**Oral Presentations**
**Tuesday 27 October**
**Session one: Regulation, Risk & Protection**

## KEYNOTE: Water for the Future: securing a critical resource for people, nature and growth

***Leonore Frear*[1]**

1Environment Agency

- Context - The role water plays in a successful and healthy society
- The dual role the EA plays and our National Framework for WR, RAPID, bit on reform
- The challenge presented by population growth, climate change, and environmental resilience
- Unprecedented new investment in the water sector – supply and demand work
  - Supply - The challenges of infrastructure delivery and maintenance when balancing growth and resilience
  - Demand – challenge and approach
- The opportunities and risks presented by investment and necessity

# Water Trading – can we make it work more effectively in the UK

***Rachel Dewhurst*** [1],

1Stantec

Water abstraction across the country has been and is subject to sustainability reductions to support river flows and ultimately ecological quality in our water courses

These statutory requirements have increased the pressures on water resources to be consistently and efficiently used. The new WRPG 2026 requires that water companies and regional water groups seek opportunities to share and trade available water licences for the benefit of all. Theoretically trading licences or water rights should be relatively straightforward and provide a "short cut" to obtaining additional public water supplies.

However, issues arise where there is insufficient understanding of 3rd party systems to enable the feasibility of transferring licences, either through licence sharing or licence transfer. Such issues might include recent actual volumes, pumping rates, infrastructure condition, water quality. Often third-party systems have been subject to inadequate modelling of their impact on water availability, and there is a significant lead in time between an option being identified and a water company being confident that a source can be used to effectively for water supply and wouldn't be at risk of future licence capping due to future sustainability reductions.

Through a number of case studies, we assess alternative approaches to water sharing including licence surrender, water companies paying for third party system improvement and water treatment. Improving data requirements through regulation and licencing could also increase the resilience of decision making and address inadequate modelling

# Hydrogeological Risk Assessment for Sustainable Development of Conservation Zones

***Leenu Raju***[1], *Dr. Soumya S Batchali*[1]

1AtkinsRealis

Iconic Tuwaiq Mountains of Diriyah (Riyadh), are characterised by rugged desert terrain underlain by stable geological formations, variable slopes, and intricate network of Wadi Valleys. These create challenges for construction, erosion control and land management in the arid. This study evaluates the suitability of Diriyah for eco-tourism and sustainable development within natural conservation areas. Strategic SWOT analysis is incorporated to identify litho-hydro-geological risk zones and delineate areas suitable for urban expansion, tourism, and ecological conservation.

Diriyah is characterised by arid climate, valuable natural heritage, and diverse geology. Karst formations, ancient aquifers, varied lithological units, and stable escarpments, collectively govern groundwater storage and distribution. Wadis, irregular rainfall patterns, increasing climatic extremes (floods and droughts), further complicate water resource management. Moreover, the presence of environmentally sensitive natural reserves necessitates a development approach that minimizes ecological degradation.

Elevation, slope gradients, terrain morphology and slope stability are evaluated for erosion susceptibility and developmental constraints. Litho-Geological investigations focused on karst stability, aquifer productivity, rock type distribution, groundwater potential, and soil fertility. Hydrological analysis examined rainfall patterns, surface runoff potential, wadi networks, and flood vulnerability. Based on these factors, geological formations and lithological soil classes, are ranked on a suitability scale of 1 to 5. Permeable and fertile wadi alluviums are assigned Rank 1 - highest suitability, whereas steep mountainous 'No-Go' zones are assigned Rank 5 due to significant constraints. Remaining litho-geological units are ranked between 2 and 4.6, based on their suitability and risk levels.

Resulting framework identifies zones suitable for urban growth, eco-tourism, and strict conservation. Combined with SWOT - region's key strengths (scenic topography, stable aquifers), associated weaknesses (limited surface water, erosion-prone areas), identified opportunities (eco-tourism, harnessing renewable solar energy), and potential threats (land degradation, groundwater vulnerability), it provides a robust decision-support tool for planners enabling Diriyah' s ecological and cultural heritage preservation.

