



# 2024 SME Minnesota Conference

April 15-17, 2024 | Duluth, MN



## CONFERENCE PROGRAM

Duluth Entertainment Convention Center (DECC)



**United States Steel**  
Minnesota Ore Operations

OVERALL CONFERENCE SPONSOR

# Opening Plenary Session - Sustainable Mining: The Past Reveals Our Future.

TUESDAY, APRIL 16, 2024 | 10:00 am – 11:30 am  
Lake Superior J-K



## Sustainable Mining: The Past Reveals Our Future

*Master of Ceremonies: LaTisha Gietzen, Market Manager, Mining North America for Kalenborn Abresist*

### About the Master of Ceremonies

LaTisha Gietzen is the Market Manager- Mining North America for Kalenborn Abresist. Kalenborn Abresist, a division of Kalenborn International, is a leading provider of wear protection solutions. In this role, LaTisha will focus on sales, business development, and brand promotion for Kalenborn's mining products. Kalenborn Abresist customers include the mining, power, cement, building products, steel, pulp and paper industries as well as the food industry. LaTisha is a fourth-generation miner and has over 25 years of mining experience in both ferrous and non-ferrous mining. Prior to joining Kalenborn in early 2024, LaTisha was most recently the Manger Public and Community Relations for PolyMet/New Range Copper Nickel a position, among a few, she held for nearly 16 years with the company. Before joining PolyMet, LaTisha worked at Cleveland Cliffs as District Manager of Public Affairs in Minnesota. Previously she has also worked for National Steel Pellet Company as Manager of Environmental and Governmental Affairs and continued in a similar role with U. S. Steel after it acquired National in 2003.



## Reclaiming Minnesota's Mined Lands: Lessons From Minnesota's Mining Past

*Peter Kero, VP and Sr. Environmental Engineer, Barr Engineering*

A critical aspect of sustainable mining is the mitigation of impacts to mined lands. The opening plenary will examine the development of state-of-the-art conservation, reclamation and repurposing practices over the past 120 years of Minnesota's iron mining history. From lean ore stockpiling techniques to the creation of award-winning mountain bike parks, this talk will demonstrate that innovation in mining can go beyond technological improvements to promote community betterment and the social license to operate.

### About the Speaker

Pete Kero is a Vice President and senior environmental engineer with Barr Engineering Company in Hibbing, Minnesota. He has over 29 years of experience in mining and industrial site cleanup and redevelopment. His work includes mine planning, permitting, remediation, water management, reclamation and repurposing at more than two dozen mine sites across Minnesota, Michigan, Arizona, Arkansas, Wisconsin and California. Pete was the visionary behind the award-winning Redhead Mountain Bike Park in Chisholm. The project repurposed several former iron mine pits and stockpiles into a destination-quality regional park for mountain biking, hiking, water recreation and all-terrain vehicles. The project has been featured in Outside Magazine and the nation-wide documentary film Biketown. In May 2023, his book *Minnescapes: Reclaiming Minnesota's Mined Lands* was published by the Minnesota Historical Society Press.



## Iron Range Resources & Rehabilitation: Our History And Future

*Ida Rukavina, Commissioner, Iron Range Resources & Rehabilitation*

Iron Range Resources & Rehabilitation is a state of Minnesota economic development agency located in Eveleth which is about one hour north of Duluth. The agency works to strengthen the businesses, communities and workforce in northeastern Minnesota. It was created over 80 years ago to diversify the economy of a region largely dependent on a natural resource based economy – primarily iron mining.

### About the Speaker

Ida Rukavina serves as the Commissioner of Iron Range Resources & Rehabilitation. As Commissioner, Ida leads an agency charged with investing resources to foster vibrant growth and economic prosperity in northeastern Minnesota by enhancing livable communities, maximizing collaborations and partnerships, and strengthening business and worker education. Prior to her appointment, she served as the executive director of the Range Association of Municipalities and Schools (RAMS). Ida has primarily worked in government and the labor movement, representing public and private employees in northern Minnesota and working with government at the state, local, and federal levels. Ida was born and raised on the Iron Range. She earned a Bachelor's Degree in Government and American Politics with a concentration in Race and Ethnic Relations from Clark University and a Master's Degree in Advocacy and Political Leadership from the University of Minnesota – Duluth. Ida and her husband Jesse enjoy living on the Iron Range with their two daughters. She is passionate about the great northwoods and enjoys spending family time camping, skiing, snowboarding, hiking and fishing.

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## Closing Plenary Program Sustainable Mining: The Past Reveals Our Future *(continued)*

WEDNESDAY, APRIL 17, 2024 | 1:00 pm – 3:00 pm  
Lake Superior J-K

United States Steel and Cleveland-Cliffs will provide corporate updates that highlight their vision for a sustainable future.



### United States Steel Updates *Erika Chan, Head of Sustainability*

#### About the Speaker

*Erika L. Chan joined U. S. Steel as the first head of Sustainability. In this role, she has enterprise-wide responsibility for all aspects of the Corporation's sustainability efforts. Prior to joining U.S. Steel, Erika worked for Dell Technologies where she shaped the corporate sustainability strategy, advanced long-term goals,*

*and identified opportunities to integrate sustainability practices into business units. Erika has also led the Asia Pacific marketing team at The Nature Conservancy, and she practiced international development consulting at Deloitte Emerging Markets Group.*

*Erika received a Bachelor of Arts degree in Environmental Resource Management and Business from The University of Texas at Austin.*

*She serves on the Advisory Council of The University of Texas at Austin Environmental Science Institute and is an Advisory Board member of The Nature Conservancy of Texas.*



### Cleveland-Cliffs Updates

*Marissa Brydle, Director of Corporate Sustainability*

Marissa Brydle, Director of Corporate Sustainability for Cleveland-Cliffs, will discuss what decarbonization technologies and pathways Cliffs is pursuing to facilitate cleaner iron and steel making across its operational footprint—now and into the future. As a member of the DOE's Better Plants and Better Climate Challenge programs, Cliffs takes a holistic approach to sustainability, from energy efficiency to emissions reduction.

#### About the Speaker

*Marissa Brydle has served as the Director of Corporate Sustainability for Cleveland-Cliffs since June 2021. Cliffs' corporate sustainability team works with leadership and cross-functionally to set sustainability goals, execute associated strategies and manage external reporting activities, including GHG emissions inventory. The corporate sustainability team also plays a key role in evaluating decarbonization opportunities for the Company, and partners with other corporate departments to engage with external stakeholders around sustainability topics.*

*Prior to joining Cliffs, Marissa spent 13 years in sustainability consulting, most recently at a global environmental services firm.*

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Plenary Speaker Panel Discussion led by Master of Ceremonies -  
LaTisha Gietzen

## 2023-2024

### SME MN Section – SME Section Committees

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## CONNECT WITH MINERAL PROFESSIONALS IN THE HEART OF THE GREAT LAKES REGION



