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SMA Environmental Forum 2023

Book of Abstracts

(Arranged alphabetically by presenter's last name)

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LESSONS LEARNED FROM 20+ YEARS POST-CLOSURE CARE OF BHP'S LEGACY MINE SITES IN NORTH AMERICA

Brian Ayres

BHP Legacy Assets, Saskatoon, Saskatchewan

BHP's Legacy Assets portfolio comprises 23 sites in various stages of closure and post-closure across Canada and the US. These sites are primarily the result of liabilities acquired through mergers and acquisitions. The current base plan for most our sites is care and maintenance in perpetuity; however, we are actively evaluating our legacy mine sites for re-purposing to add social value.
It is acknowledged that how some sites we steward were developed and/or closed in the past was not necessarily the best in terms of post-operations life when we apply a modern set of optics. Using lessons learned and hindsight from experiences within our business unit, this talk will present several case studies to convey the following key messages:

1) Relinquishment is a great aspiration for mine sites, but sites should be developed, operated, and closed in the event long-term care and maintenance becomes a reality.
2) Closure-related decisions should be based on risks, not solely on regulatory compliance, supported by robust science and thorough technical assessments to select an optimized closure strategy.
3) Selecting an optimized mine closure strategy should be based on undiscounted value of estimated closure and post-closure costs. If we select closure strategies based on NPV, we generally favour strategies that offer the least number of opportunities to build social value while at the same time, leaving the site / owner exposed to higher closure risk due to issues such as changing societal and regulatory demands, climate change, and emerging chemical species of concern.

LEVERAGING DAM SAFETY IN THE MINING INDUSTRY USING GENERATIVE AI

Lakshmin Bachu

Tetra Tech Canada., Saskatoon, Saskatchewan

Ensuring the integrity of mining dams is critical, bearing significant implications for public safety, environmental conservation, and economic sustainability. The growing complexities arising from operations, socioeconomics, and climate change call for the development of innovative solutions to enhance dam safety. Generative Artificial Intelligence (AI), a branch of AI possesses vast potential for numerous applications in dam safety. Its capabilities can streamline data management, provide data-driven predictions, and inform decision-making, even amidst uncertainty. As such, Generative AI plays a vital role in dam safety management. This presentation will shed light on the potential applications of Generative AI in augmenting dam safety, particularly in the face of changing climate and other imminent challenges. The core advantage of Generative AI is its ability to process extensive data sets and provide insights that conventional analytic methods might miss. Nevertheless, the deployment of Generative AI is not without its challenges. These include the necessity for high-quality data, the possibility of analytical bias, and the need for specialized expertise. This presentation will discuss these challenges and limitations, and propose recommendations for future research and development. This session will provide valuable insights for practitioners, regulators, and researchers who are interested in integrating generative AI to help leverage dam safety management for mining dams across the world.

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POTENTIAL EFFECT(S) OF CLIMATE CHANGE ON SURFACE MINE TAIILNGS CONTAINMENT SYSTEMS AND PLANNING FOR FUTURE AMBIGUITY

Nathan J. Brandner, P.Geo (SK)[1], Amir Safi, PhD[2], Cole Gagne, P.Geo (AB)[3], Jacques Groenewald, P.Geo (SK, AB, BC)[4], and Amir Safi, PhD [5]

[1]Barr Engineering Co. (Grand Rapids and Ann Arbor, MI); [2]Barr Engineering and Environmental Services, Canada Ltd (Calgary, AB; Saskatoon, SK)

Planning and management of surface mine tailings (SMT) is a significant undertaking due to a myriad of complexities, challenges, and regulatory requirements that face the industry. This is often due to site-specific factors, including limited surface storage area, varying subsurface stratigraphy, engineering limitations, growing social consciousness, and evolving regulatory requirements. The unpredictability of future conditions based on climate change is yet another variable that needs to be considered and accounted for in our fundamental understanding of site-specific hydrological and hydrogeological conditions at SMT sites in south-central Saskatchewan. This is of paramount importance because these site-specific conditions inform the planning and engineering of containment systems that control the long-term performance of SMTs. This presentation provides the hydrogeological perspective and examples of how climatic trends can contribute to appreciable and quantifiable effects on SMTs containment system performance. Examples provided in this presentation will include, 1) effects of large fluctuations in local/regional groundwater elevations on slurry wall performance, 2) effects of groundwater/surface water interactions (GSI) and how these dynamic flow regimes can affect SMT containment designs and how this uncertainty can be accounted for in numerical groundwater models, and 3) how regulatory requirements and expectations for SMTs can be affected by changing hydrological and hydrogeological conditions. Regardless of one's opinion regarding climate change as a result of natural or anthropological influences, the effects large swings in hydrological/hydrogeological conditions can affect SMT containment system performance and should be considered in SMT design, management, and planning for future expansions.

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FROM MINE TO MILL: WHAT YOU NEED TO KNOW ABOUT PFAS

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Per- and polyfluoroalkyl substances (PFAS) are emerging contaminants of concern in groundwater and drinking water systems. For the mining industry, their link and liability to the issue is primarily through the training and use of Aqueous Film-Forming Foam (AFFF), concentrates, and from secondary sources. PFAS have the potential to impact water supplies and are a challenge to capture and remove. The U.S. EPA and the European Union have taken aggressive steps to regulate and address PFAS in the environment. Recently, the federal government of Canada has proposed PFAS regulations as have the provinces of British Columbia and Ontario. This presentation will provide a brief history of PFAS, the current state of knowledge around sampling and testing, remediation, and water treatment techniques. In addition, we will provide insight on strategies to identify, remediate and dispose of PFAS containing materials at your facility. Attendees will leave the presentation with an understanding of the complexity of the chemistry, as well as strategies, tools and approaches from simple to sophisticate a facility can use to identify their PFAS risk profile, and prepare in advance of an emergency or regulatory action based on Barr's extensive project experience dating back to the early 2000s.