# Predicting groundwater contamination risk for a karstic quarry in the Edwards Aquifer Recharge Zone: a geospatial analysis of post-mining reclamation scenarios

***Kaitlyn Tran***[1]

1Austin Community College

Up to 25% of the world's population relies on karst aquifers for freshwater. However, karst geology remains highly vulnerable to contamination due to its porous, heterogeneous structure. Quarrying for limestone greatly worsens this vulnerability. Despite growing trends in post-mining redevelopment, regulations on groundwater quality under post-mining conditions remain scarce. The Lime Creek Quarry in Cedar Park, Texas, situated on the Edwards Aquifer Recharge Zone, exemplifies this challenge. Although mining ended in 2023, 173 years of excavation removed protective karst layers, exposing the groundwater table. The city's proposed redevelopment of the 216-acre site introduces contaminated runoff into the Edwards Aquifer, the most vulnerable karst system in the USA. This study developed and applied the first systematic modeling framework for delineating groundwater contamination risk zones in reclaimed, quarried karst. The GIS workflow established baseline vulnerability by optimizing the EPIK method, reweighing Epikarst, Protective Cover, Infiltration, and Karst conditions derived from aerial imagery and elevation data, followed by digitizing proposed development and pollutant loads. Contamination risk maps were generated by overlaying vulnerability and hazard layers for each scenario. Results showed that revegetation reduced high-risk area by 39.4% compared to minimal reclamation, and park development reduced it by 58.1% total, with highest reductions at open-pit regions. Risk models were validated through sensitivity analysis and hydrochemical testing, with $NO_3$ levels correlating with predicted vulnerability ($r \approx 0.82$). This study provides a preventive assessment tool for local decision-making and a transferable approach for cities worldwide experiencing quarry reclamation. Overall, this work demonstrates how sustainable land-use planning can significantly reduce contamination risk in karst aquifers.

# Best Practices for the continuous Inspection, Testing and Monitoring of Groundwater Abstractions, to safeguard it as a Critical Resource

***James Watson*[1], *Dr Stephen Thoma* [1], *George Frenc* [1], *Jamie Bate* [1]**

1OGI Groundwater Specialists Limited

Groundwater is a precious resource for sustaining life, providing resilient water supplies, and regulating the quality of surface water features such as rivers and lakes. However, in the civil engineering industry, the requirement for groundwater control during construction is often forgotten about at the project planning stage. In other cases, groundwater is viewed as a feared problem to be dealt with. This is due to the geotechnical hazards that groundwater can pose during construction, such as flooding of excavations, soil liquefaction, and hydraulic heave failure. Unfortunately, due to this lack of knowledge or fear of groundwater, the historic industry approach has been to "get rid" of groundwater during construction. This has been achieved by pumping groundwater out (i.e. construction dewatering), but often in an uncontrolled manner, with little thought for environmental impacts. In turn, this may have led to a negative view of dewatering by regulators, with the view that it can be harmful to water resources. However, dewatering does not need to be seen this way; it can act as an environmentally responsible technique, when compared with concrete heavy reinforcements options, which have a large carbon footprint. This is especially true when dewatering is coupled with managed groundwater recharge. What is important, is that when dewatering is undertaken, careful monitoring and modelling is carried out in advance to assess possible impacts, with this undertaken as part of a rigorous Inspection, Testing and Monitoring (ITM) Plan. Under the ITM Plan, groundwater models can then be calibrated to monitored conditions, enabling environmental impacts to be identified and mitigated early. This presentation documents the authors approach and recommendations for the development of robust ITM Plans for groundwater abstractions. It also documents examples of the importance of advanced groundwater modelling, which can be revisited continuously based on the findings of the ITM Plan.

# Problem to Resource: Smart Water Communities and the Role of Sports Turf in Delivering Water Resilience

***Anthony Hanson*[1]**

1Environmental Solutions International Ltd

Water scarcity and flooding are increasingly recognised as interconnected challenges requiring integrated, cross-sector solutions. While abstraction pressures and drought restrictions threaten water security, excess surface water, highway runoff and urban drainage flows continue to create flood risk and water quality pressures. This presentation introduces the emerging "Problem to Resource" campaign and explores how its principles align with CIWEM's Water Smart Communities initiative to create collaborative opportunities between water managers, regulators, local authorities and the community and professional sports turf sector.

