groundwater table of the Wits rises into the Karoo aquifers;
- It can be stated with a much higher degree of certainty that the establishment of an ECL will not be required;
- Consequently, the underground mine is not expected to impact groundwater levels or groundwater quality of the:
    - Karoo aquifer;
    - Groundwater users;
    - Rivers/spruits or wetlands.

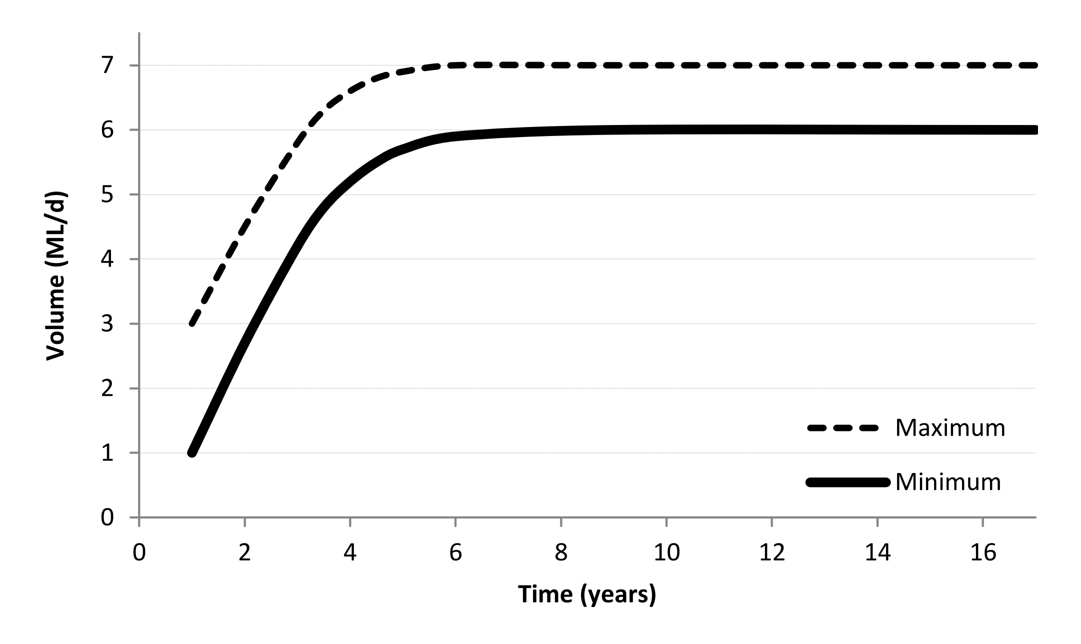


Figure 6.2 Estimated mine water volumes during mining

6.4. Assessment of Potential Impacts Associated with Plant Area

Discussion

The Plant area will be placed to the north of the WRD and TSF, around the Shaft system, as described in Section 1.2 (see location in Figures 1.3, 1.4 and 1.6). The following aspects are important and can potentially introduce contaminant water to the groundwater system at small volumes:

- ROM/Product stockpiles;
- Gold processing plant and associated dams (see Figure 1.6);
- Lined storm water and process water dams;
- Water purification plant and associated dams;
- Various workshops, storage/ lay-down yards and salvage yards;
- Administration buildings and change houses:
- Sewage treatment plant;
- General waste disposal sites;
- Explosives storage (magazine) and handling areas.

According to the findings of *Bear GeoConsultants* (July 2012) investigation most of the site is blanketed by a layer of sandy and clayey transported soil of a variable nature and thickness.

Underneath this layer, the residual soil horizon forms a clay horizon which can be divided into 2 sub-horizons (a reworked residual horizon where the macro/micro structures have been destroyed by biotic action, and a residual horizon where the macro and micro structure inherited from the parent rock remains intact and visible).

The following earth moving and construction is likely to occur in the Plant area:

- Concrete foundations will be constructed where appropriate:
    - Oil traps and sumps will be constructed (e.g. workshops);
    - Other pollution capture mechanisms, such as lined drains, will be put in place to prevent toxic contaminants from getting into contact with the groundwater system (e.g. chemicals holding areas);
- Recommended by Bear GeoConsultants :
    - The soil and clay profile will be removed to construct heavy structures;
    - Calcrete (underlying the clay profile) would be suitable in the construction of roads and terraces on site, and possibly in the construction of pavements;
- Waste rock from the Karoo, generated during Shaft sinking, is not expected to impact the groundwater system in terms of poor water quality. Such rock is likely to be utilised in the construction of roads and terraces, or wherever suitable;
- All contaminated water will be stored in tanks or suitably lined (HDPE liners) dams;
- It is assumed that potentially acid generating material in the ROM stockpile areas will be placed on lined areas.

The potential impacts of the activities in the Plant area are summarised in Table 6.4 (extracted from Table 6.1).

Table 6.4 Potential impacts associated with Plant area

Aspect	Water Volume		Water Quality		Possible Manifestation	Management Measures
	In	Out	Improve	Deteriorate		
Plant area	Possible	-	-	Possible	Aquifer, rivers/spruits, wetlands and private groundwater users	Section 7.4

Results – Construction/Operational Phase

The following impacts are anticipated:

- The natural groundwater table is relatively deep (10m to 15m deep), and should not be intersected during construction. Small seepage from a perched groundwater table on top of the clay layer may occur during the summer rainfall period;
- There does not appear to be any rivers on non-perennial streams within 750m from the Plant area, which can be impacted during surface water run-off (to be confirmed through wetland study). "Plate flow" where surface water flows after intensive rainfall events across flat land surfaces is therefore a natural occurrence;
- All activities will be positioned on previously undisturbed soils. Consequently any impacts will be easily observed:
    - The main contaminant indicators will be Na, Cl, SO_4 and CN;
- In view of the existing natural clay layer, and assuming that all potential impact areas are properly lined:
    - The impacts of the Plant area and associated activities will not be noticed on the natural groundwater levels;
    - The impacts of the Plant area and associated activities will be very small on the groundwater quality;
- In view of the local land being purchased by Gold One, it is anticipated that none of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of groundwater levels or groundwater quality.

Results – Post-mining Phase

The Plant area base/foundation layer and underlying soils may contain elevated salt concentrations.

After mining, the remaining footprints of these facilities will be removed or suitably rehabilitated.

The long-term impact on the groundwater system is therefore believed to be insignificant.

6.5. Assessment of Potential Impacts Associated with Tailings Storage Facility (TSF) and Waste Rock Dump (WRD)

Discussion

The Waste Rock Dump (WRD) and Tailings Storage Facility (TSF) are considered to be the mining activities with the highest potential of impacting the groundwater environment. See summary of potential impacts in Table 6.5 (extracted from Table 6.1).

Both the WRD and TSF will be positioned to the south of the Plant as depicted in Figure 6.3 (also refer to Figures 1.2 and 1.3 – The final shape of the WRD will most-likely be different to the indicated shape) The following descriptions of these activities are important:

- Waste Rock Dump (WRD):
  - Waste rock from the Karoo excavated during Shaft construction will be utilised for road building and Plant foundations;
  - Waste rock excavated during mining will be placed on a lined Waste Rock Dump;
- Tailings Storage Facility (TSF):
  - A site selection process was undertaken of 3 potential locations for the TSF (referred to as Site-A, Site-B and Site-C) as indicated in Figure 1.5 and summarised in Table 6.6:
    - Based on the groundwater criteria listed in Table 6.6, the most appropriate location for a TSF was chosen as Site-C;
    - From an engineering perspective, Site-C was also selected as the "preferred" site;
  - The following design aspects were provided by Fraser Alexander:
    - The TSF footprint area will be 70.7ha;
    - A Return Water Dam (RWD) (functioning as a Pollution Control Dam and Storm Water Dam) with silt trap of (3.1ha) and will be associated with the TSF;
    - The catchment paddocks will be 9.8ha;
- Geophysical traversing did not indicate any geological fatal flaws associated with the location of the WRD or TSF.

Table 6.5 Potential impacts associated with TSF and WRD

Aspect	Water Volume		Water Quality		Possible Manifestation	Management Measures
	In	Out	Improve	Deteriorate		
Tailing storage facility and Waste rock dump	Possible	-	-	Possible	Aquifer, rivers/spruits, wetlands and private groundwater users	Section 7.4

The impacts on the groundwater system associated with the TSF were determined with the FEFLOW finite element numerical groundwater modelling software package developed by WASY Institute for Water Resource Planning, Berlin – Germany. The following considerations were important:

- An 8-layered model was constructed according to the aquifer parameters listed in Tables 4.2. The model grid was refined around the RWD, TSF and rivers/streams/pans/dams. Additional modelling aspects are discussed in Section 4;
- The following important design criteria relates to the phreatic water table inside the TSF:
  - Slimes will be pumped from the Plant to the TSF at a density of 1.47. The mass ratio will be 53% solids to 47% water;
  - The internal drainage system will be designed to prevent the phreatic surface from saturating the outer slope;
  - The dam will be developed at a rate slow enough for the material to drain to allow for sufficient consolidation;
  - The rate of rise will be approximately 1.8m/a at the end of life when the dam is 40m high;
  - Consequently the phreatic level build up will be significantly lower than level of tailings deposition due to the filter drains that will be installed;

- The contamination plume that develops over the long-term (Operational and Post-Closure phases) will depend on:
  - Water quality trends that were geochemically simulated as discussed in Section 5. The following summarising aspects are important:
    - WRD:
    - - Pore sizes are larger resulting in the deeper ingress of oxygen;
    - - Pyrite will not be oxidised to the same extent as in the tailings;
    - - SO_4 concentrations will vary as a function of depth and distance from the WRD edge;
    - - Table 6.7 serves as a summary of SO_4 distribution through the WRD over time as applied in the numerical model;
    - TSF:
    - - During the Operational Phase, oxygen ingress will be restricted in the tailings material;
    - - Tailings will slowly dry out during the Post-Closure Phase (i.e. increasing oxic zone);
    - - Table 6.8 serves as a summary of SO_4 distribution through the TSF over time as applied in the numerical model;
  - The rate of rainfall recharge infiltrating into the WRD as a function of meteorological conditions, was estimated at 15% of MAP (= 80mm/a = 2.1×10^{-4}m/d = 2.5×10^{-6}m/s):
    - This is higher than the lowest coefficient of permeability (1×10^{-10}m/s), and lower than the highest coefficient of permeability (1×10^{-8}m/s) of the compacted clay layer;
    - The rate at which water seeps from the WRD to the groundwater system will be less than rainfall recharge due to water volumes draining from the Internal drains below the WRD;
  - The rate at which water seeps from the TSF to the groundwater system will be a function of hydraulic characteristics of the foundation layer below the TSF and the phreatic water table inside the TSF:
    - The Return Water Dam of the TSF will be HDPE-lined;
    - The TSF will be suitably drained to ensure that the phreatic surface in the tailings does not build up over time; i.e. the seepage rates through the base layer should not exceed the design criteria;
  - For the purpose of numerical groundwater flow and transport modelling, it was assumed that no HDPE liner will be installed at both the WRD and TSF. However, the soil profile, and sandy clay, will be removed and the clay compacted to 93% proctor density (possibly adding clay that was removed from the Plant area);
    - The in-situ clay horizon varies in depth between <1m to >2.5m; typically 1m to >2m (average thickness estimated at 1.5m – to be verified by geotechnical engineer):
    - Clay permeabilities range between 1×10^{-10}m/s to 1×10^{-8}m/s (average of 5×10^{-9}m/s);
    - During a meeting at *RHDHV* on 1/11/2012, the *Fraser Alexander* design team indicated that the clay would be compacted as 4 layers of 150mm each;
  - A coefficient of permeability of 1×10^{-9}m/s (recommended for TSF) equates to 6% of MAP.

To illustrate the importance of constructing a suitable liner system below the WRD and TSF, the following numerical modelling scenarios are highlighted:

- Figures 6.4A-B depicts the SO_4 contamination plume that will develop for scenarios where the liner system leaks water to the underlying aquifer at rates of 1×10^{-8}m/s ("worst-case" liner scenario) and 1×10^{-9}m/s ("preferred" liner scenario) respectively after 20years (i.e. at the end of the life-of-mine):
  - The contamination plume for the "worst-case" liner scenario moved further than for the "preferred" liner scenario;
  - The biggest impact however, is in terms of the total salt load in the groundwater system after 20years;
- Figures 6.5A-B and 6.6A-B depicts the "worst-case" liner scenario and "preferred" liner scenario after 100years and 200years respectively (assuming that capping will be done to reduce oxygen infiltration and reduce the long-term rate of recharge to 6% on both the WRD and TSF):
  - The "preferred" liner scenario (in terms of permeability) significantly outperforms the "worst-case" liner scenario;
  - It is clear that the spread of the contamination plume is unacceptable, even for the "preferred" liner scenario. Consequently, an effective capping solution is crucial;
- To illustrate the effect of an effective capping system, Figure 6.7 depicts the "preferred" liner scenario after 200years (assuming that capping was done to reduce oxygen infiltration and significantly reduce the long-term rate of recharge to 0.5% on both the WRD and TSF):
  - Compared to the results depicted in Figures 6.5A-B and 6.6A-B, an effective capping system can result in a much reduced impact;

- Although not indicated, it is worth noting that, if the internal drains to the Tailings Dam can be optimised (thus drying out the tailings material much faster after closure), the impact will be smaller over the short term.

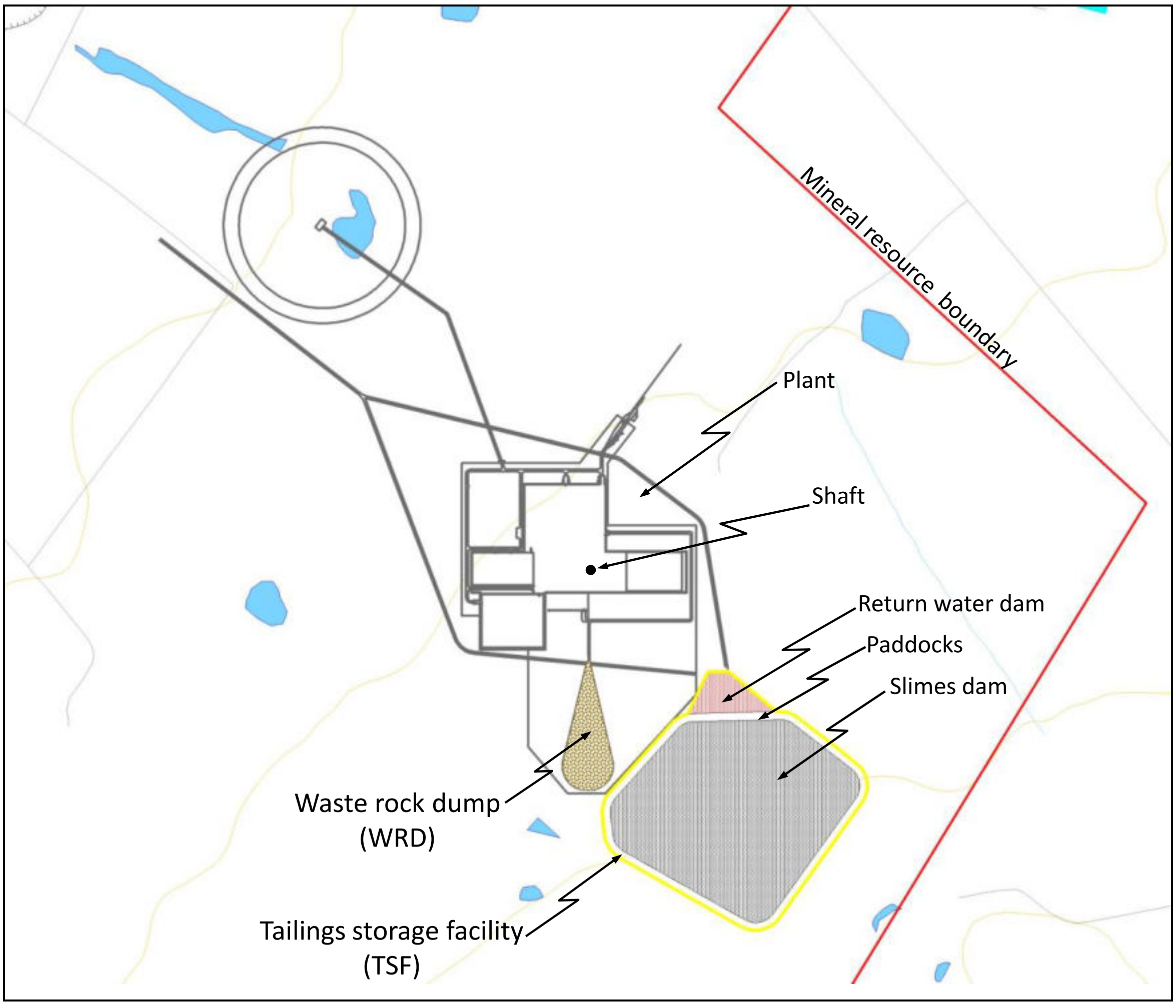


Figure 6.3 **Plant, Tailings Storage Facility (TSF) and Waste Rock Dump (WRD) layout**

Table6.6 **Ranking of TSF site alternatives - [ranking in brackets, ranging from 1 to 5 – higher numbers are more suitable]**

	Site A (Original)	Site B	Site C
Description	Northeast near tar road	North on top of old calcrete excavations	South of Plant and Rock Dump
Depth to groundwater table	5m-10m [2]	≤5m-10m [1]	>15m [4]
Distance to surface water receptors (Rietspruit, Slootspruit and Erasmuspruit)	2m-5km [3]	<1km [1]	>5km [5]
Distance to surface/water receptors (wetlands and pans, non-perennial streams)	<100m [1]	10m0-500m [2]	>500m [4]
Occurrence of clay near surface	4.5m thick sandy clay [3]	None, calcrete [1]	4m thick silty clay, thinner to the south [3]
Preferential flow paths (faults/dykes)	None, as determined by magnetic geophysics survey [5]	Not specifically investigated. Situated over a dyke/fault at depth – rough guestimate from aeromag data and Turgis shape files [2?]	None, as determined by magnetic geophysics survey [5]
Potential impact radius	Similar		
Other comments on potential fatal flaws	Proximity to wetland(s)	-	Close to plant in case of failure
Total	**14**	**7**	**21**

Table 6.7 Distribution of SO_4 (mg/L) throughout the Waste Rock Dump (WRD)

	Depth			
	2.5m	**5m**	**10m**	**20m**
20years	1600	1600	1600	1600
60years	2500	1600	1600	1600
100years	1300	3300	5000	1600
200years	1300	2300	5000	6500

Table 6.8 Distribution of SO_4 (mg/L) throughout the Tailings Storage Facility (TSF)

	Oxic conditions		Anoxic conditions	
	Thickness of oxic zone (m)	**SO_4 (mg/L)**	**Thickness of anoxic zone**	**SO_4 (mg/L)**
20years	2.5	2500	37.5	2500
40years	5	4000	35	2500
60years	8	6000	32	2500
100years	13	7000	27	2500
200years	22	7000	18	2500

Results – Construction/Operational Phase

The following impacts were calculated; predominantly through geochemical modelling and numerical groundwater flow and transport modelling:

- Water quality at source – WRD and TSF:
  - SO_4 was identified as the main contaminant indicator;
    - WRD: SO_4 = 1600mg/L;
    - TSF: SO_4 = 2500mg/L;
  - pH is anticipated to be only slightly acidic at the outer rim of the Tailings Dam during the operational phase (low potential of metals leaching at low pH);
  - CN deserves consideration;
  - Additional comments are provide in Section 5.3;
- Groundwater levels – WRD and TSF:
  - The chosen sites for both the WRD and TSF is ideal in terms of the depth to the groundwater table (10m to 15m deep);
  - Groundwater levels will rise very slowly over a period of years, with the biggest rise expected beneath the TSF:
    - It is anticipated that a 50m distance from the TSF, groundwater levels will not rise by more than 5m;
    - Due to the low topographical slope, groundwater levels will, in all likelihood not rise above the land surface to create seepage zones;
  - If seepage zones form adjacent to the WRD and TSF, it will be as a result of perched water on top of the clay foundation;
- Groundwater quality – WRD and TSF:
  - The size and extent of the groundwater contamination plume will predominantly depend on the rate of seepage through the clay liner system;
  - Due to SO_4 being identified as the main contaminant indicator, no other water quality variables were numerically simulated:
    - pH (and metals at low pH) were anticipated as a major cause of concern during the operational phase;
    - Mitigation of CN is discussed in Section 7.5;
  - Assuming the best-case liner scenario (and no spillages occurring), the SO_4 concentrations of the groundwater contamination plume, beyond the footprint area of the TSF, should not exceed drinking water standards (600mg/L) after 20years. Higher concentrations may prevail underneath the footprint area;
  - At distances further than 200m the SO_4 concentrations are expected to be <100mg/L;
  - In view of the local land being purchased by Gold One, it is anticipated that none of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of groundwater levels or groundwater quality.

Results – Post-mining Phase

The following impacts were calculated; predominantly through geochemical modelling and numerical groundwater flow and transport modelling:

- Water quality (assuming oxygen ingress is minimal) at source – WRD and TSF:
  - SO_4 was identified as the main contaminant indicator. It will vary significantly throughout the WRD and TSF as influenced by oxygen ingress and the water balance. A simplified approach was followed whereby concentrations in the contaminant transport model were assumed similar to the operational phase (i.e. assuming specific water balance and oxygen ingress conditions):
    - WRD: SO_4 = 1600mg/L;
    - TSF: SO_4 = 2500mg/L;
  - The acid generation potential for both the WRD and the TSF is anticipated to be high (i.e. low pH). This will increase the likelihood of metal leaching;
  - Mitigation of CN is discussed in Section 7.5;
- Groundwater levels – WRD and TSF:
  - Groundwater levels will drop very slowly over a period of years (while the Dam dries out) to pre-mining elevations;
  - It is anticipated that the impact on the local groundwater levels will be insignificant;
- Groundwater quality (with reference to Figure 6.7) – WRD and TSF:
  - The impact on the local groundwater quality over the long-term will depend on:
    - The contaminant mass in the groundwater system at mine closure (i.e. how much contaminated groundwater infiltrated to the groundwater system through the liner systems);
    - The rate at which water in the tailings can be drained;
    - The rate of seepage through the clay liner system;
    - The rate of rainfall recharge through the capping systems;
  - Although the water quality impact on the local groundwater system appears to be relatively small during the life-of-mine for the “preferred” liner system, it is clear that the spread of the contamination plume will be unacceptable if an effective capping solution is not installed;
  - In view of the local land being purchased by Gold One, it is anticipated that none of the private groundwater users or the local rivers/spruits/wetlands will be impacted in terms of groundwater levels or groundwater quality;
  - Although not performed for this impact assessment, a tiered approach can be followed to put the impact on the groundwater system in perspective:
    - This is a different approach to the simple SSWQO discussed before. It generally requires lengthy discussions with relevant government authorities and detailed toxicological evaluations of human exposure scenarios, as well as aquatic ecosystems, etc.;
    - All potential receptors are identified (e.g. private groundwater use, rivers, wetlands, etc.);
    - The natural mitigation/dilution mechanisms in the pathway from the source, as calculated through means of the numerical groundwater flow and transport modelling, are then considered to determine the anticipated water quality at the receptors;
    - Each receptor is unique in terms of living habits (e.g. how groundwater is used and how much groundwater is consumed) and acceptable exposure levels;
    - These should then adhere to the water quality guidelines determined through the toxicological evaluation.

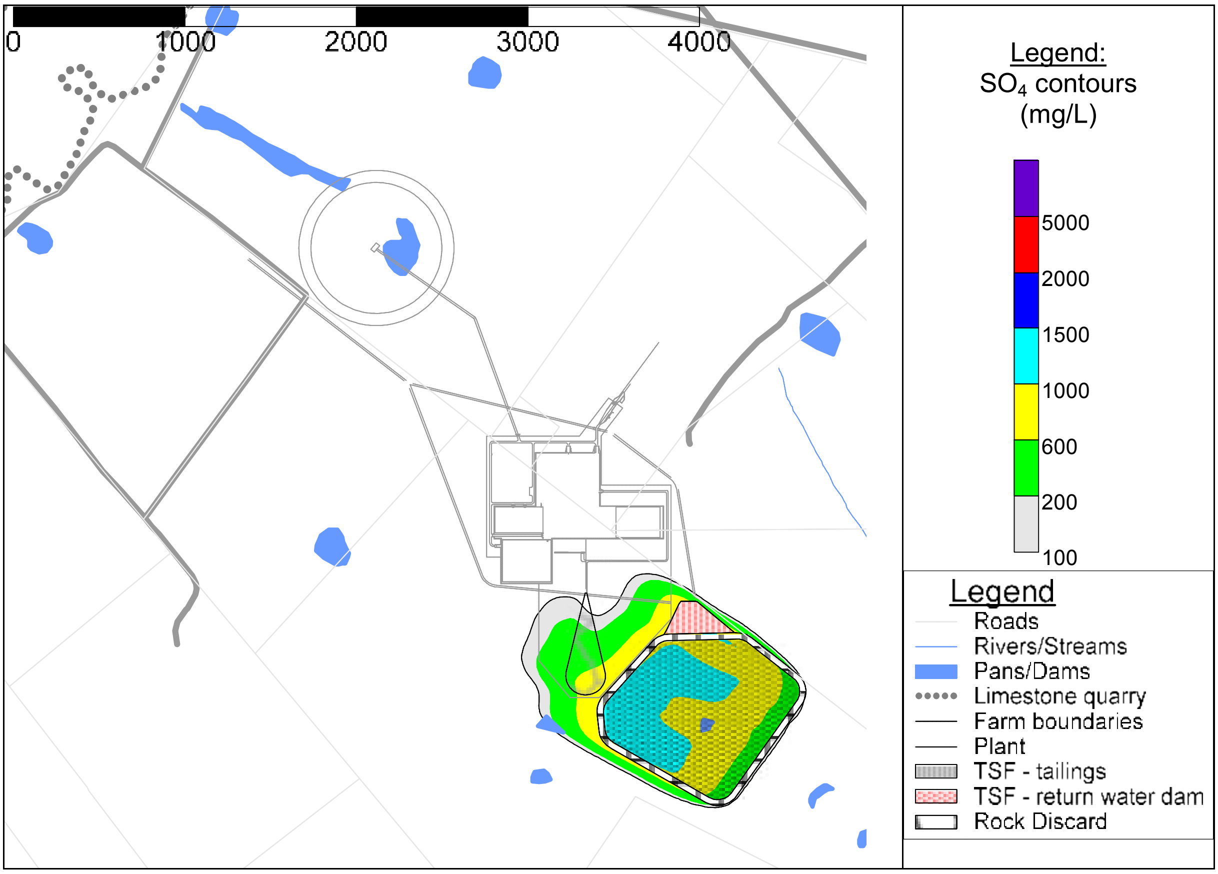


Figure 6.4A ***SO_4 contamination plume associated with WRD and TSF after 20years – liner permeability = $1x10^{-8}$m/s (worst-case)***

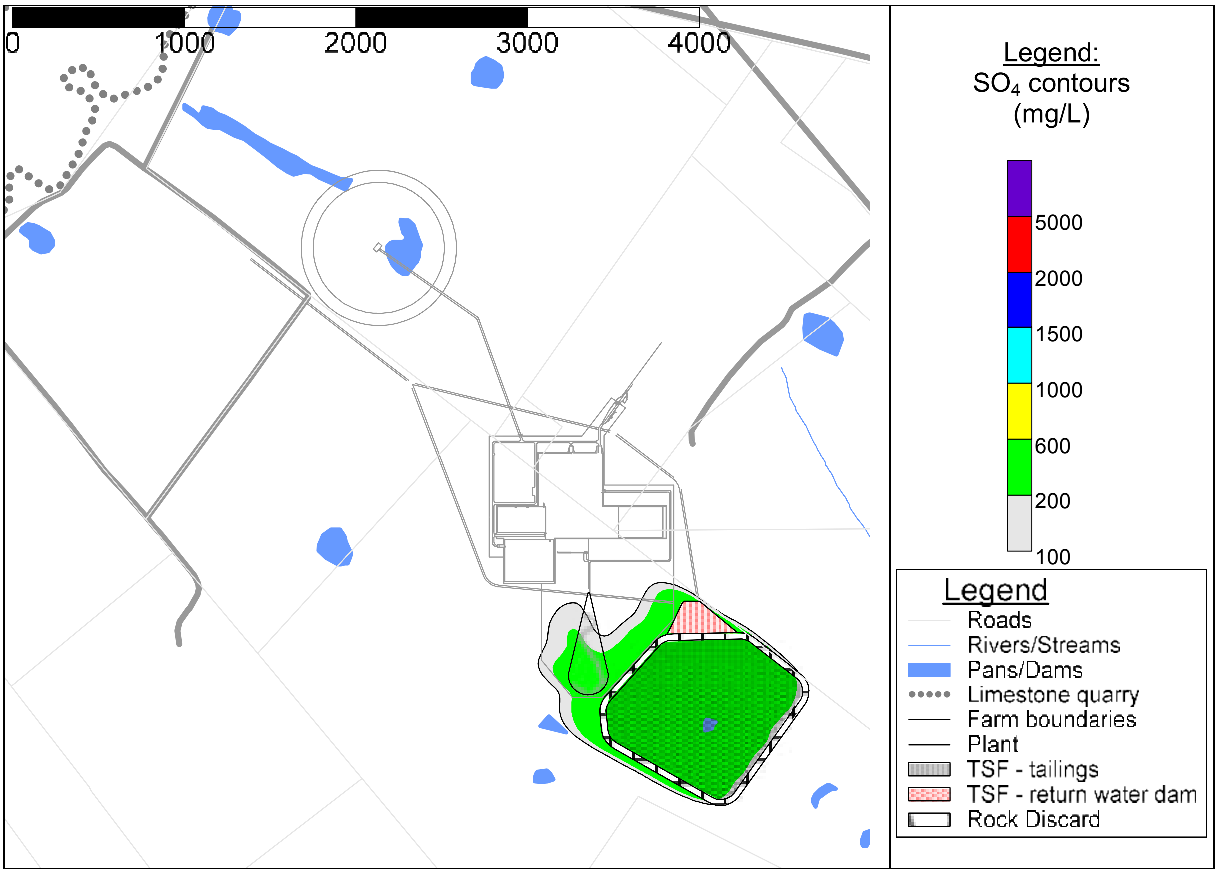


Figure 6.4B ***SO_4 contamination plume associated with WRD and TSF after 20years – liner permeability = $1x10^{-9}$m/s (preferred)***

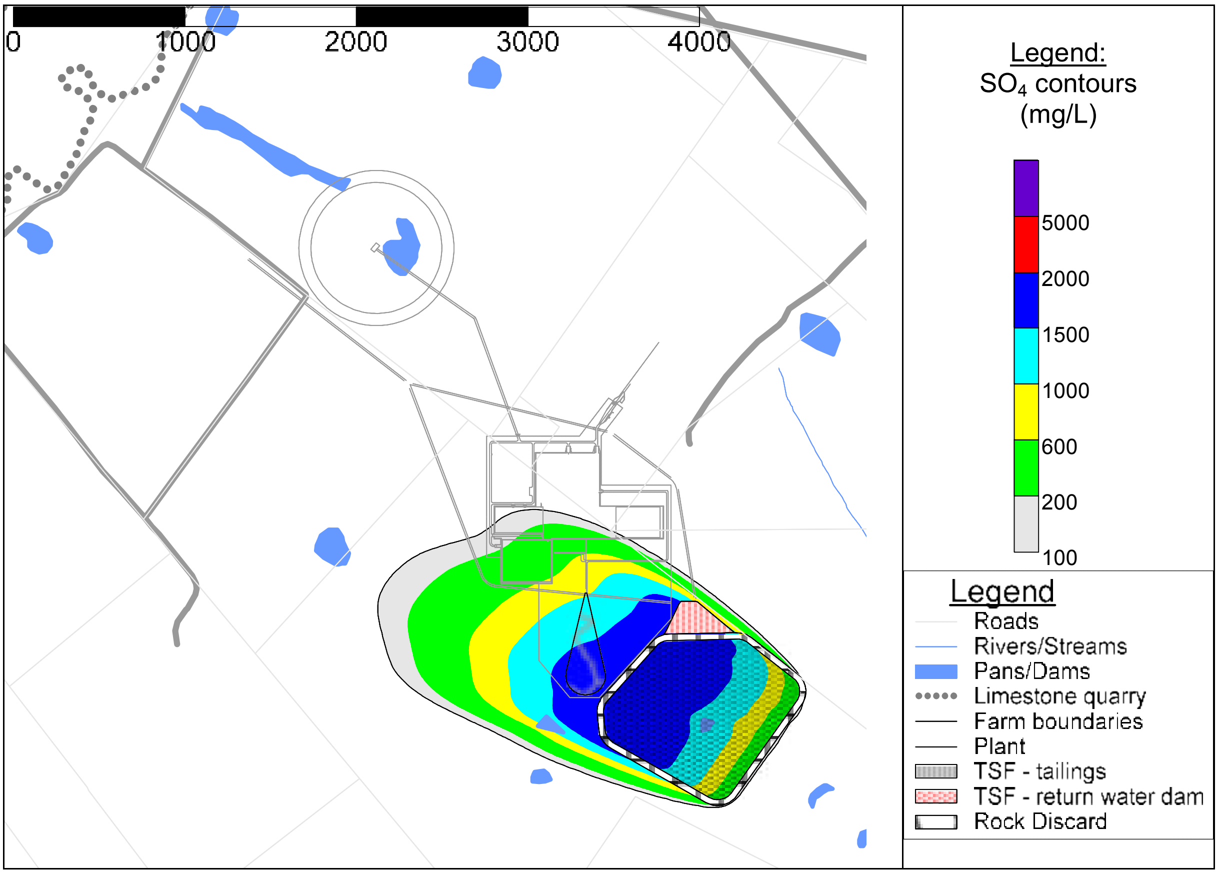


Figure 6.5A ***SO_4 contamination plume associated with WRD and TSF after 100years – liner permeability = $1x10^{-8}$m/s (worst-case)***

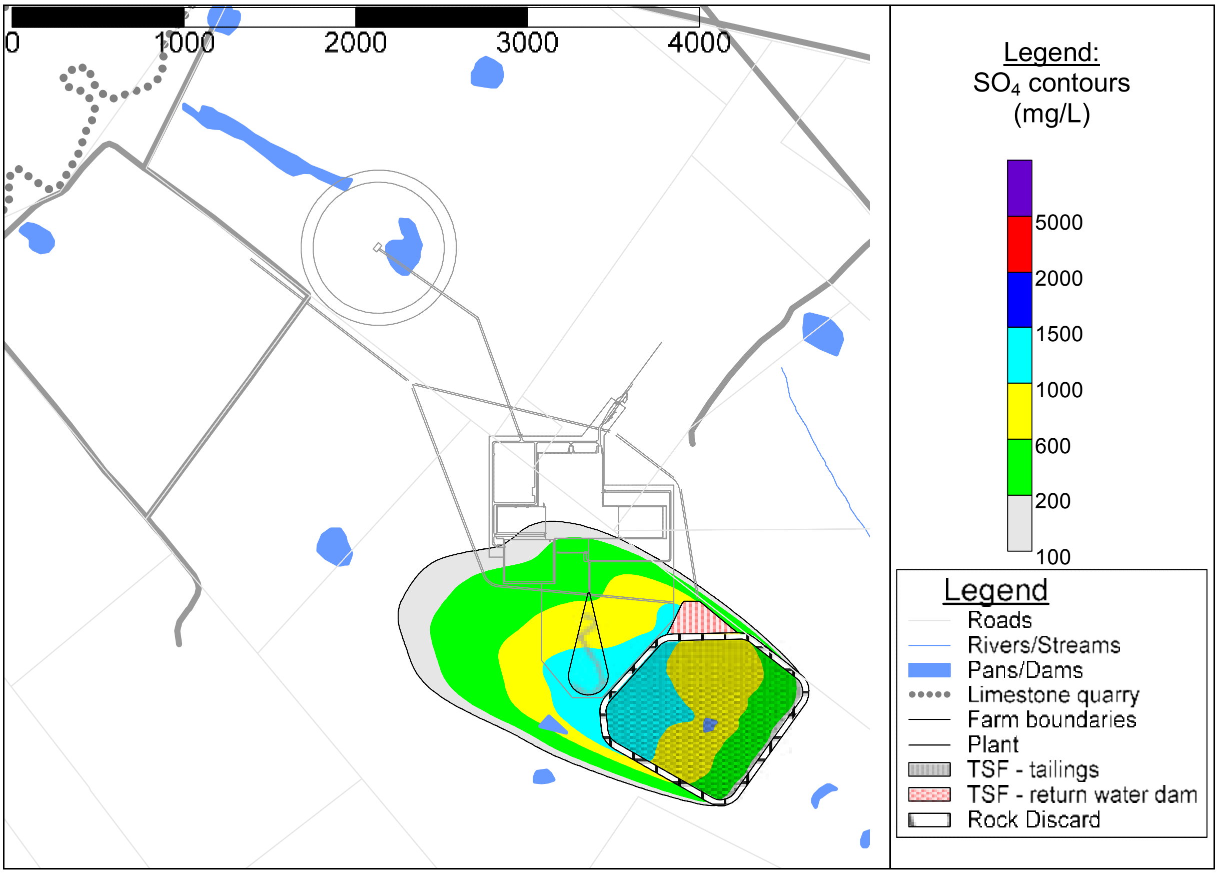


Figure 6.5B ***SO_4 contamination plume associated with WRD and TSF after 100years – liner permeability = $1x10^{-9}$m/s (preferred)***

