



Profession: Geohydrologist
Nationality: South African
Position in firm: Director
Specialisation: Safety Assessment of Radioactive Waste Disposal Systems
Groundwater Flow and Mass Transport Modelling
Radiological Public Safety Assessments of Mining and Mineral Processing Facilities
Years of relevant experience: 20

Key Areas of Experience and Achievements:

- ~ Prospective evaluation of groundwater and soil water movement, as well as radiological and non-radiological contaminant migration through saturated and unsaturated geological media
- ~ Development and application of internationally accepted methodologies for the post-closure performance and safety assessment of radioactive waste disposal systems suitable for African and Southern African conditions
- ~ Total system safety assessment of near-surface radioactive waste disposal facilities, including the development of new disposal concepts
- ~ Radiological public impact and safety assessment of mining and mineral processing industries (including the uranium mining industry) under operational and post-operational conditions
- ~ Provision of radioactive waste management consultancy and training services to the International Atomic Energy Agency (IAEA)

- ~ Served on the co-ordinating group of the IAEA ISAM (Improvement of Safety Assessment Methodologies) project and as chairman of the Scenario Development and Justification Working Group (1997 – 2000)
- ~ Serve on the co-ordinating group of the IAEA ASAM (Application of Safety Assessment Methodologies) project and as chairman of the Mining and Mineral Processing Waste Working Group (2002 -- 2007)
- ~ Serve on the co-ordinating group of the IAEA PRISM (Practical Illustration and use of the Safety Case Concept in the Management of Near-surface Disposal) project (2009 – Present)
- ~ External moderator for honour and master degree courses in geohydrology, external examiner for various geohydrology Ph.D. and master degree thesis's, study leader for master degree dissertation on biosphere modelling.

Education and Professional Qualifications:

2000 Ph.D. - Geohydrology, University of the Orange Free State
1991 M.Sc. (*Cum Laude*) - Geohydrology, University of the Orange Free State
1989 B.Sc. (Hons - *Cum Laude*) - Geohydrology, University of the Orange Free State
1988 B.Sc. (Applied Math., Computer Science), University of the Orange Free State

- ~ Member of the South African Council for Natural Scientific Professions (No. 400239/05)
- ~ Member of the Southern African Radiation Protection Association (SARPA)
- ~ Radiation Protection Specialist (RPS) accreditation with the Radiation Protection Accreditation Board (RPAB)

Languages:	Speaking	Reading	Writing
Afrikaans	Native tongue		
English	Fluent	Fluent	Fluent

**Professional Career:**

- 2000 to date** **Director, Aquisim Consulting (Pty) Ltd**
Performing total system safety assessment analysis for radioactive waste management facilities, including the derivation of quantitative waste acceptance criteria.
Performing radiological public impact and safety assessment of mining and mineral processing (including uranium mining) facilities.
Participate nationally and internationally in a project to develop long-term management solutions for disused sealed radioactive sources (BOSS concept).
Lecture at various safety assessment courses and workshops in the Russian Federation, Spain, Tanzania, South Africa and China.
Participating in various IAEA Coordinated Research Projects (CRP), e.g. ISAM (Improvement of safety assessment methodologies), ASAM (Application of safety assessment methodologies), and PRISM (Practical implementation of safety assessment in the context of a safety case).
Perform saturated and unsaturated groundwater flow analysis for tailings dam complexes, open pit mines, radioactive waste sites, waste disposal cap systems, distressed rock masses of underground mines, and industrial waste sites.
Assist in model development to evaluate the impact to an exposure group from an intrusive igneous events intruding into the Yucca Mountain high-level radioactive waste disposal facility
- 2000** **Ph.D., University of the Orange Free State (Institute for Groundwater Studies)**
The objective of radioactive waste management and its underlying principles is to ensure that human beings and the environment are protected at all times, without imposing an undue burden on future generations. This implies that, before any long-term management strategy of radioactive waste disposal can be implemented, the impact of the disposed waste must be determined as function of time - a procedure referred to as post-closure safety assessment. In the thesis, a methodology to perform post-closure safety assessment of radioactive waste disposal systems in South Africa and other parts of Africa was described.
- 1989 – 2000** **Scientist/Senior Scientist/Chief Scientist/Consulting Scientist, South African Nuclear Energy Corporation, Nuclear Liabilities Management Division**
The simulation of soil water and radionuclide movement through the unsaturated zone and the management of soil water measurements using a neutron meter.
Development of a safety assessment methodology for radioactive waste disposal facilities and the application of the methodology to radioactive waste disposal facilities in South Africa.
Managing team to perform total system safety assessments.
Development of a disposal concept for the long-term management of disused radioactive sources.
Performing radiological public impact assessment of mining and mineral processing facilities.
Participating in an IAEA Coordinated Research Projects (CRP) to compare modelling results of radioactive waste disposal systems (NSARS) and to improve safety assessment methodologies (ISAM).
- 1988 – 1989** **Student, University of the Orange Free State (Institute for Groundwater Studies)**
B.sc (Hons): Honours course in theoretical geohydrology, focusing on the physics of groundwater flow in the saturated and unsaturated zone, and mathematical methods to solve groundwater problems.