Representing around 6,000 irrigated sites, including golf courses, racecourses and sports facilities, the sector possesses extensive land assets capable of delivering multiple benefits through the capture, treatment, storage and reuse of excess surface water. Constructed wetlands, attenuation features and naturalised reservoirs can provide flood storage, improve water quality, enhance biodiversity and create resilient alternative water supplies, reducing dependence on unsustainable abstraction and potable mains water. Sector estimates suggest that up to 40 million $m^3$ of treated mains water could potentially be displaced annually.

Despite support from flood authorities, river trusts and environmental bodies, existing water resources regulations often prevent the beneficial use of excess flows. Drawing on collaboration involving CIWEM and national sports organisations, this contribution explores how regulatory innovation and catchment-scale partnerships can transform excess water from a problem into a resource, delivering enhanced flood resilience, water security, biodiversity gain and social value.

## Groundwater as critical resource during drought: examples from Africa and Asia

***Alan MacDonald***[1]

1British Geological Survey

Groundwater development is growing in many parts of the world in response to changes in climate that include prolonged intense drought periods. This critical use of groundwater as a drought resilient supply, has (often silently) solved many of the current water issues presented by a growing population, unreliable public supply' and a changing climate. However, the increased groundwater use has also led to narratives of overexploitation, breaching planetary boundaries and ultimately – crisis. Drawing on examples from Africa and South Asia I present how understanding hydrogeological, climatic, and societal conditions can throw light on past and future trajectories of change and give confidence in groundwater use as a drought resilient resource.

For example, in sub-Saharan Africa hard rock aquifers underlie much of the populated areas and sustain many rural water supplies. The low permeability aquifer often sustains water supplies though drought periods and inherently self regulates against depletion across wider areas of the aquifer. There is also growing evidence that groundwater development can increase recharge through the rainy season, and that changes in modalities of rainfall may favour groundwater recharge. In South Asia, where groundwater development is well advanced the situation is very different with high abstraction for irrigation widespread. Examples from India and Pakistan show that the construction of canals for surface water irrigation fundamentally changed the hydrogeology: increasing groundwater recharge through the worlds' largest (unintended) managed aquifer recharge scheme to help buffer drought and climate variability.

This richly complex situation means there is much room for optimism and intervention to sustain groundwater as critical resource during drought.

## The Water Risk Immune System: A Framework to Enable Proactive Water Management and Decision-Making

***Matthew Damhuis***[1]

1Acqua Rinova Group (Pty) Ltd

Mine water management has always been a complex and complicated system to effectively manage, with considerations of multiple teams and environmental aspects being required with equal levels of attention. Adding to these pressures are the severity of risks associated with poor water management, ranging from cost and reputational risks to material safety and operational risks. Water-related triggers are the leading contributor to slope failure events and competition for water resources is intensifying as global water-related conflicts have grown significantly over the last decade.

Current water management practice relies on mostly static, compliance-driven reports, studies and models that do not align with the short term operational planning window and are often narrowly scoped, limiting their application in operational risk management and adaption to changes in environmental, climatic and operational conditions. While necessary, this suite of documents is increasingly insufficient for three structural reasons: historical assumptions and datasets no longer reliably describe future conditions under climate change; catastrophic failures are consistently traced back to organisational rather than purely technical causes, since the underlying trigger was typically foreseeable; and the water cycle's component processes respond to change across multiple, overlapping time horizons that conventional planning does not capture.

This paper adapts Stanley McChrystal's "Risk Immune System" to mine water management. The resulting Water Risk Immune System (WRIS) extends McChrystal's ten risk dimensions to eleven, adding dimensions for transparency and multiple time horizons while reshaping the predictive, memory and learning dimensions to suit water-specific decision-making. The eleven dimensions are organised into four subsystems: sense-making (narrative, diversity, transparency), sensing (technology, predictive capability, memory and learning), response (action, timing, adaptability), and a temporal-structural frame (structure, multiple time horizons) underpinning the other three.

The WRIS offers a diagnostic, internally-focused framework aimed at enabling continuous, proactive decision-making and strengthening operational resilience against safety, financial, environmental and reputational risk.

# Management of basal aquifers on small volcanic islands: A case study of Graciosa Island

***Francisco Cota Rodrigues***[1], *José Carlos Fontes*[1]

1CIBIO-Azores

Graciosa Island, located in the central group of the Azores, has an area of 61 $km^2$ and a population of about 4,300 people. Its hydrological characteristics result in low surface runoff and limited infiltration. Like the other islands in the archipelago, it has two main types of groundwater: a basal aquifer (freshwater floating over seawater) and perched aquifers associated with low-permeability layers. Both are used as water sources, through wells and natural springs.