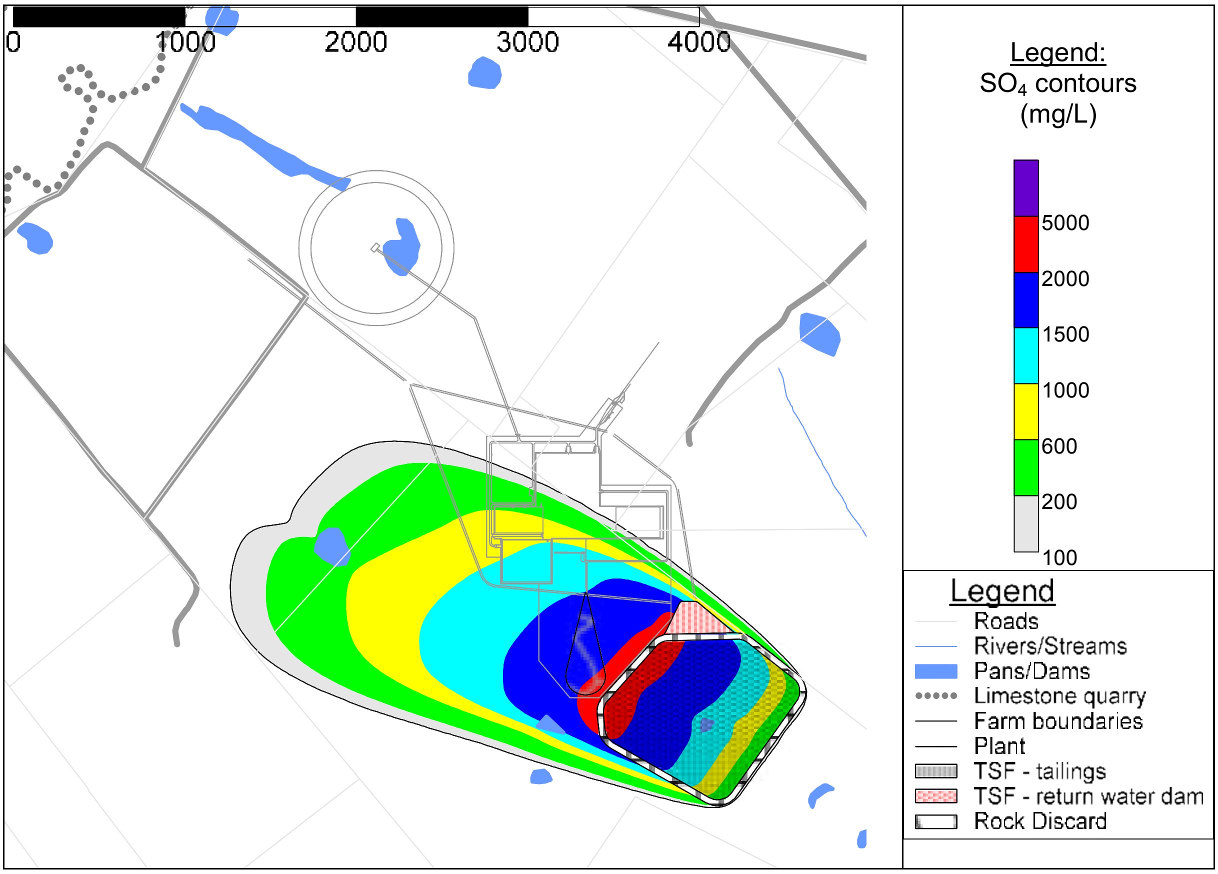


Figure 6.6A ***SO_4 contamination plume associated with WRD and TSF after 200years – liner permeability = 1x10^{-8}m/s (worst-case)***

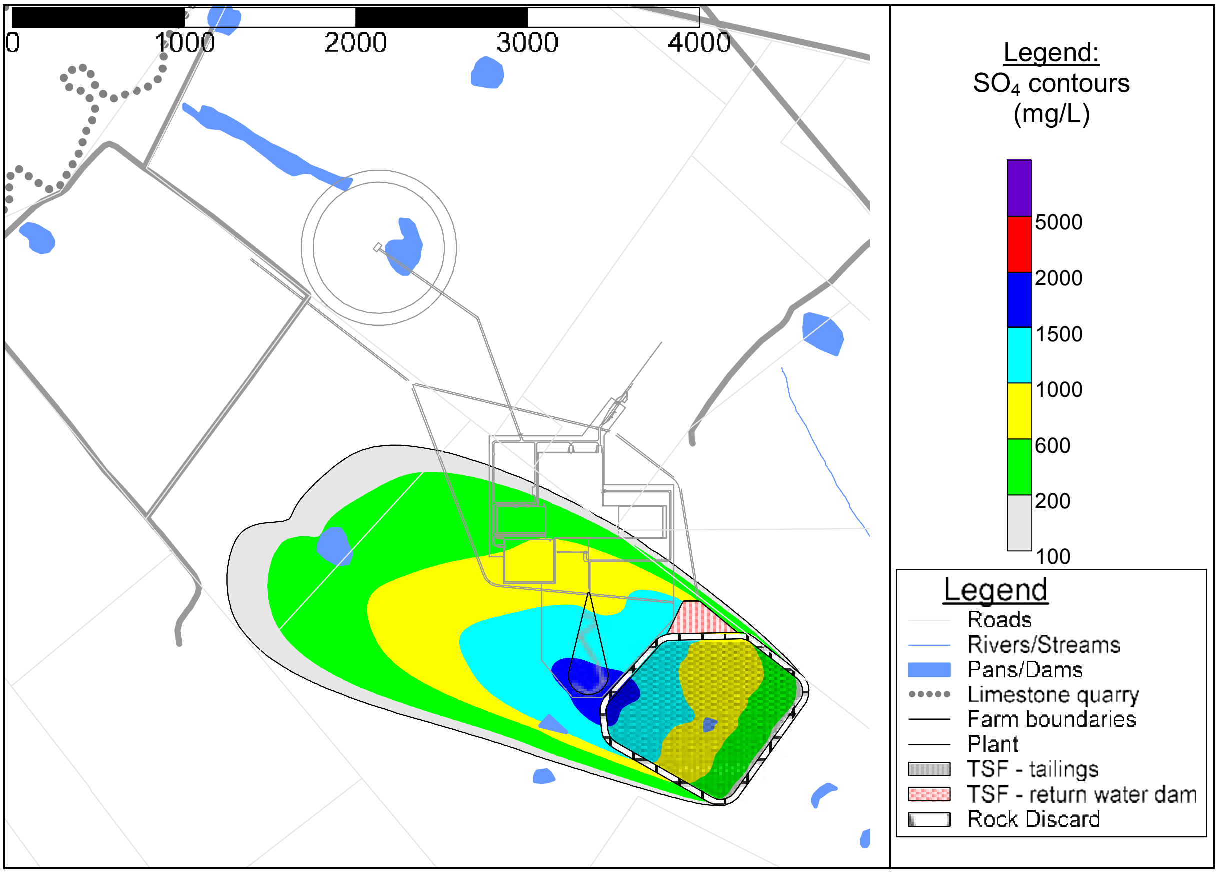


Figure 6.6B ***SO_4 contamination plume associated with WRD and TSF after 200years – liner permeability = 1x10^{-9}m/s (preferred)***

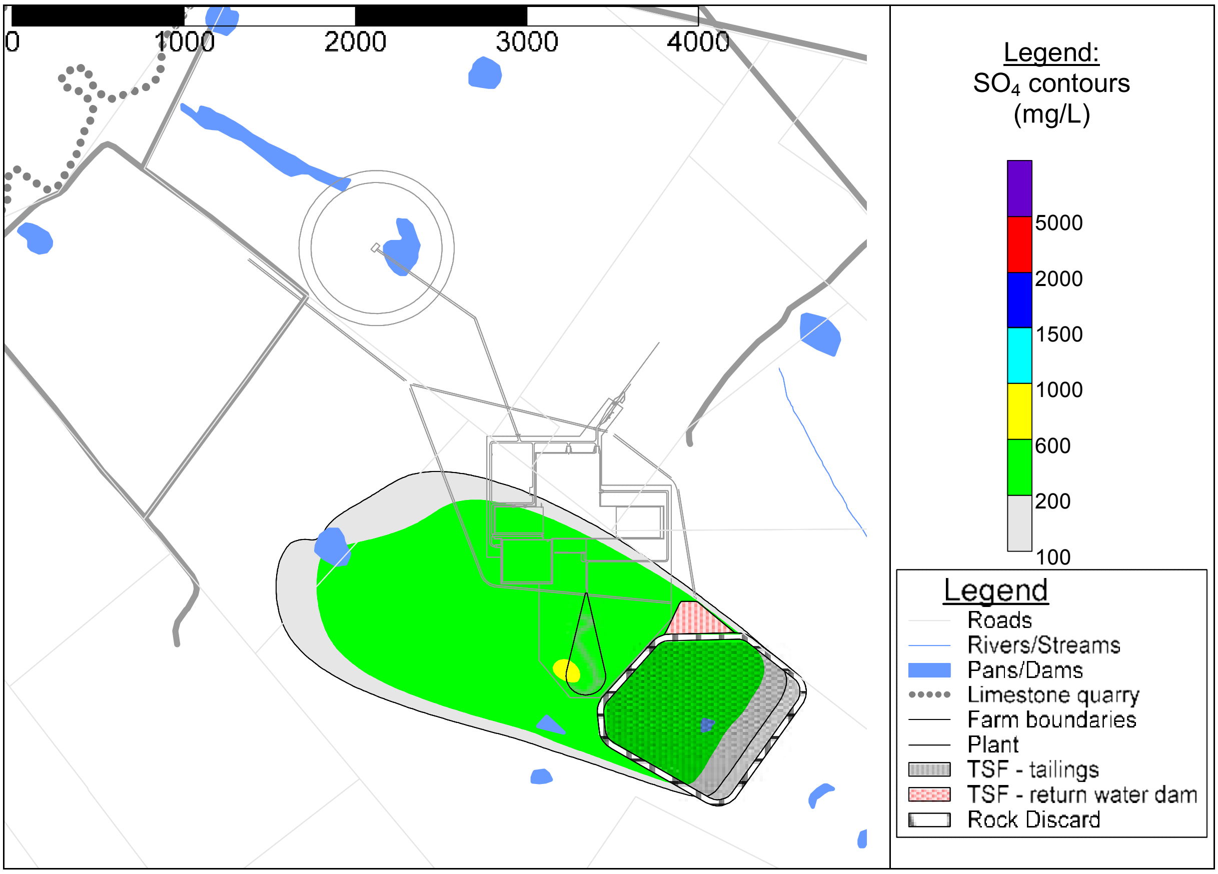


Figure 6.7 ***SO_4 contamination plume associated with WRD and TSF after 200years – liner permeability = $1x10^{-9}$m/s (preferred) --- [CAPPING TO 0.5% RECHARGE AFTER 20YEARS]***

7. RECOMMENDATIONS – MANAGEMENT OF POTENTIAL IMPACTS

7.1. General

The following aspects are important in considering mitigation and management measures of potential groundwater related impacts:

- A well-designed monitoring programme serves as a means of verifying predictions and ensuring more accurate predictions for future calculations. It is an early warning system for taking corrective actions;
- As part of the water management plan/strategy, it is necessary to comprehend the pollution mechanism and characteristics of all mining activities, and to monitor the manner in which pollution changes with time. Of specific importance is the geochemical impacts related to the TSF and WRD;
- The cumulative impacts from/on neighbouring mines and the receiving environment should be taken into account;
- In order to protect the receiving water environment, the following strategy should be pursued in order of importance.
    - Pollution should be prevented;
    - Pollution should be minimised (e.g. reuse, reclaim, treat);
    - In the event of discharge/disposal of water/waste, a site specific risk based approach should be followed. In this regard, <u>the water quality objectives of the receiving environment are of paramount importance</u>.

The latest South African Waste Management Act should be studied to ascertain the responsibility of *Gold One* in terms of aquifer restoration (i.e. to what degree should contaminated groundwater systems be "cleaned" after mining to pre-mining conditions).

7.2. Management of Potential Impacts Associated with Shaft System

<u>Management Measures – Construction/Operational Phase</u>

All rock to be excavated during shaft sinking will be placed on surface. This aspect is addressed in more detail in Sections 7.4 and 7.5.

Groundwater seepage/inflows into the Shaft system will most-likely be managed with little difficulty:

- Below the groundwater table, the typical Karoo rock can be described as "weathered", gradually becoming more competent with depth:
    - A detailed geotechnical evaluation of the AFO-054 borehole core was performed by geotechnical engineers;
    - Standard shaft-sinking operational procedures/techniques include the drilling of a diamond core borehole at the proposed shaft positions. Potential high-yielding fissures/fractures were identified for planning purposes (i.e. when to expect increased water inflow) through a combination of:
        - Geotechnical fracture logging of borehole cores;
        - Down-the-hole geophysical techniques (e.g. calliper, acoustic, neutron, density and flow) to locate fracture flow/velocity and porous zones;
- Consequently, the prevention/reduction of groundwater inflow into the shaft, through cementation/grouting of fractures/fissures (prior to shaft sinking and during shaft sinking) will most-likely be relatively easily achievable;
    - In the unlikely event of groundwater inflow volumes into the shaft becoming unmanageable, two 215mm diameter abstraction boreholes should be drilled on both sides of the shaft in close proximity to the water yielding features;
- During the Mining Phase, groundwater seepage/inflows into the Shaft system will be captured and pumped back to surface, or utilised underground, as part of the underground reticulation system.

The water quality of the deeper Wits mining environment is discussed in Sections 7.3 and 7.5.

The following recommendations apply to monitoring of the potential impacts associated with the Shaft system:

- The volumes pumped from the shaft should be recorded and reported as monthly totals;
- During shaft sinking, increased inflows due to fractures/fissures should be noted, specifically depths and initial inflow volumes;
- The following boreholes should be monitored to identify potential impacts of the Shaft on the groundwater table:
    - Existing boreholes AFO-053 and AFO-054S (currently “dry”) if not destroyed during construction;
    - Monitoring boreholes specified to monitor the impact of the WRD and TSF;
    - In addition to the above, the same monitoring recommendations as specified in Section 7.5 apply.

<u>Management Measures – Post-Closure Phase</u>

Towards the end of the life-of-mine, a groundwater study should be performed to determine whether the Vertical shaft system should be sealed above the Wits quartzite. The purpose of the study should be to determine if such a seal is required to prevent the formation of a groundwater mixing zone (i.e. mixing of uncontaminated Karoo water and highly saline water from the Wits aquifer).

It is recommended that once mining is completed the shaft is sealed above the Wits, unless determined otherwise through the mentioned studies.

The same monitoring recommendations as specified in Section 7.5 apply.

7.3. Management of Potential Impacts Associated with Underground Mining

<u>Management Measures – Construction/Operational Phase</u>

The main impact of underground mining on the local groundwater system relates to the pumping of highly saline water to surface where it will be utilised in the gold processing plant and become part of the TSF operational balance. All excess highly saline mine water should be managed as a combination of the following:

- Storage in lined surface water dams to prevent contamination of the shallow groundwater system;
- Treatment of water to catchment water quality standards before discharging to the surface water environment:
    - A decision may be taken to treat water in other water circuits of the gold processing plant or TSF, and then incorporating the mine water into those water circuits;
    - Water treatment options are being researched by RHDHV mine design engineers. Such treatment options should take cognisance of the storage of salts that remain after treatment;
- Pumping of water into dedicated deep boreholes drilled into the Wits aquifer. This option should be researched, specifically to comprehend the following aspects:
    - How much return-flow is anticipated to the underground mining activities?
    - What is the delay time before return-flow to the underground will be noticed?
    - How big is the “interim reservoir” that is created in this manner (i.e. such a system may only be effective for a short period/volume, before all additional water pumped into the deep aquifers will immediately flow into the underground workings)?

During mining, contaminants will be used in the underground such as in underground workshops (e.g. oil and diesel). As a general recommendation, the mine life-cycle should be considered in handling/storing contaminants such as hydrocarbons. E.g. such contaminants should not form part of the water circuit where highly saline water is pumped to surface. This may potentially have a negative impact on the gold processing plant.

Management Measures – Post-Closure Phase

After mining, all reusable equipment will be salvaged, and no more water will be pumped to surface. The mine will flood completely.

Mitigation measures relating to the sealing of the Shaft system are discussed in Section 7.2.

The same monitoring recommendations as specified in Section 7.5 apply.

7.4. Management Of Potential Impacts Associated With The Plant Area

Management Measures – Construction/Operational Phase

The following management and mitigation measures are recommended:

- All groundwater monitoring recommendations in Section 7.5 are applicable. The monitoring system should be evaluated and upgraded where applicable, as indicated in Section 7.5;
- Construction:
  - Engineering construction specifications should be followed (especially relevant to heavy buildings where *Bear GeoConsultants* recommended that the soil and clay profile be removed);
  - If found to be suitable in terms of construction parameters, roads, terraces and foundations can be constructed with Karoo rock (excavated during Shaft sinking), calcrete (underlying the clay profile) and sandy soils (above the clay horizon);
  - Where relevant, areas should be shaped and compacted to allow quick run-off and divert clean water around the area;
  - A soil survey material balance should determine the need to remove topsoil from construction areas, to utilise for rehabilitation at a later stage;
  - Concrete foundations will be constructed where appropriate:
    - Oil traps and sumps should be constructed (e.g. workshops);
    - Other pollution capture mechanisms, such as lined drains, should be constructed to prevent toxic contaminants from getting into contact with the groundwater system (e.g. chemical holding areas);
  - All contaminated water should be stored in tanks or suitably lined (HDPE liners) dams;
  - Potentially acid generating material in the ROM stockpile areas should be placed on lined areas. Rainfall runoff or any seepage water from the ROM material should be captured in lined facilities;
- There does not appear to be any rivers or non-perennial streams within 750m of the Plant area, which can be impacted during surface water run-off:
  - The occurrence of wetlands and surface water runoff zones need to be determined by wetland and surface water experts;
  - This information should then be utilised for clean-dirty water separation and to prevent rainfall run-off after heavy rainfall events from coming into contact with potential sources of contamination;
- Overburden should not be placed/stored in the following areas:
  - Low-lying areas or where streams appear to originate (non-perennial; i.e. during the summer rainfall period), or surface water runoff occurs after intensive rainfall events;
  - Wetlands and shallow natural pans where water may collect during the summer rainfall season;
- Accidental contaminant spills (e.g. diesel) should be cleaned immediately and rehabilitated by appropriate absorbent substances/materials. The disposal of used oils, greases and the like should take place in a responsible manner, preventing any contact with soil or the groundwater system. Off-site storage/disposal is advisable;
- Poor quality water should not be pumped to surface dams for storage, unless these are suitably lined (e.g. HDPE-lined).

Management Measures – Post-mining Phase

Plant activities (e.g. gold processing plant, dams, silt traps, sumps, dams, buildings, etc.) will be removed. The following recommendations are applicable:

- In the event that salts are identified on the footprint areas, the expertise of a soil scientist should be called upon to assess the impact and decide on the need (and appropriate clean-up techniques/technologies) to rehabilitate the footprint areas prior to placement of topsoil;
- Groundwater monitoring recommendations in Section 7.5 are applicable.

7.5. Management of Potential Impacts Associated with Tailings Storage Facility (TSF) and Waste Rock Dump (WRD)

Management Measures – Construction/Operational Phase

In line with pollution prevention and minimisation strategies (i.e. following Best Practice Guidelines), the placement/management/design of the WRD and TSF should be evaluated against the following principles:

- Site-specific water quality objectives (SSWQO) should be determined, taking cognisance of:
  - The background groundwater quality profile;
  - Drinking water standards;
  - Catchment water quality objectives;
- At this stage, a risk-based approach is not recommended. Such an approach may be considered once the final design criteria of the TSF liner system have been decided and the numerically simulated impact found to be excessive in terms of drinking water standards;
- Source reduction - WRD:
  - Due to the geochemical properties of the waste rock to be placed on the WRD (i.e. Wits hanging wall and foot wall has a high acid generation potential), it will be difficult to perform source reduction in terms of water quality seeping through the Dump during the operational phase;
  - Due to the typical shape and composition of a waste rock dump, it will be difficult to perform source reduction in terms of rainfall recharge seeping through the Dump during the operational phase;
  - In view of the anticipated leach water quality, the base layer below the WRD should be constructed according to the following guidelines (the recommendations should be reviewed and further guidance provided by a soil expert and/or geotechnical engineer):
    - Topsoil should be stripped to be utilised elsewhere during the Construction Phase (e.g. in the Plant) or during rehabilitation (Post-Mining Phase);
    - In-situ clay on the footprint area should be “reworked”/compacted, preferably to a permeability coefficient of $\leq 5 \times 10^{-9}$m/s. Based on discussions with Fraser Alexander design engineers it is likely that 4 clay layers, each 150mm thick, will be installed. If this is not possible, suitable clay material should be sourced from the adjacent construction activities. If a permeability coefficient of $<1 \times 10^{-9}$m/s is achievable with the in-situ clay, this should be the objective;
    - Calcrete with additional calcitic lime could be placed above the liner or the bottom preparation layer to reduce the acidification potential;
  - Surface water run-off should be diverted around the WRD through a system of berms/trenches. Water management measures should be introduced to manage extreme rainfall events within these diversion berms/trenches;
  - Toe seepage (predominantly expected to the west and north, flowing from a dedicated drainage system below the WRD, on top of the liner system) and rainfall runoff from the WRD sidewalls should be diverted toward a pollution control dam:
    - If the water quality in the pollution control dam is similar to the background groundwater quality profile, no further action is required. This water can be discharged to the surface environment;
    - If the water quality in the pollution control dam exceeds the SSWQO, additional

mitigation/management measures will have to be put in place as determined by a groundwater expert and geotechnical engineer. These may potentially include the construction of toe drains which should drain/divert toe seepages to a lined pollution control dam. Such a system will prevent rainfall run-off from the WRD sidewalls from being captured together with the toe-seepages;

- Contaminated water (from the lined pollution control dam) can be pumped to the TSF return water dam;
- Although serious water quality/volume issues are unlikely to occur in the toe seepages, these can be mitigated through reducing oxygen ingress and the rate of rainfall recharge into the WRD. Mechanisms to increase rainfall runoff can be put in place (if practical, clay barriers can be placed in certain areas);

- The WRD will expand toward the south (and possibly to the east – dependant on the final design criteria), which is in the upward slope direction of the surface topography. It is advisable that surface water barriers (e.g. paddocks and diversion berms) be removed/flattened to the ground surface in the direction of expansion, and drains below the footprint be constructed, to allow any water collecting in the bottom of the WRD to freely flow as toe seepages (thus reducing the rate of infiltration to the underlying aquifers);

- Source reduction – TSF:
  - Due to the geochemical properties of the tailings/slimes to be placed on the TSF, it will be difficult to perform source reduction in terms of water quality seeping through the Dam during the operational phase;
  - However, CN destruction may be possible as part of the Plant process. No CN water quality guidelines could be found (internationally [e.g. Equator Principles, WHO] and South African) dedicated to tailings facilities, to decide on the construction of a CN destruction plant. Additional research is required;
  - It is not the intention of this report to advise on the gold processing plant. The aspects mentioned should be considered if practical/feasible without interfering with the efficiency model or financial model of the gold processing plant. Pre-treatment options include:
    - If possible/practical sulphide reduction should be attempted during (or pre-treatment of) gold processing. It will be beneficial in the long-term if sulphur occur as sulphate-sulphur and not sulphide-sulphur in the tailings material. One option is the aeration of tailings to oxidise sulphides which will lower the acidification potential of the sulphides. Sulphides are often deliberately partially oxidised in gold plants 1) to release any gold traces and 2) to make the gold cyanidation process more efficient. Aeration (prior to the introduction of cyanide) of the ore in water at high pH can render elements such as iron and sulphur less reactive to cyanide, and therefore result in more efficient gold cyanidation;
    - An excess of lime could be added in the plant. Calcitic lime could be added in the final 5m - 20m of the tailings to prevent acidification;
    - Calcrete with additional calcitic lime could be placed above the liner or the bottom preparation layer on the outer rim of the Tailings Dam where acidification is expected;
  - Source reduction in terms of the water balance of the TSF will be possible:
    - The internal drainage system in the tailings/slimes dam should be designed to significantly lower the phreatic surface; thus reducing the infiltration capacity through the clay liner to the groundwater system (if this cannot be achieved, the prescribed permeability of the clay liner should be reduced or an HDPE liner should be installed);
    - During the operational phase, the possibility should be investigated of installing additional internal drains (at higher elevations) in the Tailings Dam. This will lower the phreatic head, and will allow the Dam to dry out quicker after closure;
  - The return water dam (pollution control dam) of the TSF should be lined with an HDPE liner;
  - The base layer below the TSF should be constructed according to the following guidelines (the recommendations should be reviewed and further guidance provided by a soil expert and/or geotechnical engineer):
    - Topsoil should be stripped to be utilised elsewhere during the Construction Phase (e.g. in the Plant) or during rehabilitation (Post-Mining Phase);
    - The hardpan calcrete (underlying the clay layer) from the TSF (or elsewhere, e.g. the Plant) may be utilised in the construction of starter walls. This will be beneficial in terms of the Post-Mining geochemistry of the TSF. Geotechnical engineering specifications should be followed;
    - In-situ clay on the footprint area should be “reworked”/compacted, preferably to a permeability coefficient of $\leq 1 \times 10^{-9}$m/s. Based on discussions with Fraser Alexander design engineers it is likely that 4 clay layers of 150mm thick will be installed. If this is

        - not possible, suitable clay material should be sourced from the adjacent construction activities, or an HDPE liner installed. If a permeability coefficient of $<1x10^{-9}$m/s is achievable with the in-situ clay, this should be the objective. As mentioned before, if the phreatic surface in the tailings/slimes cannot be significantly lowered below the final Dam height of 20m, the targeted permeability coefficient should be reduced (or an HDPE liner installed);
        - A low permeable base layer will have long-term benefits due to the stringent mitigation measures that will have to be introduced after mine closure;
    - Surface water run-off should be diverted around the TSF through a system of berms/trenches;
    - Unexpected seepages around the dam should be captured (e.g. through the installation of toe drains);
- Recycling and/or Treatment – WRD and TSF:
    - Unless monitoring indicates otherwise, or excess water is generated which cannot be utilised in the Plant or elsewhere, water treatment is not required/recommended at this stage;
    - This is also applicable to groundwater that may potentially be pumped from boreholes surrounding the WRD and TSF in an effort to prevent groundwater contamination plume from spreading;
- Secure disposal – WRD and TSF:
    - Excess contaminated water can only be disposed to the surface water environment if treated to SSWQO standards;
    - It is important to note that the TSF operational water balance can be reduced by lowering the water intake from underground mining, which in turn requires water pumped from underground to be disposed of. It is recommended that the disposal of Na-Cl into the Wits quartzites be researched:
        - During the deep water sampling exercise (and geological exploration drilling) it was found that water can be pumped into the Wits. However, the capacity of the Wits quartzites is not known (i.e. information on the total volume and duration). This should be assessed;
        - It can be argued that such water will only be recycled back into the underground. However, it is not known to what extent the rate of inflows will increase. This should be determined;
        - Dedicated monitoring should take place during such an exercise/experiment to ensure that the groundwater table in the Wits do not rise into the Karoo aquifer;
        - Additional comments/recommendations are provided in Section 7.3.

The following additional management measures are important:

- An Integrated Water Management Plan should be initiated at the commencement of mining:
    - During its initial stages, all the critical water balance components should be identified, followed by a phase of populating the “water database” (with reference to the DWA Best Practice Guidelines documentation);
    - Although pumping volumes will be relatively easy to measure (e.g. pumping to Pollution Control Dam), an attempt should be made to observe/measure aspects such as volumes stored in dams and water use (in some instances only a qualitatively description will be possible, e.g. emergency pumping);
    - The long-term water balance should be determined and continuously upgraded as:
        - More information becomes available;
        - Major deviations are identified;
        - Additional input parameters are identified;
    - In the event of major changes to the mining plan, or significantly different underground water balance than anticipated, or additional hydrogeological work indicate additional or altered impacts, all management measures (inclusive of the Integrated Water Management Plan) should be reviewed and adapted;
    - The water and salt balances for the catchments, sources and whole mine area, should be used to improve on the Integrated Water Management Plan;
- If feasible/practical, the impacts of the WRD and TSF can be minimised through timeous rehabilitation during the life-of-mine;
- Surface water monitoring should comply with recommendations by the project surface water expert. In this regard, it is advisable to monitor flow volumes and surface water quality at all potential sources of contamination;
- Accidental contaminant spills (e.g. dam breaches) should be immediately mitigated and

rehabilitated:
  - If the water quality exceed the SSWQO, water should be pumped back to storage facilities;
  - Depending on the recommendations of a soil expert, a thin layer of topsoil may have to be removed.
- A detailed hydrogeological investigation (inclusive of geochemical modelling and numerical groundwater flow modelling) of the impacts on the groundwater system will be required at least every 5years:
  - Specifically:
    - All additional potential impacts (considering sources, pathways and receptors) should be evaluated in adequate detail (i.e. identify impacts/potential impacts, quantify and monitor these impacts in terms of specific management objectives and measurable parameters);
    - To determine infiltration/seepage rates and quality from the WRD and TSF;
    - To assess the groundwater flow regime and determine the rate of contaminant movement in the aquifers;
    - Relevant, studies and monitoring data should be used to recalibrate the numerical models (i.e. attempting to simulate observed impacts);
  - Although numerical groundwater models will be updated/calibrated during the life-of-mine, it is important that the design criteria for any mitigation measures be determined through numerical groundwater flow and transport modelling, at least 2years prior to mine closure;
- Performance assessments of pollution prevention measures should comply with short-term and long-term license conditions and catchment objectives (e.g. SSWQO guidelines).

The impact assessments presented in Sections 6.2 to 6.5 were based on the current understanding of aquifer hydraulic properties and impacts. Three sets of monitoring boreholes exist (boreholes identified during the hydrocensus, *Gold One* "water supply" boreholes and 5 shallow holes adjacent to *Gold One* holes). These boreholes are listed in Tables 3.1 and 3.2, and depicted in Figures 3.1 and 3.2. It is recommended that the following monitoring actions be carried out to affirm predictions and to timeously take precautionary/preventative actions.

- Recommended groundwater monitoring boreholes:
  - All boreholes situated in the predicted groundwater level impact zone and groundwater quality impact zones, and <2km to the north/northwest/east should be included in the regular monitoring programme. These monitoring boreholes are listed in Table 7.1 and depicted in Figure 7.1. A groundwater specialist may determine that fewer of the hydrocensus boreholes be monitored after a baseline has been established;
  - Additional monitoring boreholes will be required (9x 45m deep, 4x 15m deep [associated with deeper holes] – 13 in total) at the early stages of mining:
    - 2x 45m holes in the Plant area;
    - 1x 45m deep hole upstream of the TSF;
    - The remainder of the boreholes should be drilled in-and-around the WRD and TSF;
  - Groundwater monitoring data and site information will most-likely require that additional boreholes be drilled within 2years of the commencement of mining;
  - Within 5years of the commencement of mining (and toward the end of mining), it might be prudent to add additional monitoring boreholes to the monitoring system, to evaluate the dewatering status around the Shafts, rising groundwater levels around the WRD and the TSF, and the potential migration of groundwater contamination plumes;
  - It will be important to evaluate newly-identified impacts;
  - Certain monitoring boreholes will be destroyed. Dedicated monitoring boreholes should be drilled to replace such boreholes to observe any potential impacts on the groundwater system (as advised by hydrogeological studies);
  - Hydrocensus boreholes which were identified during this investigation, but fall outside the regular monitoring zones, should also be monitored (less frequently);
- Surface water monitoring should continue as specified by the surface water expert. It is however recommended that the following be included:
  - Return Water Dam at the TSF;
  - Pollution Control Dam at the WRD;
  - Rietspruit and Slootspruit water qualities and flow volumes;
- Recommended spring flow and wetland monitoring:
  - All such areas identified during the hydrocensus and soil/wetland surveys, should be monitored. Any new springs that may be identified during the course of mining (i.e. during wet rainfall periods) should also be included in the monitoring system/programme;

  - At this stage it does not appear as if any monitoring weirs will be required in the local rivers (i.e. upstream and downstream of the Mine) to assess the contribution of groundwater flow from the Mine. This aspect should be addressed by a surface water expert;
- Recommended groundwater sampling methodology:
  - Boreholes should be grab-sampled at predetermined depths, as determined from the borehole water column geochemical profile (EC and temperature), geology and occurrence of water intersections (see sampling depths in Table 7.1);
  - Several privately owned boreholes are equipped with pumps and groundwater level measurements are not possible. A dedicated effort should be made to gain access to these boreholes. A feasible option is to drill a 25mm hole into the borehole cover and fit a screw cap, which can be easily accessed when the groundwater level has to be measured;
  - Boreholes containing pumps should be sampled under application conditions, i.e. collecting a pumped water sample;
- Recommended groundwater monitoring within the predicted impact zones of groundwater levels and groundwater quality:

	Groundwater levels	**Groundwater quality [*]**	**Stream quality**	**Dam quality (also record dam water level status)**
Prior to mining	Six-monthly	Annually (Lists 1 and 2)	As recommended by surface water expert	-
After commencement of mining	Monthly	Quarterly (List 1) Annually (List 2) Annually (List 3)		Quarterly (List 1) Annually (List 2) Annually (List 3)

[*] Boreholes and springs identified during the hydrocensus, but not falling within the predicted impact zones need to be monitored less frequently (annually) during the operational phase.

  - "List 1": pH, EC, TDS, Ca, Mg, Na, K, Cl, SO_4, NO_3, Tot.Alk.;
  - "List 2": Si, Fe, Mn, Al and ICP-scan;
  - The ICP-scan includes the following parameters, specifically relevant to the long-term geochemistry: Al, Co, Cr, Cu, Mn, Ni, Pb, Se, Th, U and Zn;
  - "List 3": TPH;
  - Once the various impacts of potential contamination sources have been established (sufficient information gathered), monitoring schedules and analyses can be adapted, as determined by groundwater expert in consultation with DWA;
- Borehole supplying drinking water to the mine:
  - Groundwater levels should be monitored on a weekly basis;
  - Groundwater quality should be analysed on a quarterly basis, unless otherwise determined by a groundwater expert or occupational hygienist;
- Reporting:
  - Data should be collated in a well-structured formal database;
  - Six-monthly data reports should be submitted to management;
  - Monitoring data should be reviewed in detail on an annual basis, specifically:
    - Addressing any actions that could be undertaken to reduce impacts;
    - Motivation for additional monitoring localities, change in schedules etc.;
  - If groundwater qualities are found to exceed the "Critical Values" of the SANS-241 (2006) Drinking Water Guidelines (specified in Table 4.6), <u>or site-specific water quality objectives (SSWQO)</u>, action may be required to improve/mitigate the source of contamination;
- Geochemical assessment:
  - The kinetic column test currently underway, must be completed and the updated geochemical model must make use of the updated pyrite oxidation rate;
  - During the first year of mining operations, fresh tailings samples from the plant should be submitted for geochemical tests every few months. This this will provide an excellent indication of the tailings geochemical properties over time;
  - Additional fresh tailings and tailings water/seepage from adjacent mines could be sampled (cognisance should be taken of age, deposition method etc);
  - Laboratory test work of the geological strata should then continue on an annual basis. Samples should be collected from the WRD and TSF, until otherwise indicated by a hydro-geochemist;
  - It is recommended that the future monitoring data is not only interpreted from a compliance perspective but also from a geochemical perspective in order to understand water quality trends and to predict changes in water quality;
  - The geochemical model should be updated at least every 5years to calibrate and validate its results and to construct an effective closure plan.

Management Measures – Post-Mining Phase

The following recommendations are applicable:

- The groundwater monitoring approach during the operational phase should continue for at least 2years after mine closure and then simplified/reduced as indicated by a suitably qualified groundwater specialist (based on site conditions and contamination levels);
- Source reduction - WRD:
  - Oxygen ingress and the rate of rainfall recharge should be minimised through an appropriately engineered capping system;
  - The following monitoring information (during the Operational Phase) should provide guidance to engineers and groundwater experts in designing the capping system:
    - Groundwater levels and quality adjacent to the WRD;
    - Toe seepage water volume and quality;
  - The efficiency of the capping system (i.e. long-term impact on the groundwater system) should evaluated through groundwater modelling;
- Source reduction - TSF:
  - There is a clear benefit in installing an engineered capping on the TSF; i.e.:
    - Shaping the Dump, i.e. increased run-off, without the potential for erosion;
    - Mechanisms that will reduce infiltration, such as installing a capillary break, certain vegetation, or an artificial cover;
    - Research is on-going worldwide to design alternative landfill covers. Suitable design criteria may be obtained in this manner;
  - The expertise of a soil scientist should be called upon to advise on the capping system;
  - Cognisance should be taken of both reducing/preventing rainfall infiltration and oxygen infiltration into the tailings/slimes;
  - All runoff water should be captured, until the completion of the capping exercise;
  - Recommendations relating to the installation of additional internal drains (during the Operational Phase) are again important. Any system that is put in place to speed up the process of draining the tailings material will be beneficial in terms of the impact on the local groundwater quality;
  - The lined Return Water Dam should be maintained to capture rainfall runoff and seepages until such time as the monitoring data indicates that the Dam can be rehabilitated;
- Source reduction – Groundwater contamination below the WRD and TSF footprints:
  - In the Post-Mining environment, the groundwater contamination plume that manifested during the Operational Phase constitutes a secondary source(s) of contamination. This source can be reduced;
    - Groundwater monitoring information should be evaluated by a suitably qualified groundwater expert to assess the degree of contamination;
  - Numerical groundwater modelling should be performed to evaluate all potential mitigation measures, including:
    - Active dewatering for a period; potentially associated with infiltrating clean water. Provisionally, based on the hydraulic aquifer properties that were determined for the shallow Karoo aquifers, a dewatering exercise may be possible. However, there are many practical and hydraulic aspects to consider;
    - Numerical groundwater models will be updated/calibrated during the life-of-mine. It is important that the design criteria for any mitigation measures be determined through numerical groundwater flow and transport modelling, at least 2years prior to mine closure;
- Recycling and/or treatment – WRD and TSF:
  - These principles will only be feasible if seepage water is treated. It is therefore advisable to design a capping system that will not result in polluted run-off or toe seepage.

Post-Mining monitoring will be very important to identify the efficiency of mitigation measures. The recommendations for the Operational Phase should continue for at least 1year after mine closure. Suitable monitoring recommendations should be made by a suitably qualified groundwater expert prior to mine closure.