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EVALUATION OF EXPANDING MOBILE AND DIGITAL SOLUTIONS TO ENVIRONMENTAL MONITORING

Charlene Burnett-Seidel

Cameco Corporation, Saskatoon, Saskatchewan

Digitization and digitalization are happening all around us and being mobile is needed more than ever to enhance productivity. There are many benefits to the digitalization of environmental processes, such as standardization and time savings, and the reduction in paper processes and duplication of data. There are also potential risks, such as costs, disruptions, and failures. The Mobility for Environment project's purpose is to open the door to a more digitally capable environmental team. The project identified the key processes important to environmental workers. These included: sampling, inspections, waste management, and meter readings. For each of these key processes, environmental staff completed a review to understand and align the processes among Cameco's Saskatchewan operations. This information was used to identify possible digital solutions, evaluate these digital solutions based on key requirements for each process, and develop a business case for the most promising solutions. This overview of Cameco's evaluation of expanding mobile and digital solutions to environmental monitoring hopes to spark discussion and inspire others.

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DEVELOPING A COLLABORATIVE CLOSURE VISION TO SUPPORT A SUCCESSFUL ROADMAP TO RETURNING LAND USE

Denise Chapman[1], Lyndsey Thorson[1]

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The key to developing a successful mine closure plan is fostering a synergy between multiple stakeholder objectives, regulatory requirements, and long-term environmental performance. Additionally, for this synergy to sustain itself, there must be a common vision that unite everyone through the closure process.

Okane's Closure Visioning collaborative process facilitates the expression of diverse closure objectives through cooperative and engaged dialogue, bridging the gap of expectations that often deteriorate trust between stakeholders.

For example, what does "clean water" mean to different groups? Regulators require some objective analysis with specific substances below health-risk thresholds, whereas local communities might expect drinkable and useable water for agriculture, recreational water activities, or a return to previous ecological functions reflected in a thriving fauna and returning species.

Participants in the process are invited to consider multiple aspects such as corporate initiatives, industry guidance, socio-economic impacts, environmental objectives, traditional knowledge, climate change, and returning land use alternatives. Results are commonly summarized into thematic groups like environmental objectives, socioeconomic and community support, closure economics, and long-term corporate reputation. The themes are then used to create a closure vision that have contribution and buy-in from groups across the mine closure spectrum. This in turn, provides guidance for the development of a strategic roadmap to inform decision-making during the execution of closure activities throughout the operating life of mine.

This presentation will outline some of the success stories and lessons learned leading to the development of Okane's Closure Vision process, and the benefits of early engagement with this collaborative approach.

STACKED DEPOSITS OF THICKENED AND FILTERED FLUID FINE TAILINGS USING GEOTEXTILE TUBES AS FILTRATION MEDIA – PHYSICOCHEMICAL TREATMENT RECIPE, UPDATES

Fernando Da Silva

AtkinsRéalis, Calgary, Alberta, Canada

Minimizing the accumulation of soft and wet tailings deposits behind dams and ensuring that they are reclaimed progressively during the life of a project will significantly contribute to the long-term reclamation performance of tailings facilities. This paper deals with an alternative tailings management technology using geotextile tubes that combines the enhanced physical and chemical stability of the fluid fine tailings by dewatering and densification, while the reclaiming of process water is effectively maximized. A physicochemical treatment recipe was designed to ensure that the return water was suitable for reusing in the plant/process and that the fluid fine tailings can be dewatered and densified faster. The focus of this paper is a physicochemical parametric analysis on the fluid fine tailings dispersion and flocculation behaviors to determine the causes and manners of why significant amounts of trapped water remain when the fluid fine tailings is flocculated only. The parametric analysis was performed in light of the fundamentals of soil behavior, supported by the facts observed in laboratory. The parametric analysis key findings and repair recommendations are also included.

ROOK I PROJECT AS AN IDEAL TECHNICAL SETTING FOR UNDERGROUND TAILINGS DISPOSAL

Blake Martel[1], **Nick Espenberg[1]**

NexGen Energy Ltd., Saskatoon, Saskatchewan

The Rook I Project (Project) is a proposed new underground uranium mine and mill development in the southwestern Athabasca Basin in northern Saskatchewan. Owned and managed by NexGen Energy Ltd (NexGen), Rook I is host to the high-grade Arrow Deposit, and the largest development-stage uranium project in Canada. One of the key challenges for NexGen and its stakeholders is tailings management. To ensure Rook I's elite environmental performance, NexGen has made the decision to dispose and store all tailings and waste precipitates produced at the site back into the underground setting. This presentation will explore why the Arrow deposit is the ideal setting for underground tailings disposal and the unique underground design considerations required to implement this novel tailings management strategy.