Perched aquifers are scarce and have very limited storage capacity, with low and highly seasonal flow rates. The basal aquifer, on the other hand, is highly vulnerable to saltwater intrusion due to low recharge rates, fractured rock formations, and over-extraction, especially when wells are located close together.

Although the total volume of extracted water exceeds consumption, water quality is often poor, with high salinity levels, particularly during periods of intensive and prolonged extraction. To address these issues, the study proposes recommendations focused on improving water extraction management, as well as upgrading storage and distribution infrastructure to increase supply and enhance water quality.

# More water for everyone? Efficient irrigation and other myths explored

***Mal Graham***[1]

1Mott MacDonald

Regulating scarce water resources requires trade-offs between people and the environment. In systems with high degrees of uncertainty, the precautionary principle is often invoked, lending greater protection to environmental receptors at the expense of groundwater users. But sometimes uncertainty is overstated, with known phenomena omitted from regulatory models. This can create a false impression of water scarcity, with profound implications for irrigators and water companies.

The example of irrigation return flows is used to illustrate how improving just one aspect of conceptualisation and modelling could affect environmental flow compliance and regulatory decision-making. A modified version of the North East Anglian Chalk (NEAC) groundwater model (applying spray irrigation as additional rainfall within 4R) indicates that under fully licensed conditions, return flows are equivalent to 40% of modelled irrigation rates, compared to 29% in the Historic scenario. Additional recharge mainly occurs after the main April to September period for spray irrigation, with wetter soils encouraging greater infiltration of winter rainfall. Overall, modelled compliance to environmental flow metrics is improved under both Q50 and Q97 conditions, indicating greater availability of water and challenging the long-held assumption of 100% efficient irrigation in models.

Following this example, other areas of uncertainty are explored, highlighting longstanding assumptions that remain unchallenged within model-centric decision making.

## Wednesday 28 October
## Session two: Tools and data-driven approaches

# KEYNOTE: The Evidence Beneath Our Feet: Turning Data into Action for Water, Nature and Society. Managing the challenges and opportunities of England's chalk stream catchments

***Ellie Powers***[1]

1Affinity Water

England is home to some 85% of the world's chalk streams with around 10% of these located within the Affinity Water supply area. Post World War II development in the home counties resulted in a need to develop new sources of water to feed a growing population and supply new towns such as Stevenage, Harlow and Hemel Hempstead. Chalk groundwater offered an effective solution. New boreholes in many catchments provided water which often required little treatment and could be sourced locally. Concerns over the impact of abstraction on river flows and ecology led to the first 'Alleviation of Low Flows' schemes in the 1990s, followed by further abstraction reductions over subsequent decades. Today, around 100 million litres of water per day has been returned to the environment across Affinity Water's operating area.

Alongside these interventions, extensive environmental monitoring has created a unique long-term dataset, providing valuable insight into the relationship between groundwater, river flows and ecological response. This data is improving our understanding of the relative influence of abstraction, climate change and other catchment pressures on chalk stream health.

This presentation draws on experience from Affinity Water's operating area and demonstrates that evidence-led management of the chalk aquifer can help balance the needs of public water supply, economic growth and ecosystem protection and the role groundwater can play as a critical geological resource in securing a sustainable water future.

# The benefits of a hybrid machine learning and physical model approach to predicting groundwater flows in Chalk catchments in England and infiltration to sewers.

***Mark Fermor***[1], *Hanan Karam, Ian Walkington and Geoff Parkin*

1GeoSmart

Groundwater is increasingly recognised as a key driver of flood risk through its interactions with river systems and urban drainage infrastructure. Elevated groundwater levels sustain river baseflows, exacerbate fluvial flooding during prolonged wet periods, and infiltrate sewer networks, reducing conveyance capacity and increasing combined sewer overflow discharges. Despite growing recognition of this, predictive tools that integrate groundwater dynamics with both river response and sewer infiltration remain limited. This paper presents a hybrid modelling framework that couples conceptual groundwater forecasting with machine learning to predict river flows and describes its extension to groundwater infiltration forecasting for sewer networks, supporting more integrated flood risk and urban drainage management.