# Technical Sessions

TUESDAY, APRIL 16					
8:30 am – 9:30 am ETHICS SESSION					
How Scandals Have Shaped Ethics in the Minerals Industry, <i>George Hudak, Geological Consultant, George Hudak Geoscience</i>					
9:00 am – 10:00 am REFRESHMENT BREAK IN THE EXHIBIT HALL					
10:00 am – 11:30 am OPENING PLENARY					
Sustainable Mining: Our Past Reveals Our Future, <i>LaTisha Gietzen Market Manager, Mining North America, Peter Kero, VP and Sr. Environmental Engineer, Barr Engineering Co. and Ida Rukavina, Commissioner of the Iron Range Rehabilitation and Resources</i>					
11:30 am – 1:00 pm NETWORKING LUNCH IN THE EXHIBIT HALL					
START TIME	MINE PERMITTING AND REGULATORY OBLIGATION LAKE SUPERIOR L	MINE ENGINEERING AND UNDERGROUND CONSTRUCTION LAKE SUPERIOR M-N	ADVANCEMENTS IN IRON PROCESSING AND STEELMAKING LAKE SUPERIOR O	THE GEOLOGY OF EMERGING MINERAL OPPORTUNITIES FRENCH RIVER	MINING AND PLANT MAINTENANCE SPLIT ROCK
	<b>Session Chair:</b> <i>Lauren Dickerson, Barr Engineering Co.</i>	<b>Session Chair:</b> <i>Nate Hofland, United States Steel</i>	<b>Session Chair:</b> <i>Weiguo Xie, University of Minnesota Duluth</i>	<b>Session Chair:</b> <i>Frank Pezzutto, Northeast Technical Services</i>	<b>Session Chair:</b> <i>Nicholas Maki, Cleveland-Cliffs</i>
1:00 - 1:20 PM	<b>Navigating the Mine Permitting Regulatory Challenges Related to Water Resources</b> <i>Vikas Tandon; Foth Infrastructure &amp; Environment LLC, Saint Paul, Minnesota, United States, Mike Nimmer; Foth Infrastructure &amp; Environment, LLC, De Pere, Wisconsin, United States, Larry Kramka; Foth Infrastructure &amp; Environment, LLC, Duluth, Minnesota</i>	<b>Pump Design &amp; Development for Critical Mine Dewatering</b> <i>Jason Anderson, P.E.; GPM, Inc., Duluth, MN, Minnesota, United States</i>	<b>Enhanced Iron Ore Pellet Chemistry - Project Update</b> <i>Brett Spigarelli, Rodney Johnson and Shashi Rao; NRRI, Coleraine, Minnesota, United States</i>	<b>Unraveling the Potential of Reduced Intrusion-Related Gold System (RIRGS) Mineralization in Antaña, Puno, Southern Peru</b> <i>Mirian Puma; Universidad Nacional del Altiplano-Puno, Puno, Peru</i>	<b>Increasing Grinding Circuit Robustness with Advanced Grinding Circuit Control Using On-line Analyzer Systems</b> <i>Gonzalo Chirinos; Metso, Centennial, Colorado, United States</i>
1:20 - 1:40 PM	<b>Critical Minerals and FAST-41: Streamlining Federal Environmental Compliance for Mining</b> <i>Michael Mayer; HDR, Inc, Northfield, Minnesota, United States, Nicole Pahl; HDR, Inc, St Louis Park, Minnesota, United States</i>	<b>Redefining Safety and Efficiency: Ground-Based Radar Systems in Open-Pit Mining for Continuous Slope Stability Monitoring</b> <i>Jon Reisterer; IDS Georadar North America, Kalamazoo, Michigan, United States, Jake Davidson; IDS Georadar North America, Lakewood, Colorado, United States</i>	<b>Using Automotive Paint Sludge as a Binder for Pelletizing Magnetite Ore</b> <i>Corby Anderson; Colorado School of Mines, Golden, Colorado, United States, Victoria Vaccarezza; Nth Cycle, Beverly, Massachusetts, United States</i>	<b>Archean Gold Deposits in the Superior Province of the Canadian Shield</b> <i>Frank Pezzutto; NTS, Virginia, Minnesota, United States</i>	<b>Conveyor Idler Roll Automation and Monitoring</b> <i>Ryan Loge; Superior Industries, Morris, Minnesota, United States</i>
1:40 - 2:00 PM	<b>Minnesota's Environmental Permitting Process: Benchmarking, Opportunities, and Economic Growth</b> <i>Ryan Siats; Barr Engineering Co., Duluth, Minnesota, United States, Jennifer Byers; Minnesota Chamber of Commerce, St. Paul, Minnesota, United States</i>	<b>Unleashing A.I. in Drills for Enhanced Mining Efficiency</b> <i>Kevin Moran; Hexagon, Golden, Colorado, United States, Curtis Stacy; Hexagon, Tucson, Arizona, United States</i>	<b>Turbulence Model Development for Mechanical Flotation Cells</b> <i>Weiguo Xie; University of Minnesota, Duluth, Minnesota, United States</i>	<b>Alteration Geochemistry Characterization and 3D Modeling of the Back Forty VMS Deposit, U.P. Michigan</b> <i>Margaret Upton; University of Minnesota Duluth, Superior, Wisconsin, United States</i>	<b>Strengthening your Management Operating System: The Key to Resolving Daily Tonnage Shortages, Equipment Availability Issues, and Other TPM+5S Operational Challenges</b> <i>David Truchot; Veltosis Consulting LLC, Bayport, Minnesota, United States</i>
2:00 - 2:20 PM	<b>Developing a Greenhouse Gas Inventory for Environmental Review</b> <i>Sarah Wicklund; Barr Engineering Co., Duluth, Minnesota, United States</i>	<b>SLAM LiDAR for Underground Mining</b> <i>Chris Nelms; RDO Equipment Company, Billings, Montana, United States</i>	<b>Pre-concentration of Low Grade Banded Iron Formation (BIF) by Physical Beneficiation</b> <i>Ashma Singh and Nichole Maistry; Mintek, Johannesburg, Gauteng, South Africa</i>	<b>Indicator Minerals for Bedrock Mineralization in Minnesota: New Data, New Database</b> <i>Donald Eisenheimer; Minnesota Department of Natural Resources, St. Paul, Minnesota, United States</i>	<b>Transforming Aggregate Screening: Metal7's Evolution of Roller Screen Technology</b> <i>Steve Beaudin; Metal7, Sept-Iles, Quebec, Canada</i>
2:30 pm – 3:00 pm REFRESHMENT BREAK IN THE EXHIBIT HALL					
3:00 - 3:20 PM	<b>Functional Equivalent: Determining if a Discharge to Groundwater Requires an NPDES Permit</b> <i>Jennifer Fleming; Barr Engineering Co., Duluth, Minnesota, United States</i>	<b>Building Client – Contractor Relationships Through the Help of Project Controls</b> <i>Kathleen Tew and Charles Campbell; Cementation USA, Sandy, Utah, United States</i>	<b>Flotation of South African Low Grade Banded Iron Formation (BIF)</b> <i>Nichole Maistry and Ashma Singh; Mintek, Johannesburg, Gauteng, South Africa</i>	<b>Helium Potential and Exploration in Minnesota: Leading the Global Pivot to Green Helium</b> <i>Phil Larson, Thomas Abraham-James, Michael Sturdy and Josh Bluett, Pulsar Helium Inc, White Rock, BC, Canada</i>	<b>Improving the Performance of Stainless Steel Castings Used in Iron Ore Pelletizing Equipment</b> <i>Jeff Pancher; Metso, Coal Township, PA, United States</i>
3:20 - 3:40 PM	<b>Clean Air Act Caselaw Update</b> <i>William (Bill) Hefner; Fredrikson &amp; Byron, Minneapolis, Minnesota, United States</i>	<b>Past &amp; Future Rockbolting Practice – A Mine Contractor's Perspective</b> <i>Ryan Lyle; Cementation Americas, North Bay, Ontario, Canada, Steve Immenschuh; Cementation USA, Sandy, Utah, United States, Alex MacInnes; Cementation Canada, North Bay, Ontario, Canada</i>	<b>The Application of REFLUX Classifiers in the Iron Ore Industry</b> <i>Nicolas Boonzaier; FLSmidth, Brisbane, Queensland, Australia</i>		
3:40 - 4:00 PM	<b>How to Effectively Use Environmental Justice Screening Tools in Your Project Planning</b> <i>Jennifer Koenen; Barr Engineering Co., Minneapolis, Minnesota, United States</i>	<b>Solar as a Productive Use of Reclaimed Land</b> <i>Carey Kling; BQ Energy/CleanCapital, Wappingfalls, New York, United States</i>	<b>Advances in Milling and Flotation Technology for Production of Direct Reduction Pellet Feed (DRPF)</b> <i>Fisher Wang; Swiss Tower Mill Minerals AG, Vancouver, British Columbia, Canada, Michael Moser; Swiss Tower Mill Minerals AG, Baden, Baden, Switzerland, Erich Dohm; Eriez Flotation, Erie, PA, United States</i>		
4:00 - 4:20 PM	<b>Impacts of the PM2.5 NAAQS Revision</b> <i>John Ke; Trinity Consultants, Woodbury, Minnesota, United States</i>	<b>Project Greenwood – Forestry Reclamation Approach</b> <i>Jordan Erikson; Hibbing Taconite Company, Hibbing, MN, United States</i>	<b>Metallurgical Performance of Concorde Cell in Reducing Silica in Iron Ore Fines</b> <i>Raghav Dube; Metso, Centennial, Colorado, United States</i>		
4:30 pm – 7:00 pm EXHIBIT HALL RECEPTION					