M.Sc.: Development of a finite element collocation method, using bi-cubic hermite polynomials as basis functions, to solve differential equations defined over general non-rectangular domains. The method retains all the advantages as when applied directly to a rectangular domain. A particular advantage of the method is its ability to yield continuous velocity fields, which is of considerable importance in the study of groundwater contamination problems.
- 1985 – 1987** **Student, University of the Orange Free State (Faculty of Science)**
Mathematics, Applied mathematics, Computer science, Mathematical statistics, Physics
Applied mathematics, Computer science, Mathematics
Applied mathematics, Computer science



Professional Experience: Selected Projects

- 2010 **Specialist Radiological Safety Assessment Consultant to Airshed Planning Professionals**
Perform the radiological public impact assessment as part of the Strategic Environment Assessment (SEA) of the Uranium industry in the Erongo Area in Namibia
- 2010 **Specialist Radiological Safety Assessment Consultant to Gold Fields Limited**
Perform the radiological public safety assessment for the proposed Uranium processing plant at Dreifonein No. 7 Shaft as part of Gold Fields West Wits Project
- 2010 **Specialist Radiological Safety Assessment Consultant to Gold Fields Limited**
Perform the radiological public safety assessment for the proposed Centralized Tailings Storage Facility (CTSF) as part of Gold Fields West Wits Project
- 2009 **Specialist Radiological Safety Assessment Consultant to Mine Waste Solution**
Perform the radiological public safety assessment for the proposed Tailings Storage Facility for the Stilfontein operations
- 2009 **Specialist Radiological Safety Assessment Consultant to ERM**
Perform the radiological public safety assessment for the proposed Banner Uranium Mine in the Erongo area of Namibia
- 2009 **Specialist Radiological Safety Assessment Consultant to Harmony**
Perform the public safety assessment for the proposed TPM uranium plant for the Welkom operations of Harmony Gold Mining Company Ltd.
- 2009 **Specialist Radiological Safety Assessment Consultant to Golder Associates Africa**
Perform the public and occupational radiological safety assessment as part of the re-mining of existing tailings facilities and the commissioning of a new Tailings Storage Facility for the Welkom operations of Harmony Gold Mining Company Ltd.
- 2009 **Specialist Radiological Safety Assessment Consultant to Golder Associates Africa**
Perform the radiological public safety assessment for a new uranium plant and the interim disposal of tailings material for Rand Uranium (Pty) Ltd.
- 2008 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation**
Development of the 2008 Thabana Post-closure Radiological Safety Assessment for the disposal of radioactive waste at Pelindaba.
- 2008 **Specialist Radiological Safety Assessment Consultant to Golder Associates Africa**
Perform a baseline radiological survey and assessment for the Bakouma uranium mine in the Central African Republic.
- 2007 **Specialist Radiological Safety Assessment Consultant to Argus Gibb**
Specialist studies on radioactive waste management and radiological safety and health as part of the Environmental Impact Assessment for the Pebble Bed Modular Reactor Demonstration Pilot Plant (PBMR DPP).
- 2007 **Specialist Groundwater Modeller to Golder Associates Africa**
Model development to evaluate the performance of the kiberlitic tailings dam complex at the Kao diamond mine in Lesotho.
- 2007 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation**
Development of the 2007 Vaalputs Post-closure Radiological Safety Assessment for the disposal of the best estimate national inventory at the National Radioactive Waste Disposal Site at Vaalputs.
- 2006 **Specialist Radiological Safety Assessment Consultant to Ferret Mining**
Performing a provisional radiological public impact assessment of the proposed Trekkopje uranium