A conceptual four-store groundwater model was developed to forecast groundwater levels using observed rainfall, short-range weather forecasts and climatological rainfall projections, providing predictions up to four weeks ahead. These groundwater forecasts, together with rainfall forecast information, were used as inputs to an XGBoost machine learning model to predict river baseflow in a hydraulically connected catchment. Results indicate that XGBoost alone provides strong predictive performance at test locations; however, incorporating physically based groundwater forecasts further improves predictive skill, demonstrating the added value of representing groundwater storage dynamics in data-driven river flow models.

Current work is extending the framework to groundwater-driven sewer infiltration forecasting by incorporating sewer flow observations and network metadata within the same machine learning architecture. Preliminary developments and the proposed methodology and case studies will be presented. The integrated framework has the potential to provide four-week forecasts of river flows and groundwater infiltration into sewer systems, enabling water companies to anticipate reductions in network capacity and manage the risk of prolonged combined sewer overflow discharges. More broadly, the work responds directly to the need for integrated groundwater, river and urban drainage forecasting identified in recent flood risk research and policy.

# Rinova Nexus AI: An Agentic Intelligence Platform for Mine Water Data, Compliance and Decision Support

***Matthew Damhuis*[1]**

1Acqua Rinova Group (Pty) Ltd

Water has moved from an operational input to a board level risk for the mining industry, now sitting at the intersection of tailings safety, regulatory exposure and investor facing environmental, social and governance (ESG) disclosure. The data infrastructure that most operations still rely on to manage that risk has not kept pace with this shift. More often than not operational monitoring records, laboratory results, model outputs and licence conditions reside in disconnected spreadsheets, departmental databases and the institutional memory of a small number of specialists.

This paper presents Rinova Nexus AI, an agentic artificial intelligence platform developed to unify mine water data into a single, auditable intelligence package. The platform combines a structured time series and spatial data store, retrieval augmented natural language querying with built in citation discipline, an automated statistical and hydrochemical analysis engine, a recommendation layer scored for specialist defensibility, an automated report generator, and a blockchain anchored audit trail.

This paper describes the platform's conceptual grounding in the data to information to knowledge to wisdom hierarchy, its phased development and validation methodology against seven explicit, quantified success criteria, and its pilot deployment using two paired pilot sites, Pilot Site A and Pilot Site B, as anchor datasets. We then set out the platform's intended benefits for mining operations across five dimensions: compliance assurance, investor grade ESG reporting, reduced operational and reputational liability, strategic decision support, and institutional knowledge retention.

# A National Groundwater Nitrogen Inventory for England: data driven tools to inform risk based regulation and groundwater protection

***Craig Speed[1], Natalie Kieboom[2]***, *Gareth Usher[1], Rebecca Bailey[1], Anna Saich[1], Jodie Grocott[3], Thea McCready[3], Claire Watkins, Kirsty Elliot[4], Paul Doherty[2], Rachael Dils[2], Will Tipper[2], Chris Burgess[2], Tim Bailey[2], Bob Barnes[2], Mat Davis[2], Kathy Nicholls[2]*

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Groundwater is a critical resource for public water supply, ecosystems, and industry, yet it remains vulnerable to long term pollution pressures, particularly from nitrogen. Proportionate and effective regulation requires robust, spatially consistent evidence that enables the relative contribution from different sources to be reviewed at the national, regional and local levels to inform policy and regulation. This presentation introduces the Environment Agency's first national groundwater nitrogen inventory and associated heat mapping, developed to support strategic groundwater management and risk based regulatory decision making.

The inventory integrates multiple national datasets of nitrogen releasing activities and loading coefficients from literature to characterise nitrogen loading to groundwater from more than 30 sectors, subsectors, and land use types including agriculture, waste, water, and atmospheric sources, allowing an intersector comparison of nitrogen loading to be made. By combining conceptual understanding with spatially explicit data, the approach provides a transparent, reproducible framework for identifying areas of elevated groundwater nitrogen pressure and potential future risk.

The resulting geospatial data and heat maps offer valuable insights for regulators to identify high risk sectors in particular areas, target monitoring, and inform proportionate regulatory interventions, while acknowledging uncertainty and data limitations. The work demonstrates how data driven analysis can improve consistency in regulatory assessments and enhance dialogue between geoscience, policy, and land management communities.