WEDNESDAY, APRIL 17				
START TIME	RESPONSIBLE MINE WATER MANAGEMENT LAKE SUPERIOR L	INNOVATIVE TAILINGS MANAGEMENT LAKE SUPERIOR M-N	EMERGING MINERAL PROCESSING CHALLENGES AND OPPORTUNITIES LAKE SUPERIOR O	IRON GEOLOGY AND AGGREGATES FRENCH RIVER
	<b>Session Chair:</b> Tracy Muck, NTS Northeast Technical Services	<b>Session Chair:</b> Erik Olson, Newrange Copper Nickel	<b>Session Chair:</b> Kyle Bartholomew, Metcom Technologies	<b>Session Chair:</b> Austin Siekkinen, United States Steel Minnesota Ore Operations
8:00 - 8:20 AM	<b>Preliminary Observations of Rock Characterization Data from Humidity Cell Tests of the Tamarack Intrusion and Adjacent Thomson Formation</b>  Steven Koski; Minnesota Department of Natural Resources, Hibbing, Minnesota, United States, Zach Wenz; Minnesota Department of Natural Resources, St. Paul, Minnesota, United States	<b>Towards Zero Tailings – Can We Get There?</b>  Kurt Schimpke; Barr Engineering Co., Minneapolis, Minnesota, United States	<b>Microwave Hydrogen Plasma Reduction of Iron Ore</b>  Rodney Johnson; University of Minnesota, Duluth, Minnesota, United States, Uwe Kortshagen; University of Minnesota, Minneapolis, Minnesota, United States, Brett Spigarelli; Natural Resources Research Institute, Coleraine, Minnesota, Peter Bruggeman and Qi Zhang; University of Minnesota, Minneapolis, Minnesota, United States, Patrick Schoff; Natural Resources Research Institute, Duluth, Minnesota, United States	<b>Algoma Type and Superior Type Iron Formation</b>  Frank Pezzutto; NTS, Virginia, Minnesota, United States
8:20 - 8:40 AM	<b>Groundwater Regulation 101: A Primer on Groundwater Regulation in Minnesota Relevant to the Mining Industry</b>  Jeremy Greenhouse; Fredrikson & Byron LLP, Minneapolis, Minnesota, United States	<b>Digital Twin Integration: Minimizing Risk and Gaining Holistic Geospatial Perspective in Tailings Storage Facilities Management</b>  Lance McGinn; Esri, Louisville, Colorado, United States, Pete Will; Esri, Louisville, Colorado, United States	<b>An Overview of Dry Processing Options for Mineral Industries</b>  Sunil Tripathy, Shahsi Rao, Jestos Taguta, Lysa Chizmadia, Matt Milnar; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Coleraine, Minnesota, United States	<b>The Mineralogical Characterization of Low Value Iron Formation and Their Effects on Metallurgical Response</b>  Lysa Chizmadia; University of Minnesota, Coleraine, Minnesota, United States, Jestos Taguta; University of Minnesota, Coleraine, Minnesota, United States, Sara Post; University of Minnesota, Duluth, Minnesota, Matt Milnar; University of Minnesota, Coleraine, Minnesota, United States, Rodney Johnson; University of Minnesota, Duluth, Minnesota, United States
8:40 - 9:00 AM	<b>Predictive Water Management using GoldSim for Mining Operations Under a Changing Climate</b>  Harsh Anurag; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States, Todd DeJournett; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States, Jeff Standish; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States	<b>Downstream Improvements on Upstream Dams: An Owner's Perspective of a Paradigm Shift</b>  Christopher Winter; Cleveland-Cliffs, Inc., Hibbing, Minnesota, United States	<b>ESG-Friendly Biosurfactants to Boost Performance in Iron Ore Flotation</b>  Ronney R Rodrigues Silva, Cathrine Monyake, Gabi Knesel and Renata Mendonca; Locus Mining, Montgomery, Texas, United States	<b>Feasibility Analysis of Green Ore Production from Hematite Stockpiles and Dams in Minnesota Using High-Intensity Magnetic Separation</b>  Fernanda Hoffmann, Claudio Ribeiro and Gentil Sobrinho; Gaustec America LLC, Ellicott City, Maryland, United States
<b>9:00 am – 10:00 am REFRESHMENT BREAK IN THE EXHIBIT HALL</b>				
10:00 - 10:20 AM	<b>Evaluating Groundwater and Surface Water Interaction – Modeling Approaches and Future Advancements</b>  Evan Christianson; Barr Engineering, Minneapolis, Minnesota, United States	<b>Pressure Filtration for Iron Ore Operation</b>  Ajit Baruah; Metso, Burlington, Ontario, Canada, Jason Tomasino; Metso, Brookfield, Wisconsin, United States	<b>Characterization and Evaluation of Biochar as a Green Approach for Rare Earth Elements and Critical Metals Recovery from Aqueous Solutions</b>  Oluwaseun Famobuwa, Deniz Talan, Hassan Amini, Oishi Sanyal and Shawn Grushecky; West Virginia University, Morgantown, West Virginia, United States	<b>Geological Controls on Direct Shipping Iron Ore Genesis, Mesabi Range, Minnesota: Insights from Historic Drilling Data from the Mahoning Group 1 Mine</b>  Phillip Larson; Cleveland-Cliffs Hibbing Taconite Company, Hibbing, Minnesota, United States
10:20 - 10:40 AM	<b>In Situ Metals Remediation – Tailing, Soil, and Groundwater</b>  Lowell Kessel; CERES Technologies, Marina Del Rey, California, United States	<b>Saving Money Pumping Groundwater</b>  Nicolas Steverlymck; Hose Solutions, Scottsdale, Arizona, United States	<b>Extending Longevity and Achieving ESG Targets through Modernization of Thickeners with Latest High Performing Technologies</b>  Andrew McIntosh; Metso, Frenchs Forest, New South Wales, Australia	<b>New Exploration and Discovery in the Manganiferous Iron Formation in the Emily District of the Cuyuna Iron Range, Minnesota</b>  Rick Sandri; North Star Manganese Inc & Electric Metals (USA) Ltd., Woodbury, MN, United States, Alex Steiner and Dan Peterson; Big Rock Exploration LLC, Duluth, MN, United States, Gabriel Sweet, Teddy Berg, and Jacqueline Solie, Big Rock Exploration LLC, Minneapolis, MN, United States
10:40 - 11:00 AM	<b>Biological Sulfate Reduction with Direct Reduced Iron Polishing</b>  Jeffrey Hanson and Bill Newman; Clearwater BioLogic LLC, BABBITT, Minnesota, United States		<b>Hydrometallurgical Methods for Copper Extraction from the Duluth Complex: Case Studies and Insights from Across the Globe for Base Metal and PGM Processing</b>  Lisa Rudstrom; University of Minnesota Duluth, Hibbing, Minnesota, United States, Lucas Arndt; University of Minnesota, Duluth, Hibbing, Minnesota, United States	<b>Addressing Aggregate Needs</b>  Heather Arends and Chad Crotty; Minnesota Department of Natural Resources, St. Paul, Minnesota, United States
10:40 - 11:00 AM	<b>Adding Project Value through Water – Integrating Groundwater Characterization into Exploration</b>  Jakob Wartman and Justin Brown; Foth Infrastructure & Environment, LLC, Duluth, Minnesota, United States			
<b>11:30 am – 1:00 pm NETWORKING LUNCH IN THE EXHIBIT HALL</b>				
<b>1:00 pm – 3:00 pm CLOSING PLENARY</b>				
Sustainable Mining: The Past Reveals Our Future (Continued), Erika Chan, Head of Sustainability, United States Steel and Marissa Brydle, Director of Corporate Sustainability, Cleveland-Cliffs				
<b>3:00 pm – 4:00 pm SME MN ANNUAL BOARD MEETING</b>				

# Technical Program

## Tuesday Sessions

**1:00 pm – 4:30 pm**

- Mine Permitting and Regulatory Obligation
- Mine Engineering and Underground Construction
- Advancements In Iron Processing and Steelmaking
- The Geology of Emerging Mineral Opportunities
- Mining and Plant Maintenance

## Wednesday Sessions

**8:00 am – 11:30 am**

- Responsible Mine Water Management
- Innovative Tailings Management
- Emerging Mineral Processing Challenges and Opportunities
- Iron Geology and Aggregates

## Tuesday, April 16 | Afternoon Sessions

### MINE PERMITTING AND REGULATORY OBLIGATION

*Chair: Lauren Dickerson; Barr Engineering Co., Minneapolis, MN*

#### Lake Superior L

**1:00 pm**

#### Navigating the Mine Permitting Regulatory Challenges Related to Water Resources

*Vikas Tandon; Foth Infrastructure & Environment LLC, Saint Paul, Minnesota, United States, Mike Nimmer; Foth Infrastructure & Environment, LLC, De Pere, Wisconsin, United States, Larry Kramka; Foth Infrastructure & Environment, LLC, Duluth, Minnesota*

Recent applications for permitting non-ferrous mines in Minnesota and the Upper Mid-West have endured extended regulatory approval timelines and litigation. Assessment of potential mine related impacts to the water resources is critical to the regulatory approval process. Based on experiences at multiple projects, the authors will present approaches to gain regulatory alignment by strategically defining the problem statement, and presenting solutions that address the material future effects on water resources instead of the perceived effects. Examples of progression towards regulatory consensus will be shared. Effective approaches towards optimum timing of data submittals, that typically precede the projections of impacts by operators and the regulators, will be discussed.