- mine in Namibia as part of the Environmental Impact Assessment (EIA).
- 2006 **Specialist Groundwater Modeller to Golder Associates Africa**
Model development to evaluate the dewatering of the Morila open gold mine in Mali on the groundwater flow system.
- 2005 **Specialist Radiological Safety Assessment Consultant to the International Atomic Energy Agency (Austria)**
Conducting an Expert Mission to Kitwe, Zambia to assess the radiological situation at the Amco settlement and propose remedial alternatives for the Amco tailings material.
- 2005 **Specialist Groundwater Modeller to South African Council for Geoscience**
Model development to evaluate quantitatively the ingress of surface water into the underground mine working of the central Rand Basin, South Africa
- 2005 **Specialist Safety Assessment Consultant to Rossing Uranium Limited (Namibia)**
Performing a screening level dose assessment to assess the potential radiological impact to farmers along the Swakop River following the occurrence of elevated levels of uranium in the Swakop River.
- 2005 **Specialist Radiological Safety Assessment Consultant to TICOR**
Performing a radiological similarity study between Hillendale mining site and the proposed mining site at Fairbreeze.
- 2005 **Specialist Radiological Safety Assessment Consultant to TICOR**
Performing a radiological public impact assessment of the TICOR facilities at Hillendale (mining site) and the Central Processing Complex at Empangeni. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032.
- 2005 **Specialist Groundwater Modeller to Golder Associates Africa**
Model development to evaluate groundwater flow and contaminant migration at the ISPAT ISCOR site at Vanderbijlpark.
- 2004 **Specialist Radiological Safety Assessment Consultant to Namakwa Sands**
Perform a radiological impact assessment to evaluate the impact of a proposed gypsum disposal option on groundwater at the mining site
- 2004 **Specialist Radiological Safety Assessment Consultant to Monitor Scientific LLC (USA)**
Model development to evaluate to impact to an exposure group from an intrusive igneous events intruding into the Yucca Mountain high-level radioactive waste disposal facility.
- 2004 **Specialist Radiological Safety Assessment Consultant to BPB Gypsum Limited**
Evaluation of the radiological risk to the public if phosphogypsum plaster products are being used in the building industry. Various scenarios associated with workers constructing a house and house inhabitants were considered.
- 2004 **Specialist Safety Assessment Consultant to Eskom and Technical Services International (TSI)**
Perform a radiological public impact assessment of the Duvha fossil fuel power station. The purpose of this study was to assess the levels of possible radiological exposure to the public that can be expected at the various Eskom fossil fuel power stations. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032.
- 2003 **Specialist Radiological Safety Assessment Consultant to the International Atomic Energy Agency (Austria)**
Development of a comprehensive FEPs list for near-surface radioactive waste disposal. The basis for the updated list was the FEPs list developed as part of the IAEA ISAM Project.
- 2003 **Specialist Groundwater Modeller to Golder Associates Africa**
Development of an unsaturated flow model using **HYDRUS 2D** for the distressed rock mass area beneath the open pit at Palabora Mining Company. The purpose of the model was to simulate the



infiltration of a high rainfall event through the cave mining area beneath the pit.