A key driver in NexGen's decision to adopt underground tailings management is the favorable geological setting of the Arrow deposit. This favorable setting has eliminated the requirements for complex, costly, and technically challenging engineering designs. The presentation will overview the competent crystalline basement rock which hosts the Arrow Deposit and how geology and hydrogeology has informed NexGen's approach to tailings management. Using conventional mining methods, a purpose-built underground tailings management facility (UGTMF) will be developed for the dedicated disposal of tailings and waste precipitates produced in processing operations. Tailings produced during by the processing plant will be used to create cemented paste backfill for the Arrow production mining areas, with all remaining tailings being sent to the UGTMF to be stored as structural fill called cemented paste tailings.

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CSA N288.6:22 ENVIRONMENTAL RISK ASSESSMENTS AT NUCLEAR FACILITIES AND URANIUM MINES AND MILLS – INDUSTRY AND REGULATORY PERSPECTIVES

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The CSA Group nuclear environmental management standards, CSA N288 Series, provide a framework for environmental protection associated with nuclear facilities. Of these standards, CSA N288.6, Environmental risk assessments at Class 1 nuclear facilities and uranium mines and mills, provides guidance on evaluating and characterizing potential risks to receptors resulting from potential exposures to constituents released from nuclear facilities. This involves identifying, evaluating, and prioritizing potential risks to the environment and human health by incorporating a variety of data sources, including routine monitoring results and other site-specific information, such as traditional or country foods. In 2022, the second edition of CSA N288.6 was released. This marked the culmination of two years of a collaborative effort amongst committee members, including participants from regulatory bodies, industry, consultants, and general interest groups, to produce a standard that is fit-for-purpose and practical. The presentation will provide an overview of the CSA standards development process and key features of CSA N288.6, as well as both industry and regulatory perspectives on its development.

OPTIMIZING NATURAL GAS-FIRED ROTARY DRUM DRYERS IN POTASH APPLICATIONS WITH REGULATORY CONSIDERATION OF PARTICULATE CONCENTRATION LIMITS AND GREENHOUSE GAS PERFORMANCE OBJECTIVES

Curtis Ferguson[1], **Brendan Duret**[1]

Nutrien Allan Potash

The presentation will share dryer optimization techniques tested and implemented at the Nutrien Allan Potash facility over the past two years including engineering stack test estimates collected at the Site. The presentation will highlight natural gas energy efficiency performance gains as well as the particulate emissions concentrations performance as a result of the changes. The objective of the presentation is to demonstrate that there are opportunities to improve the natural gas use efficiency of Potash drying and, in turn reduce GHG emissions. However, there are also regulatory limitations, such as the total particulate concentration measured at the stack outlet that requires consideration while optimizing rotary drum dryer performance. The Allan team will share a testing framework for dryer optimization as well as learnings from stack testing to show which dryer operating parameters were found to have the largest impact on energy performance and particulate concentration estimates measured at the stack. The presentation will also provide an overview of the current regulatory framework in Saskatchewan for Potash facilities contrasting both particulate emissions and GHG emissions.

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RISK MANAGEMENT PLANNING FOR AN ABANDONED MINE IN NORTHERN SASKATCHEWAN WITH WETLANDS

Stacey Fernandes[1], Caroline Lucas[1], Andrew. Gault[2], David Sanscartier[3], Mike Menzies[3], Kalina Malowany[2], Rachel Martz[2]

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Saskatchewan Research Council (SRC) is responsible for managing a number of abandoned mine sites in northern Saskatchewan, including the Lorado and Uranium Ridge sites. A risk-based approach based on a solid understanding of the site conditions is being taken to develop the long-term management plan for the sites.

Surface water drainage from deposits of waste rock along with seepage from drillholes feed into nearby Beaverlodge Lake. Impacted water from these sources are observed to be naturally attenuating in wetlands prior to discharge into the larger receiving environments.

A preliminary risk assessment was conducted that identified elevated concentrations of substances of potential concern (SOPCs) including metals, high TDS and hardness and low pH. The results were used to guide targeted environmental monitoring. The risk assessment was updated to incorporate the additional data, including health of plants and invertebrates as well as surface water, sediment, and soil samples. In addition, co-located vegetation and soil samples were collected. In the downstream Beaverlodge Lake, sediment samples were collected for toxicity testing.

Samples from the wetlands were collected and provided to Ensero to conduct studies to provide insight into SOPC attenuation. These studies included biogeochemical, bench-scale, and field-based studies to assess the mechanisms, stability, and longevity of SOPC attenuation within and along water features at these sites.

All of this information is to be used to develop a long-term risk management plan for the site, based on site-specific information and including consideration of the impact of climate change on the sequestration of SOPC.

K1 AND K2 SHAFT DECOMMISSIONING

Shawn Haeusler

The Mosaic Company, Esterhazy, Saskatchewan

The Mosaic Company (Mosaic) operates potash mining and milling facilities – known as K1 and K2 – near Esterhazy, Saskatchewan. The K1 and K2 mines were connected underground via mine workings and were managing localized brine inflows from surrounding formations since 1985. Mosaic had incurred significant grouting and brine pumping costs to keep the mines functioning for the last 35 years. The new K3 mine was developed to overcome this issue and eliminate these costs.

With the K3 mining operations coming online and ramping up production, Mosaic commenced with the closure and decommissioning of its mining operations at K1 and K2. The largest portion of the decommissioning effort was the engineering design and installation of the shaft plugs and closure of the shafts (Shaft Decommissioning).