Table 7.1 Recommended groundwater monitoring localities[to be updated in final report]

Borehole type	Number	Coordinate				Depth (m)
		WGS84-LO27		Decimal degrees		
		x	Y	Longitude	Latitude	
Exploration drilling water supply	AFO-044	5210	-3101764	27.053	-28.03	78
	AFO-044S					12
	AFO-045	5619	-3102190	27.0571	-28.0338	50
	AFO-054	5420	-3102992	27.0551	-28.0411	60
	AFO-054S					12
	AFO-056	6031	-3102090	27.0613	-28.0329	60
	AFO-068	4597	-3103611	27.0468	-28.0466	36
	AFO-053/ EUB-17	5777.69	-3102709	27.0588	-28.0385	80
	AFO-040/ EUB-18	5419.65	-3102990	27.0551	-28.041	
	AFO-09/ EUB-29	4023.82	-3101877	27.0409	-28.031	60
Hydrocensus	EUB-6	3618.78	-3104806	27.0368	-28.0574	86
	EUB-12	6505.8	-3101802	27.0662	-28.0303	30
	EUB-13	6285.53	-3101789	27.0639	-28.0302	
	EUB-14	6361.2	-3101888	27.0647	-28.0311	
	EUB-15	5909.53	-3102542	27.0601	-28.037	36
	EUB-16	6283.52	-3101883	27.0639	-28.031	35
	EUB-21	5140.97	-3103962	27.0523	-28.0498	35
	EUB-22	5250.96	-3104266	27.0534	-28.0526	
	EUB-23	7132.55	-3104506	27.0726	-28.0547	40
	EUB-26	7138.27	-3103142	27.0726	-28.0424	
	EUB-28	3266.51	-3102353	27.0332	-28.0353	
	EUB-101	6154.82	-3101669	27.0626	-28.0291	
Proposed monitoring:	GOS-1 [*]	5317	-3103377	27.0541	-28.0445	
	GOS-2 [*]	5938	-3103478	27.0604	-28.0454	
	GOB-9M	6535	-3104747	27.0665	-28.0569	45
	GOB-1M	4751	-3102565	27.0483	-28.0372	45
	GOB-3M	5118	-3103721	27.0521	-28.0476	45
	GOB-6M	5568	-3103840	27.0566	-28.0487	45
	GOB-6S					15
	GOB-8M	6452	-3103627	27.0656	-28.0468	45
	GOB-5M	5684	-3103447	27.0578	-28.0451	45
	GOB-4M	5278	-3103591	27.0537	-28.0465	45
	GOB-4S					15
	GOB-2M	5289	-3102433	27.0538	-28.036	45
	GOB-2S					15
	GOB-7M	5963.65	-3103405	27.0607	-28.0448	45
	GOB-7S					15

[*] Surface water monitoring

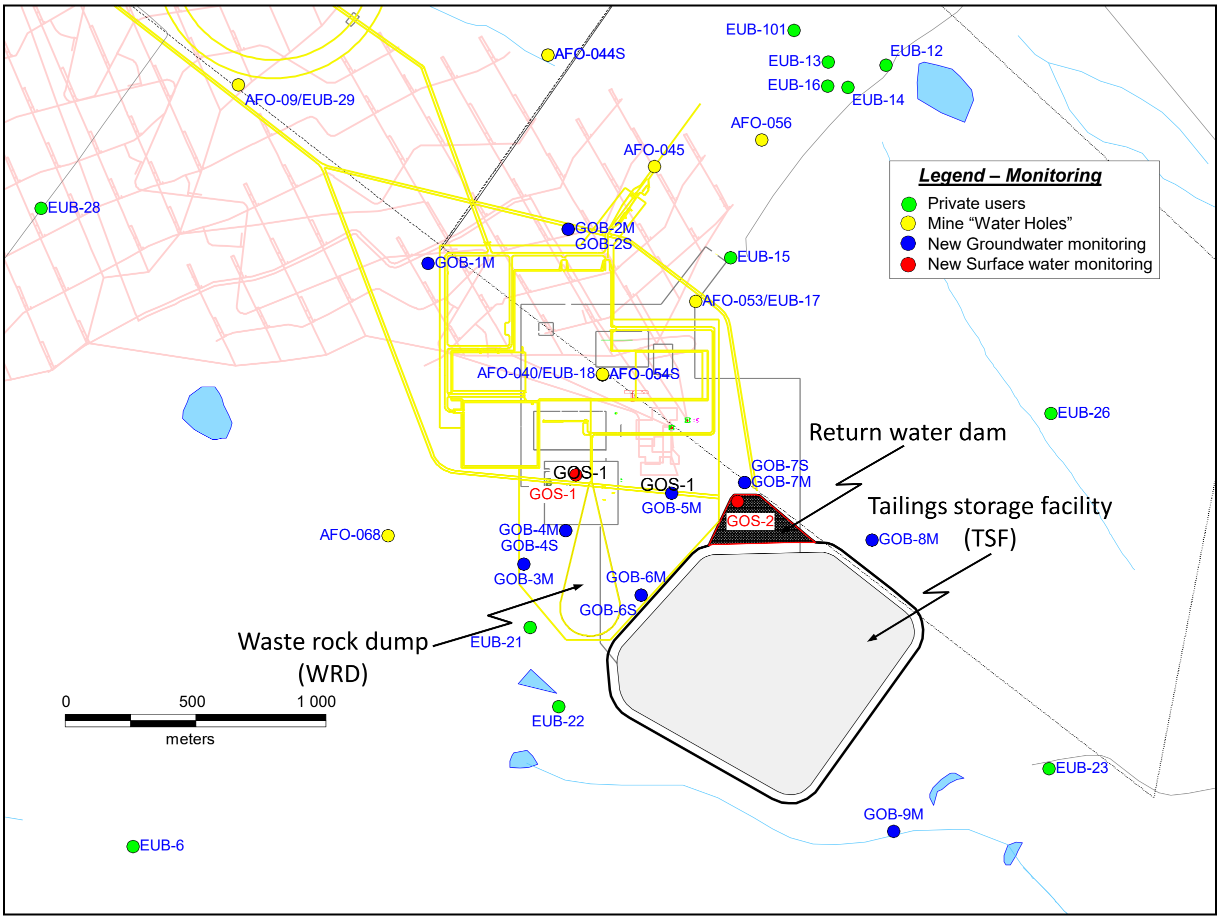


Figure 7.1 Recommended groundwater monitoring localities [to be updated in final report]

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for *GROUNDWATER SQUARE*

file: GW2_220Gold1Ventersb_GroundwaterImpactAssess_rep.doc

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Appendix 1 – Shallow Hydrogeological Borehole Logs

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION:

Site Identifier: 2827AA00001 ***Number:*** AFO044S ***Site type:*** Borehole

Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO044S

Region Type: ***Region Descr.:***

Longitude [°]:	28.029960
Latitude [°]:	27.052950
Altitude [m]:	1390.00
Coord. acc.:	Accurate to within 10 units
Coord. meth.:	Global Positioning System
Reg./BB.:	
G-Nr.:	
Topo-set.:	Hillside (slope)
Site status:	In use
Site purp.:	Observation
Use applic.:	Industrial - mining
Equipment:	No equipment
Depth [m]:	12.00
Col. ht. [m]:	0.38
Diam. [mm]:	165
Drain. reg.:	C42J
Rep. inst.:	

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

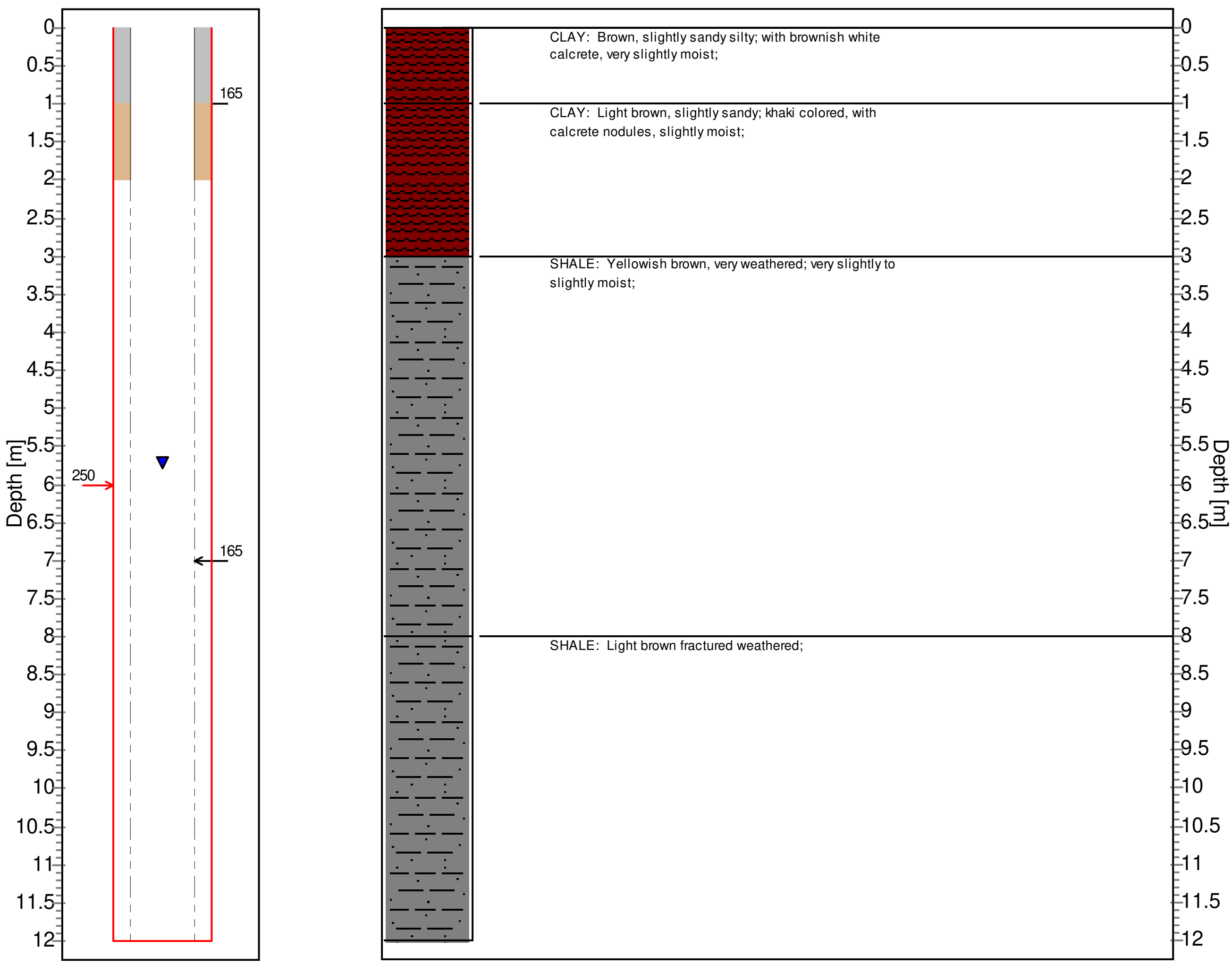
Construction and Geohydrological Legend

Hole — Casing (plain / perforated, sloted) — Screen / Mesh Screen — Piezometer

Hole diameter [mm] — Casing diameter [mm] — Waterlevel measured: 25/07/12 — Piezometer (Nr. & Diameter [mm])

Bentonite or clay — Gravel (> 2mm)

Construction / Lithology



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00001 ***Number:*** AFO044S ***Site type:*** Borehole

Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO044S

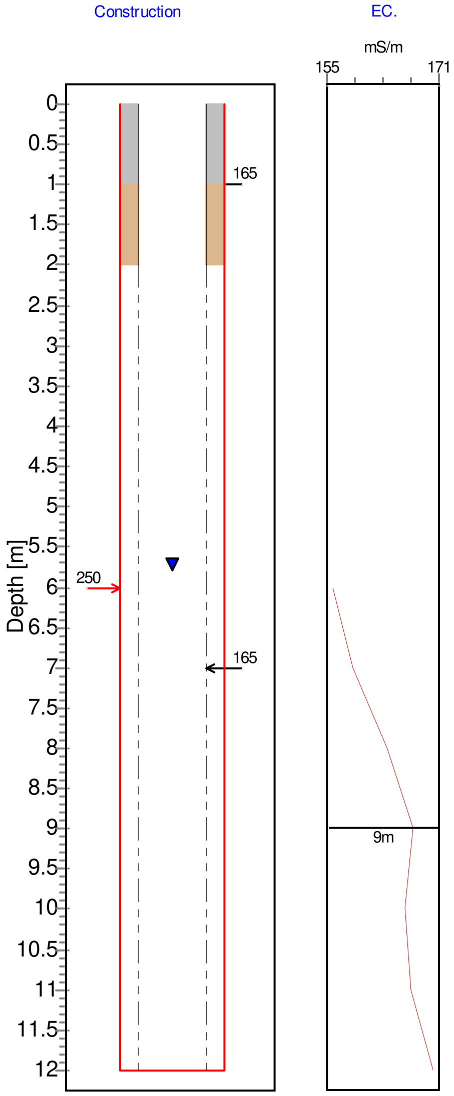
Region Type: ***Region Descr.:***

Longitude [°]:	28.029960	***Reg./BB.:***		***Topo-set.:***	Hillside (slope)	***Depth [m]:***	12.00
Latitude [°]:	27.052950	***G-Nr.:***		***Site status:***	In use	***Col. ht. [m]:***	0.38
Altitude [m]:	1390.00			***Site purp.:***	Observation	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units			***Use applic.:***	Industrial - mining	***Drain. reg.:***	C42J
Coord. meth.:	Global Positioning System			***Equipment:***	No equipment	***Rep. inst.:***	

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend

Hole	165 Hole diameter [mm]	Bentonite or clay
Casing (plain / perforated, sloted)	152 Casing diameter [mm]	Gravel (> 2mm)
Screen / Mesh Screen	Waterlevel measured: 25/07/12	
Piezometer	0:50 Piezometer (Nr. & Diameter [mm])	



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00002 ***Number:*** AFO048S ***Site type:*** Borehole

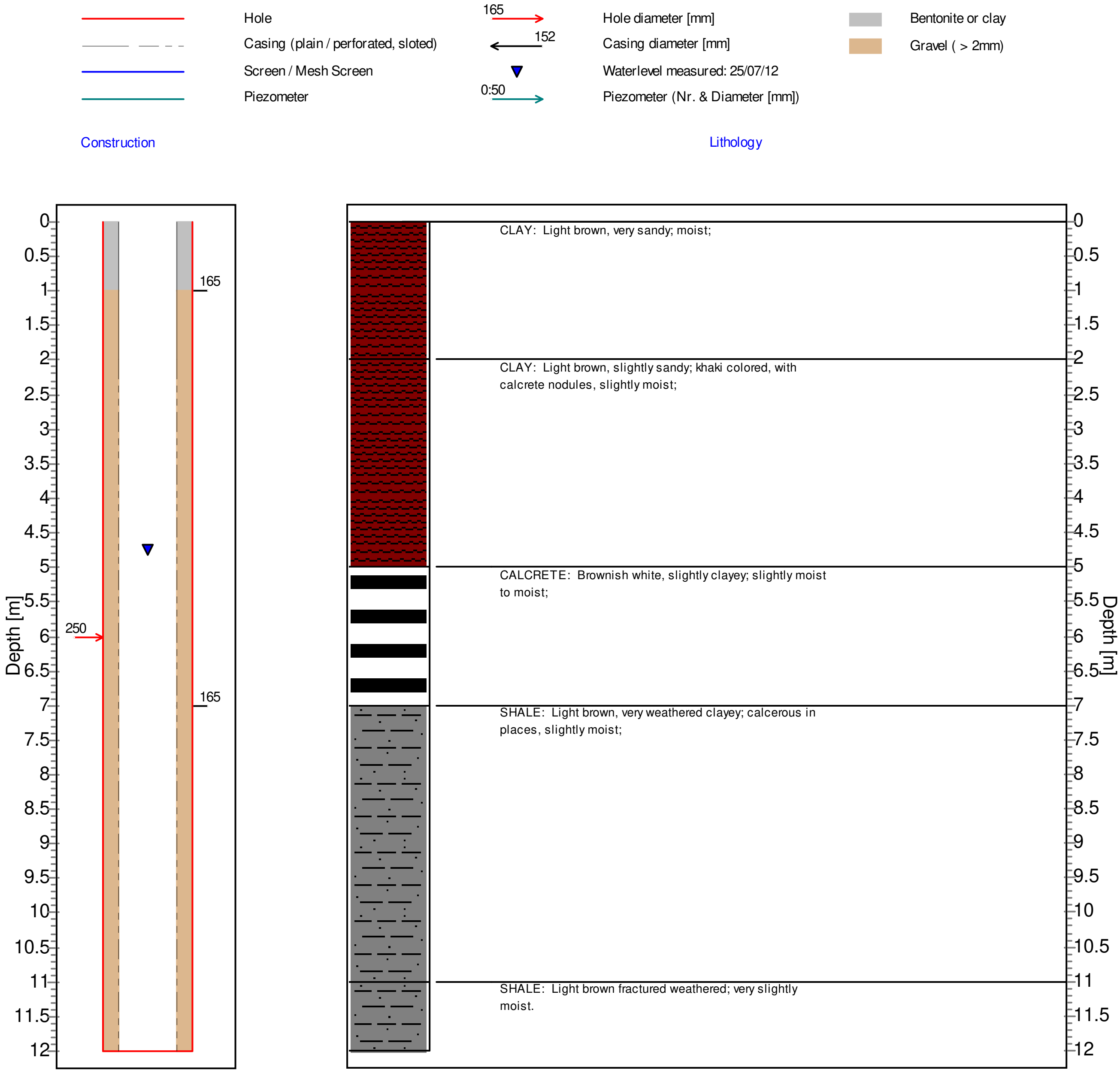
Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO048S

Region Type: ***Region Descr.:***

Longitude [°]: 28.019230	***Reg./BB.:***	***Topo-set.:*** Hillside (slope)	***Depth [m]:*** 12.00
Latitude [°]: 27.046590	***G-Nr.:***	***Site status:*** In use	***Col. ht. [m]:*** 0.28
Altitude [m]: 1387.00		***Site purp.:*** Observation	***Diam. [mm]:*** 165
Coord. acc.: Accurate to within 10 units		***Use applic.:*** Industrial - mining	***Drain. reg.:*** C42J
Coord. meth.: Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00002 ***Number:*** AFO048S ***Site type:*** Borehole

Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO048S

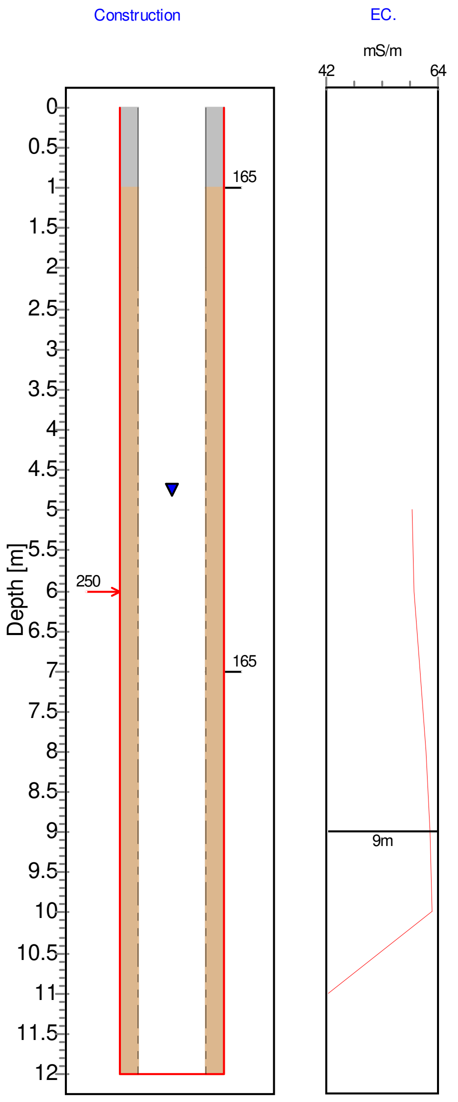
Region Type: ***Region Descr.:***

Longitude [°]:	28.019230	***Reg./BB.:***		***Topo-set.:***	Hillside (slope)	***Depth [m]:***	12.00
Latitude [°]:	27.046590	***G-Nr.:***		***Site status:***	In use	***Col. ht. [m]:***	0.28
Altitude [m]:	1387.00			***Site purp.:***	Observation	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units			***Use applic.:***	Industrial - mining	***Drain. reg.:***	C42J
Coord. meth.:	Global Positioning System			***Equipment:***	No equipment	***Rep. inst.:***	

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend

Hole	Hole diameter [mm] (165)	Bentonite or clay
Casing (plain / perforated, sloted)	Casing diameter [mm] (152)	Gravel (> 2mm)
Screen / Mesh Screen	Waterlevel measured: 25/07/12	
Piezometer	Piezometer (Nr. & Diameter [mm]) (0:50)	



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00003 ***Number:*** AFO054S ***Site type:*** Borehole

Distr./Farm No.: 720 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO054S

Region Type: ***Region Descr.:***

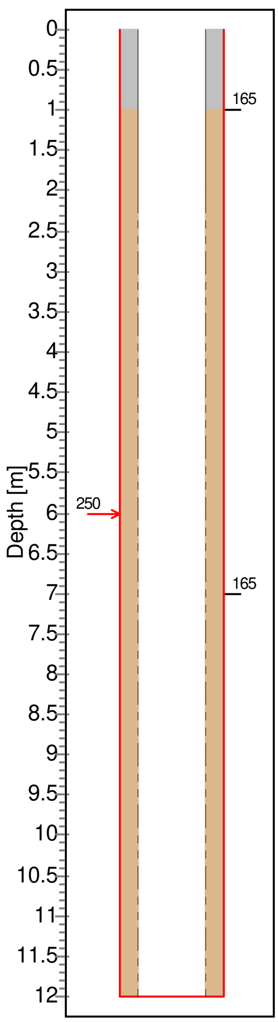
Longitude [°]:	28.041070	***Reg./BB.:***		***Topo-set.:***	Hillside (slope)	***Depth [m]:***	12.00
Latitude [°]:	27.055150	***G-Nr.:***		***Site status:***	In use	***Col. ht. [m]:***	0.47
Altitude [m]:	1406.00			***Site purp.:***	Observation	***Diam. [mm]:***	165
Coord. acc.:	Accurate to within 10 units			***Use applic.:***	Industrial - mining	***Drain. reg.:***	C42J
Coord. meth.:	Global Positioning System			***Equipment:***	No equipment	***Rep. inst.:***	

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

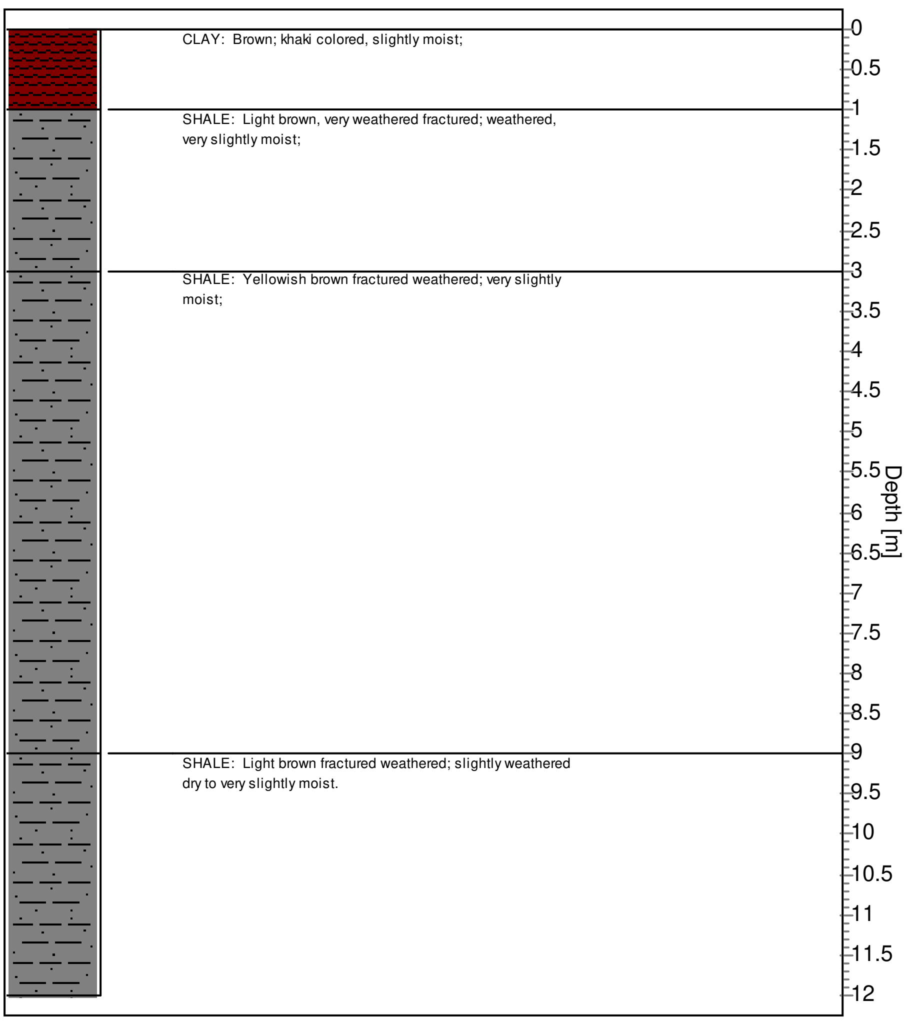
Construction and Geohydrological Legend

- Hole
- Casing (plain / perforated, sloted)
- Screen / Mesh Screen
- Piezometer
- 165 Hole diameter [mm]
- 152 Casing diameter [mm]
- Waterlevel with date meas.
- 0:50 Piezometer (Nr. & Diameter [mm])
- Bentonite or clay
- Gravel (> 2mm)

Construction



Lithology



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00004 ***Number:*** AFO063S ***Site type:*** Borehole

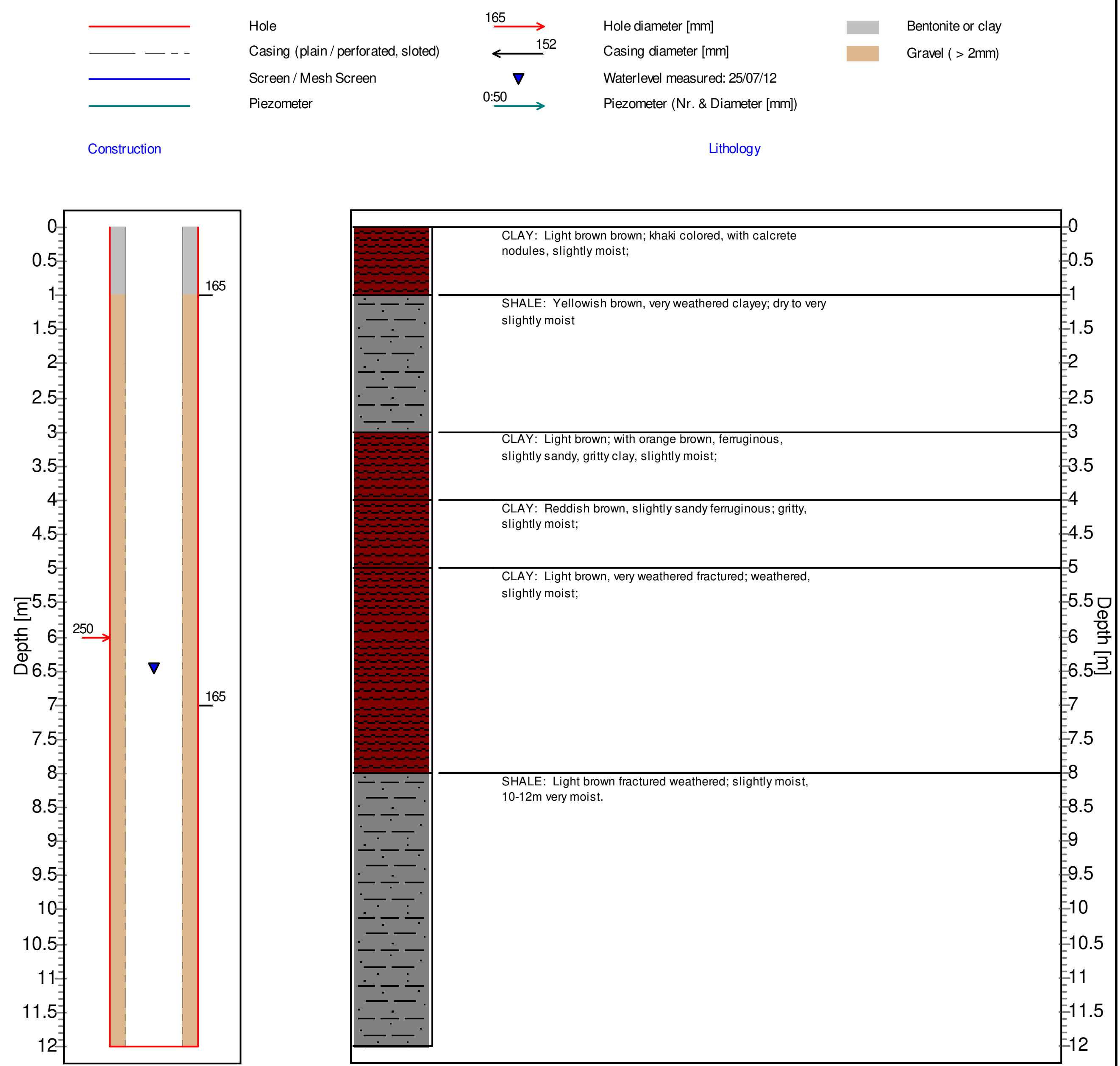
Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO063S

Region Type: ***Region Descr.:***

Longitude [°]: 28.024030	***Reg./BB.:***	***Topo-set.:*** Hillside (slope)	***Depth [m]:*** 12.00
Latitude [°]: 27.055180	***G-Nr.:***	***Site status:*** In use	***Col. ht. [m]:*** 0.34
Altitude [m]: 1394.00		***Site purp.:*** Observation	***Diam. [mm]:*** 165
Coord. acc.: Accurate to within 10 units		***Use applic.:*** Industrial - mining	***Drain. reg.:*** C42J
Coord. meth.: Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend



CLAY: Light brown brown; khaki colored, with calcrete nodules, slightly moist;

SHALE: Yellowish brown, very weathered clayey; dry to very slightly moist

CLAY: Light brown; with orange brown, ferruginous, slightly sandy, gritty clay, slightly moist;

CLAY: Reddish brown, slightly sandy ferruginous; gritty, slightly moist;

CLAY: Light brown, very weathered fractured; weathered, slightly moist;

SHALE: Light brown fractured weathered; slightly moist, 10-12m very moist.

COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00004 ***Number:*** AFO063S ***Site type:*** Borehole

Distr./Farm No.: 760 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : AFO063S

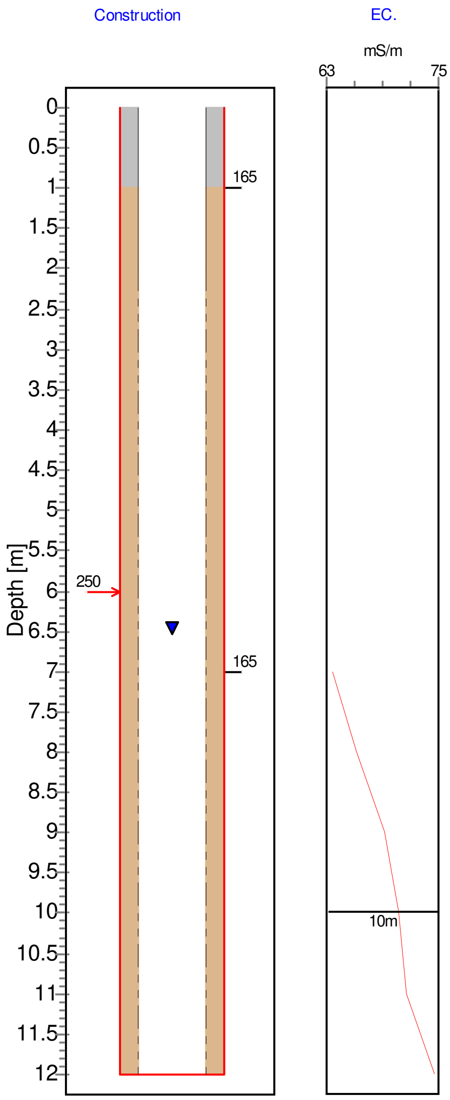
Region Type: ***Region Descr.:***

Longitude [°]: 28.024030	***Reg./BB.:***	***Topo-set.:*** Hillside (slope)	***Depth [m]:*** 12.00
Latitude [°]: 27.055180	***G-Nr.:***	***Site status:*** In use	***Col. ht. [m]:*** 0.34
Altitude [m]: 1394.00		***Site purp.:*** Observation	***Diam. [mm]:*** 165
Coord. acc.: Accurate to within 10 units		***Use applic.:*** Industrial - mining	***Drain. reg.:*** C42J
Coord. meth.: Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

Construction and Geohydrological Legend

	Hole	165	Hole diameter [mm]		Bentonite or clay
	Casing (plain / perforated, sloted)	152	Casing diameter [mm]		Gravel (> 2mm)
	Screen / Mesh Screen		Waterlevel measured: 25/07/12		
	Piezometer	0:50	Piezometer (Nr. & Diameter [mm])		



COMMENT:

User name and adress

Borehole Construction and Geological Log

Date compiled: 7/26/2012

BASIC SITE INFORMATION: ***Site Identifier:*** 2827AA00005 ***Number:*** SHALLOW_S ***Site type:*** Borehole

Distr./Farm No.: 720 ***Site Name/Des.:*** GOLD ONE VENTERSBURG : SHALLOW_SOUTH

Region Type: ***Region Descr.:***

Longitude [°]: 28.046300	***Reg./BB.:***	***Topo-set.:*** Hillside (slope)	***Depth [m]:*** 12.00
Latitude [°]: 27.059460	***G-Nr.:***	***Site status:*** In use	***Col. ht. [m]:*** 0.34
Altitude [m]: 1401.00		***Site purp.:*** Observation	***Diam. [mm]:*** 165
Coord. acc.: Accurate to within 10 units		***Use applic.:*** Industrial - mining	***Drain. reg.:*** C42J
Coord. meth.: Global Positioning System		***Equipment:*** No equipment	***Rep. inst.:***

Coordinate System: Geographic Decimal Degrees (Longitude/Latitude), WGS 1984

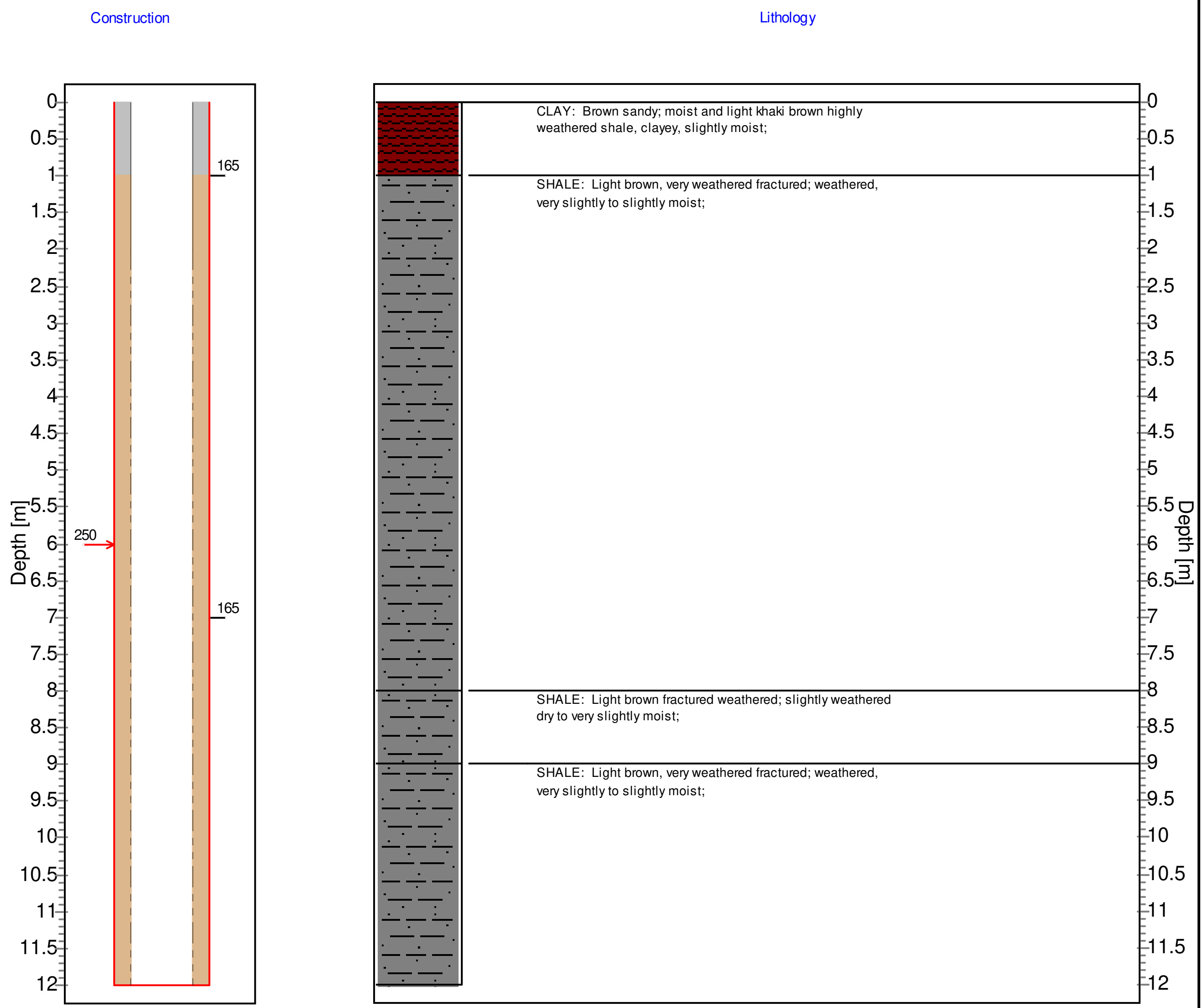
Construction and Geohydrological Legend

Hole — 165 Hole diameter [mm] — Bentonite or clay

Casing (plain / perforated, sloted) — 152 Casing diameter [mm] — Gravel (> 2mm)

Screen / Mesh Screen — Waterlevel with date meas.