**1:20 pm**

#### Critical Minerals and FAST-41: Streamlining Federal Environmental Compliance for Mining

*Michael Mayer; HDR, Inc, Northfield, Minnesota, United States, Nicole Pahl; HDR, Inc, St Louis Park, Minnesota, United States*

The federal government recognizes the need for critical minerals to facilitate the transition to electric vehicles and meet climate goals. Recently an Arizona mining project was identified as the first mining project eligible (i.e., covered project) to enroll in the FAST-41 permitting process. FAST-41 stems from the Fixing America's Surface Transportation Act and is an applicant-driven process meant to improve "the transparency, predictability, and outcomes of the Federal environmental review and authorization process for certain large- scale critical infrastructure projects". This presentation provides a primer on FAST-41 and how it overlays the National Environment Policy Act and other federal environmental requirements.

**1:40 pm**

#### Minnesota's Environmental Permitting Process: Benchmarking, Opportunities, and Economic Growth

*Ryan Siats; Barr Engineering Co., Duluth, Minnesota, United States, Jennifer Byers; Minnesota Chamber of Commerce, St. Paul, Minnesota, United States*

The Minnesota business community, including the mining industry, has expressed concern that Minnesota's environmental review and permitting processes may inhibit economic growth and development in the state. In response, the Minnesota Chamber Foundation enlisted Barr Engineering Co. and its partners to conduct a technical analysis of Minnesota's environmental program. This presentation will cover the work completed in comparing Minnesota's environmental review and permitting process to those of other states with similar physical environments and geographies and opportunities for improvement that could improve permitting processes that would lead to economic expansion while retaining strong environmental protections.

**2:00 pm**

#### Developing a Greenhouse Gas Inventory for Environmental Review

*Sarah Wicklund; Barr Engineering Co., Duluth, Minnesota, United States*

With agencies using greenhouse gas (GHG) emissions to measure a project's potential climate impacts, it is imperative that these emission calculations be as accurate as possible. In this presentation, I will walk through the process of developing an inventory of GHG emissions for projects requiring environmental review. Specific Minnesota (EAW) and federal (NEPA) environmental review requirements will be discussed. I will talk about the emission sources typically included in inventories, data needs, and calculation methods. The uses of a GHG inventory will also be considered.

**2:30 pm**

#### REFRESHMENT BREAK

**3:00 pm**

#### Functional Equivalent: Determining if a Discharge to Groundwater Requires an NPDES Permit

*Jennifer Fleming; Barr Engineering Co., Duluth, Minnesota, United States*

The Supreme Court's 2020 Maui Decision held that a National Pollutant Discharge Elimination System (NPDES) permit is required for a point source discharge through groundwater to waters of the US if it is the "functional equivalent of a direct discharge". Four years later, there is still uncertainty related to which discharges to groundwater require NPDES permits. This is pertinent to mining facilities as most have features with some infiltration or seepage to groundwater. This presentation will explore what is known about determining whether a discharge to groundwater requires an NPDES permit based on the Maui Decision, EPA guidance, and precedent.

**3:20 pm**

**Clean Air Act Caselaw Update**

*William (Bill) Hefner; Fredrikson & Byron, Minneapolis, Minnesota, United States*

Federal and state courts are constantly issuing decisions that interpret air laws and regulations affecting mining and other industrial parties. This presentation will touch on some of the more important and relevant judicial developments from the past year and their potential implications for the mining industry in the future.

**3:40 pm**

**How to Effectively Use Environmental Justice Screening Tools in Your Project Planning**

*Jennifer Koenen; Barr Engineering Co., Minneapolis, Minnesota, United States*

Understanding a facility's environmental impacts on its neighbors both individually and as part of the overall cumulative effects is a key factor in approvals for proposed projects or permits with new environmental justice rulemakings and considerations. The first step is understanding the environmental justice screening tools publicly available and their strengths and limitations at providing a snapshot of the baseline impacting the population around your facility. The presentation will discuss the various online environmental justice mapping tools both federal and local, how they can provide a better understanding of your community's baseline environmental stressors and help determine the next steps in your project planning process, including identifying pollutants of primary concern.

**4:00 pm**

**Impacts of the PM2.5 NAAQS Revision**

*John Ke; Trinity Consultants, Woodbury, Minnesota, United States*

This presentation will discuss the regulatory impacts of the revised PM2.5 National Ambient Air Quality Standards (NAAQS) and what facilities may need to prepare in order to address these changes. Because the available gap between the NAAQS threshold and background concentrations will shrink and make modeling exercises more challenging in the future, the presentation will also discuss air quality monitoring in lieu of modeling and recent updates to the Minnesota Pollution Control Agency's policy regarding monitoring off-ramps.

**MINE ENGINEERING AND UNDERGROUND CONSTRUCTION**

*Chair: Nate Hofland; United States Steel, Hibbing, MN*

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**1:00 pm**

**Pump Design & Development for Critical Mine Dewatering**

*Jason Anderson, P.E.; GPM, Inc., Duluth, MN, Minnesota, United States*

Pump design can be hidden behind IP and NDA protections, making it difficult for mine operators to gain the deep knowledge required to optimize the pump system's success. Operational success in mining requires the deployment of effective dewatering strategies. This presentation details the submersible centrifugal pump design workflow. We define required pump performance objectives, go through pump design development and CFD analysis, and then end with physical pump performance testing. It describes lessons learned in designing submersible centrifugal pumps for mine dewatering with specific attention to the iterative design of an impeller and casing. Intuition will be established for pump-specific speed, rotating frames of reference, kinetic and potential fluid energies, efficiency, and BEP.

**1:20 pm**

**Redefining Safety and Efficiency: Ground-Based Radar Systems in Open-Pit Mining for Continuous Slope Stability Monitoring**

*Jon Reisterer; IDS Georadar North America, Kalamazoo, Michigan, United States, Jake Davidson; IDS Georadar North America, Lakewood, Colorado, United States*

Modern open-pit mines are a dynamic and ever-changing environment. Critical slope monitoring, the practice of systematic and continuous assessment of slope stability, has become standard practice industry wide. As open-pit mining operations expand, the need for precise and real-time monitoring of slope stability becomes imperative. Ground-based radar systems offer a sophisticated solution for continuous deformation assessment, enabling early detection of potential instabilities. This presentation explores the significance of such technology in enhancing safety measures, predicting catastrophic slope failures, and optimizing operational efficiency. Insights into the practical applications and benefits of ground-based radar systems contribute to advancing towards state-of-the-art practices in open-pit mining.

**1:40 pm**

**Unleashing A.I. in Drills for Enhanced Mining Efficiency**

*Kevin Moran; Hexagon, Golden, Colorado, United States, Curtis Stacy; Hexagon, Tucson, Arizona, United States*

Discover the only AI-powered Drill Assist System in mining, revolutionizing drilling productivity, precision, and down-the-hole analytics. Uncover empirical results and operator insights showcasing HxGN Drill Assist's practical application. We will discuss how this technology is transforming drilling methodologies for enhanced efficiency with a very small hardware footprint.