Based on the K3 construction program schedule, mining was scheduled to stop at in the first half of 2022 at which time all K1 and K2 mill ore supply would come from K3. In June 2021, the decision was made to close the K1 and K2 mines due to larger than anticipated brine inflows. The engineering design for the plugs and construction access, along with the installation, were advanced almost a full year ahead of schedule. This work was expedited to ensure the plugs could be constructed safely, prior to the brine level reaching the plug zone. Concrete shaft plugs were installed mid-shaft in the K1 and K2 shafts. These plugs were installed to stop the possibility of artesian flow to surface which had the potential to contaminate freshwater aquifers in the area.

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UPLAND COMPENSATION COLLABORATION TO SUPPORT CONSERVATION OUTCOMES

Jennie Hunter[1], **Cameron Wood**[2]

[1]K+S Potash Canada, Saskatoon, Saskatchewan, [2]Nature Conservancy of Canada, Regina, Saskatchewan

Abstract: As part of its commitment to sustainability, K+S Potash Canada (KSPC) piloted the development and implementation of innovative upland and wetland compensation approaches. KSPC partnered with Nature Conservancy of Canada to deliver an Upland Compensation Plan using a formula-based approach for determining the direct and residual ecological impact of site development and of offset projects delivered. The formula-based approach used multipliers based on ecological criteria in an attempt to ensure equity between impacts and offsets delivered. The presentation will provide background on the development of the compensation plan, describe the process undertaken to secure offset projects, highlight positive conservation outcomes and share lessons learned that can be applied to future mitigation projects.

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INDIGENOUS PARTICIPATION IN RESOURCE DEVELOPMENT, IMPACTS, AND THE NRTA

Rangi Jeerakathil1

MLT Aikins LLP, Saskatoon, Saskatchewan

This presentation will provide an overview of recent developments in Canadian law that impact Indigenous participation in resource development, including cumulative impacts litigation, the Blueberry River First Nations Implementation Agreement. The presentation will discuss the potential impacts and applicability of these developments on consultation and collaboration with Indigenous peoples, environmental protection and restoration measures in other jurisdictions including Saskatchewan, including a discussion of the NRTA.

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AN OVERVIEW OF FORAN'S NET POSITIVE STRATEGY

Kirsten Ketilson

Foran Mining Corporation, Saskatoon, Saskatchewan

Foran Mining Corporation has adopted a net positive strategy for the company and its flagship project, the McIlvenna Bay Project. This presentation will review the key elements of the strategy in context of the McIlvenna Bay Project in northeastern Saskatchewan.

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REMEDIATION OF THE GUNNAR URANIUM SITE – PROGRESS TO DATE

Alexey Klyashtorin, Skye Muirhead, David Sanscartier, Bo Yun, Vince Zimmer

Saskatchewan Research Council, Saskatoon, Saskatchewan

The Gunnar uranium mining and milling site operated in northern Saskatchewan from 1953 through 1964 when it was abandoned, leaving behind over 6,000,000 m3 of unconfined tailings and waste rock, a flooded open pit with 3,000,000 m3 of contaminated water, a uranium mill, an acid plant, and other structures. Radioactive tailings and waste rock deposits, residual chemicals, and unstable asbestos containing structures posed serious risks to public and environmental health. In 2006, the Government of Saskatchewan contracted the Saskatchewan Research Council (SRC) to remediate the Gunnar Site to mitigate the risks and secure safe traditional use of resources around the Site. Once these objectives have been met, the Site will be transferred to the provincial Institutional Controls Program (ICP). The Environmental Impact Statement was completed by 2013, followed by the CNSC Licence issued in 2015 and allowing phased remediation. The remediation design includes construction of engineered cover over the tailings and waste rock; demolition of remaining buildings and structures; construction of landfills for demolition debris and hazardous/radioactive waste; water management to reduce contaminant release; and long-term monitoring programs. SRC has been engaging with the local indigenous communities, providing them with relevant information, addressing their feedback and advice, and engaging local contractors and equipment in the remediation activities. By 2023, most of the radioactive deposits have been covered and revegetated, all legacy structures demolished, and debris placed in the landfills. The physical remediation will be completed by 2024, followed by at least 10 years of post-construction monitoring before transferring to ICP.

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EVOLUTION OF CLOSURE PLANNING FOR AN INACTIVE TAILINGS FACILITY

Scott Laberge[1], Dale Kolstad[2], Arthur Kalmes[2], William Dehler[2]

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Sustainable mine closure requires meeting physical, chemical, ecological, and social objectives. Sometimes, these objectives conflict with one another and pose challenges to mine-closure planning. This paper summarizes the key considerations for closure of a tailings facility with emphasis on best practices and regulations for closure of tailings facilities in Saskatchewan, as well as guidance from the Canadian Dam Association (CDA) and International Council on Mining and Metals (ICMM). It addresses movement and drying of saturated tailings; closure; final site grading; and water management. The paper also discusses how the approach to closure, landform design, and reclamation of an inactive tailings facility has evolved since initial closure planning began, incorporating institutional knowledge and best practices in dam safety and integrated mine closure. A robust closure plan requires winnowing the options to the most attractive solution and applying a multi-staged approach to closure—one that recognizes environmental stewardship means more than just minimizing potential impacts.

A brief case study of an in-progress decommissioning and closure project discusses how these principles are being applied. The case study will also present the potential for economic benefit and resource gain for the surrounding communities through agricultural or natural end land uses. The provided example will demonstrate the benefit of reaching tailings dam sustainability goals that put safety and environmental stewardship at the forefront.

