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THE SOUTHERN AFRICAN INSTITUTE OF MINING AND METALLURGY JOHANNESBURG 2026

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Published by The Southern African Institute of Mining and Metallurgy
Minerals Council South Africa, 7th Floor, Rosebank Towers, 19 Biermann Avenue,
Rosebank, 2196, Republic of South Africa

ISBN 978-0-6398820-7-9

The abstracts in this volume have been for the most part prepared from Word documents supplied by the authors, with additional typesetting and formatting by The Southern African Institute of Mining and Metallurgy.

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FOREWORD

It is a privilege for me to introduce the Southern African Institute of Mining and Metallurgy (SAIMM)'s fourth Tailings Conference. Having been involved in the conference organisation since the inaugural event in 2020, I have seen it grow from strength to strength and become a well-established fixture on the SAIMM calendar. The conference continues to provide a platform which encourages collaboration between the various role players in the Southern African tailings industry, and I hope you use this year's conference to do just that.

Since the introduction of the Global Industry Standard on Tailings Management (GISTM) in 2020, the tailings landscape has changed for everyone involved. As we look to the future, the 2026 conference asks: Where to now?

In a world of new standards, evolving expectations, and emerging possibilities, what opportunities lie ahead? What residual risks still need addressing? How can we further reduce, reclaim or reuse tailings? How can we accelerate the adoption of new technologies and set new benchmarks for the industry? Which impacts, once considered acceptable, are no longer tolerable, and how can we best manage them?

The presentations and discussions over the next two days will cover a wide range of topics relevant to the future of tailings storage facilities, including both theoretical papers and practical examples from leading practitioners. Our speakers deserve a round of applause for their time and effort in preparing their presentations and papers and for being willing to share their experiences.

On behalf of the organising committee, I would like to thank our sponsors for their valued contributions which have helped make this event a success, and also to thank the SAIMM secretariat for their dedicated organisational support.

L. Spies
Chairperson: Organising Committee

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Linda Heather Spies

Principal Geotechnical Engineer/ Partner
SRK Consulting

Linda Spies is a principal geotechnical engineer with over 20 years of experience, including tailings facility design, construction and operation, geotechnical investigations and designs of foundations and earthworks. Linda is the Engineer of Record for Implats' Impala TSF complex and has undertaken several independent reviews of other tailings facilities. Linda has a developing interest in TSF closure design.

Keynote Presenters

Johan Boshoff

VP Global Tailings Management
Gold Fields Ltd

Johan Boshoff has been involved in geotechnical engineering aspects of projects for the past 30 years. His expertise includes detailed design, monitoring and project management of tailings storage facilities, mine residue stockpiles and waste disposal facilities. He has also fulfilled the role of Engineer of Record for major mining clients on key assets.

He has worked on projects in South Africa, West and Central Africa, Australasia, Asia, North America and Latin America.

Johan is also the primary and supporting author of numerous publications, conferences and work papers dealing with tailings disposal aspects and mine waste.

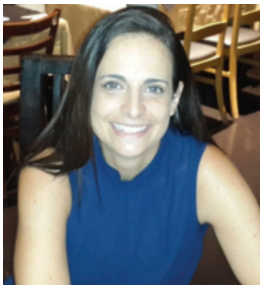
In his current role as the VP of Global Tailings Management, he is the discipline leader and subject matter expert for all company-owned and operated TSFs. He also supports the implementation of leading industry practices for effective and sustainable design, construction, operation, and closure of TSFs across all Gold Fields operations. He also supports and advises on ICMM and other standards and guidelines implementation.

Johan is involved with various industry collaborations and currently chairs the Technical Committee for the GeoStable Tailings Consortium.

Prof SW Jacobsz

Professor of Geotechnical Engineering
University of Pretoria

Prof Jacobsz obtained his BEng (Cum Laude) and MEng (Cum Laude) degrees from the University of Pretoria and completed a PhD in Geotechnical Engineering at the University of Cambridge. He gained industry experience as a geotechnical engineer at Jones & Wagener Consulting Civil Engineers before and after his PhD. In 2010 he joined the University of Pretoria, where he established a geotechnical centrifuge laboratory in 2012 with funding from the National Research Foundation and the University. His research focuses on physical modelling of tailings dam stability and the application of unsaturated soil mechanics. He has led multiple monitoring projects investigating pore pressure and stress regimes in gold, platinum and iron tailings dams, as well as expansive clay profiles. In 2023 he established a mobile soils laboratory funded by Anglo American and was appointed by the Department of Water and Sanitation to lead the geotechnical investigation into the Jagersfontein Tailings Dam failure. He received the SAICE Geotechnical Medal in 2023 and is an NRF-rated researcher.



Jacqui Hex

Board Member / Director
Global Tailings Management Institute (GTMI)

Jacqui Hex is a Director on the Board of the Global Tailings Management Institute (GTMI) and a Director and Technical Leader with 20 years' experience in environmental management, governance, and integrated project delivery across the mining, energy, and industrial sectors.

As an environmental scientist, Jacqui is guided by professional integrity, a commitment to sustainable outcomes, and the view that informed, shared knowledge underpins sound decision-making. Serving on the GTMI Board reflects her focus on supporting industry beyond compliance through evidence-based decision-making, transparent governance, and responsible tailings management. Through this role, she contributes to the advancement of global best practice, with particular emphasis on strengthening trust between industry, regulators, and communities, and reinforcing shared accountability for long-term environmental and social outcomes.

She holds a BSc in Natural and Environmental Sciences, BSc Honours, and an MSc in Environmental Management (cum laude). Jacqui joined Jones & Wagener in 2011 and has progressed through senior technical and leadership roles to Technical Director and Head of the Environmental Management team. In this role, she leads multidisciplinary teams of environmental scientists, engineers, and specialists, delivering pragmatic, cradle-to-grave solutions on complex greenfields and brownfields projects.
Her professional focus lies in the integration of environmental, engineering, and regulatory requirements to support responsible resource development. She has extensive experience coordinating large technical teams to address environmental risk, compliance, and long-term operational sustainability. Jacqui also oversees the Health and Safety portfolio at Jones & Wagener, reinforcing a strong safety culture and organisational accountability.

Jacqui serves as a Director on the Board of Jones & Wagener International Limited. She is also the Vice-Chairperson of the Environmental Assessment Practitioners Association of South Africa (EAPASA) Board, where she chairs the Quality and Standards and Public Relations portfolios, and serves on the Governance and Registrations Committees.

She is a registered professional with SACNASP and EAPASA, a published author, and an active contributor to local and international professional forums.

Dr Emma Gagen

Director Data and Research
ICMM

Emma is the Director of Data & Research at ICMM, overseeing key initiatives in materials stewardship, tailings management, and global data. She joined ICMM in 2022, leading the mine closure and water work programs before serving as acting Director of the Environment portfolio. Her background bridges technical expertise and policy, including a decade as an environmental microbiologist focusing on biogeochemical processes before government experience gained as a lead technical advisor for the Queensland Mine Rehabilitation Commissioner.

The Gold Fields tailings journey towards GISTM conformance: Can we sustain the momentum?

J. Boshoff
Gold Fields Ltd, South Africa

This presentation traces Gold Fields' transformation in tailings stewardship from a fragmented, compliance-driven past to a mature, risk-informed, governance-led system aligned with the Global Industry Standard on Tailings Management (GISTM). It examines how the 2020 release of the GISTM catalysed a fundamental cultural, organisational, and technical shift in how tailings risk is understood, managed, and communicated across the company — from the Board to operations. Before GISTM, tailings management was often peripheral, poorly understood at the leadership level, and operationally siloed. Accountability was diffuse, technical ownership unclear, and reporting focused on simplistic compliance metrics (e.g., factors of safety) rather than a true understanding of risk and control effectiveness. In response, Gold Fields introduced a comprehensive Tailings Management System (TMS), embedding governance, role clarity, risk management, operational discipline, knowledge systems, training, and performance monitoring within a single, integrated stewardship model. Central to this system is the recognition that role definition is a critical safety control. The formal introduction of Accountable Executives, Responsible Tailings Facility Engineers (RTFEs), Engineers of Record (EoRs), Independent Tailings Review Boards (ITRBs), and structured RACI frameworks eliminated ambiguity, established clear decision rights and escalation pathways, and ensured independent challenge. Complementing this are a corporate Tailings Standard, a stewardship portal, competency frameworks, and a training academy designed to build technical depth and professional "formation" — not merely training.