# Geochemical Characterization of Ore and Waste Materials at Cu-Mo Porphyry Deposit: Implications for Acid Rock Drainage and Metal Leaching Management, Peru

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1Colegio de Ingenieros del Peru

This study characterises the geochemical properties of materials exposed during open-pit mining, focusing on the long-term acid generation and metal leaching (ARD/ML) potential. Methods: A total of 125 samples (78 ore, 47 waste) underwent static testing (ABA, NAG, XRD, SPLP). To validate long-term behaviour, nine representative samples were subjected to Humidity Cell Tests (HCT) following ASTM D5744-96 for up to 40 weeks. Results: Static results classified 72% of waste and 85% of ore as Potentially Acid-Generating (PAG). Kinetic results confirmed these predictions, showing a rapid onset of acidic conditions (pH < 4.0) in most cells. Depletion rate calculations indicate that Neutralisation Potential (NP) will be exhausted significantly before sulfides, with lag times to ARD being immediate in several units. Siltstone and Breccia units exhibited high mobility of As, Cu, Cd, and Zn. Conclusions: The integration of static and kinetic data confirms a high environmental risk similar to other Andean porphyries, necessitating active water treatment and strict encapsulation strategies during the 18-year life of mine.

## Session three: Water as a commodity, resource, or tool

# Navigating the Regulatory Landscape: Environmental Permitting for Groundwater Dewatering Operations Across the United Kingdom

***Ashleigh Vause***[1], *George French*[1]

1OGI Groundwater Specialists

Every major construction project that encounters groundwater faces the same fundamental responsibility: working with regulators to ensure that groundwater during construction dewatering is appropriately managed, with no significant impact on the existing regime and natural water environment. As such, environmental legislation is a core aspect of all construction dewatering operations.

Environmental regulation across the United Kingdom is divided between four key regulators: the Environment Agency, Natural Resources Wales, the Scottish Environment Protection Agency, and the Northern Ireland Environment Agency. Whilst each regulator brings its own requirements, timescales, and associated documentation to support any dewatering application, all share a common goal and a collaborative approach: safeguarding groundwater quantity and quality across the United Kingdom.

This talk summarises the regulatory process for construction dewatering across the United Kingdom, from the perspective of an industry practitioner. Case study examples are provided from large-scale dewatering projects undertaken by the author, which required both licensing and permitting. Key aspects of regulatory engagement include the preparation of Licence and Permit Applications, Hydrogeological Impact Appraisals, Water Features Surveys, Water Management Plans, and Water Quality Risk Assessments. In doing so, specialists must navigate the practical complexities of translating site-specific hydrogeological data into scientifically robust regulatory submissions, encompassing groundwater characterisations, drawdown risk assessments, identifying water quality risks, and dewatering scheme designs across a range of construction and infrastructure projects.

As demand for groundwater management grows alongside major infrastructure investment, developing expertise at the interface of hydrogeology and environmental regulation becomes increasingly critical to delivering future infrastructure projects.

Effective permitting balances the protection of groundwater as a finite geological resource with enabling the responsible industrial activity that depends on its temporary management. Achieving that balance is a shared endeavour, requiring technical excellence and interdisciplinary thinking from specialists, as well as constructive, ongoing dialogue between applicants and regulators alike.

# Geological Interpretation to Resource Assurance: Evidence-Based Management of aVulnerable Chalk Supply

***Carl Gilbert***[1], *Mark Houchen*[1], *Simon Deacon*[2]

1Tetra Tech

2Portsmouth Water

Chalk groundwater is a critical geological resource in Southern England, with quality governed by stratigraphy, groundwater level and residence time as well as by abstraction rate. Using python code, significant volumes of operational data was digested, sorted, and analysed to identify key relationships and trends. This level of evaluation using conventional Microsoft Excel techniques would have been only possible through long timescales and heavy resource, at a high cost to our client

The evaluation of the operational data indicated that the source behaves as two main hydrostratigraphic units within the Chalk aquifer. Above an interpreted stratigraphic boundary at approximately 52 m below datum, the boreholes tap a higher-nitrate upper Chalk unit, with concentrations typically around 41–42 mg/l. When groundwater levels fall below this boundary, a deeper, lower-nitrate regime is accessed from underlying Chalk, with concentrations typically around 26 mg/l. The change reflects a formation-controlled transition rather than a discrete fracture response, and lower nitrate is only available during sustained low groundwater conditions.