- 2003 **Specialist Groundwater Modeller to Groundwater Consulting Services**
Development of a unsaturated flow model using **HYDRUS 2D** of a tailings dam complex to evaluate the behaviour of a proposed tailings dam design.
- 2003 **Specialist Radiological Safety Assessment Consultant to Stantec (Canada)**
The purpose of the project was to compile a summary description of waste rock management practices as applied in South Africa during the planning, operational and post-operational phases.
- 2003 **Specialist Radiological Safety Assessment Consultant to TICOR**
Performing a radiological public impact assessment of the TICOR facilities at Hillendale (mining site) and the Central Processing Complex at Empangeni. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032.
- 2003 **Specialist Radiological Safety Assessment Consultant to Quintessa Limited (UK)**
Contribute to the development of a generic safety assessment of the borehole disposal concept for the disposal of disused radioactive sealed sources in African countries. Specific contributions include the assessment context, system description and scenario development and justification.
- 2002 **Specialist Radiological Safety Assessment Consultant to the Placer Dome Western Area Joint Venture**
Radiological public impact assessment of a proposed new tailings dam at the Placer Dome Western Areas Joint Venture South Deep operations. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032.
- 2002 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation.**
Derivation of quantitative and nuclide specific reference levels (waste acceptance criteria) for the disposal of low- and intermediate level waste at the national radioactive waste disposal facility at Vaalputs in the Northern Cape Province.
- 2002 **Specialist Radioactive Waste Management Consultant to the South African Nuclear Energy Corporation**
Perform a technical review of the issues that will influence the design of the borehole disposal of disused radioactive sources (BOSS) concept. Specify the design requirement for the development and evaluation of the concept. This was done as part of Phase III of a project to develop a long-term management solution for disused radioactive sources in African countries.
- 2001 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation.**
Compile a total system safety assessment of the long-term radioactive waste storage facility at Pelindaba. The facilities, which come in operation in the late 1960's, contain mainly uranium contaminated waste. The focus of the assessment was to evaluate the influence of the facility on human beings and the environment over a period of 30 years, after which the site will be remediated.
- 2001 **Specialist Safety Assessment Consultant to the South African Nuclear Energy Corporation.**
Compile a total system safety assessment of the national radioactive waste disposal facility at Vaalputs in the Northern Cape Province. The focus of this assessment was only on the waste that will be received from the Koeberg Nuclear Power Station. Specific aspects that were covered are drafting the assessment context, the generation and justification of exposure scenarios, the performance of the near-field, the prospective evaluation of the unsaturated zone and the compilation of the safety case.
- 2001 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation and ESKOM.**
Perform a radiological public impact assessment of the Duvha fossil fuel power station. The purpose of this study was to assess the levels of possible radiological exposure to the workers and the public that can be expected at the various ESKOM fossil fuel power stations. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032.