A key innovation is the implementation of TSF Safety Cases, which reframes tailings risk through a structured demonstration of ALARP (As Low as Reasonably Practicable) principles, critical control verification, and lifecycle risk transparency for regulators, communities, and the Board. This shifts the narrative from "compliance" to "confidence in safety." The portfolio context (37 TSFs globally) highlights the scale of the GISTM challenge: over 7900 deliverables requiring independent verification. Gold Fields' approach emphasises credible conformance, transparent disclosure, and industry collaboration through ICMM, GTMI, AMIRA projects, and leadership of the GeoStable Tailings Consortium, which explores commingling tailings and waste rock to reduce dam reliance and advance sustainable tailings solutions. The Tarkwa commingling trials exemplify innovation to reduce footprint, ARD risk, and long-term closure liabilities.

The presentation argues that sustaining momentum requires passion for "doing the right thing" both culturally and technically: managing tailings as a complex system, implementing robust designs tolerant of uncertainty, applying rigorous risk management, and avoiding over-reliance on consequence-based design thinking that focuses only on floods and earthquakes rather than on governance, construction quality, and operational control. Finally, the talk addresses emerging industry challenges that threaten progress: ITRB fatigue, a shortage of experienced EoRs ("silver tsunami"), the rise of "online engineers" with limited site exposure, weak competency frameworks, poor role definition, and a lack of professional formation. The proposed solution is empowerment built on clear roles, strong mentorship, and decision-making authority aligned with accountability. The overarching message is that GISTM conformance is not an endpoint but a catalyst. Sustaining momentum depends on embedding a stewardship culture, strengthening talent and judgement, fostering innovation, and maintaining transparency and collaboration — within Gold Fields and across the industry.

Collaborative accountability: Empowering roles in TSF governance and risk management

M. Brink, C.R. Mtshali, G.C. Howell, N.G. Macfarlane
SRK Consulting, South Africa

Effective governance of tailings storage facilities (TSFs) hinges on adherence to international standards like the Global Industry Standard on Tailings Management (GISTM), which promotes safety, sustainability, and ethical accountability in mining. However, governance is not just about assigning titles; it demands a deep, active engagement with the responsibilities those roles entail.

This paper explores the philosophical risks of role misalignment in TSF governance. When individuals treat roles as symbolic rather than functional, they risk undermining the intent of the entire framework. Titles alone do not ensure accountability; it is the embodiment of responsibility that matters. Misalignment leads to poor communication, blurred decision-making, and a lack of long-term risk awareness. Central to this discussion are the roles of the Engineer of Record (EOR), Responsible Tailings Facility Engineer (RTFE), and Accountable Executive (AE), as defined in Principle 9 of the GISTM. The paper examines how these roles interconnect and how the AE must empower the EOR, not just formally, but in a way that enables meaningful oversight. The concept of 'empowerment' is unpacked to emphasise its practical and ethical dimensions. Additionally, the paper explores the risk ALARP (As Low As Reasonably Practicable) principle and its relevance to TSF governance. ALARP is not just a technical guideline; it reflects a commitment to minimising risk through informed, ethical decision-making. The roles of EOR, RTFE, and AE must align with this principle to ensure that risk management is both effective and morally sound. Ultimately, this paper critiques current governance practices and calls for a shift toward genuine engagement. It argues that holding a role means more than having a title; it requires understanding, commitment, and ethical accountability. By rethinking how roles are defined and enacted, the mining industry can better manage systemic risks and foster a culture of responsible stewardship.

The full paper will be published in the SAIMM Journal

Mareli Brink
Senior Civil Engineer
SRK Consulting

Mareli Brink is a senior civil engineer with over 8 years of experience, including tailings facility designs and operations, geotechnical investigations, structural designs and construction management. Mareli is the Engineer of Record Assist for a TSF complex in Zimbabwe.

The challenge of GISTM adherence for smaller mining operations in remote parts of the world and the case for a GISTM-Light process

G.V. Price
Klohn Crippen Berger Australia, Australia

This paper, with special reference to Air Upas and Sandai Mines in western Kalimantan Indonesia, describes the problems facing smaller mining operations in remote parts of the globe in acquiescing to the Global Industry Standard on Tailings Management (GISTM). The GISTM as published in 2020, references six topic areas namely Communities, Integrated Knowledge Base, Design Construction and Operation, Management and Governance, Emergency Response, and Disclosure. Each of these encompass 15 Principles in turn incorporating 77 Requirements and 219 Criteria. Tailings storage facilities are audited against these and though well-meaning and a very necessary requirement, are often difficult to adhere to in remote areas where flight access is arduous or impossible, road access is over long distances often along muddy tracks with deep rutting, satellite communications at times non-existent, specialised equipment necessary for geotechnical field testing unavailable or only accessed through difficult and costly establishment, senior geotechnical staff unwilling to locate to remote sites; these to mention but a few of the problems faced. The paper describes where adherence is possible as measured against the main GISTM topic requirements and principles, and perhaps more importantly – where not. These issues of compliance and non-compliance are integrated and presented in tabular format. The paper makes recommendations on how the most difficult adherence requirements can be overcome and concludes with suggestions of how GISTM audit requirements and processes can be softened in a 'GISTM-Light' process, where smaller remote operations can be audited against more appropriate and equitable targets, and so secure their aspirations to stay within the GISTM fold.

Keywords: GISTM, TSF, remote, compliance versus non-compliance, GISTM-Light.

Gordon Vivian ("GV") Price

Senior Staff Consultant
Klohn Crippen Berger

Dr. Gordon Vivian "GV" Price is a geotechnical engineering specialist with more than 47 years of international experience managing complex projects and leading multidisciplinary technical teams. Over the course of his career, he has directed four consulting practices in southern Africa, including two that he founded. GV holds both an MSc and a PhD in Engineering Geology from the University of Pretoria, where his doctoral research focused on rockmass characterization for tunnelling applications. His expertise spans a wide range of engineering geological and geotechnical disciplines, including open pit rock mechanics, tailings dam engineering, GISTM conformance assessments, rock slope evaluation and stabilization, water and hydropower dam investigations, construction materials engineering, and geotechnical input for major road, rail, and mega bridge infrastructure projects.

He has delivered projects across Africa, Australia, Ireland, Afghanistan, and Indonesia, bringing extensive insight into diverse geological and operational environments. In recognition of his outstanding contributions to the field of engineering geology, GV received the SAIEG Gold Medal in 2020. GV is currently a Senior Staff Consultant at Klohn Crippen Berger in Australia and resides in Brisbane with his family.

Towards developing geotechnical engineers as tailings storage facility engineers of record

A.H. Kirsten, L.H. Kirsten, D. Johns
Klohn Crippen Berger, Australia

The Engineer of Record concept originated in North America and has been applied in public and private construction since the early 20th century. In the context of mine tailings, the role gained prominence over the past decade, following several catastrophic tailings storage facility failures. The responsibilities of the Engineer of Record were formalised in the Global Industry Standard on Tailings Management. Since the introduction of the Global Industry Standard, the demand for Engineer of Record services has surged, requiring consulting firms to assign suitably qualified and experienced engineers. However, the current demand far exceeds supply. Many Engineers of Record are responsible for multiple facilities, and the combination of high workloads and long-term appointments can compromise their ability to meet duty-of-care obligations. Reluctance to accept the liability associated with the role further limits the available pool. To address this constraint, structured and continuous skills development is essential, alongside broader recruitment into mining and consulting. The long lifecycle of storage facilities presents a clear opportunity to develop aspiring engineers into competent Engineers of Record. This paper presents a framework to support the systematic development of geotechnical engineers to the role of Engineer of Record. Industry-wide adoption of such programs could increase the supply and capability of Engineers of Record, improving the quality and sustainability of appointments. The framework also enables aspiring Engineers of Record to assess their progress toward meeting role requirements. The authors have applied the framework to several tailings storage facilities since the Global Industry Standard's release. While scoring criteria are still under development, they are available on request to encourage broader adoption.

Keywords: Engineer of Record, tailings storage facility, GISTM

The full paper will be published in the SAIMM Journal

Louis Hendrik Kirsten

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Klohn Crippen Berger

Louis Kirsten is a senior civil and geotechnical engineer with experience across the resources, infrastructure, and public sectors. His work spans research, consulting, and project delivery, from concept through closure, including dispute resolution. He has led projects across Australia, Africa, Canada, and the Middle East, with a focus on tailing storage facilities and water management, dam safety, closure engineering, and foundation and slope stability. He applies practical soil and rock mechanics, deformation analysis, and reliability-based design. Louis has served as Engineer of Record on extreme consequence facilities and has provided expert opinion in forensic investigations. His approach is evidence-based, technically disciplined, and focused on sound engineering judgment.