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INDIGENOUS INCLUSION IN SMR PLANNING AND IMPLEMENTATION

Dazawray Landrie-Parker

Creative Fire, Saskatoon, Saskatchewan.

Energy generation solutions, such as SMRs, will require public support. Public support will be dependent on a communication and engagement strategy rooted in early and often communication, information distribution based on community desires, and an open and transparent-two-way information flow. Public support will need to include Indigenous Nations. Indigenous participation is integral for driving decisions about the future of Canada's Energy Mix. SMR development in Canada will not happen without the support of Indigenous communities.

Any engagement on SMRs moving forward will be influenced by the relationship, impacts and outcomes of engagements and experiences of the past. Each public participation process will need to be adapted to these unique experiences while incorporating the space for iterative information flow, cultural appropriateness, and increased local control. This presentation provides a framework for engaging with Indigenous communities in nuclear energy projects. Exploring concepts like inclusivity, early involvement, decision making, transparency and accountability, open and timely communication, relationship building and evaluation.

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THE SASKATCHEWAN MINING ASSOCIATION AND THE CONSERVATION OF ENDANGERED BATS: A NEW OPPORTUNITY FOR HABITAT STEWARDSHIP

Jeffrey Lane[1], Erin Swerdfeger[2], Iga Stasiak[2]

[1]University of Saskatchewan, Saskatoon, Saskatchewan, [2]Ministry of Environment, Government of Saskatchewan

The invasive fungal disease, white nose syndrome (WNS), has led to two of Saskatchewan's eight bat species being listed as endangered. First detected in New York in 2006, WNS has swept across the continent, leading to widespread collapses of hibernating bat populations. With the first positive detection of WNS in Saskatchewan in 2022, the time to gather information on local bat populations before they are impacted due to WNS is short. Obtaining this information in Saskatchewan is hindered because there are no known locations of hibernation sites (where the WNS fungus proliferates). Due to a relative paucity of natural cave structures, it is possible that abandoned mine sites may serve as critical overwintering habitat. Beginning in 2020, the University of Saskatchewan and partners began surveying abandoned mine sites for bat activity with passive acoustic detectors. These surveys can be used to guide more focused/active observation (e.g., netting for bats to confirm species, radio-telemetry to locate roosting/hibernation sites) to identify critical habitat for species at risk. In turn, these observation approaches can help guide stewardship initiatives (e.g., placement of 'bat-friendly' gates at mine entrances). Finally, identification of hibernation sites will allow for population monitoring, and potentially WNS-mitigation approaches. As devastating as WNS has been for North American bat species, encouragingly it has brought together interested parties from industry, academia, government and non-governmental organizations in a collective effort, that provides a potential model for what could be achieved in Saskatchewan.

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DATA MANAGEMENT TOOLS FOR ENVIRONMENTAL REMEDIATION: TWO CASE STUDIES

Jeff Lettvenuk, Skye Muirhead, Michael Bendzsak

Saskatchewan Research Council, Saskatoon, Saskatchewan

Saskatchewan Research Council (SRC) developed an Environment Data Management System (EDMS) that supports the remediation of 37 abandoned uranium mine sites in Northern Saskatchewan (including Gunnar Mine and Mill, Lorado Mill, and 35 smaller sites referred to as Satellite Sites, collectively known as Project CLEANS). This platform supports data collection, mapping, analysis, reporting and query. The EDMS has proved to be an instrumental tool in effectively managing the vast amount of data associated with the project.

Two remediation tasks will serve as case studies to demonstrate how the EDMS supports these activities from acquisition and quality control to reporting.

Gamma Surveys
The Gunnar Mine and Mill site operated in the 1960s and was abandoned shortly afterwards, leaving 81 hectares of unconfined radioactive tailings and other environmental impacts. SRC has been hired to remediate the site which includes the construction of gamma covers to reduce the radiological impacts from the tailings waste. Gamma surveys are conducted to estimate gamma radiation patterns in the impacted areas and determine areas requiring covers. Gamma surveys are also conducted after cover placement to confirm project radiological objectives have been met.

Revegetation Assessments
In 2019 SRC completed revegetation of 49 areas at four Satellite Sites around Uranium City, Saskatchewan. To evaluate vegetation success and trends, surveys were performed in 2020, 2021 and 2022. Electronic survey tools are used to collect key vegetation species, soil conditions, ecosite and topography data.

ECOSEIS: REDUCING THE ENVIRONMENTAL IMPACT OF SEISMIC SURVEYS

Mostafa Naghizadeh, Andrea Crook, Alyson Birce

Optiseis Solutions Ltd., Calgary, Alberta

Mineral exploration projects or clean tech applications such as carbon capture and storage, can benefit immensely from subsurface images provided by the acquisition of seismic reflection surveys. Generally, these surveys involve optimizing the geometry for subsurface imaging, surface constraints, and operational efficiencies. However, an equally important aspect is to optimize the geometries for reduced environmental impact. This can be accomplished by utilizing alternative geometries or even a combination of geometries within a single survey. This paper focuses on how to minimize the impact of seismic surveys on the environment while reducing costs and maintaining or improving the resolution of seismic data.

In this study, a variety of datasets were used to understand ecozones, sensitive animal habitats, and vegetation with results used to rank the sensitivity of each area. The survey area was subdivided based on terrain and habitat type with unique geometries assigned to each. GIS tools were then utilized during design to avoid sensitive or inaccessible areas. Many different geometries were considered with a focus on reducing the environmental footprint of the survey while maximizing the data quality and minimizing costs.