Piezometer — 0:50 Piezometer (Nr. & Diameter [mm])



COMMENT:

User name and adress

Appendix 2 – Groundwater Level Data

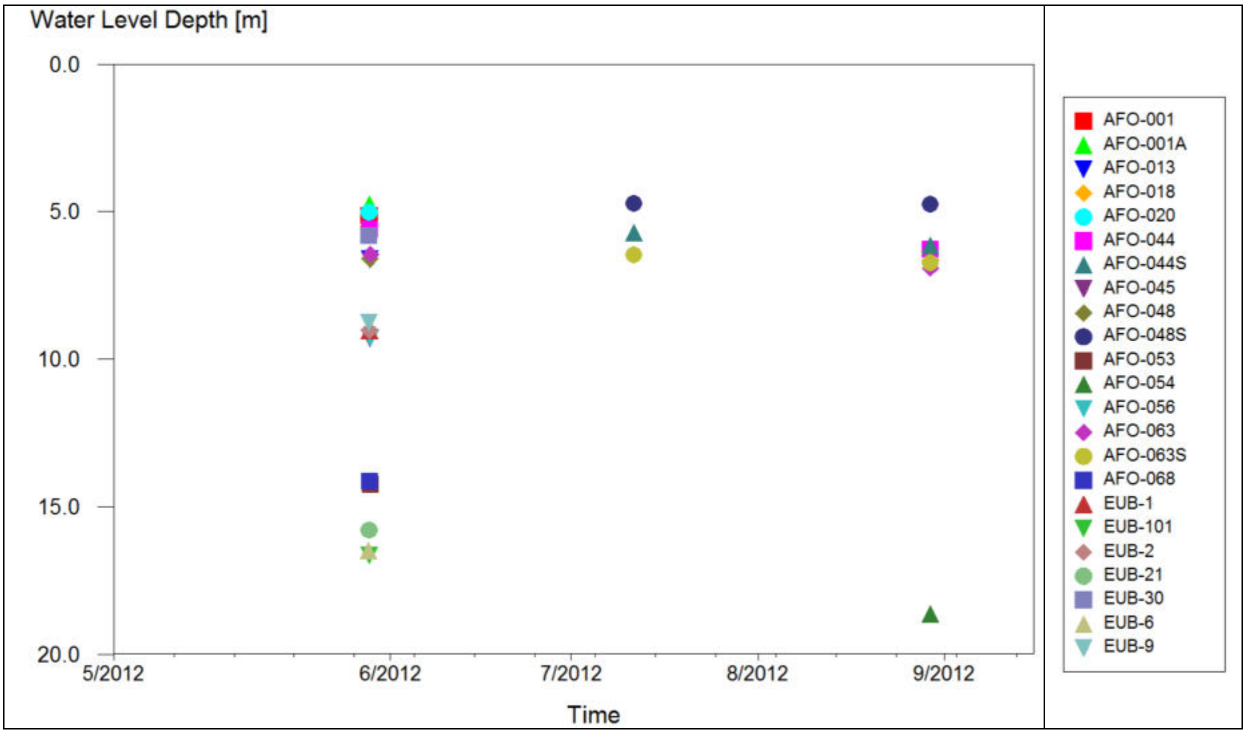
Site Name	Date	Water level (m)
AFO-001	2012/06/11	5.15
AFO-001A	2012/06/11	4.75
AFO-013	2012/06/11	6.62
AFO-018	2012/06/11	5.51
AFO-020	2012/06/11	5.02
AFO-044	2012/06/11	5.61
AFO-044	2012/09/12	6.29
AFO-044S	2012/07/25	5.72
AFO-044S	2012/09/12	6.16
AFO-045	2012/06/11	9.32
AFO-048	2012/06/11	6.61
AFO-048	2012/09/12	6.67
AFO-048S	2012/07/25	4.74
AFO-048S	2012/09/12	4.76
AFO-053	2012/06/11	14.25
AFO-054	2012/09/12	18.64
AFO-054S	2012/07/25	Dry
AFO-054S	2012/09/12	Dry
AFO-056	2012/06/11	9.29
AFO-063	2012/06/11	6.46
AFO-063	2012/09/12	6.92
AFO-063S	2012/07/25	6.47
AFO-063S	2012/09/12	6.74
AFO-068	2012/06/11	14.16
EUB-1	2012/06/11	9.02
EUB-101	2012/06/11	16.65
EUB-2	2012/06/11	9.02
EUB-21	2012/06/11	15.81
EUB-30	2012/06/11	5.82
EUB-6	2012/06/11	16.49
EUB-9	2012/06/11	8.75
S-South	2012/07/25	Dry
S-South	2012/09/12	Dry

Appendix 3 - Groundwater Quality Data

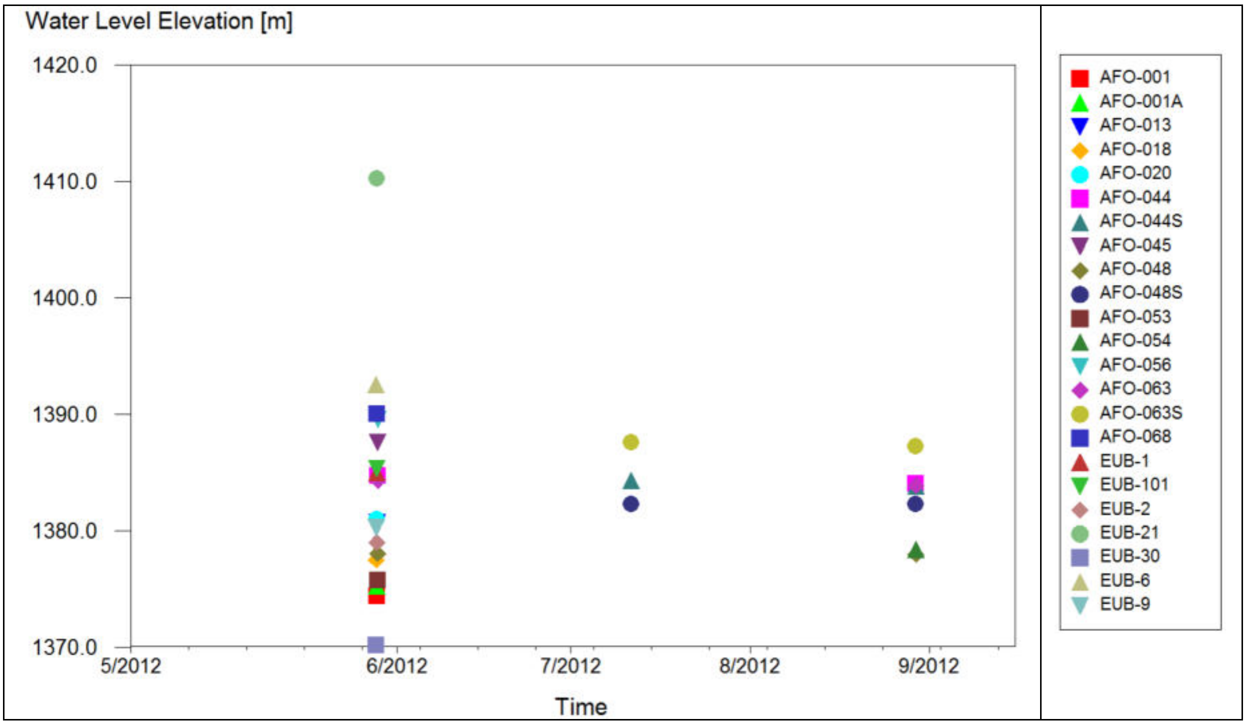
Site Name	Date	pH	EC (mS/m)	TDS (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl (mg/l)	SO4 (mg/l)	TALK (mg/l)	NO_3_N (mg/l)	F (mg/l)	Fe (mg/l)	Mn (mg/l)	Al (mg/l)
1 - Target Level (<)		**5.5**														
2 - Target Level (>)		**9.5**	**150**	**1000**	**150**	**70**	**200**	**50**	**200**	**400**		**10**	**1.000**	**0.20**	**0.10**	**0.30**
3 - Critical Level (<)		**4.0**														
4 - Critical Level (>)		**11.0**	**370**	**2400**	**300**	**100**	**400**	**100**	**600**	**600**		**20**	**1.500**	**2.00**	**1.00**	**0.50**
63W	2011/11/21	8.0	64	405			61		45	50		5.10	0.30	1.80		8.00
AFO-001	2012/06/12	8.4	75	445	19	6	147	3	21	24	369	1.17	0.25	0.04	<0.01	0.03
AFO-001A	2012/06/12	8.3	67	400	56	20	73	6	14	32	292	5.28	<0.01	0.07	<0.01	0.04
AFO-013	2012/06/11	8.1	103	644	106	33	93	14	133	32	345	5.67	0.20	0.08	0.03	0.02
AFO-018	2012/06/12	8.3	63	368	65	27	40	7	18	14	278	6.80	0.25	<0.01	<0.01	0.02
AFO-020	2012/06/12	8.2	68	407	65	27	47	10	29	30	268	8.35	0.25	0.03	<0.01	0.02
AFO-044	2012/06/12	8.0	115	659	82	43	83	7	172	67	275	9.02	0.19	0.06	<0.01	0.03
AFO-044S	2012/07/25	7.9	139	793	65	42	147	9	307	123	163	<0.01	0.22	<0.01	0.45	<0.01
AFO-045	2012/06/12	8.2	77	447	63	32	60	5	61	29	260	9.43	0.25	0.01	<0.01	0.02
AFO-048	2012/06/11	8.4	74	426	67	33	50	7	40	26	292	6.20	0.25	0.19	<0.01	0.07
AFO-048S	2012/07/25	8.0	58	325	49	27	36	8	30	36	227	<0.01	0.36	<0.01	0.01	<0.01
AFO-053	2012/06/11	8.3	73	433	67	34	52	5	18	28	300	11.00	0.19	0.01	0.02	0.02
AFO-056	2012/06/11	8.1	58	323	44	27	35	5	27	14	220	8.62	<0.01	0.67	0.01	0.38
AFO-063	2011/11/21	8.1	69	432			61		47	50		5.00	0.30	39.00		7.60
AFO-063	2012/06/12	8.0	60	354	49	21	55	6	39	19	249	3.44	0.20	<0.01	<0.01	0.02
AFO-063S	2012/07/25	7.9	65	383	49	22	53	7	44	76	218	<0.01	0.29	<0.01	0.47	<0.01
AFO-068	2012/06/12	7.9	80	499	69	36	50	20	22	32	298	20.40	0.39	0.06	<0.01	0.01
AFO-077(Zone-1) [570-600m]	2012/10/01	8.9	60	340	9	7	104	4	49	41	204	<0.20	1.60	1.54	0.13	0.50
AFO-077(Zone-2) [510-540m]	2012/10/01	9.0	130	659	11	5	217	5	267	18	220	<0.20	3.10	1.49	0.70	0.23
AFO-077(Zone-3) [470-500m]	2012/10/01	9.0	68	372	7	6	111	5	86	38	196	<0.20	1.50	0.24	0.05	0.70
AFO-077(Zone-4) [403-433m]	2012/10/01	8.2	68	416	13	18	118	8	67	38	256	<0.20	1.70	<0.03	0.05	<0.10
AFO-077	2012/11/12	8.1	546	3286	112	13	936	15	1678	<5	88	<0.20	3.30	1.15 4.57tot	0.2 0.2tot	<0.10 0.14tot
AFO-080	2012/06/13	8.6	651	4379	20	3	1668	13	2494	3	290	0.34	1.78	<0.01	<0.01	0.03
AFO-083	2012/10/30	8.3	114	730	12	<2	268	3	97	<5	408	<0.20	10.0	23	0.70	<0.10
AFO-083	2012/11/02	8.1	128	727	13	2	303	4	139	<5	436	<0.20	8.50	22	0.82	<0.10
AFO-086	2012/09/17	7.3	569	3034	29	4	979	6	1793	<5	244	<0.20		13	0.20	5.58
EUB-1	2012/06/13	8.6	84	566	74	27	99	9	42	56	380	6.48	0.29	<0.01	<0.01	0.06
EUB-101	2012/06/14	8.0	71	436	57	25	75	5	46	29	268	8.47	0.18	0.03	<0.01	<0.01
EUB-102	2012/06/14	8.7	68	395	86	28	33	7	22	3	326	4.75	0.24	<0.01	<0.01	0.03
EUB-12	2010/11/08	6.9	48	270	30	14	50	4	13	18	194	6.48	0.12	0.04	<0.01	<0.01
EUB-12	2012/06/14	8.1	45	278	33	18	52	4	14	14	200	5.20	0.19	<0.01	<0.01	0.04
EUB-13	2012/06/14	8.1	78	492	63	26	79	6	65	33	268	13.30	0.22	<0.01	<0.01	0.02
EUB-14	2012/06/14	8.2	65	398	43	18	84	4	39	32	250	6.58	0.21	<0.01	<0.01	0.02
EUB-15	2012/06/13	8.0	75	457	72	28	48	5	36	9	282	20.60	0.19	<0.01	<0.01	<0.01
EUB-19	2012/06/14	8.5	60	382	79	28	34	7	14	4	333	3.29	0.18	<0.01	<0.01	0.02
EUB-2	2010/11/08	7.6	101	592	72	26	104	10	44	66	423	5.24	1.88	0.05	<0.01	<0.01
EUB-2	2012/06/13	8.6	84	566	74	27	99	9	42	56	380	6.48	0.29	<0.01	<0.01	0.06
EUB-20	2010/11/09	7.1	69	410	80	28	27	7	7	26	357	6.15	0.87	0.02	<0.01	<0.01
EUB-21	2012/06/14	8.8	95	622	91	30	93	9	73	38	339	18.80	0.26	<0.01	0.01	0.02
EUB-23	2010/11/09	7.4	83	507	66	51	57	1	37	52	366	5.09	0.23	0.02	<0.01	<0.01
EUB-23	2012/06/14	8.3	87	549	89	37	47	1	59	75	332	9.35	<0.01	0.03	<0.01	<0.01
EUB-26	2012/06/14	8.2	56	339	43	22	63	2	15	11	273	4.40	<0.01	<0.01	<0.01	<0.01
EUB-30	2010/11/09	7.1	69	444	83	18	44	6	12	31	337	11.97	0.38	0.11	<0.01	0.12
EUB-30	2012/06/13	8.1	60	373	75	17	34	5	11	35	263	8.72	0.23	<0.01	<0.01	0.02
EUB-39	2010/11/10	7.0	95	587	98	31	78	7	45	40	414	10.49	0.08	0.02	<0.01	<0.01
EUB-42	2010/11/10	7.0	76	421	67	25	50	6	31	50	261	9.30	0.12	0.02	<0.01	<0.01
EUB-47	2010/11/11	7.2	93	551	79	18	89	7	38	69	282	19.79	0.17	0.02	<0.01	<0.01
EUB-6	2012/06/13	8.1	127	824	96	40	157	17	82	129	394	15.10	0.38	<0.01	<0.01	0.03
EUB-61	2010/11/11	7.5	76	454	60	18	76	8	32	41	266	14.20	0.13	0.04	<0.01	<0.01
EUB-66	2010/11/11	7.2	109	613	74	29	117	10	53	76	418	2.98	0.28	0.06	<0.01	<0.01
EUB-71	2012/06/12	8.4	75	441	77	32	39	6	26	57	323	1.98	0.27	0.01	<0.01	0.04
EUB-72	2012/06/12	8.4	69	413	72	28	48	6	19	25	330	3.59	0.26	<0.01	<0.01	0.02
EUB-73	2012/06/12	8.4	69	392	49	34	52	8	24	23	299	4.97	0.24	0.07	<0.01	0.16
EUB-8	2012/06/13	8.6	84	582	74	31	98	10	51	37	362	14.10	0.29	<0.01	<0.01	0.02
EUB-9	2012/06/13	8.5	80	529	74	27	94	10	39	38	367	5.84	0.27	0.21	<0.01	0.62
EUB-94	2010/11/12	7.1	138	866	147	38	81	9	109	74	448	33.30	0.15	0.04	<0.01	<0.01
SW-1	2010/11/08	7.6	144	865	50	38	208	9	163	97	502	1.33	0.39	0.04	<0.01	<0.01
SW-2	2010/11/08	8.6	159	944	25	37	273	8	182	131	482	1.55	0.96	0.03	<0.01	0.01
SW-4	2012/06/12	8.7	216	1419	48	35	405	21	478	218	341	1.53	0.38	0.05	<0.01	0.02

Site Name	Date	Si (mg/l)	N_Amonia (mg/l)	Pb (mg/l)	Ni (mg/l)	Co (mg/l)	Cu (mg/l)	As (mg/l)	CN (mg/l)	ZN (mg/l)	B (mg/l)	U (mg/l)	SS (mg/l)	Chemical Oxygen Demand CO (mg/L)
63W	2011/11/21		<0.3	0.20	0.80	0.30		0.800		<0.1		5.10		
AFO-001	2012/06/12	14.80	0.21	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.09	<0.01	1.2	4
AFO-001A	2012/06/12	19.30	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.08	<0.01	0	0
AFO-013	2012/06/11	16.00	0.08	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.07	<0.01	4.4	0
AFO-018	2012/06/12	22.00	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.09	<0.01	23.1	11
AFO-020	2012/06/12	19.40	0.05	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.13	<0.01	0	0
AFO-044	2012/06/12	15.70	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	0	0
AFO-044S	2012/07/25	1.94	1.09	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01		<0.01	4.4	42
AFO-045	2012/06/12	15.00	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.07	<0.01	6.7	6
AFO-048	2012/06/11	20.10	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.07	<0.01	8.8	0
AFO-048S	2012/07/25	2.85	1.48	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01		<0.01	2.4	31
AFO-053	2012/06/11	19.60	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	2.4	0
AFO-056	2012/06/11	21.40	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	22.5	9
AFO-063	2011/11/21		0.80	1.30	3.80	0.10		0.600		0.10		2.70		
AFO-063	2012/06/12	15.40	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.19	<0.01	0.4	0
AFO-063S	2012/07/25	2.52	0.78	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01		<0.01	12.2	8
AFO-068	2012/06/12	19.40	0.08	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.11	<0.01	18.2	39
AFO-077(Zone-1) [570-600m]	2012/10/01	0.70	0.60	<0.02	<0.025	<0.025	<0.025	<0.01		0.06	0.41			
AFO-077(Zone-2) [510-540m]	2012/10/01	1.10	0.20	<0.02	0.03	<0.025	<0.025	<0.01		0.07	0.81			
AFO-077(Zone-3) [470-500m]	2012/10/01	0.40	0.20	<0.02	<0.025	<0.025	<0.025	<0.01		<0.025	0.61			
AFO-077(Zone-4) [403-433m]	2012/10/01	2.40	<0.2	<0.02	<0.025	<0.025	<0.025	<0.01		0.06	0.49			
AFO-080	2012/06/13	3.06	1.25	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	1.30	<0.01	38.8	91
AFO-080	2012/06/13	21.90	0.98	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	54.4	141
AFO-086	2012/09/17	15.60			0.06	<0.03	<0.025	<0.010		0.03	1.94			
EUB-1	2012/06/13	20.40	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	0.4	0
EUB-101	2012/06/14	17.80	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.10	<0.01	0.8	0
EUB-102	2012/06/14	27.50	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	0.05	0.07	<0.01	4.4	15
EUB-12	2010/11/08	19.90		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-12	2012/06/14	15.10	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	0.02	0.09	<0.01	0	0
EUB-13	2012/06/14	19.20	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	0.01	0.10	<0.01	0.8	0
EUB-14	2012/06/14	18.70	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.07	<0.01	0	0
EUB-15	2012/06/13	15.30	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.13	<0.01	0	0
EUB-19	2012/06/14	27.30	0.09	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	0	0
EUB-2	2010/11/08	14.00		0.01	<0.01	<0.01	<0.01	0.010		<0.01	0.06			
EUB-2	2012/06/13	20.40	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	0.4	0
EUB-20	2010/11/09	24.30		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-21	2012/06/14	27.80	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	0.06	0.06	<0.01	0.8	0
EUB-23	2010/11/09	14.90		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-23	2012/06/14	15.40	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.13	<0.01	2.4	4
EUB-26	2012/06/14	23.20	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.04	<0.01	0	0
EUB-30	2010/11/09	18.00		0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-30	2012/06/13	15.50	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.11	<0.01	0	0
EUB-39	2010/11/10	17.30		0.01	<0.01	<0.01	<0.01	0.020		0.19	<0.01			
EUB-42	2010/11/10	17.10		0.02	<0.01	<0.01	<0.01	0.030		<0.01	<0.01			
EUB-47	2010/11/11	13.30		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-6	2012/06/13	19.40	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.06	<0.01	0.8	0
EUB-61	2010/11/11	16.10		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	<0.01			
EUB-66	2010/11/11	12.30		0.02	<0.01	<0.01	<0.01	0.010		<0.01	0.06			
EUB-71	2012/06/12	21.60	0.05	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.07	<0.01	1.2	0
EUB-72	2012/06/12	22.40	0.05	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	0.02	0.07	<0.01	0.8	0
EUB-73	2012/06/12	0.86	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.05	<0.01	0.4	0
EUB-8	2012/06/13	14.70	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.11	<0.01	1.2	0
EUB-9	2012/06/13	4.47	0.03	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	1.36	<0.01	1.2	0
EUB-94	2010/11/12	17.40		0.02	<0.01	<0.01	<0.01	0.030		0.09	0.02			
SW-1	2010/11/08	9.78		<0.01	<0.01	<0.01	<0.01	0.010		<0.01	0.02			
SW-2	2010/11/08	3.74		<0.01	<0.01	<0.01	<0.01	0.020		<0.01	0.07			
SW-4	2012/06/12	6.21	0.04	<0.01	<0.01	<0.01	<0.01	<0.005	<0.01	<0.01	0.12	<0.01	33.2	67

Appendix 4 – Groundwater Level Graphs



Groundwater level depths (m)



Groundwater level elevation (mamsl)

APPENDIX 8

Aquatic Biodiversity Compliance and Impact Statement

Scientific Aquatic Services

Applying science to the real world

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Name: Stephen van Staden
Date: Wednesday, 20 April 2022
Ref: SAS 22-1048

Prime Resources Environmental Consultants
The Workshop, 70-7th Avenue
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Johannesburg, South Africa
Tel: (Office) +27 (0)11 447 4888
Fax: +27 (0)11 447 0355
Email: gene@resources.co.za

Attention: Ms. Gené Main

RE: AQUATIC BIODIVERSITY COMPLIANCE AND IMPACT STATEMENT AS PART OF THE ENVIRONMENTAL AUTHORISATION PROCESS FOR A PROPOSED GAS EXTRACTION WELL ON FARM 720 PORTION 1 OF VOGELSRAND, WITHIN THE TOWN OF HENNENMAN NEAR VENTERSBURG, FREE STATE PROVINCE, SOUTH AFRICA.

1. INTRODUCTION AND BACKGROUND SETTING

Scientific Aquatic Services (SAS) was appointed by Prime Resources Environmental Consultants to prepare an Aquatic biodiversity[1] compliance statement as per the National Web-based Environmental Screening Tool (accessed 2022) (hereafter "screening tool") for a "gas extraction well" on Farm 720 portion 1 of Vogelsrand, within the town of Henneman near Ventersburg, Free State Province (hereafter referred to as the "study area"). The activity will include a gas extraction well and an area of approximately 20 m x 30 m fenced off around the gas well in which the agricultural crops have been cleared. An associated access road will be included as part of the activities and will mostly follow existing farm roads, apart from a short stretch crossing through agricultural fields at which the gas extraction well will be located. A 500 m "zone of investigation" around the footprint of the study area, (in accordance with General Notice 509 of 2016 (as it relates to the National Water Act, 1998 (Act No. 36 of 1998)), will be referred to as the "investigation area" (Appendix A, Figures A1 and A2).

The study area is located in the Matjhabeng Local Municipality and the Lejweleputswa District Municipality of the Free State. The study area is situated approximately 10 km north-west of

[1] Although the DEFF (2020) Screening Tool refers to 'aquatic biodiversity', for the purposes of this investigation, 'aquatic' is taken to include all freshwater ecosystems including rivers and wetlands.

Ventersburg and approximately 22 km east of Welkom. The R70 is the closest main road from the study area, approximately 2.8 km north-east thereof, with the N1 approximately 10 km east of the study area and the R73 approximately 13.7 km south-west, thereof. The general surrounding area is highly developed and land uses surrounding the gas extraction well almost exclusively comprise of agricultural fields that have been cultivated with sunflower crops.

SAS was required to report on aspects of the aquatic biodiversity and provide input into any development constraints this may have for development of the gas extraction well in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the National Water Act, 1998 (Act No. 36 of 1998). SAS was required to, as necessary, assess the risk that the gas extraction well poses to the freshwater ecosystem biodiversity within the receiving environment.

2. OUTCOMES OF THE APPLICATION OF THE DEPARTMENT OF ENVIRONMENTAL AFFAIRS (DEA) SCREENING TOOL.

The protocol for the assessment of aquatic biodiversity prepared in support of the Department of Forestry, Fisheries and the Environment (DFFE), formerly the Department of Environmental Affairs (DEA) national web based environmental screening tool which provides the criteria for assessment and reporting of impacts on aquatic biodiversity for activities requiring Environmental Authorisation (EA). For the aquatic biodiversity theme, the requirements are for landscapes or sites which support various levels of biodiversity. The relevant aquatic biodiversity theme in the national web based environmental screening tool has been provided by the South African National Biodiversity Institute (SANBI). Based on the sensitivity rating, a suitably qualified specialist must prepare the relevant report or opinion memo which is to be submitted as part of the EA application.

As part of the process of initiating the EA process, the national web based environmental screening tool was applied to the study and investigation area. According to the national web based environmental screening tool, the study area is located within an area of “low” sensitivity for aquatic biodiversity significance. As a result, an applicant intending to undertake an activity on a site identified as being of “very high sensitivity” for an aquatic biodiversity theme must submit an Aquatic Biodiversity Impact Assessment or if the area is identified as being of “low sensitivity” then an Aquatic Biodiversity Compliance Statement must be compiled and submitted to the competent authority. It is noted however that during a site survey undertaken by a suitably qualified freshwater ecologist, should the sensitivity be determined different from that assigned by the screening tool (i.e. that a high risk to the regional aquatic biodiversity or freshwater ecosystems in the area is likely even though it is assigned as a “low” sensitivity, or if it is assigned a high sensitivity but the proposed development risks are deemed low) then the relevant assessment approach must be followed based on the site survey results and not the DFFE environmental screening tool allocation.

3. DEFINITIONS AND LEGISLATIVE REQUIREMENTS

The legislation considered during this investigation included the following:

- The Constitution of the Republic of South Africa, 1996[2];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 (GN 509) as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

3.1 Freshwater Ecosystem Definition

The National Water Act, 1998 (Act No. 36 of 1998) is aimed at the protection of the country's water resources, defined in the Act as "a watercourse, surface water, estuary or aquifer". According to the National Water Act, 1998 (Act No. 36 of 1998) a watercourse means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the Gazette, declare a watercourse.

The National Water Act, 1998 (Act No. 36 of 1998) further provides definitions of wetland and riparian habitats as follows:

Wetland habitat is "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

Thus, for the purposes of this site survey the definition of a freshwater ecosystem is considered to be synonymous with the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998).

[2] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

4. DESKTOP INVESTIGATION FINDINGS

A desktop database analysis was undertaken prior to the site survey of the study area (refer to Appendix A) as well as the associated 500 m investigation area. The results are summarised in the points below with the relevant maps presented in Appendix A.

- According to the NFEPA (2011) database, there are no wetlands or rivers situated within the study and investigation area. The NFEPA (2011) database indicates that the closest wetland is a natural valley head seep located approximately 2.4km west of the study area whilst the closest river is the Rietspruit located approximately 4.66 km north and downgradient of the study area;
- According to the NBA 2018: National Wetland map 5, there are no wetlands or rivers situated within the study and investigation area. The NBA (2019) database indicates that the closest wetland to the study area is a natural depression located approximately 700 m west of the study area whilst the closest river is the Rietspruit located approximately 4.66 km north of the study area, which correlates with the NFEPA (2011) database.

4.1 Consultation of Historical Aerial Imagery

In order to ascertain conditions of the landscape prior to significant alteration and changes to the landscape, the "Department of Rural Development and Land Reform" (DRDLR, 2021) database was consulted to obtain historical aerial imagery. The historical imagery was thereafter compared with available digital satellite imagery to discern changes that have occurred (Figure 1). On review of historical aerial imagery dating back to 1963, the study area and surrounds have undergone significant changes throughout the decades. Primary modifiers identified include extensive agriculture that has occurred pre-dating 1963, and thus altered the movement, timing and pattern of water in the landscape over a period 55 years (at a minimum).

Figure 1: Historical aerial imagery from (top) 1963; and (bottom) current available digital satellite imagery from 2022 indicating the agricultural activities and the continuous anthropogenic disturbance within the study area and surrounds.

4.2 Site Assessment results

A site investigation of the study and investigation areas was undertaken on the 25th of March 2022 using visual assessment methods, use of a bucket soil auger and digital satellite imagery to identify areas to survey for the presence of any freshwater ecosystems.

The freshwater ecosystem identification took place as far as possible, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method advocated by DWAF (2008) is based on the fact that freshwater ecosystems have several distinguishing factors (indicators) including the following:

Wetlands are indicated and delineated by using presence of the following indicators:

- Landscape position (terrain unit indicator);
- The presence of water at or near the ground surface (soil wetness);
- Distinctive hydromorphic soil (soil form indicator); and
- Vegetation adapted to saturated soil (vegetation indicator).

Riparian areas are indicated and delineated by using the presence of the following indicators:

- Topography associated with watercourses
- Vegetation (distinctive change in species relative to adjacent terrestrial area as well as physical structure and robustness of growth forms)
- Alluvial soils and deposited material

During the site assessment, the presence of any freshwater ecosystem characteristics as defined by DWAF (2008) and by the National Water Act 1998 (Act No. 36 of 1998), were to be noted.

A bucket soil auger was used to verify soil characteristics in conjunction with vegetation communities that may indicate the presence, or lack thereof of any potential wetland/riparian features on the study and associated investigation area. The study area was occupied by agricultural fields cultivated with sunflower crops and common grass species which include *Cynodon dactylon* and *Urochloa masambicensis*. No facultative or obligate hydrophytic vegetation was present within the study area however, representative soil auger transects were also taken to ensure other evidence such as soil hydromorphic features were taken into consideration. The soil auger transects indicated that soil within the upper 50 cm of the profile (to qualify as a wetland) were shown to be free-draining and as such, no wetland, riparian or any other freshwater ecosystems were identified within the study area.

Localities within the investigation area which displayed digital signatures that could potentially be representative of freshwater ecosystems were surveyed during the site assessment. An artificial feature located approximately 350 m upgradient of the study area was identified and was classified as an "area of wet response". According to Ollis *et al*., (2013) an artificially created system is defined as a feature that is "produced by humans, not naturally occurring". The artificial feature was noted to have formed due to land-use changes which have altered the topography and pattern, timing and flow of water within the landscape and thus allowing runoff from agricultural activities to pond. The area of wet response was vegetated by facultative hydrophytic species which include *Cyperus rotundus* and *Setaria torta* as well infestation by Alien invasive plants (AIP's) which include *Verbena bonariensis*, *Bidens pilosa* and *Asparagus laricinus*. As the area of wet response is an artificial feature, it does not enjoy protection under the National Water Act, 1998 (Act No. 36 of 1998). Representative photographs of the area of wet response are depicted in Figure 2, below followed by Figure 3 which conceptually represents the features locality in the landscape.

Figure 2: (Left) Representative photographs of the area of wet response (artificial feature) vegetated by *Cyperus rotundus* and *Setaria torta* as well as (right) agricultural return flow that the area is subject to.

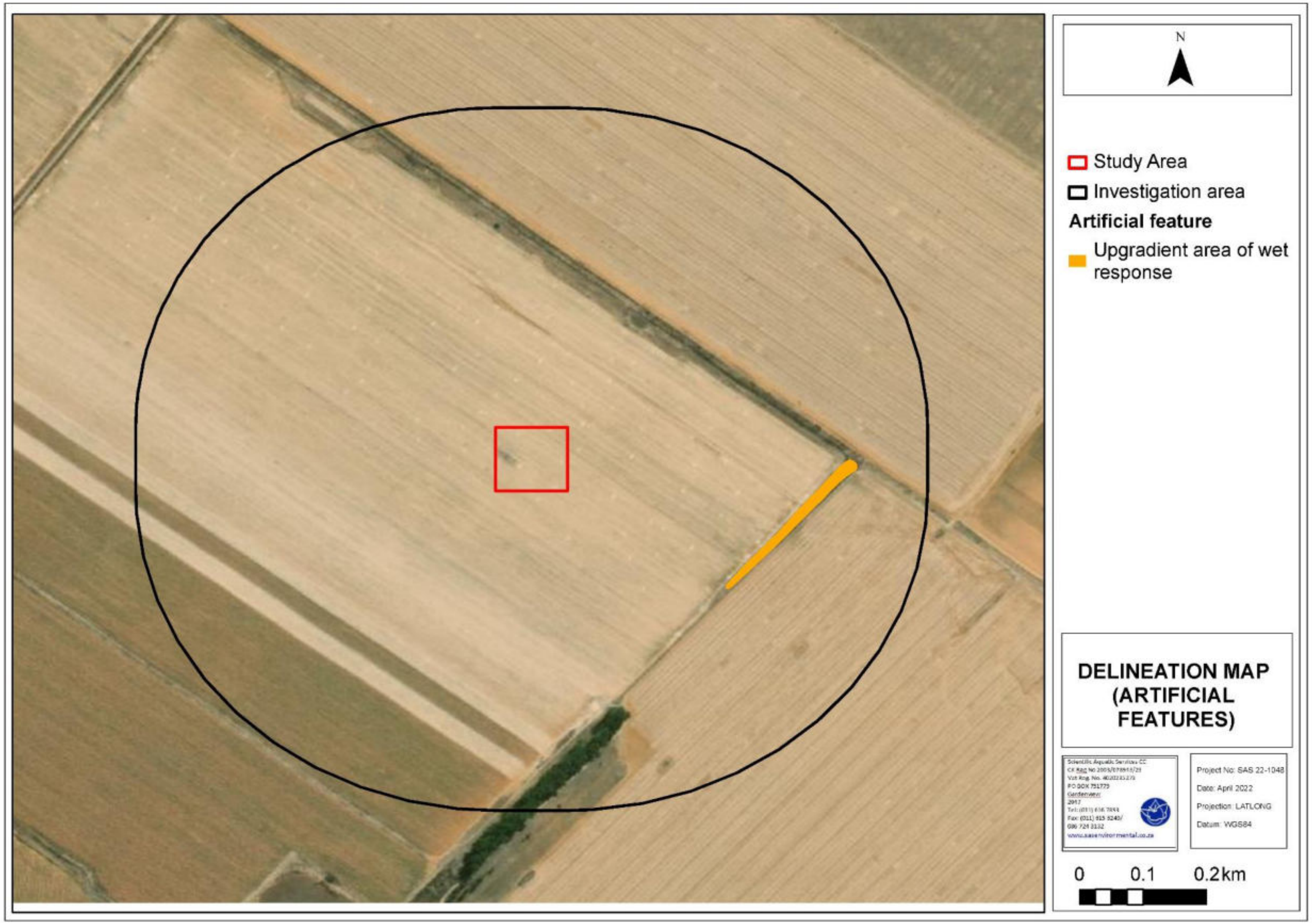

Figure 3: Conceptual representation of the upgradient area of wet response.

5. BUSINESS CASE, OPPORTUNITIES AND CONSTRAINTS APPLICABLE TO THE OPERATION OF THE GAS EXTRACTION WELL IN THE STUDY AREA.

The site assessment confirmed that there are no freshwater ecosystems situated on the study area and a low aquatic biodiversity significance as provided by the National Web-based Screening Tool outcome was confirmed. A single artificial feature classified as an area of wet response is situated approximately 350 m upgradient of the study area, within the investigation area. This feature is not defined as a wetland, riparian habitat or any other watercourse and does not enjoy protection as a watercourse as defined by the National Water Act, 1998 (Act No. 36 of 1998). Therefore, there are no development constraints applicable to the proposed gas extraction in terms of the National Environmental Management Act, 1998 (Act No 107 of 1998) nor the National Water Act, 1998 (Act No. 36 of 1998) and as such, from a freshwater ecosystem perspective, development of the gas extraction well is considered feasible.

We trust that we have interpreted your requirements correctly. Please do not hesitate to contact us if there are any aspects of this memorandum that you would like to discuss.

Yours Faithfully,

Stephen van Staden[3]
SACNASP REG.NO**: 400134/05 (Ecology)**

Declaration of independence and CV included in Appendix B and C, respectively.

[3] Co-authored by S. Pillay and reviewed by S. van Staden (Pr. Sci. Nat)

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Van Deventer, H.; Smith-Adao, L.; Mbona, N.; Petersen, C.; Skowno, A.; Collins, N.B.; Grenfell, M.; Job, N.; Lötter, M.; Ollis, D.; Scherman, P.; Sieben, E.; Snaddon, K. 2018. *South African Inventory of Inland Aquatic Ecosystems. South African National Biodiversity Institute, Pretoria. Report Number: CSIR report number CSIR/NRE/ECOS/IR/2018/0001/A; SANBI report number http://hdl.handle.net/20.500.12143/5847.*

APPENDIX A- DASHBOARD AND PROJECT MAPS

Table A1: Desktop data relating to the characteristics of the freshwater ecosystems associated with the study and investigation area.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	Highveld
Catchment	Vaal
Quaternary Catchment	Majority C42J and small southern portion C42H
WMA	Middle Vaal
subWMA	Sand / Vet
Dominant characteristics of the Highveld (11.03 and 11.08) Aquatic Ecoregion Level II (Kleynhans *et al.*, 2007)	
Ecoregion Level II	11.08
Dominant primary terrain morphology	Plains; moderate relief
Dominant primary vegetation types	Moist Cold Highveld Grassland
Altitude (m a.m.s.l)	1300 to 1700
MAP (mm)	400 to 500
Coefficient of Variation (% of MAP)	25 to 34
Rainfall concentration index	45 to 60
Rainfall seasonality	Mid to late summer
Mean annual temp. (°C)	14 to 18
Winter temperature (July)	-2 to 18
Summer temperature (Feb)	12 to 28
Median annual simulated runoff (mm)	5 to 10 (limited); 10 to 80

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The study and investigation area is located within a subWMA currently not considered a Freshwater Ecosystem Protected Area (FEPA) that would be considered important in terms of fish, aquatic or freshwater conservation.
NFEPA Wetlands (Figure A3)	According to the NFEPA (2011) database, there are no wetlands situated within the study and investigation area. The NFEPA (2011) database indicates that the closest wetland is a natural valley head seep located approximately 2.4km west of the study area.
Wetland Vegetation Type	The study and investigation area is situated within the Dry Highveld Grassland Group 3 considered Vulnerable, according to Mbona *et al.* (2014).
NFEPA Rivers (Figure A3)	According to the NFEPA (2011) database, there are no rivers situated within the study and investigation area. The NFEPA (2011) database indicates that the closest river is the Rietspruit located approximately 4.66 km north of the study area.
National Biodiversity Assessment (2019): National Wetland map 5 (Figure 4)	
According to the NBA 2018: National Wetland map 5, there are no wetlands or rivers situated within the study and investigation area. The NBA (2019) database indicates that the closest wetland to the study area is a natural depression located approximately 700 m west of the study area whilst the closest river is the Rietspruit located approximately 4.66 km north of the study area which correlates with the NFEPA (2011) database.	