Towards common ground for classifying tailings according to their metallurgical and geotechnical properties

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Understanding the properties of tailings is critical to selecting the correct metallurgical dewatering circuit and Tailings Storage Facility design which are compatible to the tailing's behaviour. It is therefore fundamental to be able to classify tailings into groupings which reflect their ease or difficulty with respect to dewatering and geotechnical behaviour. Parameters such as grain size and Atterberg limits are commonly used to classify tailings into either plastic or non-plastic groups. This method, although useful, has inherent flaws, since plastic behaviour is itself derived from intrinsic properties such as the active clay content and the pore water salinity which affect the dispersive behaviour of the clays.

This paper will be published in the SAIMM Journal

Andrew Vietti

Director
Vietti Slurrytec (Pty) Ltd

Andrew Vietti is a director of Vietti Slurrytec and has an MSc degree from the University of Natal in South Africa.

Andrew has over 30 years' experience in the solid/liquid separation field beginning at the De Beers Consolidated Mines research and development facility (Debtech) implementing Paste Thickening technology throughout the group. Thereafter Andrew co-founded a Vietti Slurrytec which is a specialist de-watering metallurgical test laboratory and consulting practice. The company provides test work data on which various solid/liquid separation circuits from Paste to dry stacking surface tailings disposal projects can be designed.

Vietti Slurrytec specializes in a fundamental understanding of how clay slurry colloidal behaviour influences the de-watering process. Our extensive data base encompasses most mineral types at both small and very large operational scale.

Characterisation of the reworked residual norite in the Rustenburg Region of South Africa

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Many tailings storage facilities (TSFs) in the Rustenburg region of South Africa's North-West Province are founded on reworked residual norite derived from the weathering of the Bushveld Igneous Complex. The weathering of these rocks results in the formation of residual soils, typically characterised by high-reactivity clays near the surface, grading into coarser materials with depth. The upper horizon, commonly referred to as reworked residual norite or black turf, typically comprises of clay contents of up to 80% with high-plasticity. Cyclic swelling and shrinkage result in remoulding and the development of non-continuous slickensides characteristic of residual soils. With the implementation of the Global Industry Standard on Tailings Management (GISTM), increased emphasis is placed on robust material characterisation, as this layer frequently controls TSF stability under both drained and undrained conditions. Laboratory testing is challenging due to very low permeability, high overconsolidation, and a non-linear shear strength envelope characterisation, with yield stresses of approximately 800 kPa. Oedometer results show decreasing coefficients of volume compressibility and consolidation with increasing stress, likely due to closure of microfissures. Undrained triaxial shear testing on undisturbed and compacted specimens indicates contractive behaviour, with peak strength mobilised at shear strains of approximately 7–10% followed by mild strain softening. The results support a non-linear failure envelope for effective stresses below the yield stress, transitioning to linear behaviour at higher stresses.

This paper will be published in the SAIMM Journal

Edoardo Zannoni

Director & Section Manager: Geotechnical
Knight Piésold

Edoardo is a registered Professional Engineer in South Africa and Chartered Engineer in the UK with more than 15 years experience in Southern Africa in the civil and mining sectors. He has been involved in geotechnical projects such as embankment stabilisation, retaining walls, road improvement, and tailings storage facilities, from geotechnical investigation planning to interpretation and design. He has been involved in tailings management systems across Southern Africa and has been a project manager for geotechnical work (investigation and design) and rehabilitation and closure as well as covering the role of deputy Engineer of Record for Extreme TSF's. He is able to create, develop and manage teams based on risk benefit approach and multidiscipline, creating a wider view of the approach to projects. He has in-depth knowledge of geosynthetics and geotechnical engineering, especially in soil reinforcement, ground improvement, barrier systems and critical state soil mechanics. He plays an active role in national and international engineering societies and is responsible for main key accounts in South Africa. His current position is Director and Section Manager of the Geotechnical Division for Knight Piésold, overseeing engineering geology, rock mechanics and geotechnical engineering; as well as a Director of the Board of Civilab, a geotechnical laboratory with more than 50 years in South Africa. He is also the current Vice President of the International Geosynthetics Society a no-profit organisation registered in the USA with more than 3000 members throughout the world and 49 countries representations.

Reliable design with limited data: Characteristic strength selection for slope stability assessment

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The selection of characteristic shear strength values for slope stability assessments of tailings storage facilities (TSFs) requires careful consideration of uncertainties in material properties, arising from both spatial variability and the inherently limited scope of site investigations. When sample size and layer geometry are not explicitly considered, the resulting design values may not reliably represent in-situ conditions. This paper demonstrates an approach to deriving characteristic shear strength values that incorporates sample size and layer geometry in accordance with Eurocode 7 (EN 1997). A case study is presented using twelve monotonic simple shear tests on a TSF foundation soil. From this data, a design value for the undrained shear strength ratio (s_u/σ'_v) is obtained by both conventional means and through a procedure guided by the 2nd Generation EN 1997. Comparisons between the two approaches highlight the sensitivity of strength selection and emphasise the importance of appropriate statistical treatment when defining characteristic values. The influence of each approach is further demonstrated through its impact on the stability of a simplified slope. The findings illustrate a structured method for selecting characteristic s_u/σ'_v values that balances limited data with explicit uncertainty treatment, supporting more reliable and defensible design decisions in TSF stability assessment.

Hugo Assis Brandao

Senior Geotechnical Engineer
Klohn Crippen Berger

Hugo Brandão is a geotechnical engineer focused on tailings dams and dry stack design; integrating geological and geotechnical data to deliver safe, resilient solutions. As a team leader, Hugo values collaboration and mentoring, helping professionals grow with confidence. He is passionate about how data science, AI, and data-driven design are reshaping geotechnical engineering—unlocking deeper insights, improving reliability-based design, and enabling smarter decisions throughout project lifecycles. Hugo sees these tools as catalysts for innovation and sustainability in the field. Excited about the future, he welcomes opportunities to connect with others who share curiosity and a commitment to advancing geotechnical practice.

Clay soil – A history of theoretical approaches to strength and the way forward

A. Smith, C.J. MacRobert
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Structural failures on clay soils date back to antiquity, with tailings storage facilities (TSFs) being particularly vulnerable due to their frequent foundation on clay. Clay's shrink-swell behaviour, low strength, high compressibility, and settlement issues pose significant challenges. Between 1910 and 2018, 17.3% of over 300 TSF failures were attributed to foundation failure, highlighting its importance. For structures on clay, including TSFs, accurate strength parameters are critical throughout the project lifecycle. Site investigations using in situ and laboratory testing remain the preferred approach for determining design parameters, while empirical correlations assist in preliminary assessments and validation. Literature over the past three centuries reflects substantial work on clay shear strength and empirical correlations, yet notable gaps persist. A reliability assessment of key correlations, informed by documented failure case studies, is recommended. This research aims to enhance TSF design by improving long-term performance, resilience, and cost-effectiveness, ultimately reducing risk for critical infrastructure.

Keywords: Clay soils, Drained, Effective stress, Shear strength, Tailings storage facility, Total stress, Undrained

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Employment - 1994 – 2000 (LTA Construction Limited, Civil and Earthworks Division), 2000 – 2025 (SRK Consulting (Pty) Ltd., Environmental Geotechnics Department), 2025 – present (fulltime research student at SU).

Specialisation - Geotechnical and pavement engineering.

Expertise - Detailed design and monitoring of tailings storage facilities (TSFs), return water dams (RWDs), and associated infrastructure. Dam safety evaluations (DSEs). Soil characterisation. Geotechnical investigations. Slope stability assessments. Risk assessments. Compilation of design reports, operations, maintenance and surveillance manuals, and continuation reports. Preparation of tender documentation and drawings. Tender adjudication, and project management.

Publications – 'South African Road Network Classification Based on the Traffic Loading' (2001), 'An Evaluation of the Adequacy of the Most Commonly used Pro forma Contracts within the South African Mining Construction Industry' (2007), and 'Platinum Tailings – Field and Laboratory Investigation to Evaluate Geotechnical Behaviour' (2018).

Geochemical characterisation of re-mined copper tailings in the Democratic Republic of Congo – best practices that can be adopted in South Africa

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As the demand for minerals increases and technology advances, the remining of waste from historical facilities has become a feasible option. This was exemplified by a specific copper mine in the Democratic Republic of Congo, which sought to enhance metallurgical recoveries to ~95%, thus significantly lowering the residual copper content in the tailings. This remining project will introduce additional water into the tailings storage facility (TSF) through hydro-mining operations. The remining process will also produce secondary tailings (finer) that are representative of future tailings to be generated at the mine, which will be disposed of in the TSF. This paper presents the findings of a comprehensive geochemical assessment, incorporating static, kinetic, and ecotoxicological testing over a 21-week period on metallurgical tailings samples. The integrated approach enabled a robust risk evaluation and provided a practical framework for similar projects in South Africa. Results indicated stable pH and declining sulfate and total dissolved solids concentrations, suggesting a low potential for acid rock drainage under laboratory conditions. However, Toxicity Characteristic Leaching Procedure, Synthetic Precipitation Leaching Procedure, and Australian Standard Leaching Procedure results classified the tailings as leachable mine waste, implying potential metal mobility. Ecotoxicological tests revealed high acute toxicity (Class IV) to aquatic organisms, indicating that undiluted leachate may adversely affect sensitive species. In the absence of geochemical modelling, drainage from the remined tailings should be treated before discharge, using passive or active systems to reduce electrical conductivity and remove elevated iron and copper. These results highlight the importance of early geochemical screening and toxicity assessment in remining projects, particularly when legacy tailings are reused or reprocessed.