**2:00 pm**

**SLAM LiDAR for Underground Mining**

*Chris Nelms; RDO Equipment Company, Billings, Montana, United States*

20 minute presentation on the use of Simultaneous Localization and Mapping (SLAM) LiDAR in underground mining. This will cover the features of SLAM compared to traditional LiDAR data capture. There will be a primary focus on the speed of data collection for as-built information walking and driving through the mine. The autonomous or remote control use with a drone in hazardous areas like stopes, historical data to study movement, spalling, overbreak and underbreak volumes, dust monitoring, mapping of electrical and utility lines, conveyor belt alignment and air shaft inspection.

**2:30 pm**

**REFRESHMENT BREAK**

**3:00 pm**

**Building Client-Contractor Relationships Through the Help of Project Controls**

*Kathleen Tew and Charles Campbell; Cementation USA, Sandy, Utah, United States*

Contractors are brought onto a project when specific experience is required- examples include rapid development, shaft sinking, underground construction, and underground production. Cementation Americas has over 25 years of underground contracting experience and many lessons learned on how to build a lasting relationship with our clients. A contract can have a life of a few months to over 15 years. Regardless of the life of the contract it is important that the client-contractor relationship remains favorable. Project Controls, at its core, is understanding how a project (or mine) is performing according to a set budget and schedule. Change is often inevitable on a project, but how and when that change is presented will affect the nature of the client-contractor relationship.

**3:20 pm**

**Past & Future Rockbolting Practice- A Mine Contractor's Perspective**

*Ryan Lyle; Cementation Americas, North Bay, Ontario, Canada, Steve Immenschuh; Cementation USA, Sandy, Utah, United States, Alex MacInnes; Cementation Canada, North Bay, Ontario, Canada*

In underground mining ground support is key to maintaining the safety of the workplace from rockfall. Cementation has wide experience with varied bolting methods over a diverse range of ground conditions. With this perspective we have seen the progression of rock bolting installation methods from using handheld gear to remote mechanized screen and bolting from an adjacent heading. We have analyzed over 10 years of our safety data for various bolting methods which clearly indicate less incidents using mechanized bolting methods. However, one significant challenge is using resin bolts with mechanized bolters. Cementation has adopted pumpable resins to overcome this challenge and innovated an injection socket for increased installation effectiveness to allow greater use of mechanized bolters.

**3:40 pm**

**Solar as a Productive Use of Reclaimed Land**

*Carey Kling; BQ Energy/CleanCapital, Wappingsfalls, New York, United States*

Solar on reclaimed mines and mine refuse piles is a compatible productive use of legacy property. Land with historic industrial use and potentially limited alternative uses, are perfect sites for renewable energy projects. Transmission lines and access roads are integral to mining sites and provide cost effective infrastructure to the solar project. Power can be sold for ongoing operations at a mine, or sold into the grid to utilities or commercial/industrial users. BQ Energy has solar projects on several reclaimed mines in Appalachia and on slag at an abandoned steel mill in Lackawana, NY.

**4:00 pm**

**Project Greenwood- Forestry Reclamation Approach**

*Jordan Erikson; Hibbing Taconite Company, Hibbing, MN, United States*

The goal of Project Greenwood is to implement the Forestry Reclamation Approach used in the coal mining regions of Appalachia to enhance species richness, minimize non-native species, and promote the natural success of forest on mine lands. By doing so, it will enhance the aesthetics of the mined land, provide a potential platform for future economic development (through recreation and tourism on the forested stockpiles, or via commercial timber harvesting) as well as provide an education and tourism attraction via the "living exhibit" of innovative mine reclamation for the forthcoming Hibbing Mineview museum.

**ADVANCEMENTS IN IRON PROCESSING AND STEELMAKING**

*Chair: Weiguo Xie; University of Minnesota Duluth, Duluth, MN*

**Lake Superior 0**

Sponsored by  **MAGOTTEAUX**

**1:00 pm**

**Enhanced Iron Ore Pellet Chemistry - Project Update**

*Brett Spigarelli, Rodney Johnson and Shashi Rao; NRRI, Coleraine, Minnesota*

The Natural Resources Research Institute has been awarded a \$2.1 million grant from the U.S. Department of Energy, Energy Efficiency and Renewable Energy, Industrial Efficiency and Decarbonization Office to explore enhanced iron ore pellet chemistry. The project will focus on the modification of ore-based feed materials to enhance gas-based direct reduction, the use of semi-oxidized iron ores in gas based direct reduction, and the creation of granulated iron products that will enhance EAF productivity and quality so that steel manufacturing and energy efficiency are improved.

**1:20 pm**

**Using Automotive Paint Sludge as a Binder for Pelletizing Magnetite Ore**

*Corby Anderson; Colorado School of Mines, Golden, Colorado, United States, Victoria Vaccarezza; Nth Cycle, Beverly, Massachusetts, United States*

Automotive paint sludge is considered a nuisance and hazardous waste material within the automotive industry around the world. Two different paint sludge samples were characterized for their organic and inorganic components. It was then determined to be a possible substitute for the standard iron ore pellet binder: bentonite clay. The iron ore pellets with paint sludge material as a binder were then tested for their standard physical and chemical properties to make sure they were comparable to pellets made with bentonite clay. It was concluded via the physical and chemical property tests that iron ore pellets made with paint sludge material with this patent pending technology were comparable to those now made with bentonite.

**1:40 pm**

**Turbulence Model Development for Mechanical Flotation Cells**

*Weiguo Xie; University of Minnesota, Duluth, Minnesota, United States*

Turbulence is one of the key parameters determining flotation performance because it affects many processes: suspension of particles, air dispersion, particle-bubble collision, attachment and detachment, and entrainment. In this paper, turbulence distribution model will be developed based on data from a water-air two phase mixture in a 3 m3 pilot flotation cell, and a three phase Metso RCS 3 m3 flotation test rig with magnetite/silica slurry and air. The effects from different impeller speeds, air flowrates and cell level (aspect ratio) will be discussed. This model can be potentially used to optimize the hydrodynamic factors to improve flotation performance.



**2:00 pm**

**Pre-concentration of Low Grade Banded Iron Formation (BIF) by Physical Beneficiation**

*Ashma Singh and Nichole Maistry; Mintek, Johannesburg, Gauteng, South Africa*

The depletion of high grade iron ore reserves in South Africa, has necessitated the exploration of low grade hematite resources in a bid to extend life of mine and maximize resource utilization, in particular Banded Iron Formations (BIF) material which makes up approximately 66% of future reserves. At Fe head grades below 40%, overall Fe product grades and recoveries are compromised. Thus the aim of the research study involved production of a pre-concentrate grading at approximately 55% Fe with potential for alternative methods such as cationic reverse flotation to be tested on the pre-concentrate for further upgrading to >63% Fe.

**2:30 pm**

**REFRESHMENT BREAK**

**3:00 pm**

**Flotation of South African Low Grade Banded Iron Formation (BIF)**

*Nichole Maistry and Ashma Singh; Mintek, Johannesburg, Gauteng, South Africa*

Flotation is the standard global process used for the beneficiation of Banded Iron Formation (BIF) ores, as it is a complex ore reserve and liberation is typically achieved below 1mm. Since flotation is an expensive process and South Africa ranks high on the production cost curve, pre-concentration via gravity separation and magnetic separation was performed prior to flotation. The results indicate that the use of an alkyl ether amine based collector partially neutralized with acetic acid is suitable for separation of hematite from illite and quartz at high pH values. Further optimization tests are being pursued to improve overall recovery and grade.

**3:20 pm**

**The Application of REFLUX Classifiers in the Iron Ore Industry**

*Nicolas Boonzaier; FL Smidth, Brisbane, Queensland, Australia*

The Reflux classifier technology has been growing in the heavy minerals industry, in particular, it has shown promising position within the iron ore beneficiation flowsheet demonstrating high metallurgical separation performance enabling the separating iron ore from silica and other impurities. The technology has 45 installations world wide in iron ore applications and is demonstrating considerable upside within the beneficiation circuits. This presentation covers some case studies specific to iron ore and elaborates on some ways the technology can be utilized to simplify and improve beneficiation circuits in iron ore.