Free State Biodiversity Plan (FSBP, 2015)	
According to the FBSP (2015) the study and investigation area is considered to be degraded.	
National web based environmental screening tool (2020)	
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
Aquatic Sensitivity	The aquatic sensitivity of the study and investigation area is considered to have a low aquatic sensitivity.

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; EPL = Ecosystem Protection Level; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area.

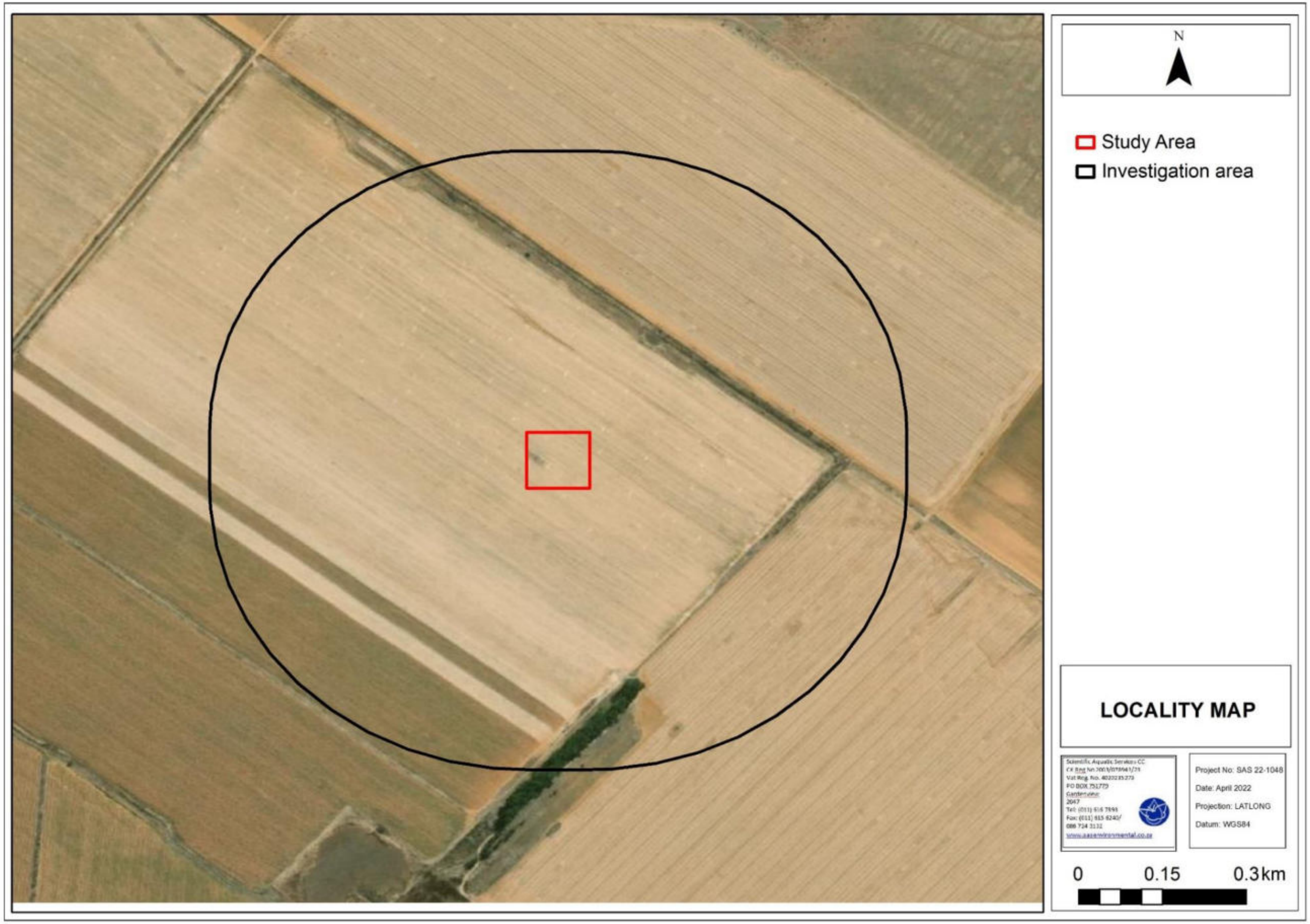

Figure A1: A digital satellite image depicting the study and associated investigation area in relation to the surrounding area.

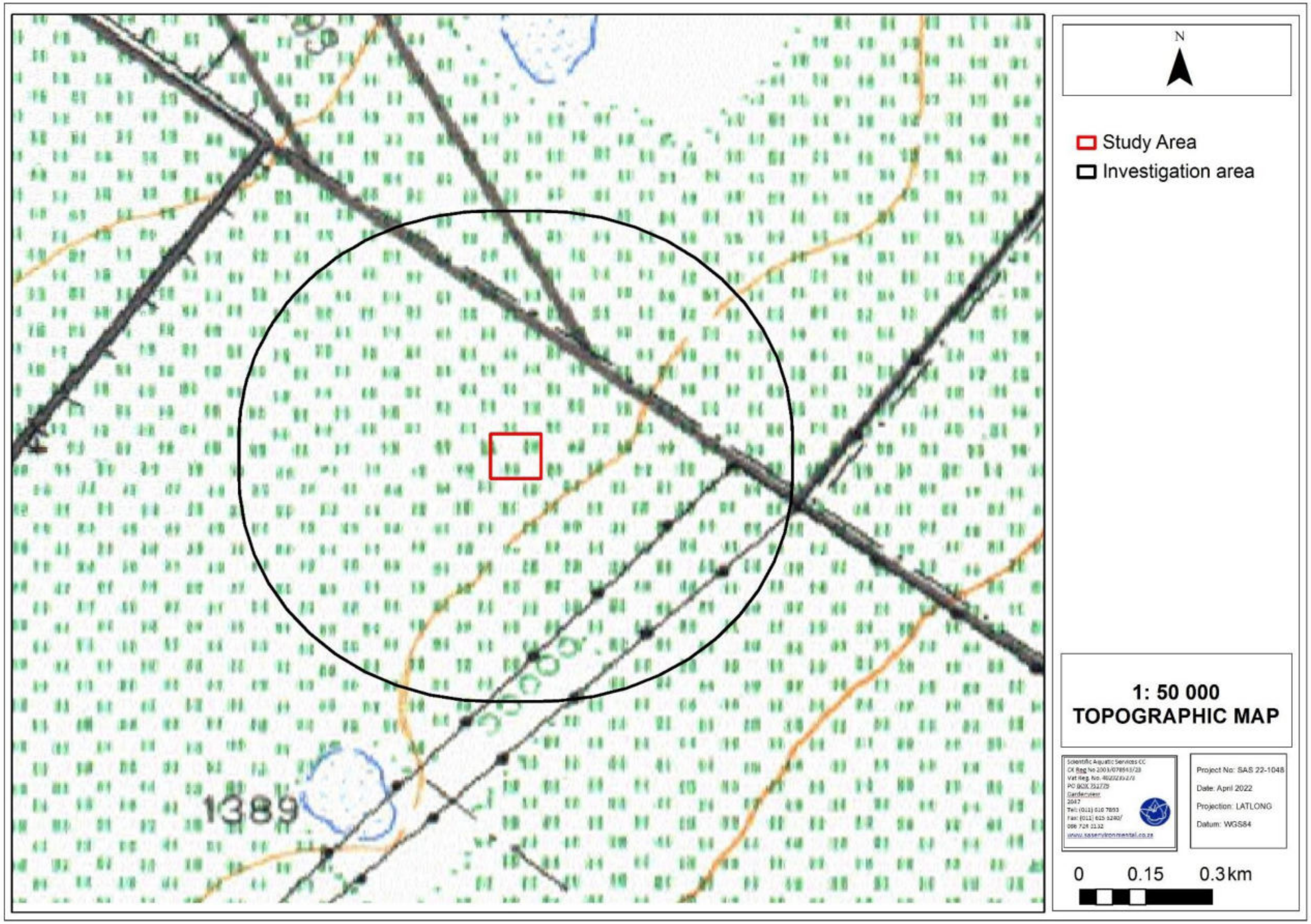

Figure A2: The location of the proposed study and associated investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

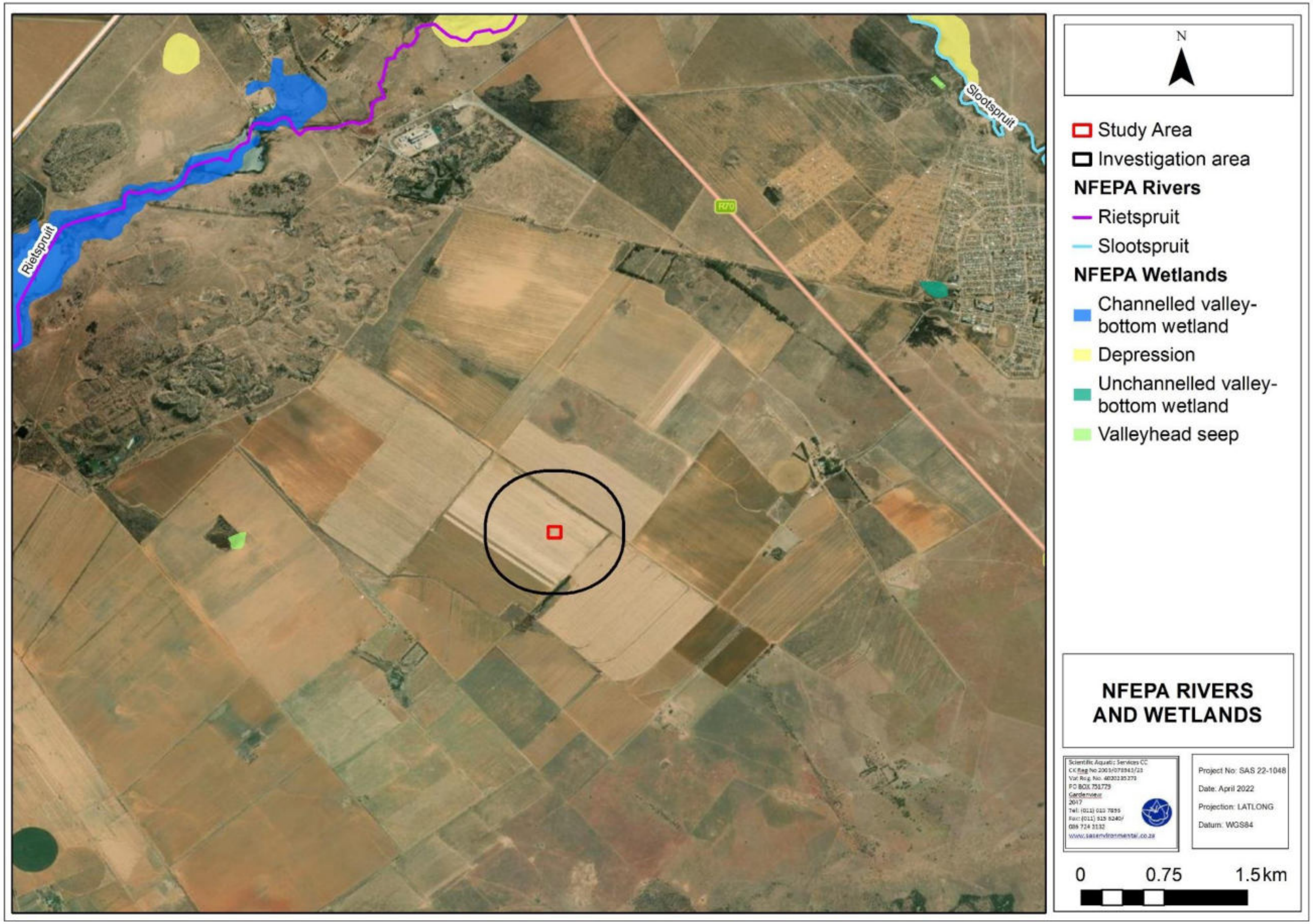

Figure A3: The wetlands and river features associated with the study and investigation areas according to the NFEPA (2011) database.

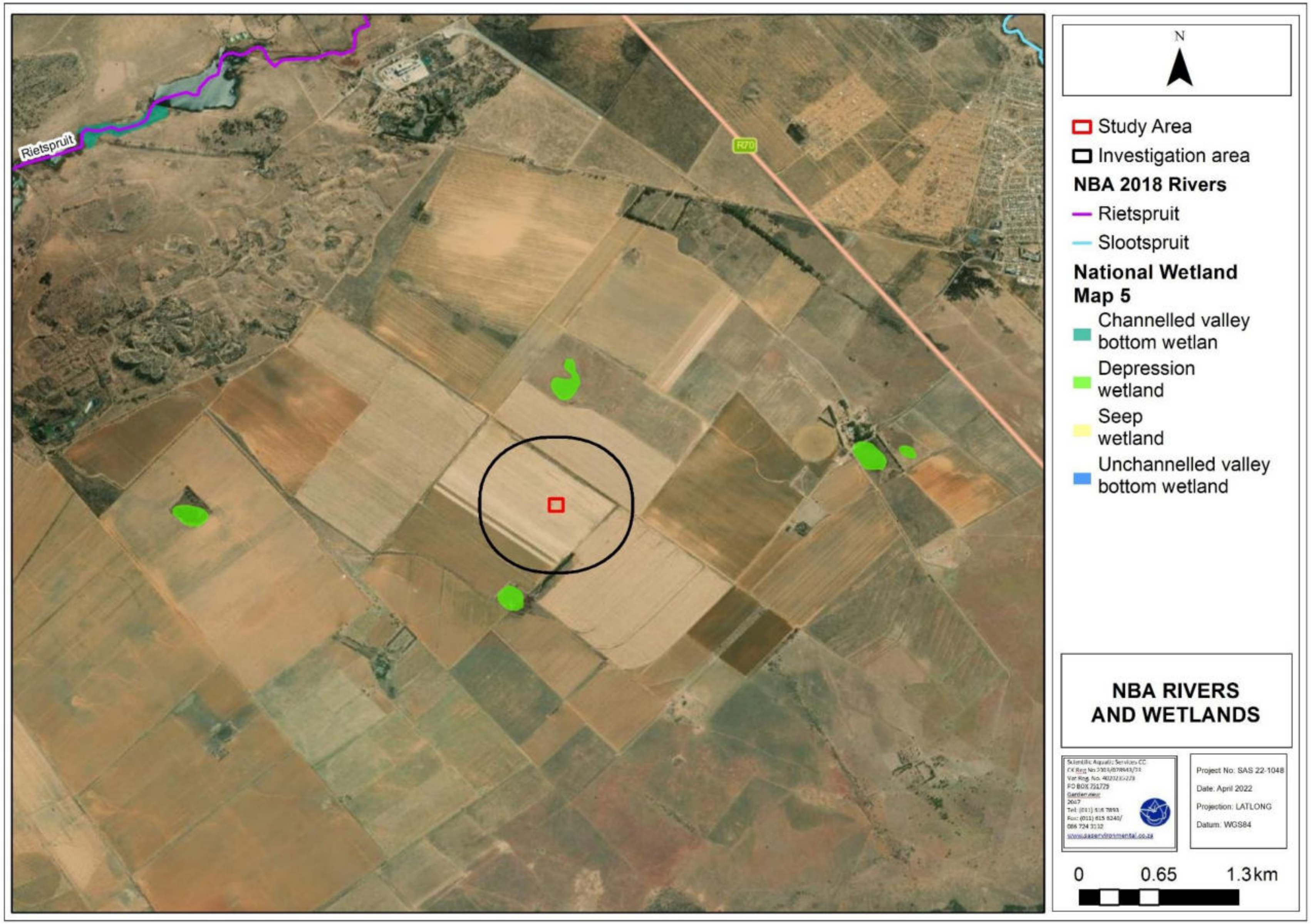

Figure A4: The wetland and river features associated with the study and investigation areas according to the National Biodiversity Assessment (2018).

APPENDIX B - DECLARATION OF INDEPENDENCE

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report:

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Sashin Pillay BSc Hons (Biological Sciences) (University of KwaZulu-Natal)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
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Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc Environmental Management (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health Practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum Member of the Gauteng Wetland Forum; Member of International Association of Impact Assessors (IAIA) South Africa; Member of the Land Rehabilitation Society of South Africa (LaRSSA)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.

Signature of the Specialist

Company of Specialist:	Scientific Aquatic Services			
Name / Contact person:	Sashin Pillay			
Postal address:	29 Arterial Road West, Oriel, Bedfordview			
Postal code:	1401	Cell:	064 966 2490	
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132	
E-mail:	sashin@sasenvgroup.co.za			
Qualifications	BSc (Hons) Biological Sciences (University of KwaZulu-Natal) BSc (Environmental and Life sciences) (University of KwaZulu-Natal)			
Registration / Associations	Member of the Gauteng Wetland Forum; Member of the South African wetland society			

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Sashin Pillay, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.

Signature of the Specialist

APPENDIX C- CV OF SPECIALISTS

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation

4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use License Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SASHIN PILLAY

PERSONAL DETAILS

Position in Company	Junior Ecologist
Joined SAS Environmental Group of Companies	2019

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the Gauteng Wetlands Forum
Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

BSc (Hons) Biological Sciences (Aquatic Ecology) (University of KwaZulu-Natal)	2017
BSc (Environmental and Life Sciences) (University of KwaZulu-Natal)	2016

SHORT COURSES

Additional Training

Back-2-Basics wetland workshop presented by Piet-Loius Grundling	(2020)
Environmental management training course by Enaq Environmental Consulting	(2018)
Young-Leaders academy, leadership development programme	(2012)

AREAS OF WORK EXPERIENCE

South Africa – KwaZulu-Natal, Gauteng, Mpumalanga, Free-State, Limpopo

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, IHIA)
- Toxicological Analysis
- Water quality Monitoring

APPENDIX 9

Terrestrial Compliance Statement

Scientific Aquatic Services

Applying science to the real world

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Name: Christien Steyn (Pr. Sci. Nat.)
Chris Hooton
Date: Tuesday, 12 April 2022
Ref: SAS22-1048

Prime Resources Environmental Consultants
The Workshop, 70-7th Avenue
Parktown North, 2193
Johannesburg, South Africa
Tel: (Office) +27 (0)11 447 4888
Fax: +27 (0)11 447 0355
Email: gene@resources.co.za

Attention: Ms. Gené Main

RE: TERRESTRIAL COMPLIANCE STATEMENT FOR A GAS WELL NEAR VENTERSBURG, FREE STATE PROVINCE.

1. INTRODUCTION AND BACKGROUND SETTING

Scientific Aquatic Services (SAS) was appointed by Prime Resources to prepare a Terrestrial Biodiversity compliance statement as per the National Web-based Environmental Screening Tool (accessed 2022) (hereafter "screening tool") for natural gas extraction on farm 720 portion 1 of Vogelsrand within the town of Hennenman, near Ventersbrug, Free State Province (hereafter referred to as the "study area") (Appendix A: Figures A1 & A2). For mapping and field verification, a 50 m buffer was applied around the point location provided by the client to define the core investigation area. The buffer, i.e., the study area of one (1) hectare (ha), was used on site to identify and assess potential sensitive, terrestrial habitat.

The activity will include gas extraction from an existing well where an area of approximately 20m x 30m has been fenced off already around the gas well. An associated access road is planned as part of the gas extraction activities and will mostly follow existing farm roads, apart from a short stretch crossing through agricultural fields from where the gas extraction well is located.

The study area is in the Matjhabeng Local Municipality, and the Lejweleputswa District Municipality of the Free State. The study area is approximately 10 km north-west of Ventersburg and approximately 22 km east of Welkom. The R70 is the closest main road from the study area, approximately 2.8 km north-east thereof, with the N1 approximately 10 km east of the study area and the R73 approximately 13.7 km south-west thereof. The general surrounding area is highly developed and land uses surrounding the gas extraction well are mostly comprised of agricultural fields that have been cultivated with sunflower crops presently forming the crop around the facility.

This compliance statement will follow the requirements as stated in the procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The outcome of the site sensitivity verification is presented 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;
- Contains a motivation and evidence (e.g., photographs) of either the verified or different use of the land and environmental sensitivity; and
- Does not include results of a full terrestrial biodiversity assessment. Sensitivities provided in this report only confirm or dispute the screening tool outcomes. If a "Very High" sensitivity is confirmed, the requirements must be followed as outlined in Sections 24(5)(A) and (H) and 44 of the NEMA.

2. OUTCOMES OF THE APPLICATION OF THE NATIONAL WEB-BASED ENVIRONMENTAL SCREENING TOOL

On 20 March 2020, the Minister gazetted a set of protocols for the assessment and minimum report content requirements of environmental impacts for various environmental themes. The assessment requirements of these protocols are associated with a level of environmental sensitivity determined by the screening tool[1]. For terrestrial biodiversity, the requirements are for landscapes and/or sites which support various levels of threatened or unique biodiversity. The relevant faunal and floral biodiversity data is stated in the screening tool and has been provided by the South African National Biodiversity Institute (SANBI).

As part of the process of initiating the Environmental Impact Assessment (EIA) process, Prime Resources applied the screening tool to the study area. According to the screening tool, the study area falls within an area of "Low" sensitivity for the animal and plant species themes. The terrestrial biodiversity combined sensitivity is indicated as "Very High".

3. LEGISLATIVE REQUIREMENTS

The legislation considered during this investigation included the following:

- The Constitution of the Republic of South Africa, 1996[2];
- The NEMA;
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
    - Government Notice (GN) number R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated 25 September 2020 as it relates to the NEMBA;
    - GN number 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020;
- Government Gazette 45421 dated 10 May 2019 as it relates to the Department of Forestry, Fisheries and the Environment (DFFE)'s (previously the Department of Environmental Affairs

[1] The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the environmental authorisation process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. The different sensitivity ratings pertaining to the plant [and animal] protocols are described below:

- Very high: habitat for species that are endemic to South Africa, where all the known occurrences of that species are within an area of 10 km^2 are considered critical habitat, as all remaining habitat is irreplaceable. Typically, these include species that qualify under critically endangered (CR), endangered (EN), or vulnerable (VU) criteria of the IUCN or species listed as critically/ extremely rare under South Africa's national red list criteria. For each species reliant on a critical habitat, all remaining suitable habitat has been manually mapped at a fine scale;
- High: recent occurrence records for all threatened (CR, EN, VU) and/or rare endemic species are included in the high sensitivity level;
- Medium: model-derived suitable habitat areas for threatened and/or rare species are included in the medium sensitivity level; and
- Low: areas where no SCC are known or expected to occur.

[2] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

(DEA)) national environmental screening report required with an application for EA as identified in regulation 16(1)(v) of EIA Regulations, 2014, as amended:
- GN No. 320 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity as published in Government Gazette 43110 dated 20 March 2020; and
- GN No. 1150 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant and Terrestrial Animal Species as published in Government Gazette 43855 dated 30 October 2020.

4. INVESTIGATION FINDINGS

The results of the desktop assessment are summarised in the points below and in Appendix B, with the relevant maps presented in Appendix A.

Study Area:
- The study area is located in the Grassland Biome within the Dry Highveld Grassland Bioregion (more details provided in Appendix B: Table B1). The associated vegetation type is the Vaal-Vet Sandy Grassland vegetation type (Appendix B: Table B1). According to the 2018 National Vegetation Map (SANBI 2018a) as well as the National Biodiversity Assessment (SANBI 2018b), this vegetation type has an Endangered status (Appendix A: Figure A3);
- The National List of Threatened Ecosystems (as listed in the National Gazette No 34809, Government Notice 1002 of 9 December 2011) indicates that the study area is not within any remnant of a threatened ecosystem, but that remnants of an **Endangered ecosystem** (i.e., the Vaal-Vet Sandy Grassland**)** are located within 2 km of mapped remnant Vaal-Vet Sandy Grassland – this contradicts the screening tool outcome that states the study area being present within an endangered ecosystem (Appendix A: Figure A4);
- According to the 2015 Free State Terrestrial Critical Biodiversity Area (CBA) dataset, there are no CBAs or Ecological Support Areas (ESAs) associated with the study area (Appendix A: Figure A5); and
- According to the SAPAD (2021 Q3), SACAD (2021 Q3), and the NPAES (2010) datasets, the study area is not within any protected or conservation areas (although some are present within 10 km of the site) (Appendix A: Figure A6).

Field Observations:

A field investigation to ground truth the desktop findings was undertaken on the 25th of March 2022. The broader study area was considered utilising digital satellite imagery prior to and after the field investigation. Within 200 m – 400 m, the land use constitutes agricultural field (Figure 1 below).

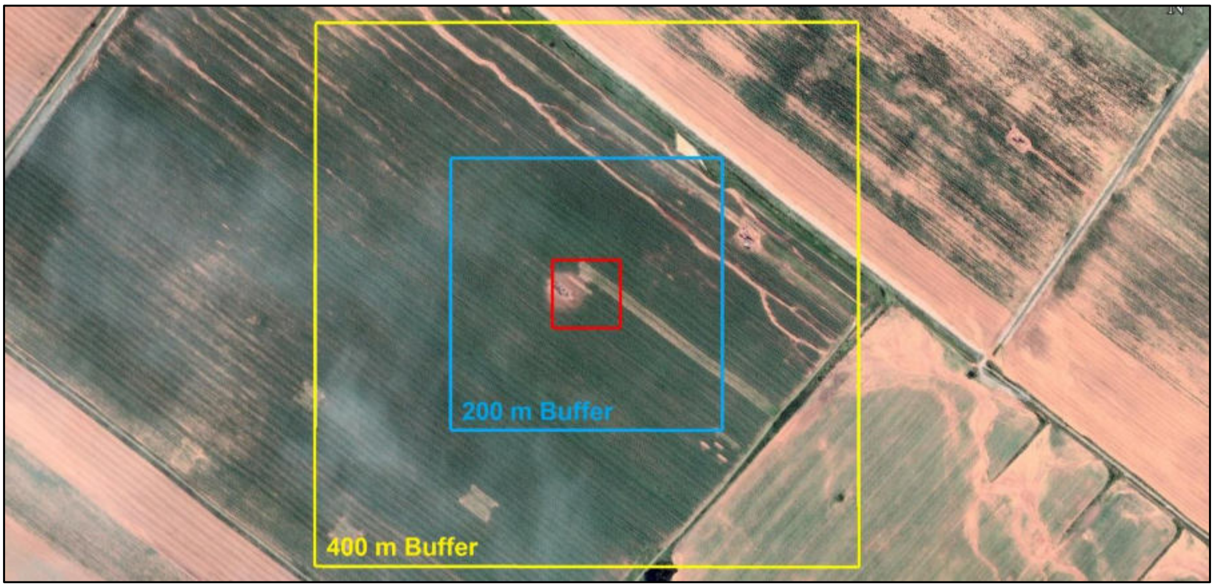

Figure 1: General land use surrounding the study area.

The study area, situated entirely within a sunflower field (Figure 2a below), is at least 360 m from the closest patch of non-cultivated habitat; however, this non-cultivated patch includes degraded vegetation that includes a stand of alien trees. Cultivated fields host monocultures and thus support homogenous floral communities that include commercial species (sunflower in this case) and several typical agricultural weeds e.g., *Amaranthus hybridus*, *Richardia brasiliensis*, *Schkuhria pinnata,* and common grasses such as *Cynodon dactylon* and *Urochloa mosambicensis*. No habitat which is important for floral species was thus present. The surrounding areas have been cultivated for several decades and no habitat that may support the establishment of important floral communities or floral species of conservation concern is available within a 200 m – 400 m radius surrounding the study area (refer again to Figure 1 above).

The faunal assemblage associated with the study area and surrounds was low to moderately low. The sunflower fields still provide a small semblance of habitat; however, these provide increased food resources only during the planting season for existing faunal assemblage (e.g., avifauna (Figure 2b), general invertebrates, and small mammals) but when fallow (Figure 2c), these food resources decrease dramatically. No faunal species of conservation concern were encountered during the field investigation, and the probability of any such species utilising the study area is highly unlikely.

Given the above, the low sensitivity indicated for the plant and animal species themes is confirmed for the study area.

Figure 2: Sunflower fields and faunal evidence within and surrounding the study area.

The Very High sensitivity for the terrestrial biodiversity theme was triggered by the presence of a threatened ecosystem. According to SANBI (2018a), the study area falls within the Vaal-Vet Sandy Grassland vegetation type, which is listed as an Endangered (EN) ecosystem in the 2018 NBA Terrestrial dataset as well as in the 2011 National Threatened Ecosystems dataset; however, the study area is neither within the remaining extent of the 2018 NBA or 2011 National Threatened Ecosystems databases (Appendix A: Figs A3 & A4; Appendix B: Table B1). No remaining habitat to support the important biodiversity features of the Vaal-Vet Sandy Grassland EN ecosystem is located within close proximity of the study area. The Very High sensitivity is disputed for the study area and surrounds.

5. BUSINESS CASE AND IMPACT STATEMENT APPLICABLE TO THE PROPOSED GAS WELL ASSOCIATED WITH THE STUDY AREA.

The study area is of low to moderately low ecological importance. No significant biodiversity features are associated with the study area nor within a 200 m radius of the study area. The probability of floral and faunal species of conservation concern establishing viable populations on site, or within the surrounding habitat, is deemed low. This can be attributed to the long-term association with historic and current cultivation, and fragmentation of the study area from larger, ecologically functioning natural areas.

Based on the findings of both the desktop and field assessment, SAS confirms the designation of the study area as having a low sensitivity for the Animal Species and Plant Species Themes as provided by the National Web-based Screening Tool outcome. The Very High sensitivity for the terrestrial biodiversity is disputed due to the complete transformation of the triggered threatened ecosystem to agricultural fields. This will not change in the foreseeable future as the area forms part of an active commercial farming operation.

The extraction of gas occurring in the study area, along with associated activities, is not anticipated to result in clearance of indigenous or sensitive vegetation, nor will it result in significant or important loss of faunal habitat. Even with potential leakage of gasses from the gas well, there is no sensitive habitat for flora or fauna within 200 m – 400 m and no impact to floral and faunal ecology is anticipated. It is, however, recommended that stringent mitigation measures be in place to counter the release of natural gasses into the atmosphere during gas extraction activities to minimise the potential cumulative negative impacts of gas emissions.

We trust that we have interpreted your requirements correctly. Please do not hesitate to contact us if there are any aspects of this memorandum that you would like to discuss.

Yours Faithfully,

Christien Steyn
SACNASP REG.NO**: 127823/21**

Chris Hooton

Declaration of independence and CVs included in Appendix C

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National Environmental Management: Biodiversity (Act No.10 of 2004). NEMBA

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Water Research Commission. 2017. SWSA Surface water [Vector] 2017. Available from the Biodiversity GIS website.

APPENDIX: PROJECT MAPS

Figure A1: Satellite image depicting the location of the study area in relation to surrounding areas.

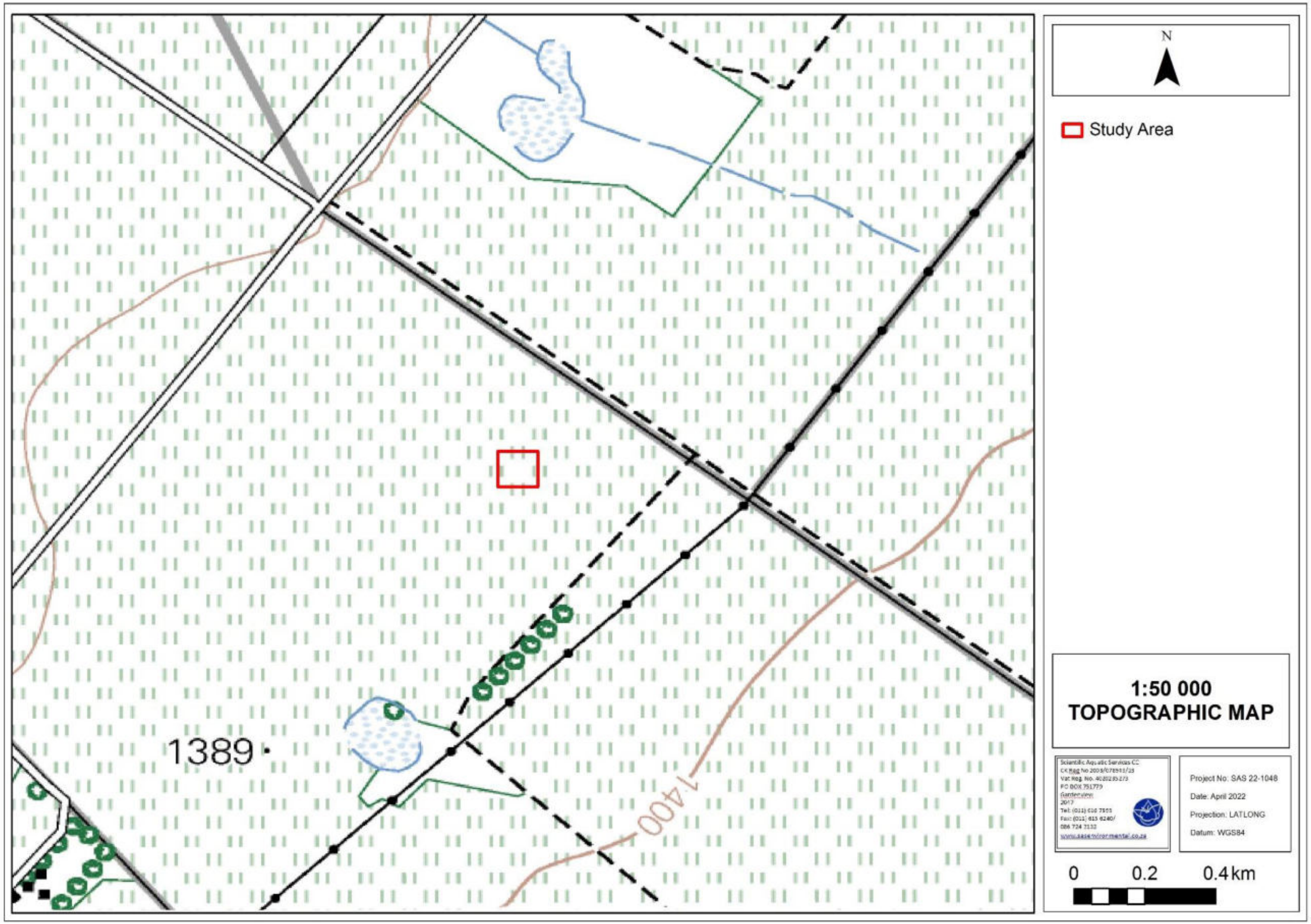


Figure A2: The study area depicted on a 1:50 000 topographical map in relation to the surrounding area.

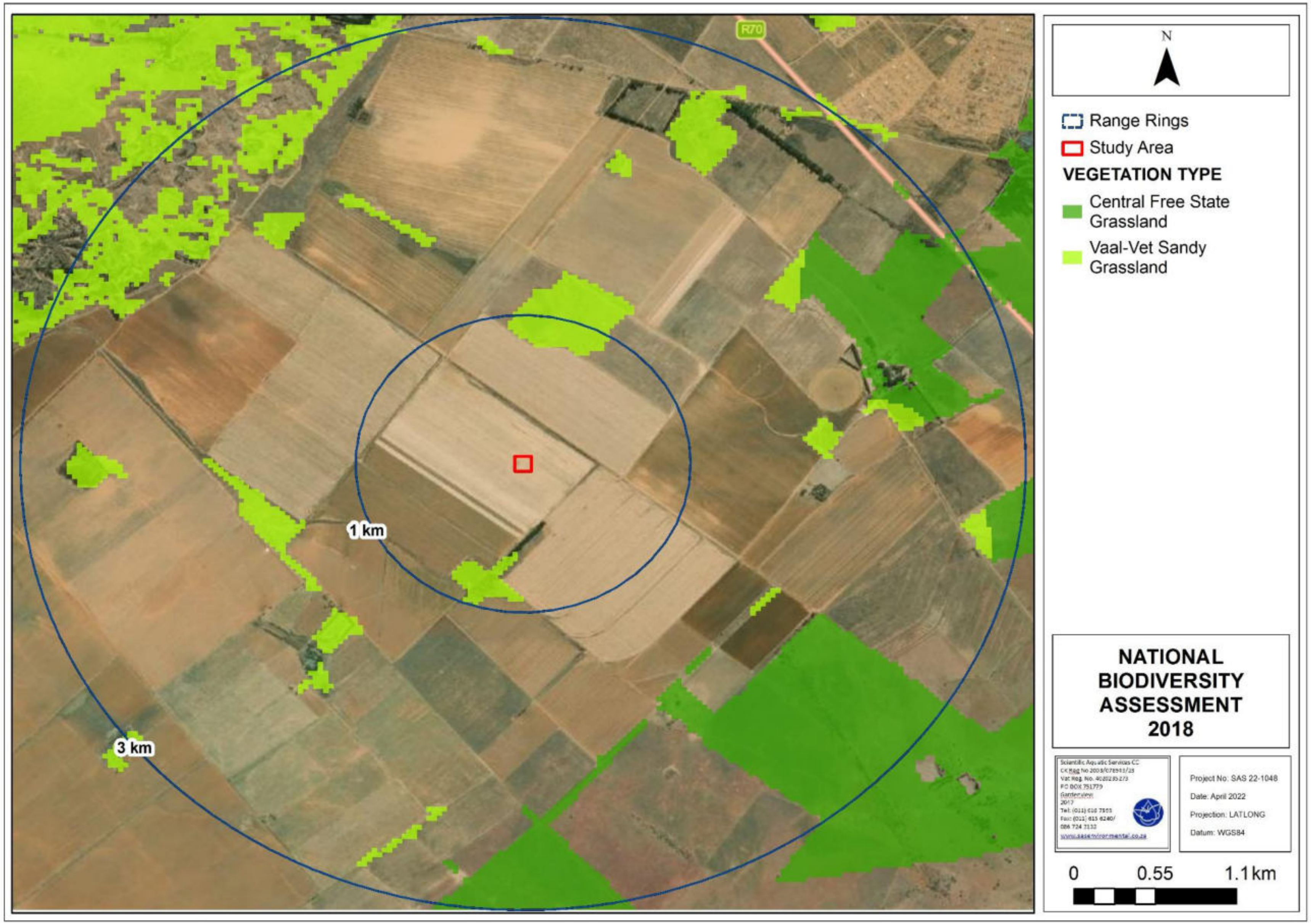


Figure A3: Extent and threat status of vegetation type(s) according to the National Biodiversity Assessment (NBA, 2018).