The study contributes practical insights into the environmental risks and mitigation requirements associated with re-mined copper tailings and offers a transferable approach for improving environmental outcomes at similar operations in South Africa.

Keywords: Copper mine, acid rock drainage, metal leaching, environmental risks, remining, Democratic Republic of Congo, ecotoxicological tests, static and kinetic tests

Mpule Gloria Dube
Associate
WSP Africa Pty Ltd

Gloria is presently working for WSP Africa Pty Ltd, Associate position and recently promoted to Line Manager. With almost 13 years of experience, she has developed expertise in geo-environmental sciences, focusing specifically on areas affected by mining activities. Her professional background encompasses geochemical characterisation of legacy, operational, and greenfield mines across South Africa and other African countries, as well as geochemical modelling and environmental risk/ impact assessments, among others. She is passionate about addressing challenges associated with mining and aims to enhance the geochemical modelling aspect of her career.

New method for tailings valorisation

S. Mxinwa, A. Kotsiopoulos, S.W. Robertson
Mintek, South Africa

The copper mining industry has generated large quantities of below-cut-off grade waste rock and flotation tailings with residual copper content. These tailings dam materials are amenable to hydrometallurgical treatment, such as heap leaching, but dissolve slowly under typical processing conditions. The main factors influencing the leaching kinetics in heaps include the ore bed hydrodynamic properties that control solution percolation and metal dissolution. Fine-grained tailings and low-permeability ores commonly exhibit poor percolation, leading to uneven flow, low copper recoveries, and, in severe cases, heap instability. Another issue, with respect to the leaching of refractory copper minerals in heaps, is the need for elevated temperatures which may require an external heat source. To address these issues, Mintek has developed new technologies, such as MinbindTM, which allows fine material to be agglomerated with an inorganic binder, significantly improving solution percolation. Additionally, solar heating technology, whereby the feed lixiviant stream is heated, combined with acidic chloride or bioleach technologies and applied to dissolve refractory minerals such as chalcopyrite has shown potential. To date these technologies have been demonstrated at laboratory scale, indicating that high recoveries can be obtained from a low-permeability micaceous copper stockpile material. The chloride technology was demonstrated on a low-grade chalcopyrite ore, achieving 87% copper dissolution.

TSF-specific water balance as a standard practice

A. Scholtz, K.M. Uderstadt, L. de Villiers, G.C. Howell
SRK Consulting, South Africa

Site-wide water balances provide valuable oversight of mining water management, but the complexity and critical role of Tailings Storage Facilities (TSFs) require a focused, facility-specific approach. TSFs often remain a "black box" in conventional balances, particularly with respect to entrapped and interstitial water. Yet, understanding how much water is stored within a TSF, and how it changes over time, is fundamental to water optimisation, environmental stewardship, and dam safety. This paper highlights the advantages of developing TSF-specific water balances. By explicitly accounting for inflows and outflows, including slurry water, rainfall, evaporation, seepage, recovery processes, and entrapped water, operators can better characterise water dynamics that are typically underestimated in broader site-wide assessments. A case study illustrates how such focused analysis provides clearer insights into water storage and release, supporting improved conservation, regulatory compliance, and enhanced stability of TSFs. Given that TSFs evolve over decades, with changing tailings properties and seepage regimes, a robust water balance informed by up-to-date hydraulic data is essential for long-term management. It is proposed that TSF-specific water balances should be regarded as standard practice in mining. Such an approach not only strengthens operational decision-making but also supports sustainable water use and minimises environmental impacts, ensuring that TSFs continue to perform their essential function without compromising safety or integrity.

Kurt Uderstadt
Principal Engineer
SRK Consulting

Kurt Uderstadt is a Principal Engineer with over 30 years of experience in geotechnical, civil, structural, and environmental engineering. Based in Johannesburg, South Africa, he specialises in the design and project management of complex infrastructure projects, including tailings storage facilities (TSFs), stormwater systems, and structural foundations. Kurt has extensive expertise in geotechnical investigations, stability analysis, hydraulic structures, and environmental rehabilitation.

The Jagersfontein tailing dam failure

S.W. Jacobsz
University of Pretoria, South Africa

The Jagersfontein tailings dam failed on 11 September 2022, releasing approximately 6 million cubic metres of tailings and water into the environment. The disaster resulted in the loss of three lives, damage to nearly 200 mostly residential properties and a negative impact on agricultural land, livestock and water sources. The keynote lecture will present the findings of an investigation, commissioned by the Department of Water and Sanitation, and carried out by the Departments of Civil Engineering of the Universities of Pretoria and the Witwatersrand into the causes of the failure. The lecture will focus on the geotechnical aspects of the disaster. Extensive use was made of satellite imagery to track the development of the dam over time and to identify events contributing to the failure. The development history of the dam, as compiled from aerial and satellite images, will be presented, as well as events during the life of the dam which contributed to the failure. Lessons learnt regarding the use of satellite imagery for tailings dam surveillance will be highlighted, as well as comment on the use of INSAR (interferometric synthetic-aperture radar) for tailings dam monitoring.

Adapting to change: Filtered tailings and the future of tailings management

K. Naidoo, V. Balakistan
WSP in Africa, South Africa

In recent years, the mining industry has placed a spotlight on the operation and management of tailings storage facilities (TSFs) due to the devastating repercussions of mismanagement of TSFs. The focus of the experts in the industry has been directed at minimising the risk of failure that is usually associated with traditional slurry/wet deposition. This has led to the development of standards such as the Global Industry Standard for Tailings Management (GISTM).

For this reason and among others, mining companies are turning to alternative forms of deposition that pose less of a risk than conventional slurry deposition. Hence, the rising popularity of a relatively new technology referred to as filtered tailings (FT) deposition.

FT deposition is deemed a safer option primarily because of the low water content of the tailings. However, since the FT stacking method of deposition is a relatively new concept, we find ourselves facing new challenges and hurdles that have not been tackled before when it comes to its design and operation. There are plenty of unknowns and not enough research or case studies to understand how the facilities/materials will behave under certain conditions. There are also a host of different types of risks that arise with FT operations. This paper highlights our personal experiences in overcoming setbacks through innovative ideas and unique ways of thinking. It also delves into various case studies, showcasing the challenges encountered during the design and construction phase of an FT facility.

After all our research and experiences with FT stacking, we are left with a compelling question: Is FT stacking truly a better alternative to traditional slurry deposition? One can argue that the most dangerous risks – slope failure and breaches of liquefied tailings – are almost entirely mitigated with an FT operation. However, certain types of wet TSFs, such as those with engineered embankments (e.g., impoundment TSFs), significantly reduce the risk of slope failure as well. Therefore, a more refined question is: Are the new risks and challenges that come with FT stacking worth the effort, or should the industry continue exploring other methods of tailings storage?

Kiasha Naidoo

Tailings Engineer
WSP Africa

Kiasha Naidoo is a Tailings Engineer at WSP with a strong focus on geotechnical engineering and tailings storage facility (TSF) design. She holds a Bachelor of Science in Civil Engineering from the University of the Witwatersrand and has been actively involved in the mining and infrastructure sector since 2023. Although relatively new to the industry, Kiasha has already contributed meaningfully to several high-impact projects across South Africa, particularly in the field of filtered tailings (FT) and dry stack TSF operations.

Her experience includes serving as an assistant Engineer of Record (EoR) for operational monitoring of TSFs at three mines where she conducted inspections, analysed instrumentation data, and contributed to safety and performance reporting. She also played a key role in the development of a Dry Stack Tailings Storage Facility, where she authored the Operations, Monitoring, and Maintenance Manual. This work involved integrating GISTM-aligned protocols, developing surveillance and emergency response strategies, and addressing the unique challenges of FT stacking in a high-risk environment.

Kiasha has also conducted airspace modelling, geotechnical assessments, and design reviews. Her academic background includes a geotechnical design project focused on landfill slope stability and barrier systems, further reinforcing her technical foundation in critical state soil mechanics and slope performance.

She is proficient in a wide range of engineering software, including GeoStudio, Slide, AutoCAD Civil 3D, and HEC-RAS, and is particularly passionate about fluid mechanics, tailings dam design, and pump and pipeline systems. Her recent work on moisture content optimization for FT deposition reflects her commitment to innovation and problem-solving in the face of evolving industry challenges.