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- 2000 **Specialist Radiological Safety Assessment Consultant to the South African Nuclear Energy Corporation.**
Performance assessment studies (using **FEFLOW**) to evaluate the movement of moisture through the engineered clay caps of Trench B01 and Trans A01 at the National Nuclear Radioactive Waste Disposal Facility at Vaalputs in the Northern Cape Province.
- 2000 **Specialist Groundwater Modeller. Consultant to Southern Africa Geoconsultants and Southern Era (Ltd)**
Construct a single-layered finite element aquifer model for the Marsfontein mine in the Northern Province using **FEFLOW**. The objective of this investigation was to assess the influence of mine dewatering on the regional hydrological and geohydrological system and to determine inflow rates into the open pit mine workings.
- 1999 - **Specialist Radiological Safety Assessment and Radioactive Waste Management Consultant to the International Atomic Energy Corporation - Project Manager**
2000 Phase II of the project to develop a long-term management solution for disused radioactive sources in African countries entail the development and evaluation of BOSS concept in terms of its technical feasibility and economic viability. It also included a preliminary safety assessment of the concept at two sites in South Africa, performed in collaboration with co-workers in the USA.
- 1999 **Specialist Radiological Safety Assessment Consultant to Foskor Ltd. - Project Leader**
Perform a radiological public impact assessment of the mining and milling processing facilities at Foskor. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032. The objective of the study was to assess the possible radiological risk of sources at Foskor to members of the public.
- 1998 **Specialist Radiological Safety Assessment Consultant to Palabora Mining Company**
Perform a radiological public impact assessment of the mining and milling processing facilities at Palabora Mining Company. This was done in accordance with the National Nuclear Regulator licensing guide LG-1032. The objective of the study was to assess the possible radiological risk of sources at Palabora Mining Company to members of the public.
- 1997 **Safety Assessment Analyst for the South African Nuclear Energy Corporation**
Perform a geohydrological performance assessment (using **HYDRUS-2D**) of Trench BO1 at the national radioactive waste disposal facility at Vaalputs in the Northern Cape Province. The objective of the investigation was to assess the performance of the unsaturated geosphere following the release of radioactive material from the trench.
- 1996 **Safety Assessment Analyst for the South African Nuclear Energy Corporation**
Perform a geohydrological performance assessment of Thabana at Pelindaba. The objective of the investigation was to determine the consequences to man and his environment of the storage facilities, to guide remedial actions in cases where safety criteria have been exceeded and to demonstrate adequate safety to obtain a licence for Thabana as an interim storage facility.
- 1994 **Groundwater Modeller for the South African Nuclear Energy Corporation**
Evaluate the moisture movement in and around the radioactive waste disposal trenches at the national radioactive waste disposal facility at Vaalputs.
- 1994 **Groundwater Modeller for the South African Nuclear Energy Corporation**
Perform moisture and radionuclide movement studies for the IAEA co-ordinated research programme on safety assessment of near-surface radioactive waste disposal facilities (NSARS) - Test Case 2b (Seville - Spain).
- 1992 **Groundwater Modeller for the South African Nuclear Energy Corporation**
Perform moisture and radionuclide movement studies for the IAEA co-ordinated research programme on safety assessment of near-surface radioactive waste disposal facilities (NSARS) - Test Case 2a (Augusta - USA).



Major Research Conducted

- 1988 – 1989 Masters degree, University of the Orange Free State (Institute for Groundwater Studies)**
Development of a finite element collocation method, using bi-cubic hermite polynomials as basis functions, to solve differential equations defined over general non-rectangular domains. The method retains all the advantages as when applied directly to a rectangular domain. A particular advantage of the method is its ability to yield continuous velocity fields, which is of considerable importance in the study of groundwater contamination problems.
- 2000 Ph.D., University of the Orange Free State (Institute for Groundwater Studies)**
The objective of radioactive waste management is to ensure that human beings and the environment are protected at all times, without imposing an undue burden on future generations. This implies that, before any long-term management strategy of radioactive waste disposal can be implemented, the impact of the disposed waste must be determined as function of time - a procedure referred to as post-closure safety assessment. In the thesis, a methodology to perform post-closure safety assessment of radioactive waste disposal systems in South Africa and other parts of Africa was described.

List of Publications:

- Van Blerk, J.J., and J.F. Botha, "Numerical solution of partial differential equations on curved domains by collocation," Numerical Methods for Partial Differential Equations (9) pp 357-371, 1993.
- Van Blerk, J.J., and M.W. Kozak, "Borehole Disposal of Spent Radiation Sources: 1. Principles," IAEA-CN-78, pp. 194-187, Proc. International Conference of the Safety of Radioactive Waste Management, Cordoba, Spain, 13-17 March 2000.
- Kozak, M.W., and J.J. van Blerk, "Borehole Disposal of Spent Radiation Sources: 2. Initial Safety Assessment," IAEA-CN-78, pp. 48-51, Proc. International Conference of the Safety of Radioactive Waste Management, Cordoba, Spain, 13-17 March 2000.
- Kozak, M.W., J.J. van Blerk, and J.P. Vivier, "Borehole Disposal of Spent Radiation Sources," Proc. International Symposium on Radiation Safety Management, November 5-7, Daejeon, Korea, pp 407-416, 2001.
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