The analysis showed that nitrate cannot be managed reliably through pumping operation alone: the controlling factor is the regional aquifer state. This case study showed how hydrogeological structure governs the quality and resilience of a potable Chalk resource, and why effective management depends on understanding the aquifer as a layered geological system rather than a uniform water supply.

# Mineral, Spring or Table? The Hidden Story Behind Your Bottle of Water

***Shona Symon***[1], *Jenny Harrison*[1]

1Envireau Ltd

*For most consumers, bottled water is simply a product on a supermarket shelf. However, the water in each bottle has its own origin story of geology, hydrogeology, chemistry, source development, regulation and resource stewardship.*

*The development of a bottled water source often begins with the identification and characterisation of suitable groundwater resources. Geological conditions influence not only the availability and sustainability of a source, but also its chemical composition, creating the distinctive characteristics that underpin product identity. Water chemistry, source protection and long-term resource management are therefore fundamental considerations throughout the lifecycle of a bottled water source.*

*The UK bottled water sector provides a unique example of water functioning simultaneously as a natural resource and a commercial commodity. And when other systems fail, it steps in as a critical public health resource, ensuring that access to safe drinking water is maintained.*

*Exploring the differences between natural mineral, spring, and bottled waters, how they are developed and regulated, and where they are used highlights the importance of securing and protecting high-quality water resources for the future.*

# Adsorptive Removal of Zn(II) Ions from Polluted Water Using an Eco-friendly Biomodified Cordierite/$ZrO_2$ Ceramic Microfiltration Membrane

***Fatima Jmaito*** [1]

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Heavy metal cations, such as $Zn^{2+}$, pose significant environmental and health challenges, necessitating advanced treatment methods beyond conventional, complex, and costly membrane technologies such as reverse osmosis and nanofiltration. An environmentally conscious ceramic membrane has been developed to remove Zn(II) ions from contaminated water. The innovation lies in modifying a cordierite/ZrO2 ceramic microfiltration membrane with inert solid biomaterials (ISBMA) derived from dried Carpobrotus edulis plant material. This biomaterial, rich in chelating groups such as carboxylate and amino groups, forms a dynamic superficial layer (1-2 µm thick) on the zirconia surface, with C. edulis microparticles largely under 2 µm in size. The modified cordierite/ZrO2/ISBMA membrane demonstrated significantly improved performance, achieving a $Zn^{2+}$ retention rate six times higher than that of the unmodified ceramic membrane. This enhanced retention remained stable over time and was influenced by initial concentration and pH, with higher pH values leading to increased retention due to complexation and adsorption. The ISBMA layer effectively functions as an ion-exchange membrane, facilitating equilibrium adsorption/desorption of $Zn^{2+}$ ions on both sides. This innovative membrane system presents a highly promising and economically viable approach to wastewater treatment, capitalizing on the intrinsic adsorptive characteristics of C. edulis as well as the filtration efficacy of ceramic membranes.

# Tracer testing and residence times for better resource management: two case studies in Geothermal Energy and Aquifer Storage and Recovery.

***Sofie de Volder***[1], *Amaël Poulain*

1TRAQUA S.A.

Accurate characterisation of hydrogeological parameters is essential for the sustainable management of subsurface resources, particularly in applications such as Aquifer Thermal Energy Storage (ATES) and Aquifer Storage and Recovery (ASR). Tracer testing is a cost-effective method to improve conceptual models, particularly in heterogeneous or fractured geological settings. TRAQUA presents two case studies in which tracer testing was performed:

(1) a geothermal ATES system in the fractured bedrock of the Brabant Massif in Brussels, and

(2) an ASR system in the chalk aquifer of Sint-Truiden in Flanders. For both investigations, sodium fluorescein was used as the tracer and the restitution was monitored using STREAM® fluorometers under constant pumping conditions.

Results from both sites revealed unexpected preferential flow pathways through fractures, challenging the initial hydrogeological models. These results illustrate the complexity of subsurface environments and demonstrate the value of tracer tests in improving resource management strategies.