To test the data quality of these geometries, decimated geometries were created from a high-density survey and then processed and interpreted. Results demonstrated that data quality could be maintained with up to a 55% reduction in linear km of seismic and equivalent reductions in greenhouse gas emissions. The geometries also resulted in cost savings due to fewer linear km of seismic and lower equipment/personnel requirements.

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SASKATCHEWAN WOODLAND CARIBOU PROGRAM UPDATE

Amy Nixon, Shawn Francis

Ministry of Environment, Government of Saskatchewan, Saskatoon, Saskatchewan

The Saskatchewan Ministry of Environment Woodland Caribou Program is developing a better understanding of woodland caribou ecology in Saskatchewan and is working toward meeting Recovery Strategy objectives and conserving the species and its habitat. Saskatchewan's landscape-scale approach to woodland caribou management focuses on maintaining boreal ecosystems that continue to support woodland caribou and healthy wildlife populations. Range planning was initiated in the boreal plain (SK2 conservation unit), where risks to woodland caribou are highest. Working with industry and other stakeholders and Indigenous communities, the ministry developed two provincially approved range plans and one draft range plan. The start of range planning for the boreal shield (SK1 conservation unit) is planned for fall 2023. SMA members and other mineral sector representatives will be key stakeholders in the development of that plan. Population assessments have been completed in SK1 and SK2 to assess population structure and trend and support range planning. The initial SK1 population assessment received direct funding support from the SMA and member companies. The ministry's woodland caribou program is working closely with northern industries, including the mineral sector, to build greater awareness of the range plans and to integrate practical and effective mitigation strategies into existing planning, assessment and permitting processes to support efficient regulatory reviews. Continuing to develop and implement caribou range plans through Saskatchewan's innovative approach supports healthy northern landscapes and wildlife populations, demonstrates responsible economic development and supports the provincial growth agenda and the critical minerals strategy through improved regulatory certainty.

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ROOK I PROJECT – INTEGRATED WASTE AND WATER MANAGEMENT

Chad Novotny

NexGen Energy ltd, Saskatoon, Saskatchewan

NexGen Energy Ltd. (NexGen) is proposing to develop a new uranium mining and milling operation in northwestern Saskatchewan, Canada called the Rook I Project (Project). The proposed Project is subject to both a federal and provincial environmental assessment (EA) process, and requires federal and provincial licences, approvals, and permits. The Project is currently undertaking a cooperative provincial and federal EA process, as well as advancing the application for a license from the Canadian Nuclear Safety Commission (CNSC) and completing engineering to support Project development.

The Project will produce mine waste rock and tailings as part of construction (e.g., shaft sinking, lateral development) and operational mining activities. Mine impacted waters that interact with mine waste products will be a key driver of environmental performance for the Project. NexGen sets and maintains a standard of excellence in planning and execution, combining innovation with low technical risk. Consistent with this approach, NexGen has adopted an integrated and proactive approach to development of the Project in terms of mitigating environmental impacts and meaningful engagement with local Indigenous groups and communities. NexGen's mine waste and water management philosophy, underpinned by an integrated Project planning approach, ensures waste and water management are considered holistically across the Project and uses risk-based decision making when developing designs and management plans.

NexGen's risk-based mine waste and water management philosophy is defined by the following key aspects:

- protection of people and the environment;
- design and management using fit-for-purpose approaches that consider the unique characteristics and risks of each waste stream coupled with industry-proven practices;
- accounting for the influence that waste management practices have on effective site water management and vice versa;
- progressively decommissioning and reclaiming, wherever possible, and reducing the reliance on active institutional controls following the Project closure phase;
- reducing the generation of constituent mass loadings at the source wherever possible;
- maximizing diversion of non-contact water surface runoff away from Project infrastructure;
- maintaining control of contact water from the point of collection to release;
- minimizing freshwater intake through water reuse and recycling wherever possible;
- facility design and management planning that is practical and supportive of Project construction; and
- complying with applicable requirements.

This presentation will provide an overview of NexGen's integrated mine waste and water management philosophy and approach. Key examples presented will be the decision-making process related to integrated mine waste and water management option selection; waste rock and water management from a Project design perspective; and planning for closure in the waste rock storage area through design.

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THE COMPLEX WORLD OF PARTICULATE MATTER IN AIR (AND WHY IT MATTERS)

Kent Orosz

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The world of measuring and reporting particulate matter in air from industrial operations is a surprisingly complex one. Particulate matter from sources can be called Particulate Matter, Primary Particulate, Filterable Particulate, Condensable Particulate, and others depending on the sampling method to quantify it, the process that releases it, or the purpose for measuring and reporting it. Adding to the complexity, definitions between and within jurisdictions lack consistency or even conflict. How can environmental managers and consultants know what definition to use when and what to include? How do these relate to ambient air quality standards for Total Suspended Particulate and NPRI reporting requirements for particulate matter?

The presenter will draw on a background in stack sampling, ambient air monitoring, air dispersion modelling, and environmental protection plan (EPP) preparation to explore the various definitions of particulate matter, what should be included in reporting, and how to determine what to include in air dispersion models and environmental protection plans. Some possible impacts of improperly interpreting particulate matter definitions and test results will also be discussed.