**3:40 pm**

**Advances in Milling and Flotation Technology for Production of Direct Reduction Pellet Feed (DRPF)**

*Fisher Wang; Swiss Tower Mill Minerals AG, Vancouver, British Columbia, Canada, Michael Moser; Swiss Tower Mill Minerals AG, Baden, Baden, Switzerland, Erich Dohm; Eriez Flotation, Erie, PA, United States*

The growing demand for Direct Reduced Iron (DRI) reflects the steel industry's shift toward greener practices to combat climate change. However, DRI production requires premium iron ore concentrate, demanding advanced mineral processing methods. This paper delves into the challenges of conventional milling and flotation techniques for making DR grade iron ore concentrate and suggests an integrated processing flowsheet employing state-of-art milling and flotation technologies. By identifying the limitations of conventional mineral processing practices and introducing innovative technologies such as fluidized stirred mills and coarse particle flotation, this paper aims to support the mineral processing industry in adopting more sustainable and efficient practices for DR grade iron ore concentrate production.

**4:00 pm**

**Metallurgical Performance of Concorde Cell in Reducing Silica in Iron Ore Fines**

*Raghav Dube; Metso, Centennial, Colorado, United States*

The Concorde Cell™ is a high-intensity pneumatic flotation technology dedicated to recovering fine and ultrafine particles. With its high energy dissipation and its fine bubbles, the Concorde Cell is typically used as a standalone unit, reducing energy consumption and plant footprint. The impact of operating and design parameters on the metallurgical performance of the Concorde, such as air-to-pulp ratio, wash water flow rate or Blast Tube residence time, will be presented using different ores, from lab to industrial scale.

**THE GEOLOGY OF EMERGING MINERAL OPPORTUNITIES**

*Session Chair: Frank Pezzutto, NTS Northeast Technical Services, Inc., Virginia, MN*

**French River**

**1:00 pm**

**Unraveling the Potential of Reduced Intrusion-Related Gold System (RIRGS) Mineralization in Antaña, Puno, Southern Peru**

*Mirian Puma; Universidad Nacional del Altiplano-Puno, Puno, Peru*

This pioneering study is centered on the investigation of Reduced Intrusion Related Gold Systems (RIRGS) in an underexplored region, with the potential to revolutionize mineral exploration. Our objective was to determine the potential for RIRGS mineralization through petrographic analysis, multi-elemental rock studies, and spectral analysis. The results revealed a clear presence of reduced magma, characteristic of this type of deposit. This confirms a significant mineralized target, integrating into the model of mineralization for Intrusion-Related Gold Systems and epithermal styles. This work offers a valuable contribution to the geological community and the mineral exploration industry, promising to enrich future research and findings in the field.

**1:20 pm**

**Archean Gold Deposits in the Superior Province of the Canadian Shield**

*Frank Pezzutto; NTS, Virginia, Minnesota, United States*

In North America, most gold production is derived from the ancient Superior Province of the Canadian Shield. The Superior Province is characterized by east-west trending greenstone belts bounded by gneiss terranes. In the greenstone belts, lode gold deposits are commonly associated with large-scale deformation zones in spatial association with felsic intrusive rock. Gold deposits are marked by distinct quartz/carbonate veins, often with sulfides and other marker minerals. A depositional model can best be summarized by creation of greenstone belt, subsequent folding and deformation. Introduction of late stage felsic intrusives, leading to more shearing, deformation, and alteration. Felsic intrusives also provide gold bearing mineralizing fluids. Mapping is critical in gold exploration because an understanding of structural components is key.

1:40 pm

### Alteration Geochemistry Characterization and 3D Modeling of the Back Forty VMS Deposit, U.P. Michigan

*Margaret Upton; University of Minnesota Duluth, Superior, Wisconsin, United States*

The Gold Resources Back Forty zinc-and-gold-rich polymetallic volcanogenic massive sulfide (VMS) deposit is located in the Upper Peninsula of Michigan. Alteration data spatial distribution can be used to unravel the geochemical evolution of the system and help locate mineralization. The relationship between host rock alteration mineralogy to structures and ore zones at the Back Forty is essential for understanding its genesis. This study 1) identifies the alteration mineral assemblage present using litho-geochemistry results; 2) calculates elemental gains and losses associated with hydrothermal alteration; 3) creates a model of the alteration zonation in coordination with the existing stratigraphy and mineralization.

2:00 pm

### Indicator Minerals for Bedrock Mineralization in Minnesota: New Data, New Database

*Donald Eisenheimer; Minnesota Department of Natural Resources, St. Paul, Minnesota, United States*

The Minnesota DNR has analyzed glacial sediment samples collected via rotonic drilling by the MGS's County Geologic Atlas program for indicator minerals associated with bedrock gold mineralization, diamond-bearing kimberlites, and magmatic base metal deposits. This project involves core samples collected on a statewide scale, offering advantages over surface sampling in areas with complex glacial histories and thick layers of overburden. Results have been incorporated into a new comprehensive geospatial database of indicator mineral samples from Minnesota (n>2000). This database also includes state, academic and exploration company datasets of surface and rotonic core samples collected at statewide, regional, and prospect scales.

2:30 pm

### REFRESHMENT BREAK

3:00 pm

### Helium Potential and Exploration in Minnesota: Leading the Global Pivot to Green Helium

*Phil Larson, Thomas Abraham-James, Michael Sturdy and Josh Bluett, Pulsar Helium Inc, White Rock, BC, Canada*

The global helium shortage and helium's critical role in health care and manufacturing has started a new exploration boom: searching for unconventional helium resources. The most significant new discovery is Pulsar Helium Inc's Topaz helium project in Lake County, Minnesota, where an exploratory boring encountered over-pressured gas with an extraordinarily high helium concentration of 10.5%. The generation of helium from Archean granites, liberation and concentration via the Midcontinent Rift, and trapping will be detailed. An update specific to the Topaz project will be followed by a review of the potential for additional helium discoveries in Minnesota and the broader region

## MINING AND PLANT MAINTENANCE

*Chair: Nicholas Maki; Cleveland-Cliffs, Hibbing, MN*

### Split Rock

1:00 pm

### Increasing Grinding Circuit Robustness with Advanced Grinding Circuit Control Using On-line Analyzer Systems

*Gonzalo Chirinos; Metso, Centennial, Colorado, United States*

Establishing stable operating conditions that allow continuous utilization of the opportunities to maximize throughput, energy efficiency and ensure optimal particle size with minimal fluctuations to downstream processing is a high priority, but also a challenging task for any grinding circuit. Variable feed ore characteristics and circulating loads with sometimes complex circuits and varying operator skills between shifts are common sources of variance observed in the process. Advanced Process Control (APC) systems have been one of the most beneficial tools in past decades in the minerals processing industry. They have been used in decreasing process variance and enabling operation closer to process boundaries. However, it is important to understand that the performance of these systems is highly dependent on the reliable on-line information available from the process, which is needed for good control actions. In order to run grinding circuits more optimally, new analyzer systems for on-line 3D based particle size imaging and for strain gauge based mill charge analysis have been developed. As indicated by the results observed at industrial grinding circuits, the introduction of these new systems has provided a more holistic view to the status and performance of the circuits and thus made it possible to implement more robust and beneficial APC strategies for stabilization and optimization.

1:20 pm

### Conveyor Idler Roll Automation and Monitoring

*Ryan Loge; Superior Industries, Morris, Minnesota, United States*

Presentation regarding the developing technology in conveyors and conveyor rolls. Roll automation and monitoring is the latest technology in the conveyor world. Learn how new technology is allowing plant operators and owners to have continuous conveyor monitoring with real-time alerts. Including rolls with an internal power generator and sensors that monitor vibration, bearing temperature, idler seizure, load measurements, and tube temperature. Information is sent from the rolls to a LoRa Gateway and then into a cloud service where the plant operator can monitor every roll via their computer and phone. Customizable alerts in real-time should a concern arise will alert the operation to potential issues before they ever occur. Data is stored for 2 years and gives historical idler trends.

1:40 pm

### Strengthening your Management Operating System: The Key to Resolving Daily Tonnage Shortages, Equipment Availability Issues, and Other TPM+5S Operational Challenges

*David Truchot; Veltios Consulting LLC, Bayport, Minnesota, United States*

Strengthening your Management Operating System: The key to resolving daily tonnage shortages, equipment availability issues, and other TPM+5S operational challenges. Management Operating Systems (MOS) are not well understood, and this course aims to share our expertise, key tools, and training to start identifying gaps and missing links that slow your organization's successes and launch sustainable corrective action plans. We will review with you best practices that are in use in maintenance and share some of this insider knowledge so you can start optimizing your maintenance operations with your frontline leaders, including TPM+5S. Key elements: Leader Standard Work, Short Interval Controls, Daily Weekly Reports, Skills Flex Matrices, Action Logs, Root Cause Corrective Action processes, and 10 Active Management Behaviors.