## Poster Presentations

# Can the application of remote sensing improve bathing water quality assessments?

***Kiera McMahon*[1]**

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Improving coastal bathing water quality is essential for minimising potential health risks associated with recreational activities such as swimming or water sports. In the UK, guidance for bathing water quality is given under The Bathing Water Regulations 2013 where microbial concentrations (Escherichia coli and Intestinal Enterococci) are measured from water samples and used to classify the designated bathing site. During bathing season, one sample is taken approximately every week. However, sampling is not thought to be representative of the whole designated bathing catchment due to the fast-changing conditions of coastal areas. Determining site-specific characteristics of an individual bathing water catchment improves the understanding and analysis of microbial contamination, providing an initial assessment of the potential faecal sources that may put the area at risk and the pathways through which these contaminants can reach the bathing waters.

Remote sensing (Sentinel data) can be used to identify and predict spatial and temporal patterns of pollutant events, including contamination of faecal matter. Unlike single-point sampling, Sentinel data covers the entire bathing water catchment with new data uploaded approximately every 3 days, reducing data sparsity. Along with identifying trends and predictions, it is thought that remote sensing could be used to track the source of pollution events when incorporated with a catchment-specific characteristic assessment.

This study presents the development of a data-driven predictive tool using multiple data sources, including remote sensing, land use, sanitary surveys and citizen science monitoring to create a robust, site-specific source-pathway receptor model. The model is applied in the context of a site that has the classification of ‘poor’ water quality, located in the southeast of England.

# Pesticide risk in groundwater

***Aimee Fraser***[1], *Susie Roy*[1]

1WSP

Groundwater is a critical geological resource for public water supply, yet pesticide contamination presents an ongoing challenge for its protection and sustainable use.

Two UK case studies are presented illustrating pressures from both legacy and current day use of pesticides on groundwater systems. The first focuses on Atrazine, banned in the UK since 2004, where rising concentrations of its metabolite (Atrazine Desisopropyl) were observed in a Chalk aquifer abstraction between 2019 - 2024. Long-term monitoring and trend analysis, integrated with hydrogeological understanding and land-use assessment, enabled refinement of the conceptual model. While initial hypotheses considered in-aquifer processes, the investigation demonstrated the importance of anthropogenic pathways, with leakage of treatment plant discharges from sewer infrastructure and facilitating rapid transport under shallow groundwater conditions. Targeted intervention through sewer rehabilitation resulted in declining concentrations, highlighting the importance of infrastructure integrity and site operation in groundwater protection.

The second case examines Bentazone, a currently approved pesticide in UK groundwater. Its high mobility and persistence in the subsurface result in rapid transport through the unsaturated zone and limited degradation within the aquifer. Increasing concentrations were linked to agricultural application within the catchment, with seasonal trends reflecting its environmental behaviour. It was identified that the existing 'Know the Bentazone Risk' maps for this study area are currently ineffective at communicating the Bentazone risk to the agricultural sector due to their lack of consideration of the dual porosity nature of the Chalk aquifer meaning enhanced fracture flow/ karst features, which play a crucial role in groundwater and contaminant transport in this local area, are not being correctly represented. This case highlights the challenge of managing diffuse pollution and the need for proactive engagement with land users in a method that could be easily understand by non-technical specialists, alongside regulatory controls.

Together, these examples demonstrate the value of integrating data-driven trend analysis, geological conceptual modelling, and interdisciplinary engagement to manage risk.

# Analysis of the surface water balance of the Chancay–Huaral basin using the SWAT model

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This investigation analyzes the surface water balance of the Chancay–Huaral River basin using the SWAT (Soil and Water Assessment Tool) hydrological model. It brings together gridded climate datasets, local hydrometric information, and thematic cartography processed within GIS platforms. The model was calibrated and validated with specialized tools to evaluate its ability to reproduce runoff patterns at the Santo Domingo station. The results show that SWAT reasonably captures the seasonal behavior of streamflow and the timing of peak flows, although it tends to smooth extreme values. The water balance produced by the model reveals the relationship

between precipitation, infiltration, runoff, and storage, emphasizing the limitations in water availability during low-flow periods. These findings offer a useful technical basis for water resource management in the basin and support future hydrological assessments related to territorial planning.