Driven by a deep sense of responsibility for the communities and environments affected by mining operations, Kiasha is passionate about advancing the field of tailings engineering. She is especially interested in improving surveillance, monitoring, and risk mitigation strategies for TSFs, recognizing the devastating consequences of tailings failures. Her work is guided by a strong ethical foundation and a desire to contribute to safer, more sustainable mining practices.

Kiasha is committed to continuous learning and collaboration, and she brings a fresh, enthusiastic perspective to the field. Her goal is to help shape the future of tailings management through thoughtful design, rigorous analysis, and a proactive approach to risk.

Veshania Balakistan

Tailings Engineer
WSP Africa

Veshania is a Tailings Engineer with four and a half years of experience in design, surveillance and monitoring of Tailings Storage Facilities (TSFs). She is currently employed at WSP Africa and is part of the Mine Waste team. Prior to this, she worked in the Tailings Department at Jones and Wagener for nearly three years. Her qualifications consist of a Bachelor of Science degree in Civil Engineering, which she obtained from the University of the Witwatersrand in 2020.

Throughout her career, she has had the opportunity of working on projects for various prominent Mining companies such as Anglo Gold Ashanti, De Beers, Glencore, etc. Her experience and expertise includes surveillance and design of a range of tailings facilities with various deposition and construction methods, namely; traditional upstream slurry deposition, impoundment facilities, dry stacking and filtered tailings facilities.

Improving tailings dewatering with ATA for paddocked buttress formation: A pilot study

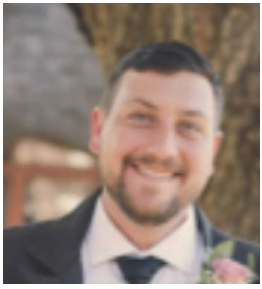
J.C. van der Linde[1], E.D. Brooks[2], C. Spagnuolo[1], A.J. Fischmann[3], J. Raath[4]
[1]Clean TeQ Water, South Africa
[2]Stitchwise, South Africa
[3]Clean TeQ Water, Australia
[4]Harmony Gold, South Africa

The St Helena tailings storage facility (TSF), operated by Harmony Gold, receives tailings from several Harmony Gold processing plants in the Welkom area of the Free State, South Africa. To improve structural integrity and extend the operational life of the TSF, a tailings paddock buttressing method is currently being implemented. In this method, the buttress is constructed using deposited tailings in paddocks, with walls typically shaped and placed by an excavator. Whilst this method provides the necessary structural integrity, it is a time- and resource-intensive method that is limited by the drainage rate of the ultra-fine tailings, equipment availability and weather conditions.

This paper demonstrates the use of Clean TeQ Water's ATA® Rapid Dewatering Technology as an alternative approach, utilising woven geotextile dewatering bags in combination with the ATA® technology to construct and fill the paddock buttress. ATA® is a three-component system where the tailings stream is separated into fines and coarse fractions utilising a hydro-cyclone. These fractions are treated separately with complementary polymeric reagents and recombined to create anchored particles. These anchored particles enhance dewatering performance by capturing the fines and creating a granular agglomerate structure that promotes improved free drainage and rapid water release. A 9 t/h pilot plant was operated on site, benchmarking the ATA® enhanced paddocking method with the current method. The results from the pilot demonstrated that the use of ATA® offers significant advantages, including higher homogeneity in the buttress, higher permeability and faster settling rates. The moisture content of the ATA®-treated material is lower and trafficability was achieved at an accelerated rate, reducing turnaround time between lifts and enabling more efficient and safer tailings facility management.

Keywords: Polymers, Buttressing, Permeability, Trafficability, Phreatic line, Direct deposition

The full paper will be published in the SAIMM Journal



Janna van der Linde

Process Engineer
Clean TeQ Water

Janna van der Linde is a Process Engineer with a Master of Engineering (MEng) from North-West University (NWU), currently working at Clean TeQ Water. He plays a central role in the development and commercialisation of Clean TeQ's ATA® technology, supporting both lab-scale optimisation and pilot-scale deployments.

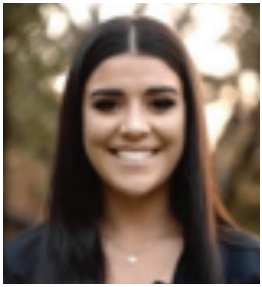
He has worked on a wide range of process development projects in the mining industry, gaining hands-on experience in on-site testing, process troubleshooting, and pilot-scale implementation. His practical experience across both laboratory and operational settings gives him a strong foundation for bridging the gap between research and real-world application.

Janna is passionate about applying innovative technologies to solve complex challenges in the mining and water sectors, with a strong focus on sustainability, efficiency, and operational impact.

Assessment of causeway-induced loading on penstock towers

S.C.T. Luis, T. Armstrong
SRK Consulting, South Africa

Tailings storage facilities (TSFs) in South Africa commonly incorporate centrally located concrete penstock towers to facilitate the decanting of the supernatant pond from the TSF surface. During operation, these towers must be progressively raised in accordance with the rising elevation of the tailings. This is typically achieved by stacking prefabricated, interlocking concrete rings, often accompanied by internal grout sleeving to ensure vertical integrity and watertightness. The responsibility for raising the penstock towers lies with the TSF operator and any appointed contractors. To enable ongoing access to the penstock tower, which is located near the centre of the facility where the supernatant pool is managed, a tailings-constructed access structure (commonly referred to as a causeway or pool handle) is typically constructed and progressively raised. A catwalk is generally installed at the end of this structure to permit personnel access across the supernatant pool for inspection, maintenance and operational activities. However, the presence and geometry of this causeway introduces additional geotechnical considerations that are often not considered. If constructed in close proximity to the penstock tower, the causeway can impose unbalanced surcharge loads that may induce pressures which affect the structural integrity of the tower. If not properly accounted for, these loads could lead to tower distress or deformation through soil-structure interaction mechanisms. This paper investigates the interaction between the surcharge loading induced by a tailings causeway. Using analytical methods, the study examines the critical relationship between causeway height, distance from the tower, and the resulting impact on the tower's performance. A key focus of this paper is the determination of the critical causeway height and position, relative to the penstock tower, at which the structural integrity of the penstock tower is at risk of being compromised. The findings of this study aim to support engineers of record (EoR), designers and TSF operators by providing design guidance and operational limitations for causeway construction near penstock towers. By quantifying the critical parameters influencing soil-structure interaction in this context, the study contributes to the development of safer and more robust TSF operating guidelines. The outcomes are also applicable to other scenarios where surcharge loading adjacent to vertically stacked infrastructure in soft or transitional material poses a potential geotechnical risk.



Simone Luis

Civil Engineer
Company: SRK Consulting (South Africa)

Simone Luis is a Junior Civil Engineer with over two years of experience in structural and geotechnical engineering, with a strong focus on the tailings industry. Her work has involved supporting the design, analysis, and monitoring of tailings storage facilities, contributing to safe and sustainable mining practices. She has contributed to greenfield tailings dam designs, with specific focus on concrete infrastructure such as penstock towers, return water dam intake towers, and silt traps. She has also contributed to penstock pipeline alignment design and on-site QA/QC during construction phases. She brings a practical and detail-oriented approach to projects, drawing on a solid foundation in civil engineering principles and a growing expertise in managing geotechnical challenges in complex environments.

Tyler Armstrong

Senior Geotechnical Engineer
SRK Consulting (South Africa)

Tyler Armstrong is a senior geotechnical engineer and project manager at SRK Consulting, where he has worked for the past five years. With an Honours degree in geotechnical engineering, Tyler Armstrong brings deep technical expertise and a strong project leadership background to the field of tailings engineering.

Throughout his career, Tyler Armstrong has specialised in the design, analysis, and management of tailings storage facilities. His work spans a wide range of critical activities including laboratory testing, numerical modelling, construction QA/QC, dam breach analysis, stability assessments, penstock structural analysis, and critical state soil mechanics. His integrated approach ensures the delivery of robust and resilient tailings solutions in line with evolving industry standards and sustainability objectives.

As a presenter at this conference, Tyler Armstrong shares insights grounded in both technical proficiency and practical experience, contributing to the advancement of geotechnical and tailings engineering practices globally.