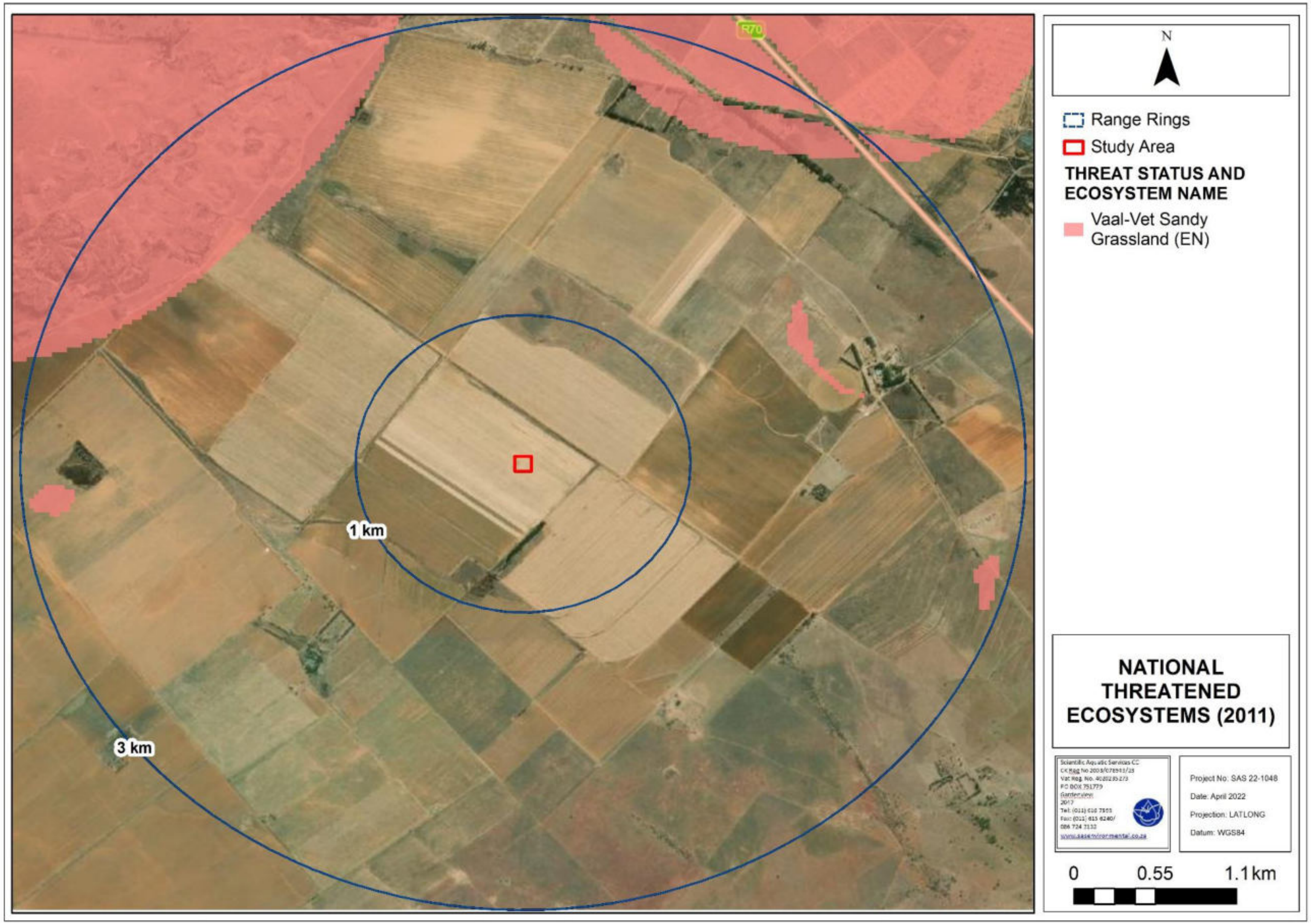


Figure A4: Threatened Ecosystems associated with the study area according to the National Threatened Ecosystem database (2011).

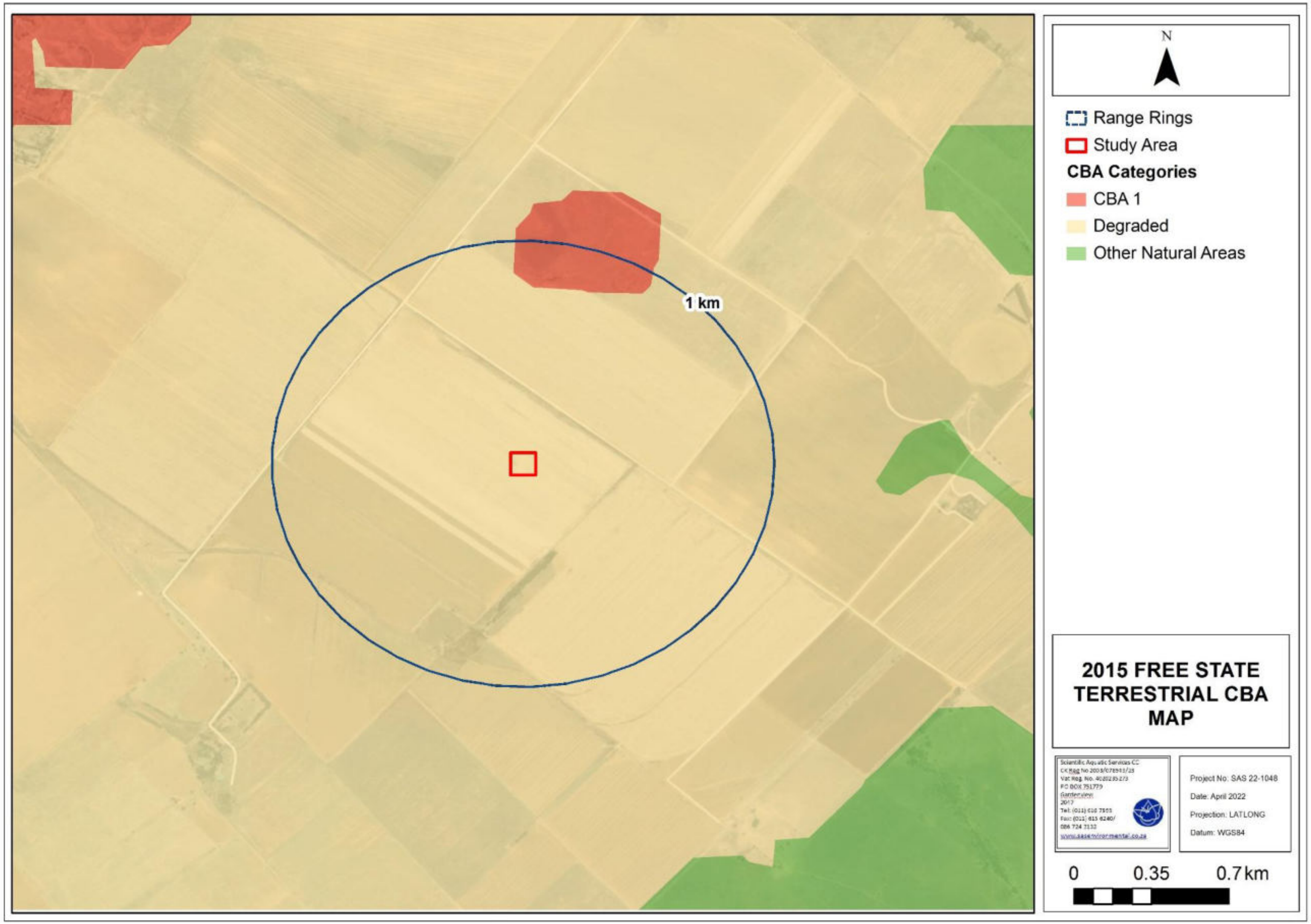


Figure A5: The study area in relation to areas classified in the Free State Terrestrial CBA dataset (2015).

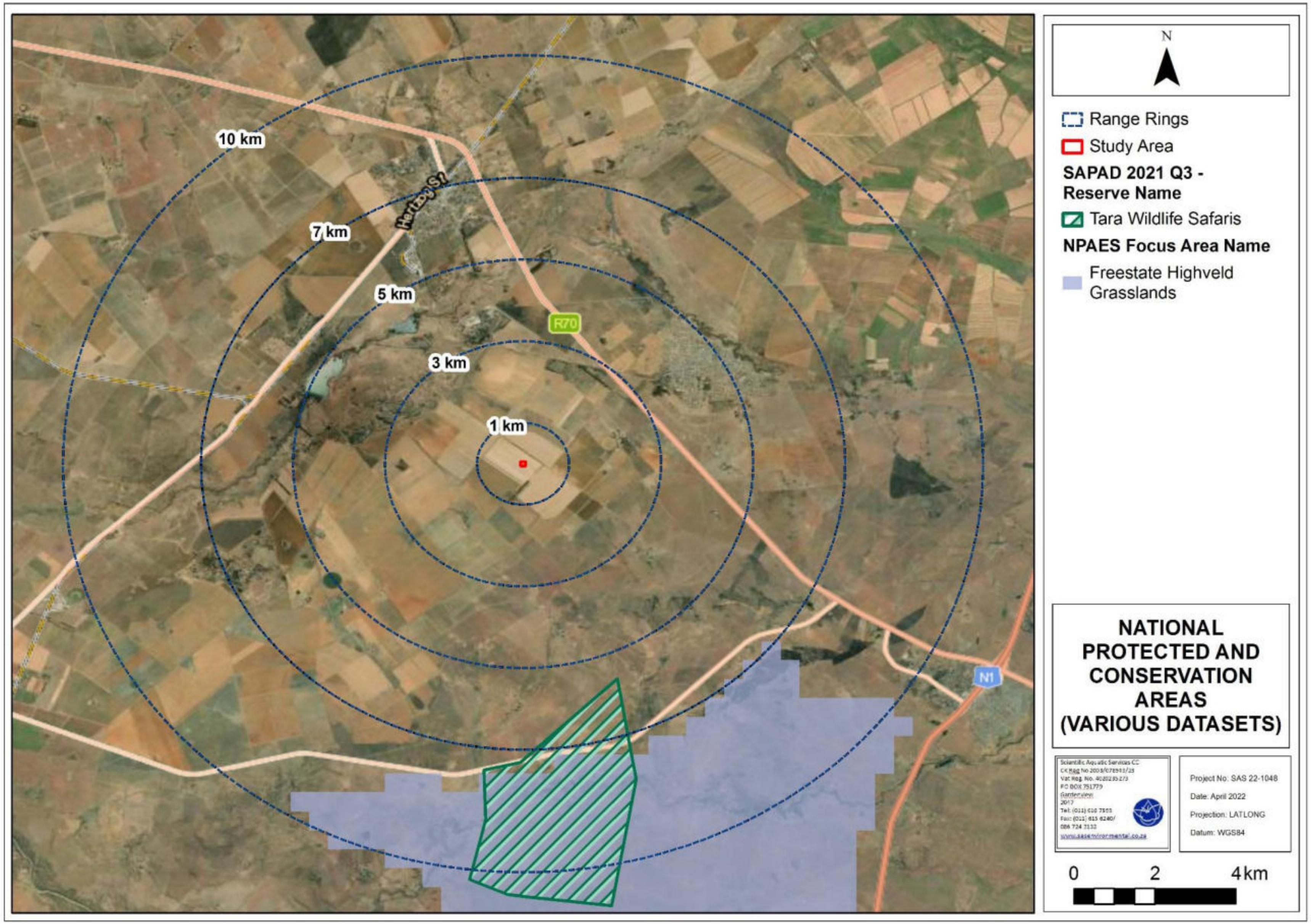


Figure A6: Protected and Conservation areas within a 10 km radius of the study area, according to SAPAD (Q3, 2021) and NPAES (2010).

APPENDIX B: BACKGROUND INFORMATION

Table 1: Summary of the biodiversity characteristics associated with the study area [Quarter Degree Squares (QDS) 2827AA].

DETAILS OF THE STUDY AREA IN TERMS OF SANBI (2018a)	
Biome	The study area is situated within the **Grassland Biome.**
Bioregion	The study area is located within the **Dry Highveld Grassland Bioregion**
Vegetation Type	The study area is situated within the **Vaal-Vet Sandy Grassland** vegetation type**.**
CONSERVATION DETAILS PERTAINING TO THE STUDY AREA (VARIOUS DATABASES)	
NBA (2018): 1) **Ecosystem Protection Level** 2) **Ecosystem Threat Status**	The study area is not located in a listed threatened ecosystem; however, the Vaal-Vet Sandy Grassland ecosystem (currently **not protected** and of which the remaining extent is **EN)** is indicated within 3 km of the study area**.** Ecosystem types are categorised as "not protected", "poorly protected", "moderately protected" and "well protected" based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act, 2003 (Act 57 of 2003), and compared with the biodiversity target for that ecosystem type.
SAPAD (2021, Q3); SACAD (2021, Q3); NPAES (2010)	No areas under the South African Conservation Areas Database (SACAD, 2021 Q3) were indicated within 10 km of the study area. The South African Protected Areas Database (SAPAD, 2021 Q3) indicates the **Tara Wildlife Safaris** reserve approximately 6 km south of the study area. The National Protected Areas Expansion Strategy (NPAES, 2010) database indicates the **Freestate Highveld Grasslands focus area** approximately 7 km south of the study area. No other protected or conservation areas were indicated within 10 km of the study area.

DESCRIPTION OF THE VAAL-VET SANDY GRASSLAND (GH10) VEGETATION TYPE RELEVANT TO THE STUDY AREA (MUCINA & RUTHERFORD 2006)	
Distribution	North-West and Free State Provinces: South of Lichtenburg and Ventersdorp, stretching southwards to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort area north of Bloemfontein.
Climate	Warm-temperate, summer-rainfall climate. High summer temperatures. Severe frost (37 days per year on average) occurs in winter.
Altitude (m)	1 220–1 560 m, generally 1 260–1 360 m
Conservation	**Endangered**. Target 24%. Only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63% transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep. Erosion very low (85.3%) and low (11%).
Geology & Soils	Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karoo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north. Soil forms are mostly Avalon, Westleigh and Clovelly. Dominant land type Bd, closely followed by Bc, Ae and Ba.
Vegetation & landscape features	Plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated

Climate:

MAP (mm)	**MAT (°C)**	**MFD (days)**	**MAPE (mm)**	**MASMS (%)**
530	16.4	37	2423	79

IBA (2015)	The study area is not located in an Important Bird and Biodiversity Area (IBA), nor is it located within 10 km of one.		increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall.

MINING AND BIODIVERSITY GUIDELINES (2013)
According to the Mining and Biodiversity Guidelines (2013), the study area is not located in an area considered to pose a risk to mining from a biodiversity perspective.
2015 FREE STATE TERRESTRIAL CRITICAL BIODIVERSITY AREAS DATABASE)
The study area is not located in an area important for meeting provincial biodiversity targets. The 2015 Free State Terrestrial CBA database indicates the study area to be in an area considered **Degraded**, i.e., portions of land that are not in climax condition due to factors other than physical disturbance. Large portions of the Free State have been degraded and are not available for conservation. According to the 2009 land cover map of the Free State (GeoterraImage, 2011) a large percentage of the province is degraded while 33.67% is transformed.

National web-based ENVIRONMENTAL Screening Tool (accessed 2022)	
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	
Animal Species Theme	For the Animal Species theme, the entire study area is considered to have a Low Sensitivity.
Plant Species Theme	For the Plant Species theme, the entire study area is considered to have a Low Sensitivity where no Red Data Listed (RDL) plant taxa are anticipated to occur due to unsuitable habitat conditions.
Terrestrial Theme	The Terrestrial Sensitivity for the entire study area is considered to have a Very High Sensitivity. The triggered sensitivity feature is the EN ecosystem (i.e., the Vaal-Vet Sandy Grassland).

NBA = National Biodiversity Assessment; SAPAD = South African Protected Areas Database; SACAD = South African Conservation Areas Database; NPAES = National Protected Areas Expansion Strategy; IBA = Important Bird Area; MAP = Mean annual precipitation; MAT = Mean annual temperature; MAPE = Mean annual potential evaporation; MFD = Mean Frost Days; MASMS = Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply); CBA = Critical Biodiversity Areas; ESA = Ecological Support Areas.

APPENDIX: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Christien Steyn	MSc Plant Science (University of Pretoria)
Christopher Hooton	BTech Nature Conservation (Tshwane University of Technology)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Christien Steyn		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Fax:	086 724 3132
Telephone:	011 616 7893		
E-mail:	christien@sasenvgroup.co.za		
Qualifications	MSc (Plant Science) (University of Pretoria) BSc (Hons) Plant Science (Invasion Biology) (University of Pretoria) BSc Environmental Science (University of Pretoria)		
Registration / Associations	Member of the South African Association of Botanists (SAAB) Member of the Botanical Society of South Africa (BotSoc) Professional member of the South African Council for Natural Scientific Professions (SACNASP) Member of the Grassland Society of South Africa (GSSA) Member of the Land Rehabilitation Society of Southern Africa (LARSSA)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Christopher Hooton, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.

Specialist Signature

I, Christien Steyn, declare that -

- I act as the **independent specialist** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

CSteyn

Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Senior Scientist, Member Biodiversity Specialist
Joined SAS Environmental Group of Companies	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Free State
Africa - Zimbabwe, Sierra Leone, Zambia

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTIEN STEYN

PERSONAL DETAILS

Position in Company	Floral Ecologist
Joined SAS Environmental Group of Companies	2018

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 127823/21)
Member of the Botanical Society of South Africa (BotSoc)
Member of the Grassland Society of South Africa (GSSA)
Member of the Land Rehabilitation Society of Southern Africa (LARSSA)
Member of the South African Association of Botanists (SAAB)

EDUCATION

Qualifications

MSc Plant Science (University of Pretoria)	2017
BSc (Hons) Plant Science (Invasion Biology) (University of Pretoria)	2014
BSc Environmental Science (University of Pretoria)	2013

Short courses and Training

- Advanced Grass Identification Course
- Practical Plant Identification, including Herbarium Usage and Protocols
- Vegetation Classification and Mapping: Use of Geographic Information System for understanding vegetation pattern and biodiversity conservation.
- Introduction to Statistics for Biologists: Applications of plant ecology principles in plant conservation, i.e., species distribution modelling, alien plant invasions, conservation planning
- International Plant Functional Trait Course: Hands-on, field-based exploration of plant functional traits, along with experience in the usage of plant traits data in climate-change research and ecosystem ecology. https://www.uib.no/en/rg/EECRG/97477/plant-functional-traits-course-2

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Free State

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Terrestrial Ecological and Biodiversity Scoping Assessments
- Terrestrial Ecological and Biodiversity Screening Assessments
- Floral Assessments
- Input into Terrestrial Rehabilitation Plan design with the focus on the re-establishment of vegetation
- Floral Rescue and Relocation Plans
- Alien and Invasive Plant Control and Management Plans (AIPCPs)
- Alien and Invasive Plant Identification and awareness training
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Desktop Studies, Mapping and Background Information Research

APPENDIX 10

National Screening Report

SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number: TBA

Project name: TBA

Project title: Ventersburg - Gas Bulk Sampling

Date screening report generated: 20/04/2022 11:53:42

Applicant: Gold One Africa Ltd

Compiler: Prime Resources

Compiler signature:

…………………………………………………………………………………………………

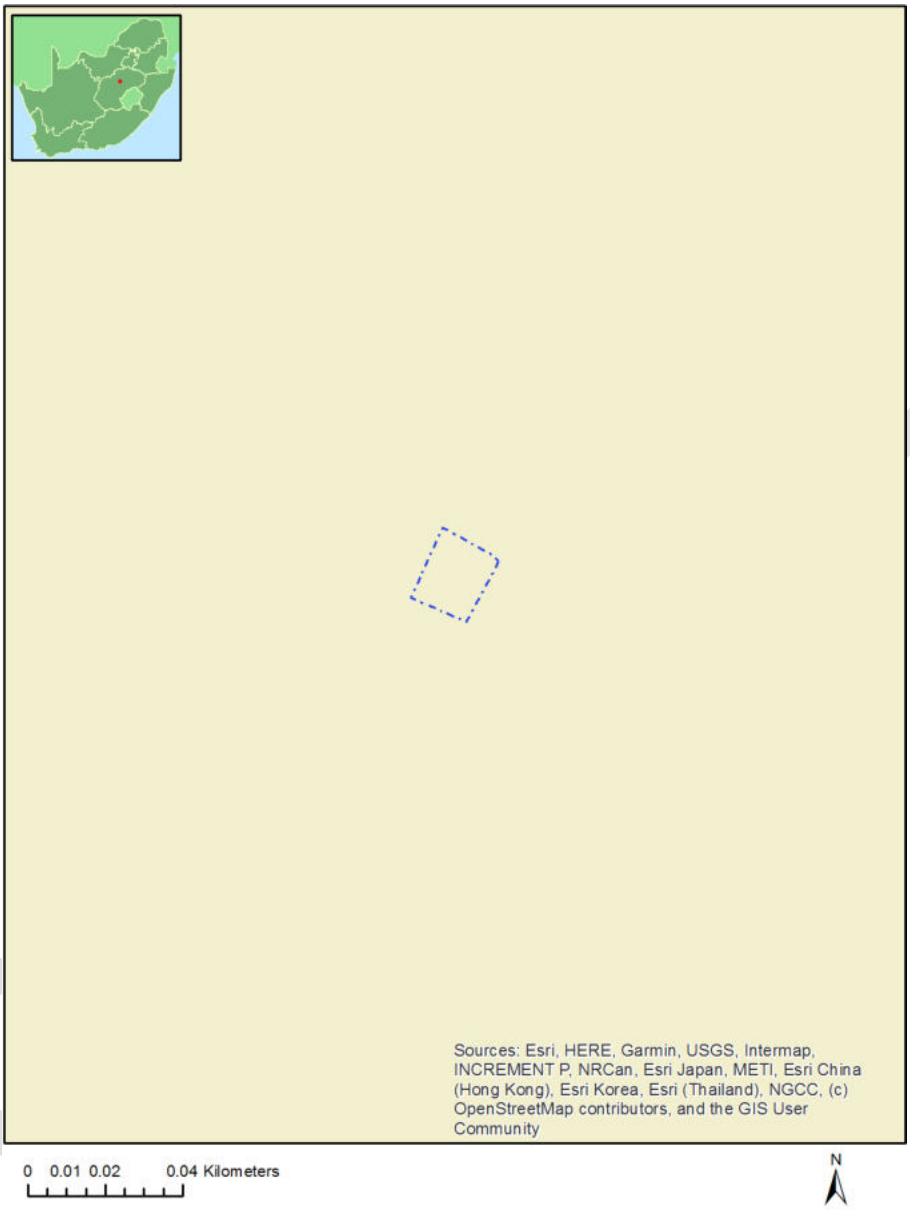
Application Category: Mining|Exploration Right|Gas or Oil Terrestrial

Table of Contents

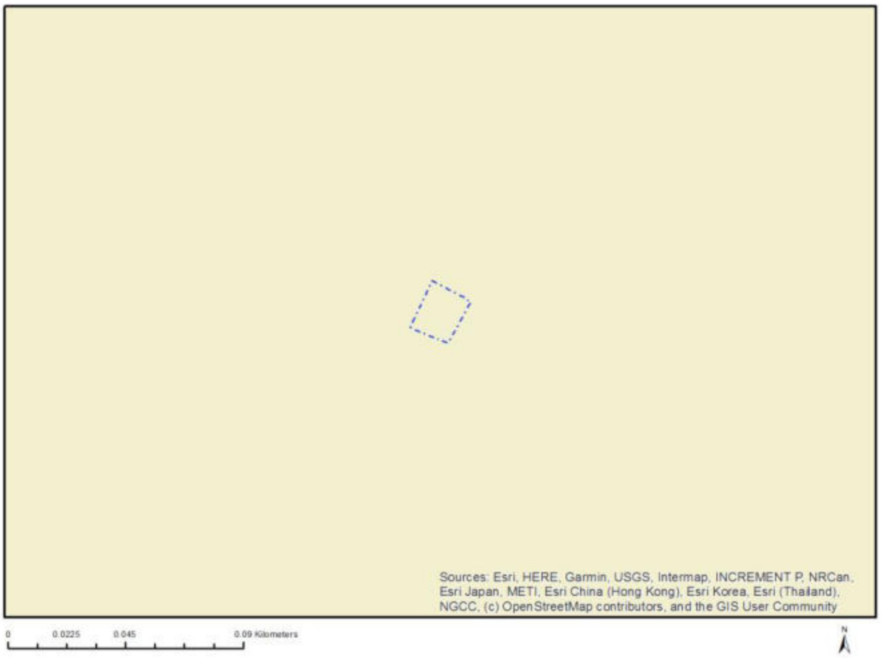
Proposed Project Location

Orientation map 1: General location

General Orientation: TBA



Map of proposed site and relevant area(s)



Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	VOGELS RAND	720	0	28°2'54.14S	27°2'55.52E	Farm
2	VOGELS RAND	720	1	28°2'18.09S	27°2'15.56E	Farm Portion

Development footprint[1] vertices:
No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No	EIA Reference No	Classification	Status of application	Distance from proposed area (km)
1	12/12/20/2669/A	Solar PV	Approved	28.6
2	12/12/20/2669	Solar PV	Approved	28.6
3	14/12/16/3/3/1/1322	Solar PV	Approved	2.6

[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is:
Mining|Exploration Right|Gas or Oil Terrestrial.

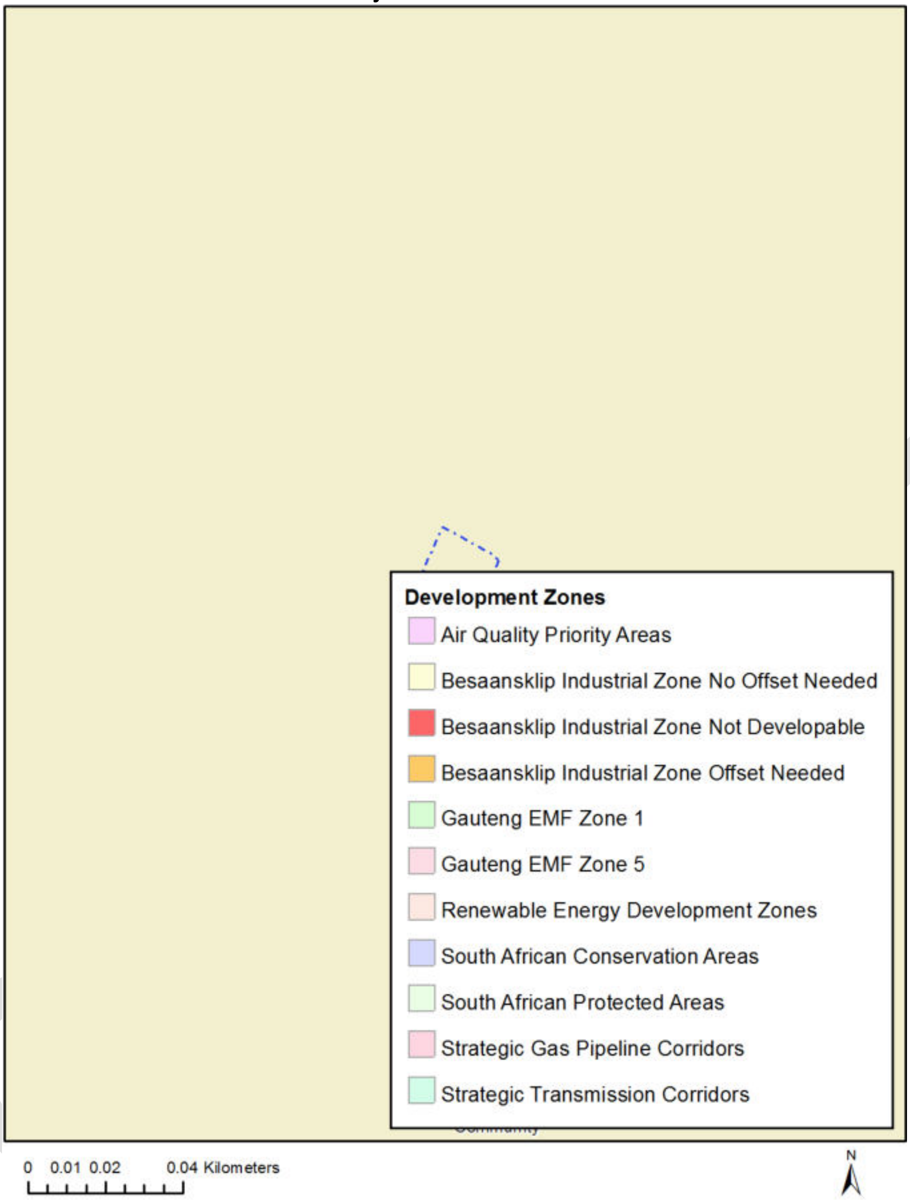
Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

No intersection with any development zones found.

Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones

Project Location: TBA



Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

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
Paleontology Theme			X	
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Agricultural Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf
2	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
5	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
6	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
7	Hydrology	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols

	Assessment	/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	RFI Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
9	Noise Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Noise_Impacts_Assessment_Protocol.pdf
10	Geotechnical Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
11	Health Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
12	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
13	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
14	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 8 km of other civil aviation aerodrome

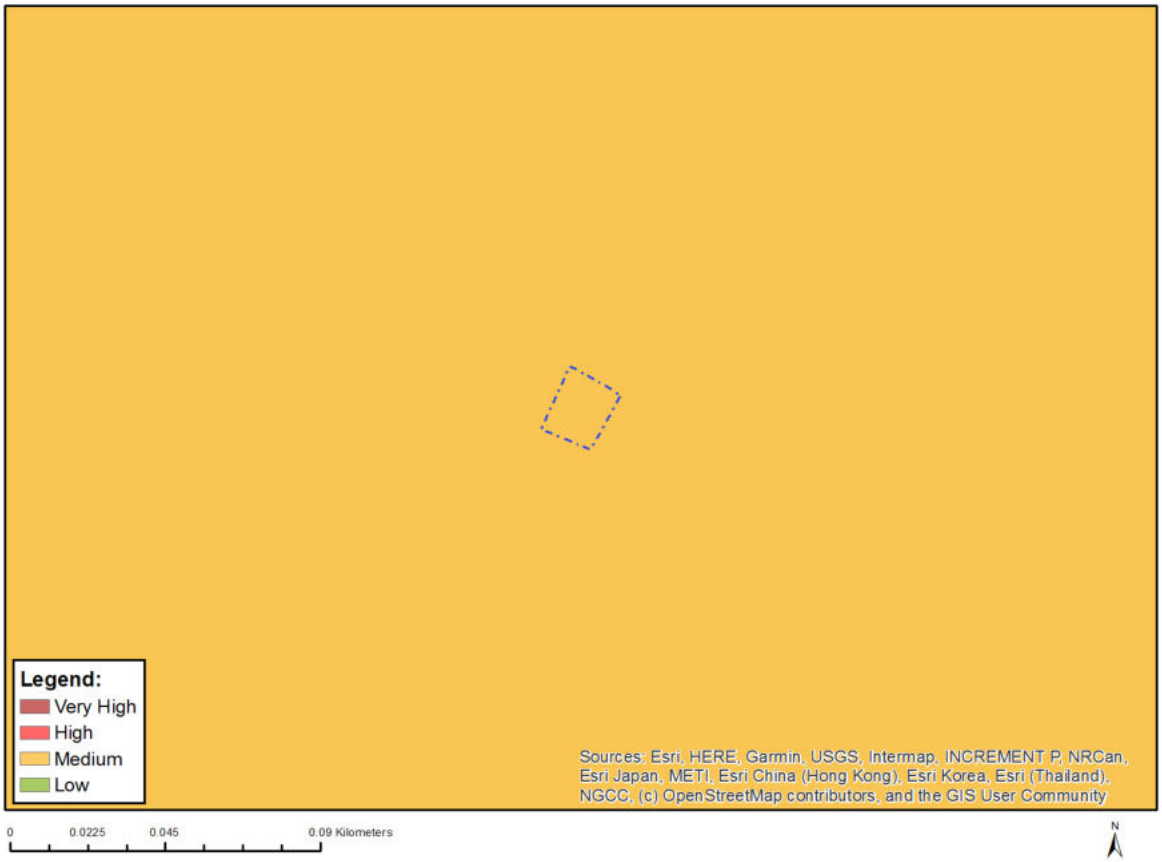
MAP OF RELATIVE DEFENCE THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity

20/04/2022

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY

Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Endangered ecosystem

APPENDIX 11

Site Sensitivity Verification Report

Prime Resources (Pty) Ltd
The Workshop 70–7th Avenue Parktown North 2193
PO Box 2316 Parklands 2121
T +27 11 447 4888 **F** +27 86 604 2219 **E** prime@resources.co.za
www.resources.co.za

prime | resources
environmental
consultants

GOLD ONE AFRICA LTD

SITE SENSITIVITY VERIFICATION REPORT FOR THE PROPOSED VENTERSBURG NATURAL GAS BULK SAMPLING PROJECT

MAY 2022

PREPARED FOR

GOLD ONE
AFRICA LIMITED

Gold One Africa Limited
Postnet Suite 415
Private Bag X75
Bryanston
2021

DECLARATION OF INDEPENDENCE

Prime Resources is an independent environmental consulting firm with no vested interest in the proposed project other than to fulfil the contract for delivery of specialised environmental consulting services including, among others, those stipulated in the terms of reference.

We, Gené Main and Monique van der Westhuizen, in our capacity as environmental consultants under the employ of Prime Resources, hereby declare that we –

- Act as independent consultants;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- Have not, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not;
- Based on the information provided to Prime Recourses by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of our professional ability;
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and / or further work in this field; and
- Undertake to have our work peer-reviewed regularly by a competent person.

Report Compiled by:	**Reviewed by:**
Monique van der Westhuizen Environmental Scientist prime | resources environmental consultants	Gené Main Principal Environmental Consultant *Reg. EAP (EAPASA) No 2019/1257* prime | resources environmental consultants

TABLE OF CONTENTS

FIGURES

TABLES

ACRONYMS

ATNS	Air Traffic & Navigation Services
ACC	Area Control Centre
CBA	Critical Biodiversity Area
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act No. 73 of 1989
ECO	Environmental Compliance Officer
EN	Endangered
ESA	Ecological Support Area
E-GIS	Environmental Geographic Information System
EIA	Environmental Impact Assessment
ER	Exploration Right
ESR	Environmental Screening Report
EMPr	Environmental Management Programme Report
FEPA	Freshwater Ecosystem Protected Area
Ga	Giga-annum / billion years
GHG	Greenhouse Gases
GIS	Geographic Information System
IBA	Important Bird and Biodiversity Areas
ICOA	International Civil Aviation Organization
Ma	Mega-annum / million years
MPRDA	Mineral and Petroleum Resources Development Act (No. 28 of 2002)
NECSA	Nuclear Energy Corporation of South Africa
NEMA	National Environmental Management Act (No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act (No. 10 of 2004)
NPAES	National Protected Area Expansion Strategy
NWA	National Water Act (No. 36 of 1998)
PIA	Palaeontological Impact Assessment
SACAA	South African Civil Aviation Authority
SACAD	South African Conservation Areas Database
SANBI	South African National Biodiversity Institute
SANRAL	South African National Roads Agency SOC Ltd
SAPAD	South African Protected Areas Database
SAHRIS	South African Heritage Resources Information System
SAS	Scientific Aquatic Services
SSV	Site Sensitivity Verification
SWSA	Strategic Water Source Areas
UNESCO	United Nations Educational, Scientific and Cultural Organization
WMA	Water Management Area

1 INTRODUCTION

Gold One Africa Limited (hereafter referred to as the Applicant or Gold One Africa) is the holder of an Exploration Right (12/3/214 ER) which covers various farms situated in the Magisterial Districts of Hennenman, Virginia and Ventersburg in the Free State Province, South Africa. Gas reserves are confined to northeast striking Virginia and Ventersburg faults and intrusive dykes, which act as conduits for natural gas. Gold One Africa has submitted an application in terms of Section 20 of the Mineral and Petroleum Resources Developments Act, Act No. 28 of 2002 (MPRDA) to undertake bulk sampling of natural gas.

Gold One Africa has appointed Prime Resources (Pty) Ltd (Prime Resources) as the Environmental Assessment Practitioner (EAP) to conduct the necessary scope in fulfilment of an Application for Environmental Authorisation for the proposed bulk sampling project. As per GN960 of 2019[1], read with Section 24(5)(a) of the National Environmental Management Act No. 107 of 1998 (NEMA), an Environmental Screening Report (ESR) was generated for the application using the National Web-based Screening Tool. The ESR identified the initial sensitivity of several environmental themes and the required assessments per the protocols described in GN320 and GN1150 of 2020 (Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes).

This report has been prepared in fulfilment of the following requirement of GN320 and GN1150: *Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the national web based environmental screening tool (screening tool), where determined, must be confirmed by undertaking a site sensitivity verification (SSV).*

1.1 Terms of Reference

GN320 and GN1150 prescribe the following for the SSV:

1. The SSV must be undertaken by an EAP or a specialist.
2. The SSV must be undertaken through the use of
    a. a desktop analysis, using satellite imagery
    b. a preliminary on-site inspection
    c. any other available information.
3. The outcome of the SSV must be recorded in the form of a report that
    a. 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.
    b. contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity
    c. is submitted together with the relevant reports prepared in accordance with the requirements of the NEMA Environmental Impact Assessment (EIA) Regulations (2014).

This report serves to record the outcomes of the SSV for the proposed natural gas bulk sampling project.

---

[1] Notice of the Requirement to Submit a Report Generated by the National Web Based Environmental Screening Tool in Terms of Section 24(5)(h) of the National Environmental Management Act, 1998 (Act No 107 of 1998) and Regulation 16(1)(B)(V) of the Environmental Impact Assessment Regulations, 2014, as Amended

1.2 Details of authors

Prime Resources, established in 2003, is a specialist environmental consulting firm providing environmental and related services. Prime Resources was founded by Peter Theron (PrEng, SAIMM), who has over 30 years' experience in the field of environmental science and engineering.

Gené Main (Pr. Sci.Nat, Environmental Science), the Project Manager and Principal Scientist for the proposed project, has a M.Sc. (Botany) from the University of the Western Cape and 15 years' experience in the field of environmental science. Gené is registered as an Environmental Assessment Practitioner with EAPASA.

Monique van der Westhuizen is an Environmental Scientist with a BSc Honours in Hydrogeology. She has experience in groundwater systems, environmental monitoring, laboratory work, reporting, auditing, ECO work, and various Environmental Authorisation processes.

Certain elements of the verification were also carried out by the specialists who undertook the site visits for their respective specialist studies. These specialists are referenced in this report.