2:00 pm

### Transforming Aggregate Screening: Metal7's Evolution of Roller Screen Technology

*Steve Beaudin; Metal7, Sept-Iles, Quebec, Canada*

Metal7 is well established within the iron ore pelletizing community for its pioneering roller screen technologies and expertise. Building upon this legacy, Metal7 has strategically adapted its proven roller screen technology beyond its original application to screen hard particles and aggregates. This adaptation aims to address critical challenges associated with the use of vibrating screens, including issues such as dust generation, excessive noise, breakage of screened materials, machine breakdowns, and maintenance-related shutdowns, all while ensuring higher screening efficiency. This presentation will delve into Metal7's innovative adaptation of roller screen technology, emphasizing its potential to revolutionize the screening process for aggregates. It will explore how this adaptation stands as a solution to the inherent limitations of vibrating screens, presenting a new era of enhanced efficiency and reliability in the screening of hard particles and aggregates across various industries.

2:30 pm

### REFRESHMENT BREAK

3:00 pm

### Improving the Performance of Stainless Steel Castings Used in Iron Ore Pelletizing Equipment

*Jeff Pancher; Metso, Coal Township, PA, United States*

Stainless steel castings are used in abundance in the mineral processing industry. In rotary kiln-based processes, these castings are typically exposed to high loads, corrosive elements, mechanical abrasion and cyclical temperature exposure. In the processing of iron ore pellets, it is typical to use a traveling grate preheater or a straight grate furnace to heat the pellets. Both machines have a conveyor that is mainly comprised of high temperature stainless steel castings. It is these castings which are the focus of this study. The expected life of these castings can be quite short, their cost quite high and the effort to replace them very labor intensive. The goal of this study was to gain a better understanding of the failure modes of these castings. With that basic understanding, modifications to the alloy content could be made to achieve a new operational paradigm. That paradigm could be a cheaper casting, a longer lasting casting or a casting tailored to special operating conditions (for example, highly corrosive gases or sudden temperature shocks). Over the past 4 years, Metso Minerals has sought to achieve a better understanding of the failure modes through modeling, laboratory testing and sampling of used castings from various end-users. In addition, we have tested new alloys in a laboratory setting and also in the field to see how they would perform compared to the existing "standard casting". Our testing has revealed interesting data concerning the impact toughness, sigma phase content and formation, chloride attack and other performance attributes of various grades of stainless steel when exposed to cyclical temperatures. Interesting results were also obtained concerning the addition of rare earth elements (Niobium, Boron, etc), nitrogen and manganese to a typical ASTM A297 grade of stainless steel. To date, a few hundred test castings have been installed in iron ore pellet plants worldwide. Many of these test castings have already experienced a year or more of operation with good results.

## Wednesday, April 17 | Morning Sessions

### RESPONSIBLE MINE WATER MANAGEMENT

*Chair: Tracy Muck; NTS Northeast Technical Services, Inc., Virginia, MN*

#### Lake Superior L

Sponsored by **Fredrikson**

8:00 am

### Preliminary Observations of Rock Characterization Data from Humidity Cell Tests of the Tamarack Intrusion and Adjacent Thomson Formation

*Steven Koski; Minnesota Department of Natural Resources, Hibbing, Minnesota, United States, Zach Wenz; Minnesota Department of Natural Resources, St. Paul, Minnesota, United States*

The MN DNR Lands and Minerals Environmental Research Program utilizes a variety of mine waste characterization techniques to collect baseline chemical, physical, and microbial data to assess rock reactivity and to evaluate the geochemistry of the rock weathering environment. In 2021, the DNR in cooperation with Talon Metals, initiated 23 humidity cell kinetic tests from 15 samples of drill core. Sample splits were also subjected to a series of chemical and physical static tests. This presentation evaluates the first three years of results and compares this information to similar projects on other rock types in northern Minnesota.

8:20 am

### Groundwater Regulation 101: A Primer on Groundwater Regulation in Minnesota Relevant to the Mining Industry

*Jeremy Greenhouse; Fredrikson & Byron LLP, Minneapolis, Minnesota, United States*

Mining operations impact groundwater in many ways, including but not limited to dewatering of aquifers to allow mining, using groundwater for mineral processing, discharging to groundwater via infiltration from tailings basins or stockpiles, and discharging pollutants to surface waters that eventually reach groundwater. State statutes and regulations on groundwater govern all of these activities. And as groundwater supplies, both worldwide and in Minnesota, are increasingly pumped at unsustainable rates, regulators and the public have sharpened their focus on how groundwater is consumed and protected. This presentation will outline Minnesota's multi-agency approach to regulating groundwater and explain the basics of the state's groundwater regulatory programs most relevant to the mining industry.

8:40 am

### Predictive Water Management Using GoldSim for Mining Operations Under a Changing Climate

*Harsh Anurag; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States, Todd DeJournett; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States, Jeff Standish; Geosyntec Consultants Inc., Minneapolis, Minnesota, United States*

Effective water management is crucial for large mining operations, addressing operational risks and environmental impacts. Increasing climate variability heightens the importance of robust water infrastructure for operational resilience. We demonstrate how a GoldSim site model facilitates both short-term planning and long-term decision-making by identifying infrastructure vulnerabilities and informing design of effective solutions. The tool's insights become more valuable when viewed through an Environment, Social, & Governance (ESG) lens, as it can be used to estimate the benefits relative to social and governance matters resulting from different operational water management scenarios. By adopting a strategic and holistic ESG perspective, organizational decision-makers can align water management strategies with climate-ready operational plans for large-scale mining facilities.

**9:00 am**  
**REFRESHMENT BREAK**

**10:00 am**  
**Evaluating Groundwater and Surface Water Interaction – Modeling Approaches and Future Advancements**

*Evan Christianson; Barr Engineering, Minneapolis, Minnesota, United States*

Evaluating the interaction between groundwater and surface water is increasingly needed for effective mine planning and environmental assessments. Often, numerical simulations of these systems lack integration, resulting in conceptual gaps, mass balance errors, and uncertainty challenges. Recent modeling advancements now facilitate improved integration of groundwater and surface-water simulations. An overview of simulating groundwater and surface-water interaction will be presented, ranging from simple to fully integrated. Strategies to overcome common challenges in Minnesota, such as glacial stratigraphy and wetland systems, will be explored. Additionally, the discussion extends to future computational approaches and the requisite data needed to support these advancements.

**10:20 am**  
**In Situ Metals Remediation – Tailing, Soil, and Groundwater**

*Lowell Kessel; CERES Technologies, Marina Del Rey, California, United States*

Background Remediation of metals is accomplished by chemical, physical or biological technologies resulting in immobilization (e.g., ion exchange, complexation, precipitation or stabilization), sequestration (i.e., sorption), solidification (e.g. cementation) and/or reduction in bioavailability. However not all of these mechanisms are permanent and can be reversible under certain conditions.

Technical Discussion and Approach: Many metals and metalloids function cationically, oxi-anionically and or amphotericly depending on the biogeochemical conditions present in the soil, groundwater and/or ash environment in which the remediation (i.e., reactions) are to take place. pH adjustment alone is not a solution. Now combine this complexity with complex mixtures of heavy metals such as arsenic, boron, molybdenum, lithium, lead, barium, cobalt and others all in one location such as are commonly present at coal combustion residuals (CCR) sites and you have a special kind of challenge. Additional complexity is derived from variable redox conditions across a treatment area resulting from seasonal changes or from upgradient groundwater source(s). The bottom line is that not all heavy metals can be sequestered or immobilized the same way and therefore a combination of the above methods are required and must be administered in chemically compatible ways incorporating site biogeochemical data and often employing lab scale treatability studies. Results: The results of more than 25 heavy metals remediation projects including soil, groundwater, CCR sites and industrial waste media, demonstrate up to 100% reduction of maximum leachable concentrations of heavy metals in accordance with TCLP and SPLP testing methods with average reduction of 91% across all mixed metals sites. The average site wide reagent dosage rates also varied from approximately 1% to 10% percent by soil weight with an average site wide average dose of approximately 4% (industrial waste applications skewing the average to 6% with a dose range of 5-18%). All projects included bench trial analysis to verify COCs and scavengers and to establish a dose – response curve for the site-specific conditions.