Evaluating mine tailings reuse potential through geotextile dewatering

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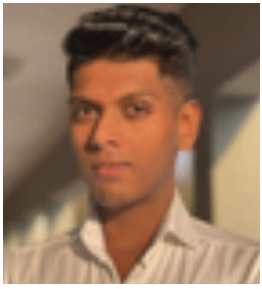
Mine tailings management is commonly based on a linear disposal approach, where fine residues are stored as slurry with limited opportunity for reuse. Circular economy principles offer an alternative by transforming waste materials into reusable resources, with dewatering serving as a key enabling step. This paper presents a structured, qualitative methodology for early-stage assessment of geotextile-based dewatering of fine industrial residues, including fly ash and fine tailings. The paper adopts a conceptual and analytical approach based on published experimental studies, reported field applications, and bench-scale filtration observations. Governing material, process, and outcome parameters are organised into evaluation categories to support early screening rather than detailed design. The results show that dewatering performance cannot be inferred from material classification alone and that systematic early-stage assessment is essential for reducing uncertainty and supporting more sustainable tailings management.

Keywords: Geotextile dewatering, Tailings management, Geosynthetics' Circular Economy



Nikhiel Budhai

Civil Engineer
Maccaferri SA

Nikhiel Budhai is a civil engineer, systems thinker, and conscious designer whose work bridges technical innovation with sustainability and purpose. With expertise in geosynthetics, infrastructure resilience, and tailings valorisation, his approach integrates circular economy thinking into practical engineering solutions, particularly in the modelling of passive dewatering systems for mine waste reuse and water recovery. Certified in project management and engaged in postgraduate research in civil and environmental engineering, his work is grounded in both academic rigour and applied impact. His lifestyle, shaped by the principles of balance, clarity, and intentional living, informs a practice of engineering that is as mindful as it is technical.

Nikhiel brings a future-facing perspective to the mining and infrastructure sectors, where sustainability is not just a requirement but a conscious design choice that regenerates environments, strengthens systems, and uplifts the communities they serve.

Introducing the Global Tailings Management Institute

J. Hex
Global Tailings Management Institute (GTMI), South Africa

The Global Tailings Management Institute (GTMI) is an independent, multi-stakeholder governed organisation dedicated to improving the safety of mine tailings facilities worldwide. It was established in South Africa in 2025 to promote widespread adoption and implementation of the Global Industry Standard on Tailings Management (GISTM).

On 25 January 2019, a tailings dam disaster in Brazil's Brumadinho claimed 272 lives. This, and other tailings facility failures, led to decisive action by ICMM, the United Nations Environment Programme (UNEP) and the UN-backed Principles for Responsible Investment (PRI) to make mine tailings facilities safer.

Together, they co-convened the Global Tailings Review, and in 2020 developed and published the GISTM. The establishment of the GTMI is the next transformative step.

The GISTM requires mine operators to take responsibility and prioritise the safety of tailings facilities, and the GTMI is responsible for managing the assurance framework through which tailings facilities will be audited and certified against the Standard, by qualified, independent third-party assessors. This will be supported by efforts to drive awareness, share knowledge, and disclose auditing outcomes.

At SAIMM's 2026 conference on Tailings, Jacqui Hex, GTMI Board Member and Environmental Scientist at Jones & Wagener, will introduce the Institute and provide an overview of its role and scope. Now that a GTMI CEO has been appointed and a Technical Committee has been established, she will discuss the Institute's 2026 plans. This includes ramping up its core activities, appointing qualified auditors, and welcoming Signatories (members of the mining industry) and Supporters (other interested stakeholders).

The GTMI's goal is to achieve zero harm to people and the environment, with zero tolerance for human fatality.

Assessment and mitigation of slope stability risks for TSF closure

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The closure of a tailings storage facility (TSF) requires a comprehensive slope stability assessment to ensure long-term structural integrity and prevent potential post-closure failures, which can lead to severe environmental and social consequences. Closure planning must align with regulatory requirements, international standards (e.g., ICMM, GISTM), and corporate ESG commitments.

An extreme consequence classification TSF, located in South Africa, and receiving tailings from underground mining operations, is nearing the end of its life and is being planned for closure. To reduce the risks associated with this TSF, the option of partial remining (i.e., harvesting/excavating tailings) is being considered.

The initial slope stability assessment was based on available historical data, however, updated investigations were recommended for improved understanding of geotechnical parameters and pore pressure distribution and to support a more accurate stability analysis.

An updated slope stability assessment was carried out post completion of the recommended updated site investigation work, and for all loading conditions assessed the estimated factors of safety (FoS) values were below recommended targets.

Minimum FoS values were assessed with reference to established international guidelines including ANCOLD, CDA & GISTM guidelines. The two mitigation options were recommended:

- Raise the buttress, or
- Reprofile the downstream (local) slope, between the crest and first step-in/bench.

The assessment considered operational, constructability and freeboard constraints and indicated that either of these mitigation measures would need to be implemented, if feasible, and partial remining by itself is not adequate to reduce the TSF instability.

Keywords: TSF Closure, SLOPE/W, Slope Stability, Remining.

Dr. Priyanka Sharma

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Dr. Priyanka Sharma is an accomplished civil engineer specializing in geotechnical and earthquake engineering, with a proven track record in research, design, and technical consultancy. She currently serves as an Engineer-Tailings at WSP India, Noida, where she focuses on geotechnical interpretation, CPTu analysis, and slope stability assessment in tailings and global mine waste management projects.

Dr. Sharma holds a Ph.D. in Soil Dynamics from the prestigious Indian Institute of Technology (IIT) Roorkee, where her research focused on seismic hazard assessment and liquefaction potential in the Indo-Gangetic Plains.

Over the years, she has worked extensively in both academic and industry roles. Her previous role as a Senior Engineer at TechFab India Industries Ltd., New Delhi, saw her leading the design and analysis of reinforced soil structures and rockfall mitigation solutions, while managing client interactions and guiding a team of engineers and draftsmen.

In academia, she served as Faculty at National Institute of Technology (NIT) Jalandhar. She has authored multiple peer-reviewed publications in reputed journals and international conferences. She is a registered Engineer-in-Training (EIT) with the Association of Professional Engineers and Geoscientists of Saskatchewan (APEGS), Canada, further validating her international professional credentials.

With a strong foundation in research, technical expertise, and practical engineering, Dr. Priyanka Sharma continues to contribute meaningfully to advancing safe and resilient infrastructure through innovative geotechnical solutions.

State-dependent undrained strength envelopes for gold tailings from NorSand simulations

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Conventional tailings stability assessment often relies on constant undrained strength ratios (Su/p′) that do not account for spatial or stratigraphic variability in soil state. This paper presents a methodology to develop state-dependent undrained strength envelopes using critical state soil mechanics and the NorSand constitutive model, with application to stability assessment of existing tailings facilities.

Laboratory testing on a representative blended sample of gold tailings established the critical state line from six triaxial tests (consolidated-undrained and consolidated-drained). NorSand was calibrated to match observed stress-strain behaviour, then used to simulate peak and residual undrained strength across a range of state parameters (ψ = -0.05 to +0.30) and confining stresses (100-800 kPa). The resulting state-dependent strength envelope was validated against field conditions at two South African gold tailings facilities using CPT-inferred state parameters from 36 soundings across eight cross-sections.

Field state parameters ranged from ψ = -0.11 to +0.07, with the contractive fine/transitional tailings domain predominantly exhibiting ψ = -0.03 to +0.03. The envelope yields spatially-varying strength ratios of Su/p′ = 0.20 to 0.30 for this range, compared to the constant Su/p′ = 0.25 typically assumed in practice. The methodology provides a transparent, traceable framework for defensible strength assignment in stability assessment, with direct traceability from laboratory testing through field inference. The workflow is reproducible and applicable to stability assessment of any tailings facility where representative sampling and in-situ testing enable state parameter characterisation.

Keywords: Tailings; NorSand; Undrained strength; State parameter; Critical state; CPTu; Triaxial test

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Juan Swanepoel is a Junior Geotechnical Engineer at Knight Piésold in South Africa, currently completing his ECSA candidacy. He specialises in geotechnical investigation, in-situ testing interpretation, and slope stability analysis of tailings storage facilities. Juan's experience includes CPTu, SCPTu, DMT, resistivity profiling, and Vane Shear testing, as well as laboratory interpretation for CU, CD, DSS and consolidation tests. He is actively involved in advanced constitutive modelling, with a particular focus on calibrating NorSand and critical state frameworks to tailings behaviour. His work integrates field data with statistical and empirical modelling to develop representative parameters for use in design and analysis. Juan has contributed to projects across South Africa, Madagascar, and the DRC. He is passionate about improving design confidence in TSF analysis through modern geotechnical methods and has authored multiple papers on saturation profiling, strength interpretation, and state parameter modelling in mine tailings

Cross-calibrated in-situ shear strength of gold tailings from CPTU, Vane Shear, and Norsand modeling

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Reliable undrained shear strength (Su) characterization is essential for stability assessment of tailings storage facilities. This paper presents a tri-method validation approach for deriving site-specific cone penetration test (CPT) undrained strength calibration in gold tailings, integrating field vane shear testing (VST), CPT interpretation, and laboratory-based NorSand constitutive modelling.