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REVEGETATION OF MINING SITES IN NORTHERN SASKATCHEWAN: A PROJECT CLEANS CASE STUDY

Elizaveta Petelina[1], Alexey Klyashtorin[2], Michael Bendzak[2]

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The Saskatchewan Research Council (SRC) manages a multi-year project called Project CLEANS (Cleanup of Abandoned Northern Sites), which involves remediating 37 abandoned uranium mine and mill sites in northern Saskatchewan. The final remediation stage includes revegetating disturbed areas with unfavorable soil properties, e.g. poor growth media, shallow coarse soil, uneven terrain, and steep slopes prone to erosion. Since SRC has committed to using native plant species, the revegetation team had a limited choice of plants capable of quick proliferation under harsh northern conditions. Another challenge was the lack of propagation material available in the Canadian market. To meet these challenges, SRC's team extensively researched native plant species to identify those suitable for challenging environmental conditions of northern Saskatchewan and optimize soil treatment and amendments to promote plant growth. The research included a review of regulatory guidelines, a desktop study of natural succession processes, greenhouse and field trials with different plant species and soil treatments, and a sustainability assessment with a traditional Indigenous knowledge component. The latter included several workshops with representatives of local Indigenous communities to obtain their feedback on the proposed revegetation plans and get their advice on preferred plant species. By the end of 2023, SRC will have revegetated over 130 hectares of the disturbed land utilizing various approaches. This presentation provides an overview of the revegetation methods SRC applied at the Project CLEANS' sites to date, with a focus on how the team's research and planning helped to optimize their effort and led to project success.

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ENVIRONMENTAL ASPECTS OF SELENIUM MANAGEMENT AT URANIUM MILL OPERATION

Elizaveta Petelina, Tina Searcy

Orano Canada Inc., Saskatoon, Saskatchewan

The mining industry faces multiple challenges related to the management of selenium concentrations released in effluent to the receiving environment. This chemical element, although an essential micronutrient, is well known for its toxicity and potential to adversely affect aquatic ecosystems. There is insufficient understanding of selenium fate in mining waste and limited availability of augmentative selenium removal technologies. Since 2008, Orano Canada Inc. (Orano) has undertaken considerable effort to understand and mitigate potential environmental risks due to selenium presence in treated effluent from the McClean Lake Operation (a uranium mill in northern Saskatchewan). Our presentation focuses on the investigations taken by Orano to improve understanding of the selenium related risks for aquatic environments and the adaptive management implemented to reduce selenium concentrations in the treated effluent, such as the investigation and implementation of selenium treatment, the development of a site-specific ecological risk assessment (EcoRA) framework, derivation of site-specific selenium benchmarks and reference levels, and arranging a collaborative research on selenium transfer in boreal lakes with the University of Saskatchewan. The presentation will include a summary of the effectiveness of the application of Orano's adaptive management plan via the EcoRA.

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RESETTING ANTHROPOGENIC DISTURBANCE: NATURAL REVEGETATION OF LINEAR FEATURES FOLLOWING WILDFIRE AND THE IMPLICATIONS FOR WOODLAND CARIBOU (RANGIFER TARANDUS CARIBOU) HABITAT MANAGEMENT

Hans G. Skatter[1], Michael L. Charlebois[1], Simon. Coats[1], **Jay Cooper**[2]

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The federal recovery strategy for woodland caribou identifies wildfires within the last 40 years and anthropogenic disturbance visible at a scale of 1:50,000, including a 500-m buffer, as disturbed. Long-term vegetation recovery on linear features post-fire has not yet been documented. We examined vegetation recovery including stem density and height, hiding cover, and reindeer lichen cover along 40+ year-old legacy linear features in Northern Saskatchewan, in both uplands and lowlands 1-41 years post-fire. We compared these results with burned areas off-lines and unburned lines. On unburned lines in uplands there was minimal recovery, while there was significant recovery of stem count, height and hiding cover on burned lines and burned off-lines. Reindeer lichen cover and thickness remained significantly lower on burned lines and burned off-lines than on unburned lines until the 41-year age group, where there was no longer a significant difference. On unburned lines in lowlands, the stem density and stem height were initially significantly higher on unburned lines than on either burned lines or burned off-lines. After 27-32 years post-fire there was no longer a significant difference in stem densities. Our findings show that fires substantially accelerate natural revegetation and instigate a recovery that is similar on and off disturbance features in both uplands and lowlands. These findings can inform management decisions on restoration planning and calculation of range disturbance metrics. We suggest that the anthropogenic 500-m buffer should be removed post fire, as anthropogenic disturbance is reset, and anthropogenic disturbance should be classified as naturally recovering.

RESEARCH AND METHODS DEVELOPMENT FOR IDENTIFICATION OF BENTHIC INVERTEBRATES USING GENETIC TECHNIQUES

Helga Sonnenberg[1], Yoamel Milián-García[1], Ian Thompson[1], Hendrika C. Sonnenberg[1], Sarah Adamowicz[2], Robert Hanner[2]