2 BRIEF PROJECT DESCRIPTION

The proposed Ventersburg Natural Gas Bulk Sampling Project will take place at an existing borehole (AFO-024), which was drilled during previous prospecting activities. The application area proposed for bulk sampling is situated on Portion 1 of the Farm Vogels Rand 720, within the Lejweleputswa District Municipality and Matjhabeng Local Municipality. The subject area is situated 4.6 km southwest of Phomolong, 6.5 km south of Hennenman and 11.2 km northwest of Ventersburg. The objective of the proposed bulk sampling is to identify whether there is any economically exploitable and commercially quantifiable natural gas. If viable, this energy source can be utilized to generate electricity for Gold One Africa’s approved mining activities.

Bulk sampling of natural gas will be conducted over a 2-year period by means of using a blower / portable compression unit. It is proposed that a high-efficiency flare equipped with a flow meter will be installed at the existing well. The flare will combust methane flowing from the well for approximately 2 weeks. Thereafter, a sample will be collected from venting holes via low-pressure pipes from the venting well leading to a portable compressor. Gas samples will be compressed into individual high-pressure cylinders for storage and transported to the Nuclear Energy Corporation of South Africa (NECSA) for analyses. No hydraulic fracturing (fracking) will be undertaken as part of the project activities.

The extent of the proposed sampling will require a 50 m x 70 m test rig surface area. Access to the test site will be gained via the existing farm road and a new dirt road of approximately 300 m. A gas-operated generator and blower / portable compression unit will be positioned on pre-cast concrete plinths within the fenced off test rig area. The test rig area will be surfaced with crushed aggregate. Other than the establishment of the fence, no construction activities will take place.

The general surrounding area is highly developed and land uses surrounding the gas extraction well almost exclusively comprise of agricultural fields. Upon completion of the bulk sampling, the test rig area and the dirt road will be rehabilitated to its pre-exploration state. If gas samples are deemed to be unfeasible, well decommissioning and plugging will be done in accordance with Regulation 132 of the MPRDA (GNR466 of 2015). Refer to Figure 1 for a locality map and Figure 2 for a site layout plan.

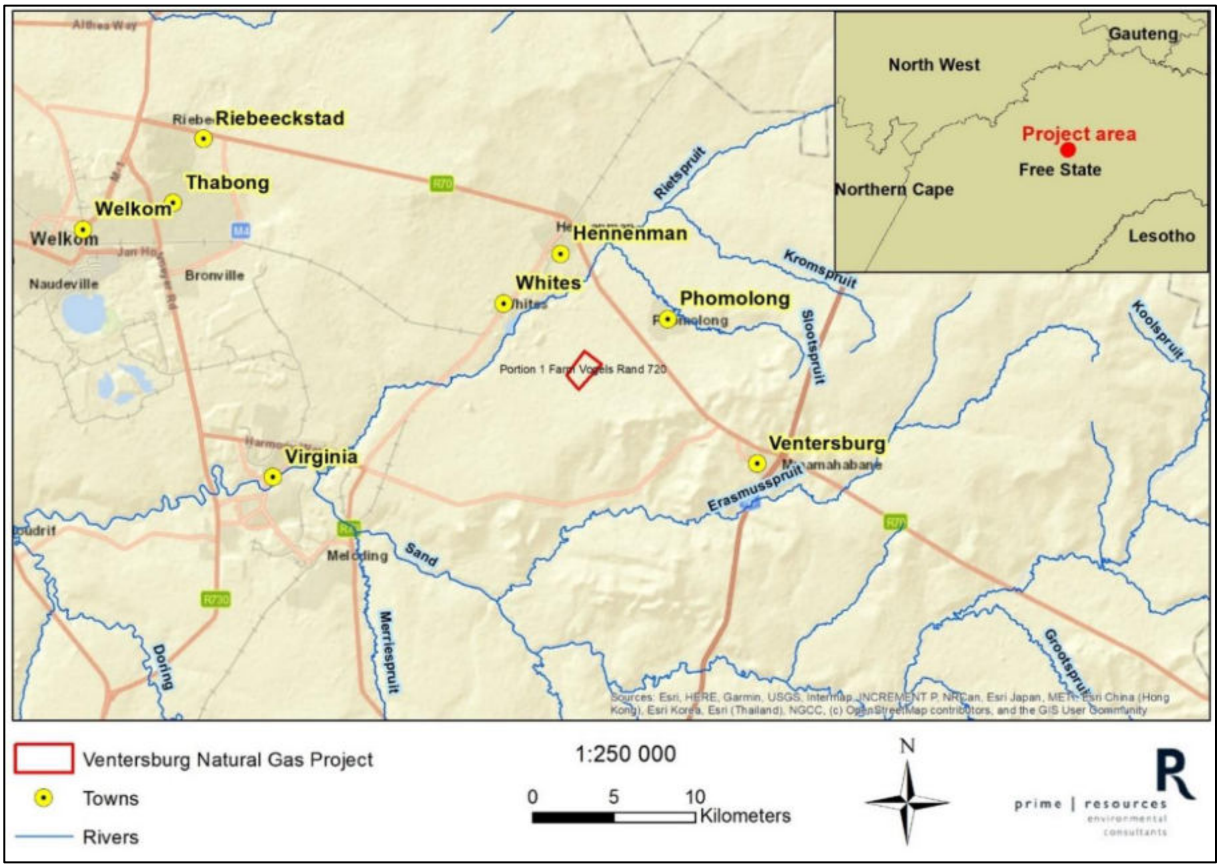


Figure 1. Locality map for the proposed project

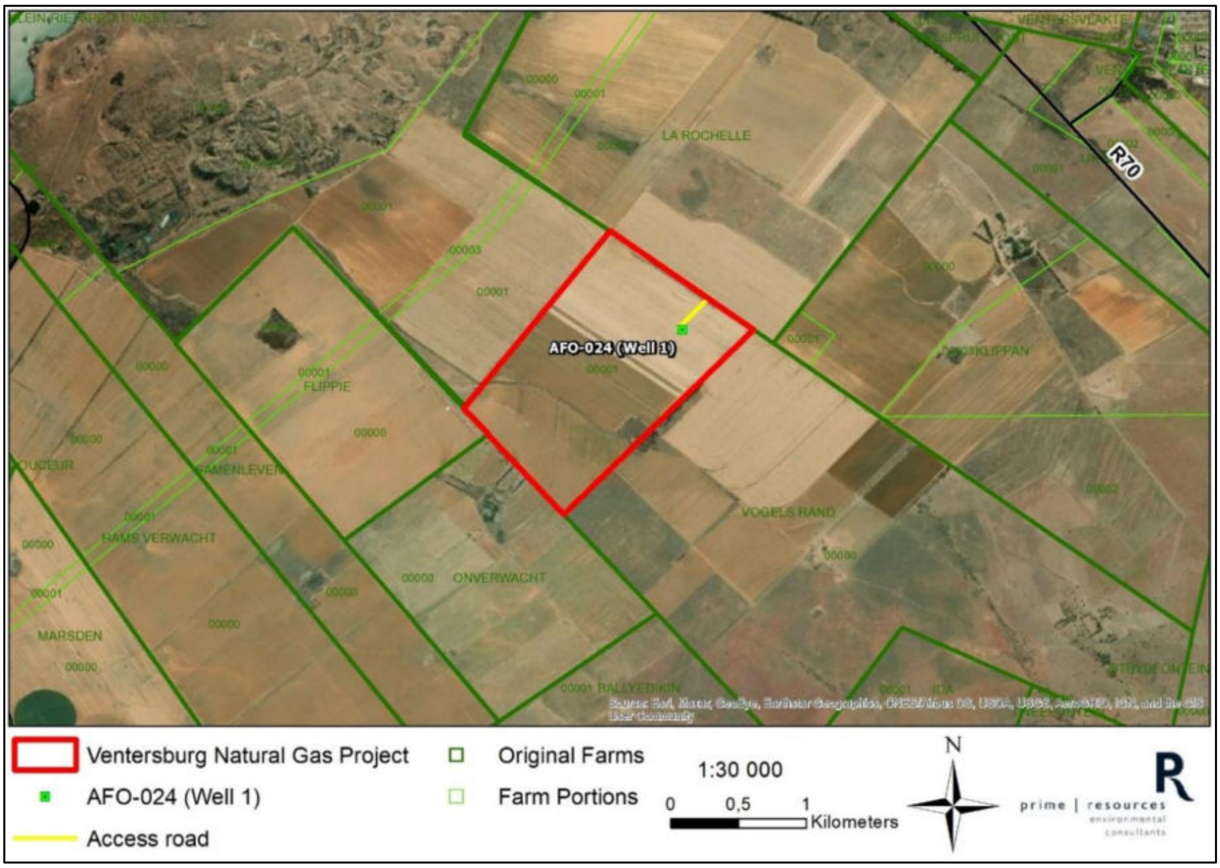


Figure 2. Site plan showing the existing well and proposed route position of the dirt access road

3 METHODOLOGY

A comparative analysis of the current use of the land and the environmental sensitivity versus that presented in the ESR was undertaken through the use of the following:

3.1 Desktop analysis

Geographical data was sourced from the Department of Forestry, Fisheries and the Environment (DFFE) Environmental Geographical Information Systems (E-GIS), the South African National Biodiversity Institute's (SANBI) Biodiversity spatial datasets, the Free State Biodiversity Plan, the South African Heritage Resources Information System (SAHRIS), the South African Protected Areas Database (SAPAD, 2020), the South African Conservation Areas Database (SACAD, 2020), and ICT Service Strategy and Systems and the spatial datasets (satellite imagery) provided by Google and Microsoft to assess the expected sensitivity. Existing surface geology maps were also consulted.

3.2 Preliminary on-site inspection

Photographs of the site were taken in October 2020. Additional photographs were taken by Prime Resources in May 2022 during a preliminary on-site inspection. Photographs were also taken by various specialists during site visits conducted in 2022. These photographs were used to assess the current status of the site in order to confirm or dispute the current use of the land and the environmental sensitivity as identified by the National Screening Tool. Photographs have been included as evidence of the verified / disputed environmental sensitivity.

3.3 Other information available

Applicable information was also sourced from other EIAs compiled for projects in the area.

4 SUMMARY OF ENVIRONMENTAL SCREENING REPORT (ESR)

Table 1 below summarises the sensitivities for environmental themes per the ESR (Appendix 10 of the Scoping Report) as well as the required specialist assessments / procedures as per GN320 / GN1150. Additional environmental receptors were identified by the EAP in addition to the themes of the ESR which are further reported in the Scoping Report.

Table 1. Environmental Sensitivity as identified in the ESR

No	Theme	Predicted sensitivity	Verification method
1	Agriculture	**High**	*Specialist assessment*
2	Animal Species	**Low**	*Specialist assessment*
3	Aquatic Biodiversity	**Low**	*Specialist assessment*
4	Archaeology and Cultural Heritage	**Low**	*Specialist assessment*
5	Civil Aviation	**High**	*Other data source*
6	Defence	**Low**	*Other data source*
7	Palaeontology	**Medium**	*Specialist assessment*
8	Plant Species	**Low**	*Specialist assessment*
9	Terrestrial Biodiversity	**Very High**	*Specialist assessment*

5 RESULTS AND DISCUSSION

This section summarises the outcomes of the comparative analysis performed for the purposes of verifying the sensitivity of the various environmental themes for the site under application per the ESR. The various specialist studies carried out are attached as appendices to the Scoping Report.

5.1 Current land use

From Google Earth satellite imagery (Figure 3) and site visits undertaken in 2022 (appointed specialists, Figure 6; Prime Resources, Figure 7), the land use associated with the proposed project surrounding the gas extraction well is confirmed to be agricultural fields that have been cultivated with sunflower crops. Refer to Figure 4 for the land cover map of the subject area.

Figure 3. Google Earth Imagery of the proposed project area displaying agriculture as the dominant land use

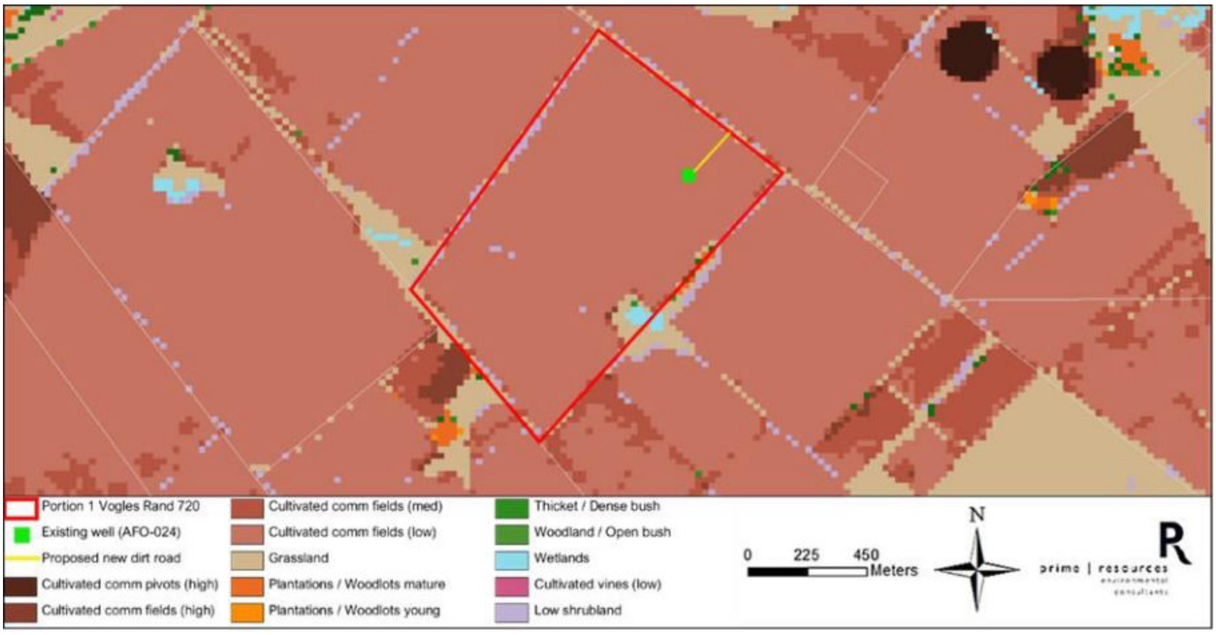


Figure 4. Land cover map of the application area (SANBI, 2014)

Figure 5. Photographs showing the state of the site as at October, 2020

Figure 6. Photographs depicting the land uses associated with the investigation area (SAS, 2022)

Figure 7. Photographs showing the state of the site as at May 2022

5.2 Agriculture

According to the ESR, the area has a "high" sensitivity in terms of *Agricultural* theme (refer to Figure 8). The SSV for this theme was performed as part of the Soil, Land Use and Land Capability Compliance Statement for the proposed project by Zimpande Research Collaborative (Pty) Ltd in May 2022 (refer to Appendix 4 of the Scoping Report). The Compliance Statement was compiled according to the protocol for the specialist assessment and minimum report content requirements for the environmental impacts on agricultural resources (GN320 of 2020).

The soils in the area include soils of the Bainsvlei/Avalon forms, which are generally ideal for arable agriculture. These soils are characterised by the presence of a water table below a 1.2 m depth with a weak apedal structure and a loamy texture. The Avalon soil form (Av) consists of an Orthic A horizon, a yellow-brown apedal B horizon, and a soft Plinthic C horizon. The A and B horizons have good internal drainage properties; therefore, water can move freely through them. However, the Plinthic C shows signs of mottling and localization of iron and manganese concretions as a result of a fluctuating water table. Anaerobic conditions occur in this zone and iron and manganese reduce and then later when the water table drops, these metals oxidize into localized concretions. These soils are highly sought after for dryland crop production as they can produce good crop yields due to the ability of the A and B horizons to drain freely and the ability of the Plinthic horizon to store water in the lower part of the profile, where the water can then be tapped by roots at a later stage during the growing season.

The land capability is classified as Class II (arable, with minor limitations) and land potential is classified as L3 (good potential land). Class II land has limitations that reduce the choice of plants or require moderate conservation practices. It is the specialist's opinion that due to the size and nature of the proposed project, the impact on soils, land use and land capability will be very low to negligible impact on soils, land use and land capability.

Figure 8. Agricultural sensitivity of area under application (as per the ESR)

5.3 Archaeological and cultural heritage

The ESR classifies the area as having a "low" sensitivity in terms of the *Archaeological and Cultural Heritage* theme (refer to Figure 9). The SSV for this theme was obtained from the phase 1 Heritage Assessment, dated December 2011. The application area falls within the same footprint covered in the 2011 study. Refer to Appendix 6 of the Scoping Report.

No sites of archaeological significance were identified within the footprint of the proposed project; however, a cemetery comprising of approximately 40 graves was identified 1.5 km southwest of the exploration well. Refer to Figure 10. The archaeologist recommended that a 60 m buffer be implemented around the cemetery, therefore not affecting the proposed project.

The area is deemed to be a low-risk area for containing heritage resources due to the nature of the current land use (agricultural). The ESR sensitivity for the archaeological and cultural sensitivity theme of "low" is therefore verified.

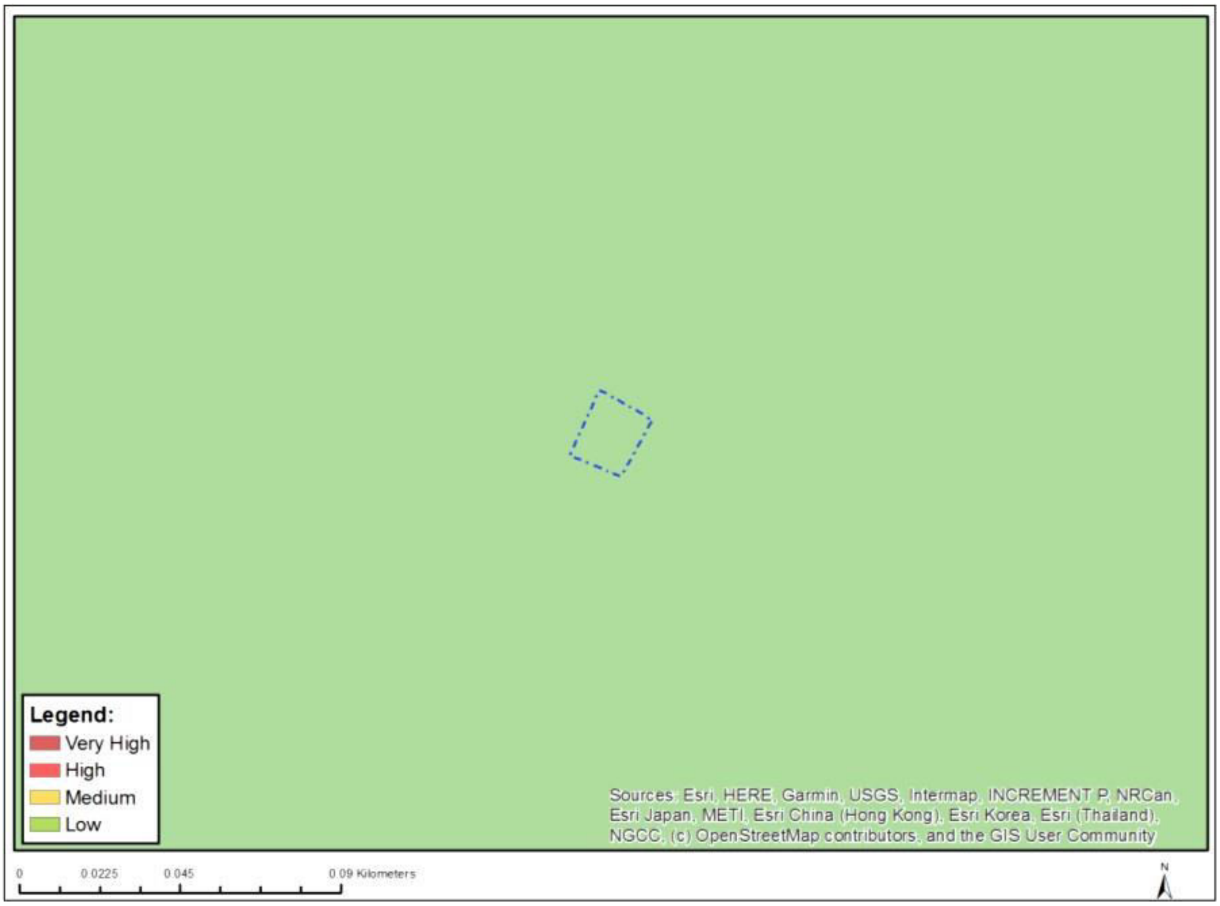


Figure 9. Archaeological sensitivity of area under application (as per the ESR)

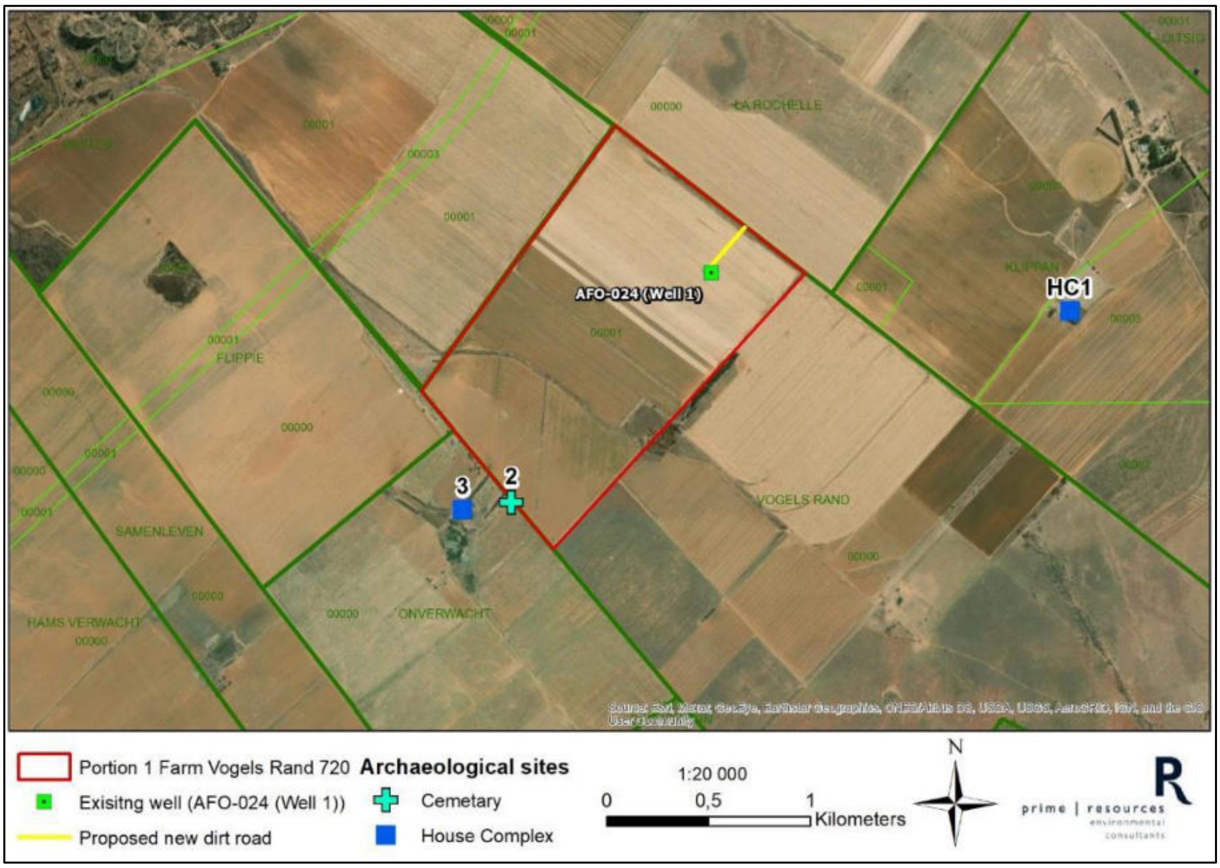


Figure 10. Archaeological sites of the greater surrounds

5.4 Palaeontology

The ESR classifies the area as having a "medium" sensitivity for the *Palaeontology* theme (refer to Figure 11). The SSV for this theme was performed as part of the specialist Palaeontological Impact Assessment (PIA) report compiled by Prof Marion Bamford (March 2022). Refer to Appendix 5 of the Scoping Report for the aforementioned specialist report.

According to the online South African Heritage Resources Information System (SAHRIS) map, the area is indicated as having a "moderate" sensitivity in terms of fossil occurrence; therefore, only a desktop study is required. Refer to Figure 12.

From the findings of the PIA, there are no UNESCO World Heritage Sites in the vicinity of the proposed project. The study area is located in the southern part of the Witwatersrand Basin. The stratigraphic successions are as follows: the Karoo Supergroup (302 to 180 Ma), which overlies the Ventersdorp Supergroup (2.7 Ga), which overlies the Witwatersrand Supergroup (2.8 Ga). Rocks belonging to the Karoo Sequence are typically 270 m to 300 m thick. The basic surface geology around the proposed well consists of sand, limestone, dolerite, sandstone / siltstone / shale / mudstone from the Ecca Group (Vryheid and Volksrust Formations) and the Beaufort Group of the Karoo Supergroup. Andesitic lavas of the Ventersdorp Supergroup (Klipriviersberg Group) underlie the Karoo Supergroup. A succession of andesitic lavas and poorly sorted conglomerates with interbedded fine sediments of the Ventersdorp Supergroup (Klipriviersberg Group) underlie the Karoo Supergroup. The proposed site lies on the moderately sensitive Quaternary sands (refer to Figure 13) and alluvium which are probably underlain by the highly sensitive rocks of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup).

The Adelaide Subgroup of the Beaufort Group contains a biostratigraphic zone, the *Daptocephalus* Assemblage Zone, which may contain fauna and flora from the late Permian Age. The Adelaide Subgroup includes a rich and diverse vertebrate fauna of exceptionally high scientific significance due to the diversity of the tetrapod fauna from Pangea / Gondwana and their part in recording the evolutionary transition from reptiles to mammals. Various types of superficial deposits of Late Caenozoic (Miocene / Pliocene to Recent) occur widely throughout the Great Karoo Basin.

The specialists confirmed that it is extremely unlikely that fossils will be encountered and the potential impact on fossil heritage resources is low. Therefore, the "medium" sensitivity for the palaeontological theme is disputed and argued to rather have a "low" sensitivity. It is, however, recommended that a Fossil Chance Find Protocol be implemented during all phases of the project.

Figure 11. Palaeontology sensitivity of area under application (as per the ESR)

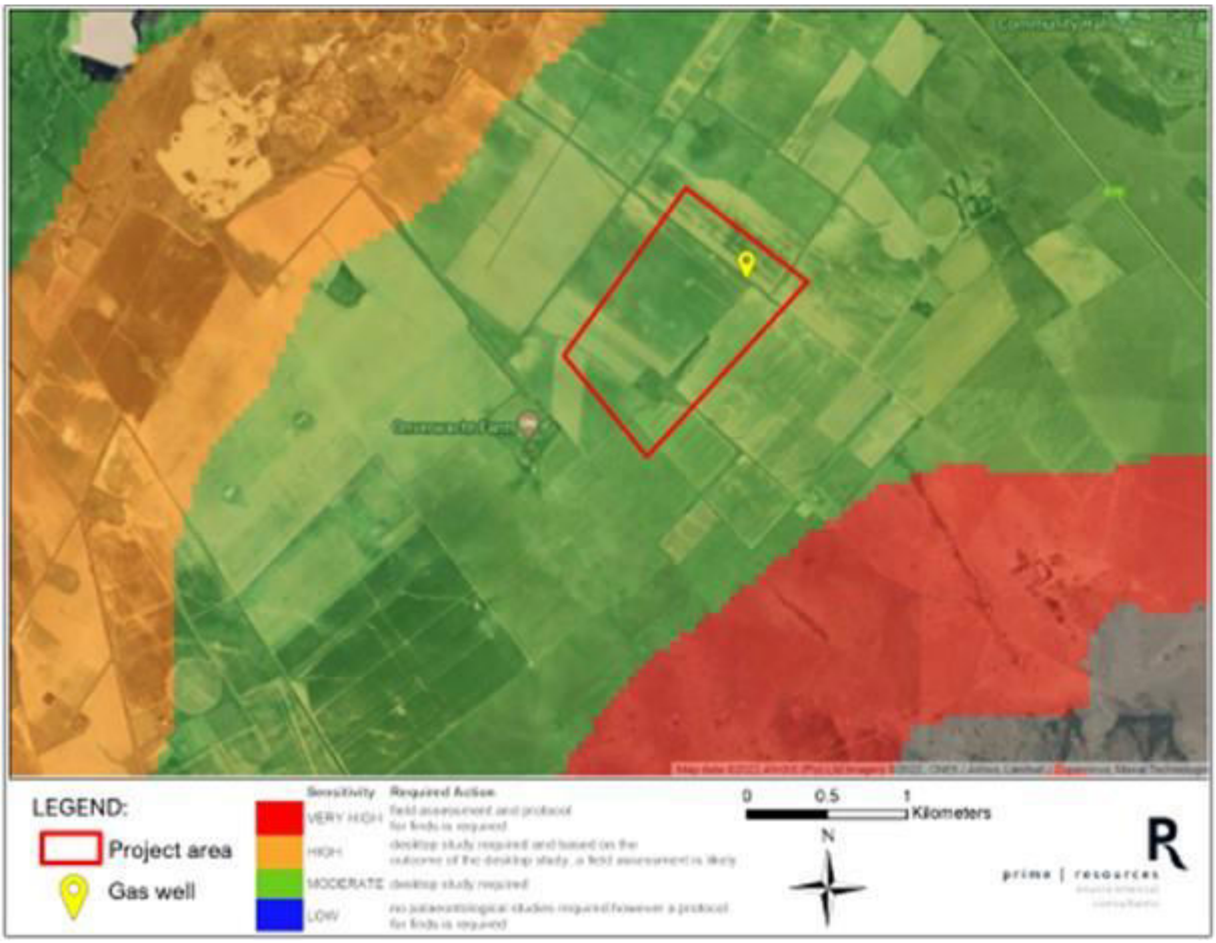


Figure 12. Palaeo-sensitivity map (SAHRIS, 2020)

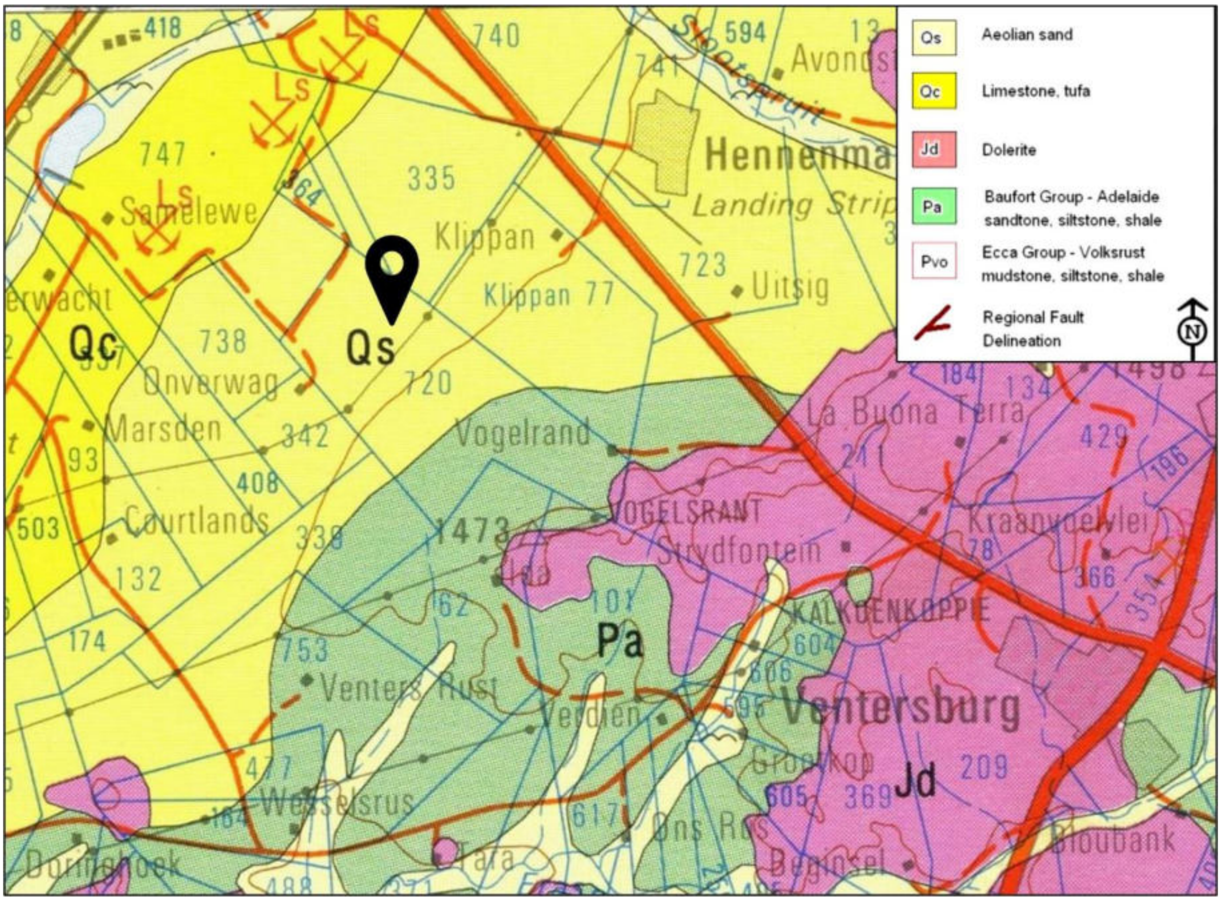


Figure 13. General surface geology of the study area

5.5 Terrestrial biodiversity, plant species and animal species

The ESR classifies the area as having a "very high" sensitivity (refer to Figure 14) for the *Terrestrial Biodiversity* theme, and "low" sensitivity for both the *Animal Species* (refer to Figure 15) and *Plant Species* (refer to Figure 16) themes.

The SSV for these themes was performed as part of the Terrestrial Ecology Compliance Statement for the proposed project by Scientific Aquatic Services in April 2022 (refer to Appendix 9 of the Scoping Report).

According to the Free State Biodiversity Plan (2015), the application site is not listed as a Critical Biodiversity Area (CBA) or an Ecological Support Area (ESA). The project area is classified as degraded due to the area being utilised for the cultivation of sunflower crops. Refer to Figure 17.

The project area falls within the Grassland biome and the Dry Highveld Grassland bioregion. The dominant vegetation unit is the Vaal-Vet Sandy Grassland (refer to Figure 18), which is classified as Endangered (EN) in terms of Section 52 of NEMBA. According to the appointed ecologist, there are no longer any natural areas of the Vaal-Vet Sandy Ecosystem remaining within the project area as the entire area has been cultivated (sunflower fields) for several decades.

The monoculture of sunflower fields supports several agricultural weeds (*Amaranthus hybridus*, *Richardia brasiliensis* and *Schkuhria pinnata*) and grasses (*Cynodon dactylon* and *Urochloa mosambicensis*). These provide food resources during the planting season for existing avifauna, general invertebrates, and small mammals.

No floral and faunal species of concern were identified during the investigation within the study area. The terrestrial ecology compliance statement confirmed that the prevailing habitat of the study area and its surrounds is not suitable for Orange and/or Red Listed species; therefore, it is unlikely to be influenced by the proposed project. The study area does not occur within any National Protected Area Expansion Strategy (NPAES) Focus Areas (2010) or an Important Bird and Biodiversity Areas (IBA) (SANBI, 2015).

The "very high" sensitivity for the *terrestrial biodiversity* theme was triggered by the presence of a threatened ecosystem. However, according to the outcomes of the specialist study undertaken, no remaining habitat to support the important biodiversity features of the Vaal-Vet Sandy Grassland EN ecosystem is located within close proximity to the study area. The "very high" sensitivity is disputed for the study area and surrounds. The application area is considered to rather have a "low" to "moderate-low" ecological sensitivity.