CPT testing at 36 locations and VST at 21 depths were conducted at two South African gold tailings facilities. Quality screening of 31 VST tests identified 16 exhibiting clear undrained response suitable for calibration (Group A), with the remainder excluded due to blade damage or drained conditions. Back-calculation from Group A measurements yielded site-specific cone bearing factor Nkt ranging from 8.8 to 46.8 (mean = 24.7, median = 21.4). After statistical screening, regression analysis established Nkt = 23.1 for CPT-based strength derivation.

Tri-method validation demonstrates convergence of three independent approaches. At average state parameter $\psi = 0.01$, VST yields $Su/p' = 0.27$, CPT with calibrated Nkt = 23.1 yields $Su/p' = 0.24$, and NorSand modelling (Paper 1) predicts $Su/p' = 0.25$. This agreement, all methods within 12%, validates the site-specific calibration. In contrast, CPT with default Nkt = 15 yields $Su/p' = 0.37$, overestimating strength by 48%.

The calibrated approach narrows the Su/p' distribution significantly (standard deviation reduced 47%). The workflow, comprising systematic VST quality grouping, CPT-VST back-calibration, and validation against constitutive modelling, offers a reproducible framework for site-specific strength calibration with quantified confidence through multi-method triangulation.

Gold tailings; undrained shear strength; CPTu; Vane shear; Nkt calibration; NorSand

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Juan Swanepoel is a Junior Geotechnical Engineer at Knight Piésold in South Africa, currently completing his ECSA candidacy. He specialises in geotechnical investigation, in-situ testing interpretation, and slope stability analysis of tailings storage facilities. Juan's experience includes CPTu, SCPTu, DMT, resistivity profiling, and Vane Shear testing, as well as laboratory interpretation for CU, CD, DSS and consolidation tests. He is actively involved in advanced constitutive modelling, with a particular focus on calibrating NorSand and critical state frameworks to tailings behaviour. His work integrates field data with statistical and empirical modelling to develop representative parameters for use in design and analysis. Juan has contributed to projects across South Africa, Madagascar, and the DRC. He is passionate about improving design confidence in TSF analysis through modern geotechnical methods and has authored multiple papers on saturation profiling, strength interpretation, and state parameter modelling in mine tailings

From commitment to conformance: Tracking global tailings management progress

E. Gagen
ICMM, United Kingdom

The 2020 launch of the Global Industry Standard on Tailings Management (GISTM) marked a pivotal shift toward preventing catastrophic failures and enhancing tailings facility safety worldwide. ICMM members committed to achieving conformance for "extreme" and "very high" consequence facilities by 2023, with all others following by August 2025. This commitment galvanised unprecedented, sustained action across the sector.

Analysis of 2025 disclosures revealed significant momentum, though full conformance remains a work in progress. Of 836 ICMM member facilities, 67% have achieved full conformance, while 33% are in partial conformance. Over 80% of extreme and very high consequence facilities were in full conformance in 2025. South America (83%) and Oceania (71%) had the highest full conformance rates as a proportion of facilities regionally.

This presentation will provide a transparent snapshot of collective progress towards GISTM implementation across the ICMM membership, highlighting examples of industry best practices and technological innovation while acknowledging the practical challenges of GISTM implementation. It will also offer a look ahead to the evolving responsible mining standards landscape, specifically to how the Consolidated Mining Standards Initiative will shape the future of safe and responsible mining practices.

Undrained shear strength selection within a critical state framework

L.H. Kirsten, H.A. Brandão, F.D. Walsh, L. Murray
Klohn Crippen Berger, Australia

Reliable evaluation of shear strength for tailings storage facility design requires consistent interpretation of stress history and consolidation state. This paper presents a method for selecting representative peak undrained shear strength ratio for uncompacted bauxite residue within a critical state–based, SHANSEP framework. Laboratory and field data are interpreted through yield stress ratio and state parameter (ψ), which together describe consolidation and density state. Bayesian updating is applied to combine multiple datasets and refine representative strength estimates. The approach results in peak undrained strength ratio that is consistent across consolidation domains and supported by both theoretical and empirical evidence.

Keywords: undrained shear strength, critical state soil mechanics, SHANSEP, tailings storage facility, consolidation state, Bayesian updating

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Louis Kirsten is a senior civil and geotechnical engineer with experience across the resources, infrastructure, and public sectors. His work spans research, consulting, and project delivery, from concept through closure, including dispute resolution. He has led projects across Australia, Africa, Canada, and the Middle East, with a focus on tailing storage facilities and water management, dam safety, closure engineering, and foundation and slope stability. He applies practical soil and rock mechanics, deformation analysis, and reliability-based design. Louis has served as Engineer of Record on extreme consequence facilities and has provided expert opinion in forensic investigations. His approach is evidence-based, technically disciplined, and focused on sound engineering judgment.

A new tool for tailings storage facility management: Insights from archived satellite imagery

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[1]PhotoSat, Canada
[2]PhotoSat, South Africa

This paper discusses how archived satellite imagery dating back to the 1960s can be used to gain valuable insights into tailing storage facilities (TSFs). Drawing on case studies of the Mufulira mine in Zambia and the Jagersfontein mine in South Africa, this paper shows how archive data can compensate for a lack of on-going monitoring and as-built records by retroactively producing orthophotos, topographic surveys, and other key indicators such as component maps, cut/fill maps, volume calculations, capacity measurements, embankment height, and operational freeboard measurements. The datasets incorporates both mono and stereo imagery. Stereo pairs of images can be used to create a topographic surface, which accurately portrays the elevation and terrain of the area. Mono images can be used to map key components of the site. The historical data can also be used to verify existing survey data and complete any discrepancies in terms of missing as-built data. This type of information may be valuable in the event of a dam breach, as it can be used to determine total tailings volume stored in the TSF and total tailings volume released during a breach. The insights derived from this data are key indicators that can help engineers understand how legacy assets were constructed, operated, and maintained.

Brad Forrest

Africa Account Executive
PhotoSat

Since 1993, it has been PhotoSat's mission to support safe and responsible mining projects around the world by applying their expertise in ways that offer smart solutions to real world challenges. PhotoSat has a proven track record of helping clients make informed decisions, streamline operations, and solve complex geospatial challenges, across all stages of the mining lifecycle, including Tailings Monitoring.

Seeing the unseen – Improved InSAR surface displacement monitoring with MDA CHORUS

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Interferometric synthetic aperture radar (InSAR) observations enable routine monitoring of ground displacements over wide areas at high resolution. Satellite InSAR time series monitoring is critical to ensuring safety and stability of infrastructure, such as tailings dams. Displacement measurements with mm-precision are captured along the line-of-sight from the satellite sensor to the target. However, available viewing geometries are limited by the orbit of the satellite. Since most SAR satellites operate in near-polar orbits and are side-looking, InSAR measurements are largely confined to the east-west plane with little sensitivity to displacement in the north-south plane. This introduces a bias in the amount of displacement detected that depends on how the true surface displacement is aligned with the sensor line-of-sight. The upcoming MDA CHORUS SAR constellation will be launched into a mid-inclination orbit, offering viewing geometries with significantly improved sensitivity to displacement in the north-south plane. Targets not visible from near-polar orbiting SARs will be imaged from these new geometries enabling a more complete monitoring programme, especially over critical assets where measurement density must be sufficiently high. By combining different imaging opportunities from ascending and descending orbit passes, and potentially with other observations from near-polar orbiting SARs, CHORUS will enable recovery of the three-dimensional components of surface displacement. Here we present case studies of simulated InSAR-derived surface displacement over tailings dam structures. By comparing simulations of InSAR measurements from different beam combinations, we demonstrate how CHORUS will improve measurement coverage and retrieval of three-dimensional surface displacement components.

Keywords: 3D InSAR (3-dimensional Interferometric Synthetic Aperture Radar), ground displacement, satellite remote sensing, tailings dams, MDA CHORUS, RADARSAT-2

The full paper will be published in the SAIMM Journal

Jin Baek

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MDA Space

Jin Baek received the M.Sc. degree in Geoinformation Engineering from the Sejong University, Seoul, South Korea, and Ph.D. degree in Geomatics Engineering from the University of Calgary, Calgary, AB, Canada in 2008 and 2014, respectively. She has been working on various InSAR monitoring programs and InSAR-related research projects as a Geospatial Analyst at MDA Space since 2017.

Installation of an advanced monitoring network for a Tailings Storage Facility

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Catoca diamond mine is a 26-year-old open pit diamond mine in North-Eastern Angola. It has a very large active tailings storage facility (TSF) and two smaller dormant TSFs. Over three years, a bespoke monitoring network has been installed that is fully automated and linked to a detailed dashboard. The network comprises suspended vibrating wire piezometers (VWPs), sealed VWPs, water level monitoring sensors, weather stations and inclinometers.