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In Canada, federal regulations of the Fisheries Act require operating mines and pulp mills to undertake Environmental Effects Monitoring programs (EEMs) every three years to assess potential effluent-related effects in their downstream receiving environments. In addition, other federal and provincial regulations and requirements need the quantitative assessment of benthic invertebrate communities at pre-development baseline conditions, during operations, and post-closure to monitor the health of aquatic ecosystems and as part of regulatory permits. Benthic invertebrates provide a sensitive and integrated living register of ecosystem health. As different groups of organisms have differential sensitivity to pollutants and other environmental factors, the benthic biotic community provides a rich source of information about the system's health regarding freshwater quality and the status of fisheries habitat. Biomonitoring surveys would benefit from including DNA-based approaches (e.g., DNA-barcoding and eDNA metabarcoding) to accelerate species detection and reduce costs associated with processing large numbers of individual specimens. However, careful validation is needed before Environmental firms can routinely adopt the molecular methods in regular biomonitoring. During previous research, we addressed numerous field and sample preservation issues to improve the DNA sequencing success rate. However, a 27% failure rate remained where no sequencing data could be obtained, hindering the specimens' molecular identification. Actions to improve field and preservation methods enhanced the success rate by ~20%. Nevertheless, significant limitations still need to be addressed based on the high-throughput analyses. The consistency and reliability of results are crucial if these methods are to be accepted more broadly by regulators and proponents outside the academic realm to assess the “health” of aquatic ecosystems. The current proposed research project focuses on the first large-scale direct comparison in Canada of commonly accepted quantitative benthic invertebrate survey methods vs. cutting-edge DNA-based methods for specimen identification. The project's general objective is to validate whether molecular methods can provide the same results as traditional quantitative survey methods required by regulation.

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DESIGNING FOR MEANINGFUL ENGAGEMENT FROM EXPLORATION TO EXTRACTION

Katie Suek

Canada North Environmental Services, Saskatoon, Saskatchewan

The engagement and consultation landscape related to resource development in Saskatchewan is evolving. Communities are becoming increasingly vocal about their expectations for meaningful engagement at every phase of development, from exploration to extraction, and beyond. The existing frameworks or guidance documents that have historically guided or set out expectations for engagement or consultation requirements from exploration through to environmental assessment rarely align with or fully respond to community expectations. The misalignment between what is "required" by regulators and what is "expected" by communities can lead to mistrust, unnecessary conflict, challenges building strong relationships, project delays, and in some cases negative media coverage and investor concern. CanNorth works closely with potentially impacted communities and mining companies to design engagement strategies and programs in a way that builds or maintains strong, long-term working relationships and aims to bridge the gap between regulatory and community expectations. This presentation will discuss some of the design features and considerations that we have found to work well to lay a foundation for meaningful life-of-mine engagement.

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TOWARDS BIOLOGICALLY INFORMED THIOSALTS MANAGEMENT

Lesley Warren[1], Lauren Twible[1], Lin-Xing Chen[2], Tara Colenbrander Nelson[1], Kelly Whaley Martin[1,3]

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Thiosalts, reactive sulfur compounds that can cause toxicity, acidity, and contamination, remain an environmental management issue for many mines. The challenge reflects (1) incomplete knowledge of all the possible reactive sulfur compounds that can occur in a tailings facililty (TF), (2) the inability to fully monitor these compounds, (3) the inability of currently available treatments to fully eradicate all possible sulfur compounds that may pose risks to receiving environments, and (4) the roles that microorganisms that metabolize sulfur may play in the generation, alteration or sequestration of sulfur within TF. Sulfur compounds generated during the milling of sulfide hosted ores are biologically reactive and typically occur at much higher concentrations in TF than found in natural contexts. Thus, these environments provide a rich habitat for sulfur metabolizing organisms that can survive in the geochemically challenging conditions found in TF. Results through partnered research with Hudbay, Glencore Sudbury INO and Rambler, investigating the possible roles of sulfur oxidizing bacteria (SOB) in TF sulfur cycling reveal a distinct set of TF SOB that occur across all 4 TF involved, indicating a likely mining specific microbiome; i.e, results here have broad applicability. Further, which SOB genera occur is dependent on TF conditions such as oxygen and sulfur compound concentrations, and this in turn, influences sulfur outcomes. These emerging results identifying clear links between TF geochemical characteristics, SOB community composition and sulfur compound outcomes highlights opportunities for biologically informed adaptive management strategies.

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CRITICAL MINERALS: CHALLENGES AND OPPORTUNITIES

Mark Wittrup

Clifton Engineering Group, Calgary, Alberta

There are several pressing issues that threaten our planet's environment, including plastics in the oceans, overpopulation, the unequal distribution of wealth, and climate change. Arguably, the one that has the most attention from the public and politicians is climate change, and governments have been working on solutions to limit greenhouse gas emissions and move to a net-zero world. One of the solutions is the development of a net-zero economy based on electrification and the elimination of fossil fuels. This policy shift away from fossil fuels requires significant mineral resources including the goods and services necessary to support replacement electric appliances, heating, vehicles, and the expansion of the grid to support it all. Recognizing the need for more specialized minerals, the government has identified a series of critical minerals as a priority in support of electrification and GHG reduction. However, to meet the demand these minerals will have to be discovered, mined and processed. This takes time and resources, and under the current regulatory system, we are not likely to meet our 2035 or 2050 targets.

Focusing on Canada, over the last thirty years, government, writ large, has built up significant barriers to the development and mining of minerals with the shift from a largely science based environmental approvals approach to a more socio-political approach as most recently manifested in the federal Impact Assessment Act. Government cannot impose a fundamental shift in energy and material usage without providing the tools and mechanisms to allow that to happen unless they want significant social and economic chaos. Critical minerals are fundamental to achieving the goal of electrification and reducing GHGs. But, to that list I would also add iron, limestone and fossil fuels (and likely others) as these are all critical components in building the necessary infrastructure. This talk will look at the barriers to developing Canada's critical minerals in a timely manner and offer some suggestions for expediting that process.