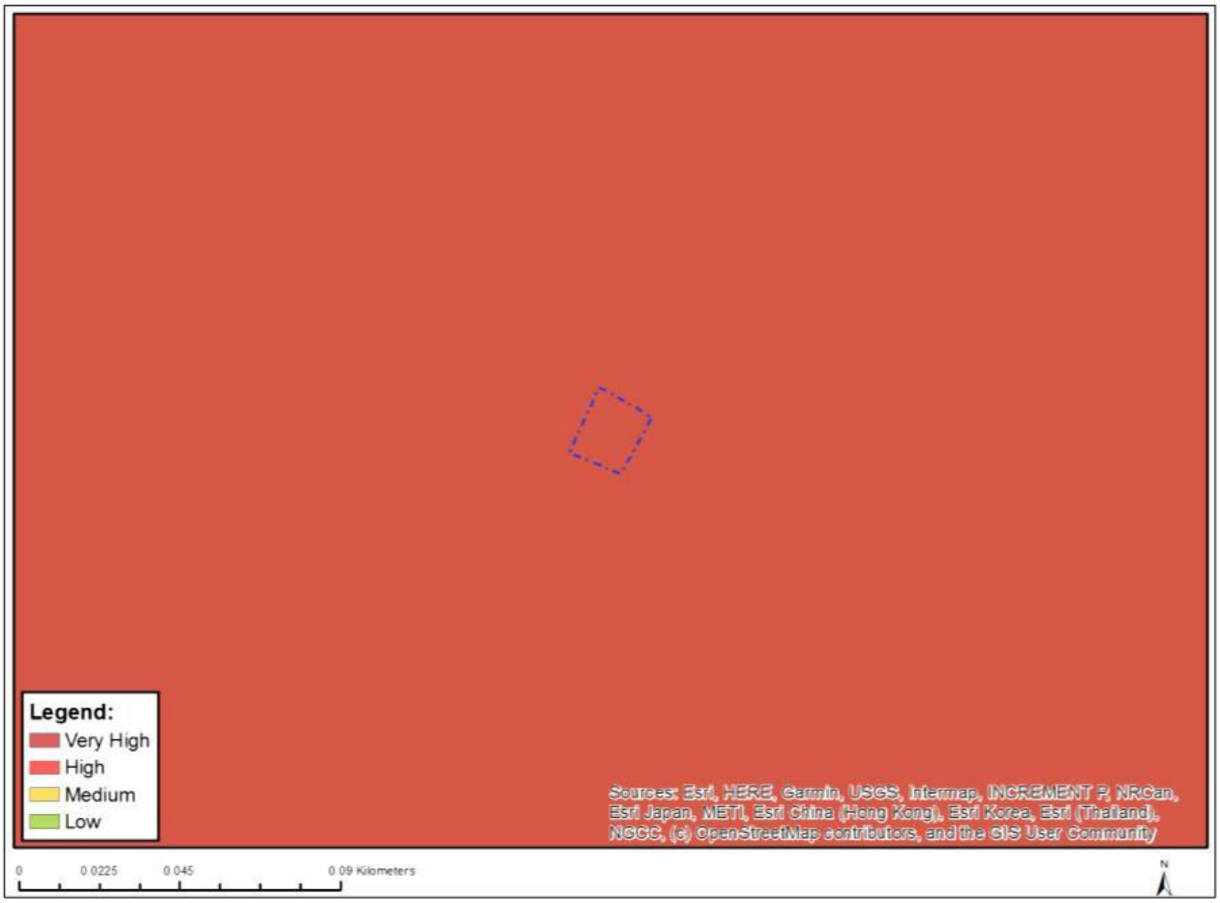


Figure 14. Terrestrial biodiversity sensitivity of area under application (as per the ESR)

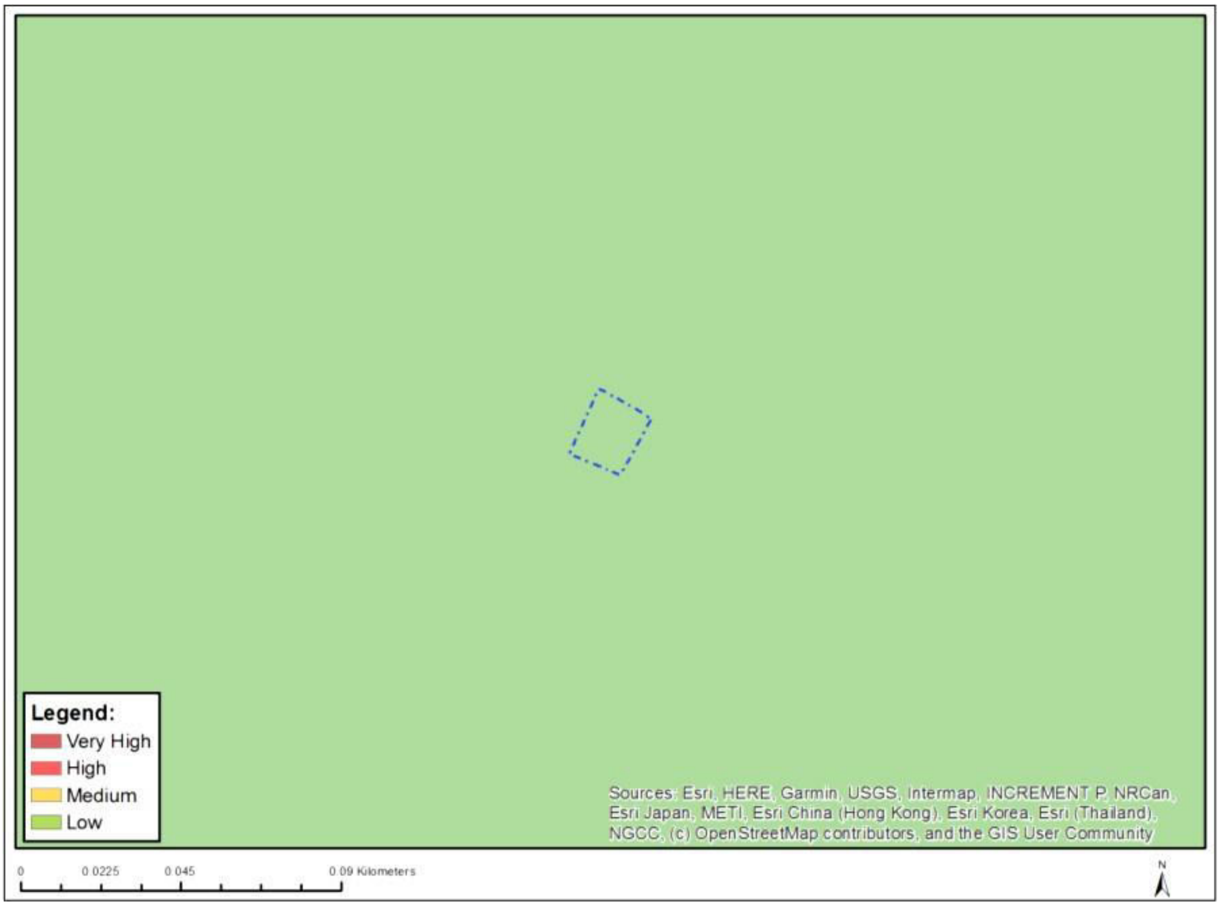


Figure 15. Plant species sensitivity of area under application (as per the ESR)

Figure 16. Animal species sensitivity of area under application (as per the ESR)

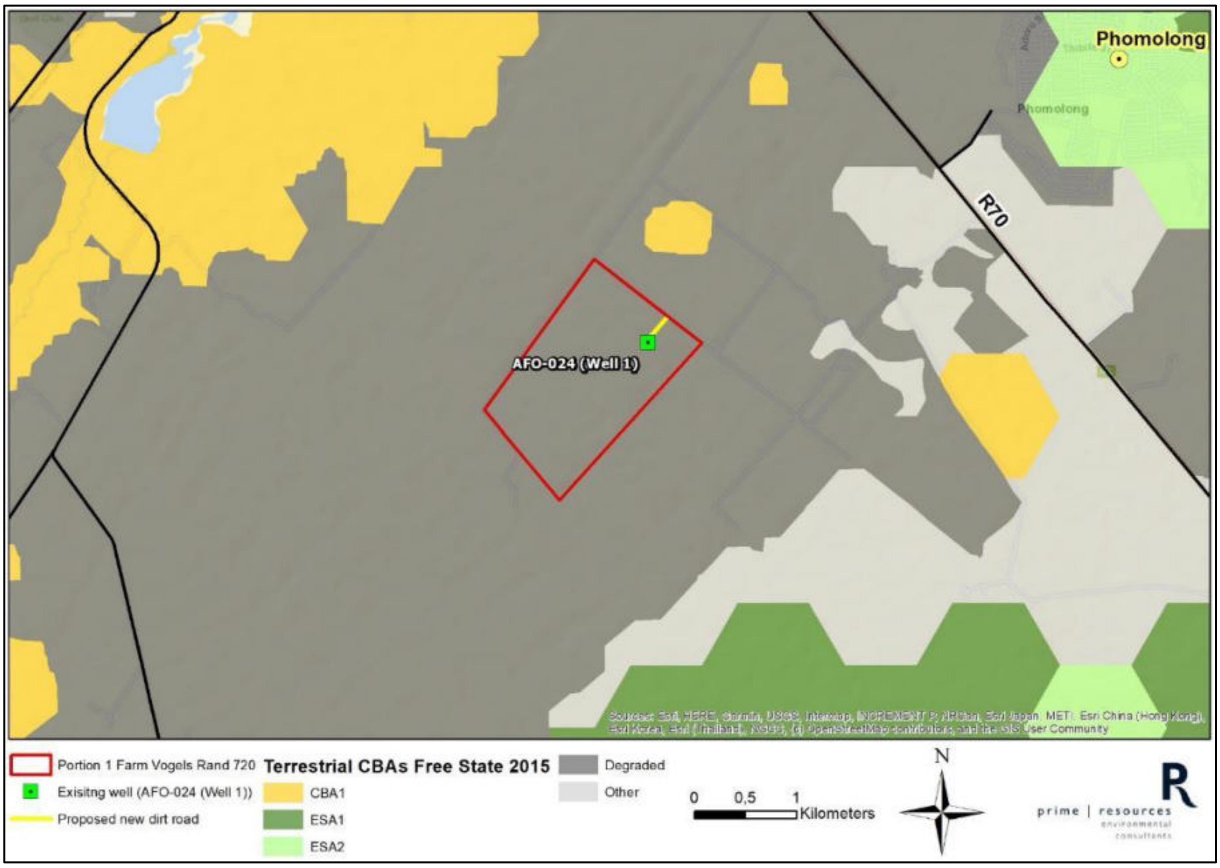


Figure 17. Free State Province Biodiversity sector plan

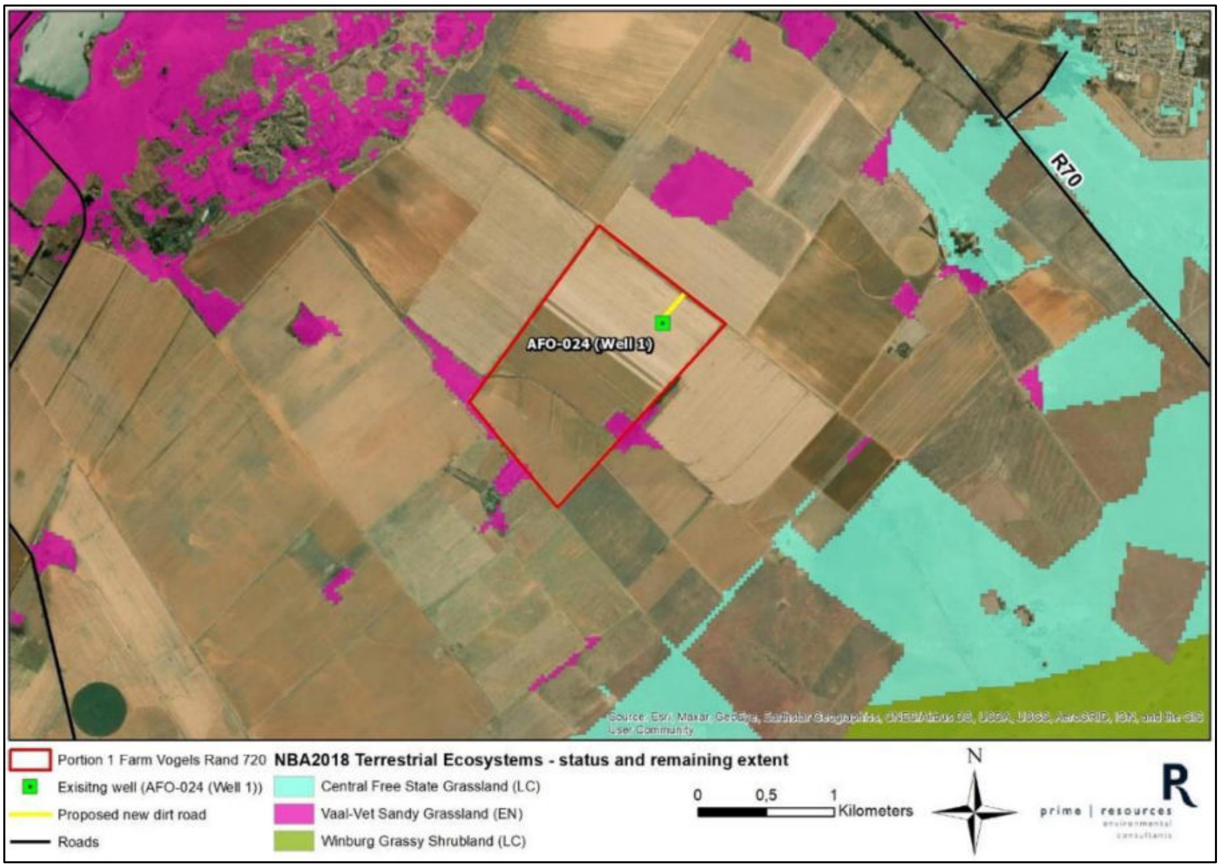


Figure 18. Status and current extent of the prevailing vegetation types

5.6 Aquatic biodiversity

The ESR classifies the area as having "low" sensitivity for the *Aquatic Biodiversity* theme (refer to Figure 19). The SSV for this theme was performed as part of the specialist Aquatic Biodiversity Compliance Statement, compiled by Scientific Aquatic Services in April 2022 (refer to Appendix 8 of the Scoping Report).

The proposed project is mainly situated in the C42J quaternary catchment with a small portion occurring in the C42H quaternary catchment of the Middle Vaal Water Management Area (WMA). The application area is located within a sub-WMA which is currently not considered a Freshwater Ecosystem Protected Area (FEPA). Furthermore, no rivers and wetlands are within the study area. The closest river, the Rietspruit, is located approximately 4.66 km north of the study area. According to the 2019 National Biodiversity Assessment (NBA) database, the closest wetland which is a natural depression is situated approximately 700 m south of the study area. Refer to Figure 20.

The findings of the appointed specialist noted a single artificial feature (refer to Figure 21) classified as an area of wet response is situated approximately 350 m upgradient of the subject area; however, this feature is not defined as a wetland, riparian habitat or any other watercourse as defined by the NWA. The subject area does not occur within a Strategic Water Source Areas (SWSA) (SANBI, 2017).

The site assessment conducted by the appointed specialist confirmed that there are no freshwater ecosystems situated at the study area and a "low" sensitivity in terms of *Aquatic Biodiversity* as provided by the ESR is therefore verified.

Figure 19. Aquatic biodiversity sensitivity of area under application (as per the ESR)

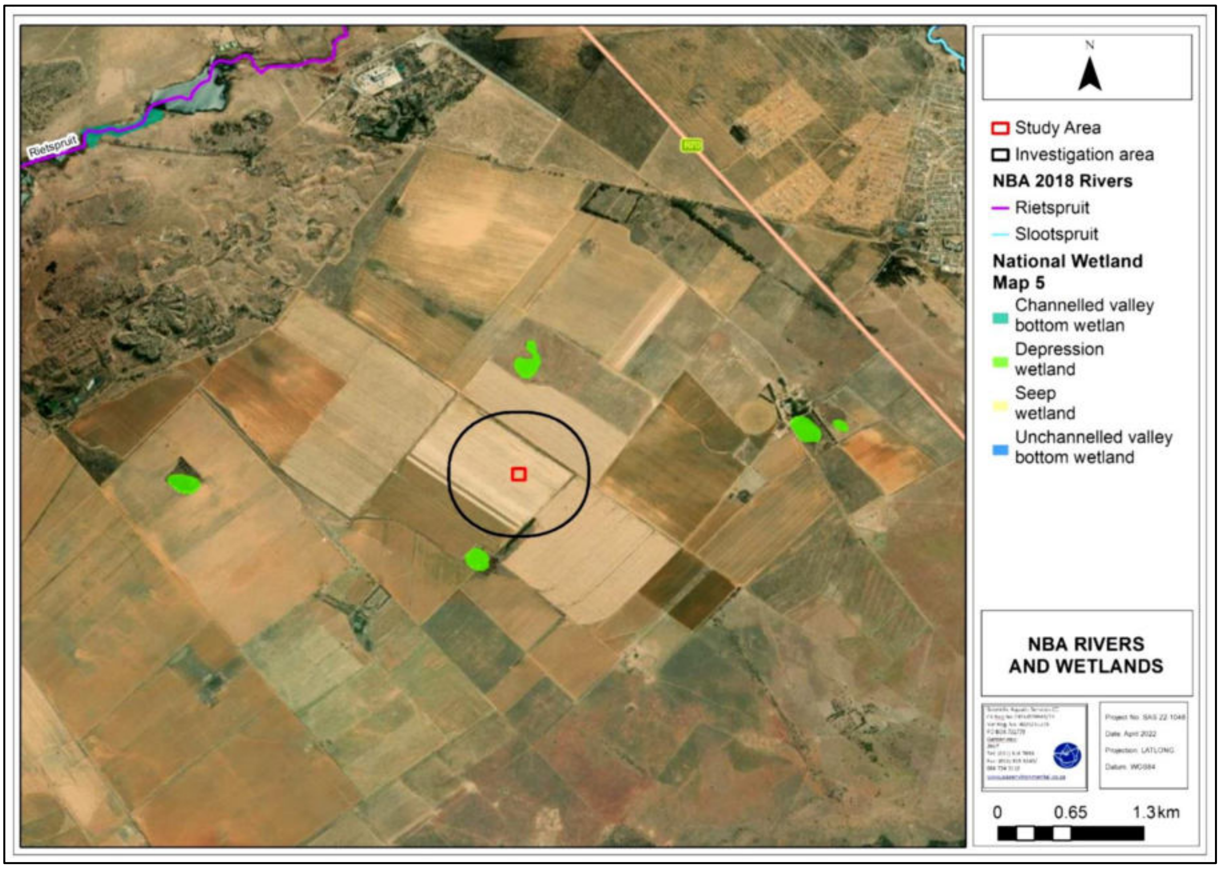


Figure 20. Wetlands and rivers associated within the project area (SAS, 2022)

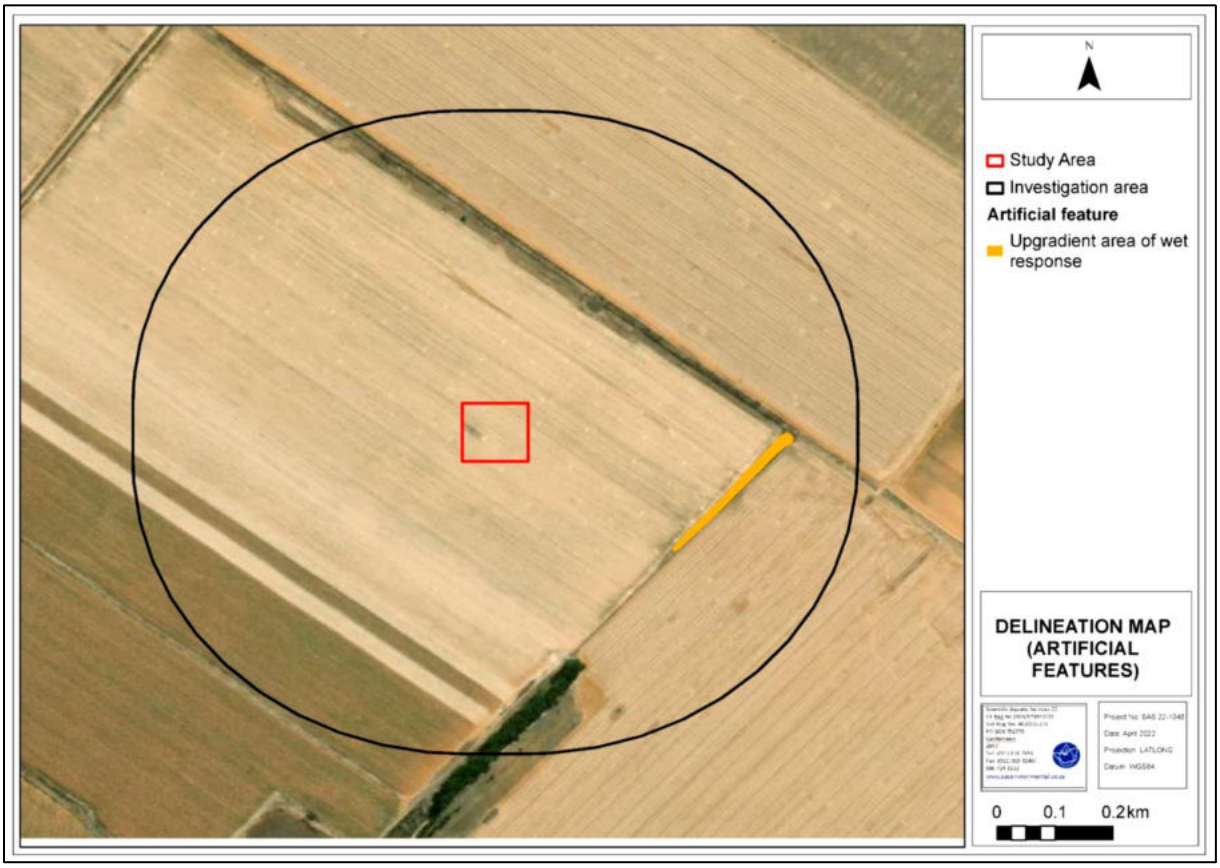


Figure 21. Conceptual representation of the upgradient area of wet response (SAS, 2022)

5.7 Civil aviation

The ESR indicates that the *Civil Aviation* theme has a "high" sensitivity because the proposed project is located within 8 km of an aerodrome, namely the Hennenman Airport (refer to Figure 22). The SSV for this theme has been undertaken by the EAP utilising desktop analysis and consulting the airspace GIS data published by the Air Traffic & Navigation Services (ATNS) in April 2022.

The Henneman Airport is situated approximately 4 km east-northeast of the proposed project (refer to Figure 23). According to the online ATNS data, the Henneman Airport (International Civil Aviation Organization [ICOA] airport code: FAHN) is a small, unlicenced airport which mainly focuses on paragliding and skydives. The subject area falls within the Hennenman glider area (refer to Figure 24). The ATNS data also indicated air flight routes associated with Johannesburg's Area Control Centre (ACC); however, these routes occur at high altitudes and will not be negatively impacted by the proposed project. The project area does not occur within a restricted airspace and will not affect any civil aviation installations.

In accordance with the South African Civil Aviation Technical Standards List of 2011 (Document SA-CATS 139 - Aerodromes and heliports), no activities of the proposed project will exceed 45 m above ground level or 150 m above the mean ground level. Furthermore, the proposed project will not cause an obstruction or potential hazard to aircraft navigation, affect the performance of radio navigation, or impact instrument landing systems.

With the above taken into consideration, it is not expected that the proposed project will have an impact on any aspects of Civil Aviation. The "high" sensitivity is therefore disputed and argued to rather have a "low" sensitivity in terms of the *Civil Aviation* Theme. However, the South African Civil Aviation Authority (SACAA) should be notified of the proposed project.

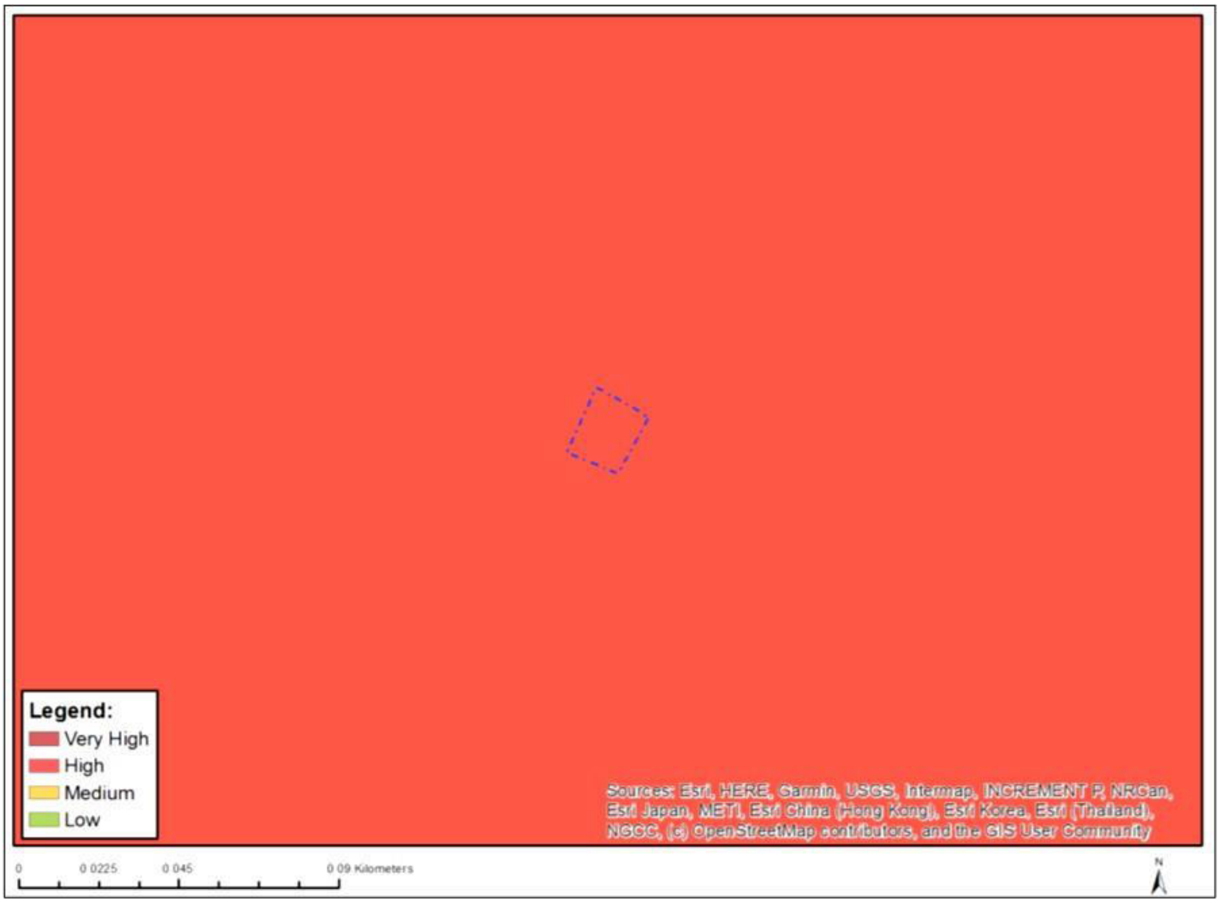


Figure 22. Civil aviation sensitivity of area under application (as per the ESR)

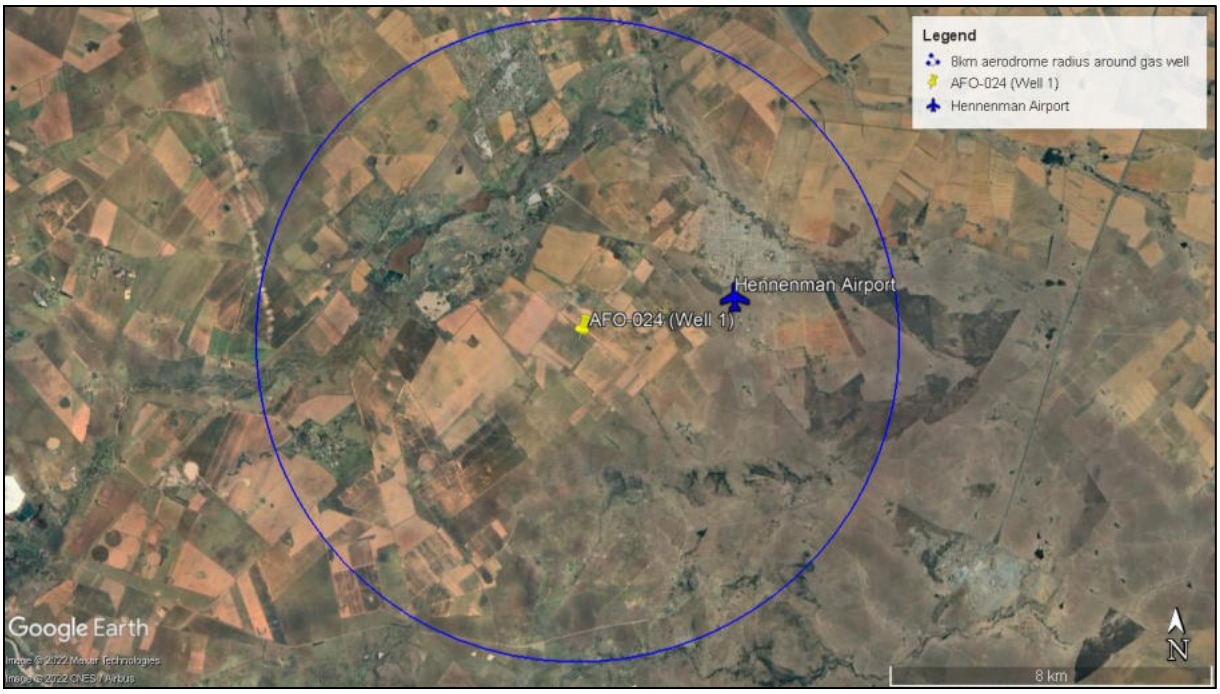


Figure 23. Location of the gas well in relation to aerodromes within an 8 km radius

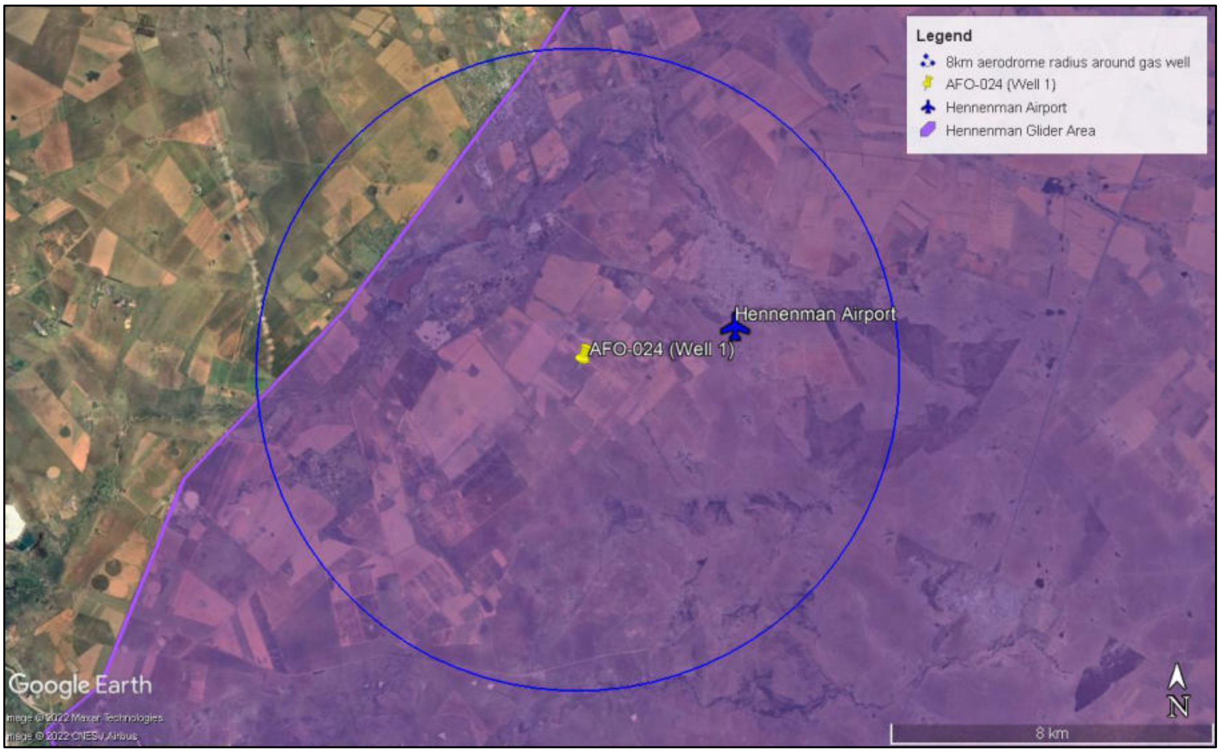


Figure 24. Location of the gas well in relation to the Hennenman glider area

5.8 Defence

The ESR indicated that the *Defence* Theme has a "low" sensitivity (refer to Figure 25). The EAP conducted this verification as a desktop analysis. The proposed project is well located in terms of road infrastructure and regional accessibility, with the R70 being the closest main road situated approximately 2.8 km northeast of the subject area. Additional road infrastructure includes the N1 highway situated approximately 12 km to the east and the R73 situated approximately 14 km southwest of the project area.

The N1 is a Class 1 national road under the jurisdiction of SANRAL of approximately 1 940 km in length that runs through Cape Town, Bloemfontein, Johannesburg, Pretoria and Polokwane to Beit Bridge on the border of Zimbabwe. The R70 is a Class 2 provincial road that runs west past Ventersburg and connects to the N1. This road acts as the primary distributor for the nearby urban areas of Phomolong and Welkom. The R73 is classified as a Class 2 provincial road that connects Welkom with Winburg.

There are no military bases / facilities within the vicinity of the project site. The closest military base is the Kroonstad Army Base, located 48 km north-northeast of the project site. The proposed project is highly unlikely to compromise the ability of the defence force to defend against any unrest / threats to security. None of the components of the proposed project will have an impact on military radar installations or any defence-related aspect.

As the road network surrounding the proposed project area is existing and due to the magnitude of the project, there will be no negative impact on any defence installations. The ESR sensitivity for the *Defence* theme of "low" is verified and no further assessment is deemed necessary.

Figure 25. Defence sensitivity of area under application (as per the ESR)

6 CONCLUSION

The outcomes of the comparative analysis performed for the purposes of verifying the sensitivity of the various environmental themes for the site under application per the ESR as well as the adjusted / verified sensitivity are shown in Table 2 below.

Table 2. Summary of the outcomes of the ESR and the adjusted / verified sensitivity as per the outcomes of the SSV

No	Theme	Predicted sensitivity	Adjusted / verified sensitivity	Verification method
1	Agriculture	**High**	**Low**	Specialist assessment
2	Animal Species	**Low**	**Low**	
3	Aquatic Biodiversity	**Low**	**Low**	
4	Archaeology and Cultural Heritage	**Low**	**Low**	
5	Civil Aviation	**High**	**Low**	Undertaken by the EAP utilising desktop analysis, on-site inspection and other available and relevant information
6	Defence	**Low**	**Low**	
7	Palaeontology	**Medium**	**Low**	Specialist assessment
8	Plant Species	**Low**	**Low**	
9	Terrestrial Biodiversity	**Very High**	**Low - Medium**	

Based on the ESR, the following list of specialist assessments were identified for inclusion in the assessment report. As part of these studies, specialists have gathered relevant information / data in order to identify and assess any environmental impacts that might occur as a result of the proposed project in their particular field of expertise. The results of the specialist studies will be integrated into an EIA Report.

Specialist assessments that will not be undertaken are indicated with a strikethrough along with the reason for not including such.

Table 3. Specialist assessments identified in the ESR and included in the assessment report

Specialist study	Scope	Reason for not including
Agricultural Impact Assessment	Compliance Statement (refer to Appendix 4 of the Scoping Report)	N/A
~~Landscape / Visual Impact Assessment~~	*Not included*	Due to the footprint and life-cycle of the proposed project, no significant visual impacts are anticipated during all phases of the project. The proposed project will not dominate the view frame and experience of receptors, nor is the proposed project located near any scenic routes. The bearing of visual character and the potential significance of visual intrusion associated with the proposed development is expected to be very low. The activities related to the proposed project will create the same visual effect related to farming activities and will therefore not cause a nuisance to nearby receptors.
Archaeological and Cultural Heritage Impact Assessment	Phase 1 Heritage Assessment, dated December 2011 (refer to Appendix 6 of the Scoping Report)	N/A
Palaeontology Impact Assessment	Phase 1 Paleontological Impact Assessment (refer to Appendix 5 of the Scoping Report)	N/A
Terrestrial Biodiversity	Compliance Statement (refer to Appendix 9 of the Scoping Report)	N/A

Specialist study	Scope	Reason for not including
Impact Assessment		
Aquatic Biodiversity Impact Assessment	Compliance Statement (refer to Appendix 8 of the Scoping Report)	N/A
Hydrology Assessment	Compliance Statement (refer to Appendix 8 of the Scoping Report)	N/A
~~Noise Impact Assessment~~	*Not included – A desktop analysis is included in the relevant section of the Scoping Report*	Due to the footprint and life-cycle of the proposed project, no increase in ambient noise levels are anticipated. Noise levels induced by the proposed project will typically mimic those of farming-related activities.
~~Radioactivity Impact Assessment~~	*Not included*	The proposed project is not related to any materials / procedures / activities that will generate / any radioactivity.
~~Traffic Impact Assessment~~	*Not included*	Due to the footprint and life-cycle of the proposed project, no additional permanent road infrastructure will be required and the impacts on the current road infrastructure are deemed negligible.
~~Geotechnical Assessment~~	*Not included*	No development will occur at the site; therefore, no geotechnical assessment is required.
~~Health Impact Assessment~~	*Not included*	Due to the footprint and life-cycle of the proposed project, no health impact assessment is required as the intention is to contain gas (with initial flaring) by means of collecting samples from venting holes in containers. Staff operating at the site will adhere to all sampling procedures and will be equipped with appropriate PPE.
~~Socio-Economic Assessment~~	*Not included – A desktop analysis is included in the relevant section of the Scoping Report*	Due to the footprint and life-cycle of the proposed project, no socio-economic assessment will be required as the proposed project will only allow for limited job opportunities. Sampling activities will be undertaken by a third party.
~~Ambient Air Quality Impact Assessment~~	*Not included – A desktop analysis is included in the relevant section of the Scoping Report*	The activities associated with the proposed exploration are unlikely to result in exceedances in the air quality standards. The intention is to contain the gas (with initial flaring) by means of collecting samples from venting holes in containers which will then be transported to a laboratory for analysis. Measures for the management and control of dust arising from exploration activities will be provided in the EMPr during the EIA phase.
Greenhouse Gasses Assessment	A specialist has been commissioned to conduct an assessment of potential greenhouse gasses (GHG) emissions as a result of the proposed sampling activities. The findings and recommendations will be included in the EIA Report.	
Plant Species Assessment	Compliance Statement (refer to Appendix 9 of the Scoping Report)	N/A
Animal Species Assessment	Compliance Statement (refer to Appendix 9 of the Scoping Report)	N/A

APPENDIX 12

Land Claims

COMMISSION ON RESTITUTION OF
LAND RIGHTS

OFFICE OF THE REGIONAL LAND CLAIMS COMMISSIONER: FREE STATE
Ground floor, Post Bank Building, cnr Selbourne and East Burger Street, Bloemfontein, 9300
Tel: (051) 430 0423/25/29

Enquiries: Geraldine Booysen

You Ref: Monique van der Westhuizen

Prime Resources

70- 7th Avenue
Parktown North
Johannesburg
2193

Email: moniquwe@resources.co.za

Dear Sir/Madam

LAND CLAIMS ENQUIRY;

1. **PORTION 1 OF FARM VOGELS RAND 720, VENTERSBURG DISTRICT, FREE STATE PROVINCE.**

We refer to your letter dated 03 June 2022.

We confirm that as at the date of this letter no land claims appear on our database in respect of the Property. This includes the database for claims lodged by 31 December 1998; and those lodged between 1 July 2014 and 27 July 2016 in terms of the Restitution of Land Rights Amendment Act, 2014.

Whilst the Commission takes reasonable care to ensure the accuracy of the information it provides, there are various factors that are beyond the Commission's control, particularly relating to claims that have lodged but not yet been gazetted such as:

1. Some Claimants referred to properties they claim dispossession of rights in land against using historical property descriptions which may not match the current property description; and

2. Some Claimants provided the geographic descriptions of the land they claim without mentioning the particular actual property description they claim dispossession of rights in land against.

The Commission therefore does not accept any liability whatsoever if through the process of further investigation of claims it is found that there is in fact a land claim in respect of the above property.

If you are aware of any change in the description of the above property after 19 June 1913 kindly supply us with such description so as to enable us to do a further search.

Yours faithfully

L Naran (MS)
CHIEF DIRECTOR: LAND RESTITUTION SUPPORT
OFFICE OF THE REGIONAL LAND CLAIMS COMMISSIONER: FREE STATE

DATE: 30/06/2022