The monitoring network is state of the art for modern TSF monitoring in line with the principles of the Global Industrial Standard for Tailings Management (GISTM). The network integrates monitoring of water levels, beach lengths, pore pressures, slope movement and weather information and is linked to an early warning system that not only addresses movement but also addresses the causes of movement of a TSF.

The paper describes the drilling techniques used and the protocols followed for the installation of each type of equipment. The installation took over a year to install and the project management and installation sequences are given in detail.

The installation is an excellent example of collaboration of engineering, geotechnical interpretation, instrumentation design and software connectivity. It is an example of African initiative and innovation leading the world.

Keywords: Angola, Tailings Storage Facilities, Monitoring, VWPs, inclinometers, water levels, risk management.

Anton Hertenberger

CEO Africa
Tecwise Africa

Anton Hertenberger is a seasoned business leader with a strong passion for developing and commercialising advanced technical and engineering solutions across the African continent. His career spans senior development and leadership roles within globally recognised industrial brands, including PowerTeam Ernest Lowe, Donaldson Filtration, and his current role as CEO of TecWise Africa.

Throughout his career, Anton has played a pivotal role in growing and positioning leading technology brands such as Sisgeo, Worldsensing, Norgren, Donaldson, and Nederman. Under his guidance, these brands have achieved exceptional market growth, consistently outperforming industry benchmarks and expanding their footprint across Africa.

Anton combines deep engineering insight with strong commercial acumen. He holds an MBA and a Postgraduate Diploma in Business Administration from the Gordon Institute of Business Science (GIBS), equipping him with strategic and managerial expertise that complements his technical background.

The application of remote sensing techniques in mapping abandoned tailings storage facilities in the West Rand, Gauteng, South Africa

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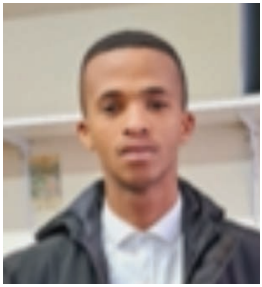
The tailings storage facilities (TSFs) associated with abandoned mine sites are characterised by sparse vegetation, erosion features, deposition, and are surrounded by contaminated water. The TSFs' abandonment results from the poor management of mine sites, which can occur due to sudden or temporary mine closures. The TSFs associated with abandoned mine sites tend to lack the development of flora owing to the toxicity of their metal content. These TSFs tend to cause environmental impacts, such as soil, water, and air pollution. The contamination of soil, water, and air can result in damage to aquatic life, animals, plants, and threaten human health. It is not clear what the quantity of abandoned TSFs is in the Gauteng Province of South Africa. It is for this reason that it remains challenging to estimate the extent of the hazard posed by the abandoned TSFs. This study aims to identify and quantify the number of abandoned TSFs in the Gauteng Province. The study used remote sensing techniques to understand the TSFs' spatial features and classify them. Sentinel 2A and B satellite imagery were used to classify the reflected TSF spatial features and understand their distribution. The Google Earth Engine (GEE) was used to process and analyse satellite data and allowed users to access and analyse remotely sensed imagery without the need to download the data onto local computers. The GEE computing programme was utilised to perform machine learning (ML) supervised classification to classify Land Use and Land Cover (LULC), intending to identify the different types of TSFs. Three types of TSFs were identified: active, dormant, and abandoned TSFs. The active TSFs are marked by ongoing deposition and growing plantations, while the dormant TSFs have no active deposition from mining operations and feature mature plantations. They were found using coordinates and characteristics. The abandoned TSFs typically exhibit sparse vegetation, polluted water sources, and pronounced erosion gullies. This paper shows how the integration of ML and satellite imagery data can assist in mapping and categorising TSFs in the West Rand of the Gauteng Province. The detection of active, dormant, and abandoned TSFs with outstanding spatial accuracy was made possible by the combination of Sentinel-2 MSI data and ML algorithms (RF and SVM). Using short-wave infrared (SWIR) and NIR bands, the abandoned TSFs are often obscured by partial vegetation or misclassified due to spectral similarities, which were effectively identified, revealing their environmental impact and proximity to at-risk communities. In terms of overall accuracy, the RF model performed better than the SVM, especially when it came to differentiating between the various types of surrounding land cover and different TSFs. The significance of scalable, data-driven methods for environmental monitoring, adherence to regulations, and rehabilitation priority is highlighted by these findings. This paper helps create a more open and proactive structure for handling South Africa's mining heritage in accordance with global tailings governance standards.

Keywords: Tailings storage facilities, abandoned, active, dormant, remote sensing techniques



Nqasha Lusizo

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University of Witwatersrand and Vahlengwe Mining Advisory and Consulting

Nqasha Lusizo is a dedicated Geoscientist and Environmental Specialist whose work integrates environmental management in water quality and waste management, geospatial science, and sustainable development. Lusizo holds a Master of Science in Geography from the University of the Witwatersrand, grounding his work in strong academic and scientific principles. His multidisciplinary exposure has strengthened his ability to interpret environmental dynamics, assess ecological risks, and contribute to mitigation strategies aligned with national legislation and industry best practice. With advanced expertise in Environmental Management, GIS, and Remote Sensing, he has built a solid foundation in environmental consulting, particularly in mining rehabilitation and natural resource management. His professional experience includes environmental impact assessments, environmental auditing, and the use of geospatial technologies to support evidence based environmental decision making. As a Senior GIS and EIA Consultant at Vahlengwe Mining Advisory and Consulting, Lusizo plays a key role in MPRDA and NEMA regulatory processes that guide responsible resource use. He leads advanced geospatial workflows, applying machine learning, CNN modelling, and geospatial programming to tasks such as land use/land cover classification, environmental change detection, and spatial data integration for environmental reporting. His technical capabilities are complemented by practical experience in environmental health and safety, water quality assessment, waste management, and field-based ecological surveys. Driven by a commitment to environmental sustainability and scientific rigor, he continues to advance his professional profile through research, technical development, and active engagement in environmental consulting, with a long term vision of contributing to more sustainable

Combining real-time and scheduled monitoring of upstream raised TSFs and a filter stack – why both are required

D. Johns, J. Olivier
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The paper presents examples of risk-informed dam safety decisions based on real-time and traditional monitoring systems at an Australian site with several upstream-raised tailings storage facilities (TSFs) and a filtered tailings stack. The real-time monitoring system is described, including vibrating wire piezometers, shape arrays, GNSS surface displacement, and slope monitoring radar. Other monitoring at the site includes manual inclinometers and prisms, InSAR surveys, high-resolution photogrammetric surveys and frequent drone photography. The most recent data is available at all times via a website maintained by the owner. In the first example, a combination of monitoring methods and historical construction records allowed the rapid analysis of a potential dam safety concern related to displacement of the TSF slope. The analysis concluded that the movement was due to consolidation settlement. In the second example, real-time pore pressure monitoring of the filter stack alerted the dam safety team to a potential concern during construction of a buttress. The multi-year monitoring record allowed the team to determine that the observed large pore pressure increase was a typical response to wet season rainfall. This information informed a decision to continue with buttress construction. Construction induced pore pressures are examined in a third example. The paper concludes that both real-time and scheduled or 'traditional' non-real time monitoring methods provide value. Access to drone aerial imagery and photogrammetric construction progress are also valuable, as well as a full record of all monitoring data. Instantly available data facilitated rapid decision making; this is often needed where the safety of TSFs is concerned.

Keywords: real-time monitoring, risk-informed decision making, dam safety, automatic trigger alerts, filtered tailings.

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David is a consulting geotechnical dam engineer with 20+ years' experience in tailings management, with a focus on design and operation of upstream tailings dams, filtered tailings, embankment dams (tailings and water) and waste rock dumps in Australia, Southern Africa, South America and PNG covering diverse geologic, seismic and climatic conditions.

David is a Chartered Professional Engineer with Engineers Australia and a Registered Professional Engineer of Queensland.
David is an Engineer of Record for major tailings dams in Australia. He has been lead designer or senior reviewer for many of KCB's dam projects and has completed design and dam safety reviews in Australia, Africa, and South America. Recently David led the construction and commissioning of two major upstream tailings dams for Rio Tinto and BHP.

His interests include the application of geosynthetics in mining, quantitative risk assessments of embankment dam failure modes, advanced soil laboratory testing, and critical state soil mechanics in the assessment of soil liquefaction. Construction monitoring of major embankment dams in PNG and Australia introduced David to the challenges of construction in very high rainfall and tropical environments, where he also gained experienced with tropical residual and lateritic dam foundations.