**10:40 am**  
**Biological Sulfate Reduction with Direct Reduced Iron Polishing**

*Jeffrey Hanson and Bill Newman; Clearwater BioLogic LLC, Babbitt, Minnesota, United States*

Clearwater BioLogic will present details on their patented biological sulfate reduction system. It is a low-cost system for biological sulfate reduction that includes DRI (Direct Reduced Iron) polishing for hydrogen sulfide elimination. The multistage system reduces sulfate concentrations of up to 2,500 mg/L, or more, of sulfate in mining impacted water discharges to below 10 mg/L. It is a modular and scalable system that can handle anywhere from 1 GPM to several thousand GPM. Actual test results will be shared demonstrating the reduction of 350 mg/L of sulfate in local mine pit lake water to less than 10 mg/L consistently over years of operation. This is achieved without the addition of any dangerous or toxic chemicals.

**11:00 am**  
**Adding Project Value through Water - Integrating Groundwater Characterization into Exploration**

*Jakob Wartman and Justin Brown; Foth Infrastructure & Environment, LLC, Duluth, Minnesota, United States*

Mineral exploration typically precedes the implementation of a groundwater characterization program, often by years. The exploration program is focused on collecting data for mineral resource estimates, structural controls, and mine engineering. To best leverage exploration programs, there are time-critical and opportunistic activities and processes projects should consider to inform and prepare the groundwater characterization program. By implementing these processes, projects will leverage exploration expenditures to add significant value to their groundwater program and overall project. This talk will review processes for projects to consider adopting early on during the design of their exploration program to create additional value for the project.

**INNOVATIVE TAILINGS MANAGEMENT**

*Chair: Erik Olson; Newrange Copper Nickel, Hoyt Lakes, MN*

**Lake Superior M-N**

Sponsored by



**8:00 am**  
**Towards Zero Tailings – Can We Get There?**

*Kurt Schimpke; Barr Engineering Co., Minneapolis, Minnesota, United States*

Tailings have long presented a challenge to mining companies in terms of operational cost. In recent years, other costs such as social license to operate, have become apparent as well. As challenges continue to mount, the mining industry has begun looking at tailings reduction methods with the ultimate aspirational goal of zero tailings. The presentation will discuss tailings-related challenges facing the mining industry and the status of the tailings reduction initiative, and whether the goal of zero tailings can be achieved.

**8:20 am**

**Digital Twin Integration: Minimizing Risk and Gaining Holistic Geospatial Perspective in Tailings Storage Facilities Management**

*Lance McGinn; Esri, Louisville, Colorado, United States, Pete Will; Esri, Louisville, Colorado*

Tailings Storage Facilities (TSF) pose significant environmental risks to the health & safety of mining operations and surrounding areas if not managed effectively. Traditional stewardship methodologies rely on the interpretation and monitoring of independent data sources. By incorporating a geospatial framework into TSF management strategies, it becomes possible to aggregate disparate data sources into a digital twin. Such representation offers enhanced visibility for informed decision-making, interactive risk mitigation, relative false positive identification, and seamless integration of imagery, geotechnical feeds, and inspection reporting.

**8:40 am**

**Downstream Improvements on Upstream Dams: An Owner's Perspective of a Paradigm Shift**

*Christopher Winter; Cleveland-Cliffs, Inc., Hibbing, Minnesota, United States*

Mining companies with tailings storage facilities that use the upstream construction method have been challenged to track the evolution of industry standards, assess risks, revise design and communicate design revisions with regulators. While best practices and industry standards have evolved in recent years as an attribute of continual improvement, the controlling standard in the design of many upstream dams is understanding the foundational strengths of hydraulically deposited tailings. Hibbing Taconite Company managed and owned by Cleveland-Cliffs, Inc, following best practices and industry standards began the re- evaluation of foundation strengths underlying a system of upstream dams in 2017. This paper explores the path that the Owner followed to understand the paradigm shift and construct downstream improvements. That path involved, tailings re-characterization, dam design revisions, operating plan reconciliation, budget revisions, wetland permitting, dam safety permit amendments, stormwater prevention plans, borrow materials studies, a new concrete decant structures and the pursuit to cognize and be consistent with industry standards.

**9:00 am**

**REFRESHMENT BREAK**

**10:00 am**

**Pressure Filtration for Iron Ore Operation**

*Ajit Baruah; Metso, Burlington, Ontario, Canada, Jason Tomasino; Metso, Brookfield, Wisconsin, United States*

Filtration process in any mining and mineral processing operation is critical. An efficient filtration process ensures proper water balance in the overall process and optimizes operational cost and efficiency. Modern day pressure filters with advanced automation ensures consistent cake moisture with higher throughput rate, consequently enhancing operational efficiency. Additionally, pressure filtration process for tailings is becoming an increasingly popular and proving to be a sustainable way of managing tailings, compared to conventional thickened tailings storage facilities. Dry stack filtered tailings also aligns with modern environmental and safety standards in the mining industry. The subject presentation would cover the design & operational details of Pressure Filtration processes for both concentrate and tailings operations in a large Iron Ore operation located in Western Australia.

**10:20 am**

**Saving Money Pumping Groundwater**

*Nicolas Steverlync; Hose Solutions, Scottsdale, Arizona, United States*

Mines pump water to safer access areas where they are actively mining or they pump water as part of their processing, extraction of minerals, or dust suppression. Boreline FlexiRiser is used to dewater mines through submersible pumps set in deep wells. Mineflex High- Pressure Dewatering Hose is used to move water around mines, along the surface, or underground. Safety is the number one concern and that is why we, at Hose Solutions, have focused on deployment and retrieval systems, making it quick, easy, and safe to get up and pumping in all situations.

**EMERGING MINERAL PROCESSING CHALLENGES AND OPPORTUNITIES**

*Chair: Kyle Bartholomew; Metcom Technologies, Grand Rapids, MN*

**Lake Superior 0**

**8:00 am**

**Microwave Hydrogen Plasma Reduction of Iron Ore**

*Rodney Johnson; University of Minnesota, Duluth, Minnesota, United States, Uwe Kortshagen; University of Minnesota, Minneapolis, Minnesota, United States, Brett Spigarelli; Natural Resources Research Institute, Coleraine, Minnesota, Peter Bruggeman and Qi Zhang; University of Minnesota, Minneapolis, Minnesota, United States, Patrick Schoff; Natural Resources Research Institute, Duluth, Minnesota, United States*

This research utilizes an iron ore reduction process using microwave hydrogen plasma, developed in the High Temperature and Plasma Laboratory at the University of Minnesota. Hydrogen plasma reduction is a fully electric technology that could eliminate both carbon-intensive reduction and energy-intensive induration. Our plasma technology has demonstrated rapid over-90% reduction of iron oxides, up to one hundred times faster than other carbon-free hydrogen approaches. It may also enable the utilization of lower quality ores. As a virtually instant on-off technology, hydrogen plasma is exceptionally compatible with intermittent renewable electricity. Research supported by the Minnesota Environment and Natural Resources Trust Fund.

**8:20 am**

**An Overview of Dry Processing Options for Mineral Industries**

*Sunil Tripathy; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Minnesota, United States, Shahsi Rao; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Select One, Minnesota, United States, Jestos Taguta; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Coleraine, Minnesota, Lysa Chizmadia; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Coleraine, United States, Matt Milinar; Natural Resources Research Institute (NRRI), University of Minnesota Duluth, Coleraine, Minnesota, United States*

Due to depleted ore deposits and strict quality requirements, beneficiation of minerals is necessary, and conventional wet processing methods are often used. However, dry processing is increasingly necessary due to rising demand for metal production and limited water recycling options. Additionally, a significant amount of water is lost during handling and in tailing ponds. So, dry processing is an alternative to addressing the issue of water scarcity and sustainability. There have been a few advances in developing dry-based separators and classifiers based on gravity, magnetic, and electrostatic methods. Also, there is an array of options on ore sorting to use at the coarser size segregation. A detailed technology review will be presented with an emphasis on mineral separation.

**8:40 am**

### ESG-Friendly Biosurfactants to Boost Performance in Iron Ore Flotation

*Ronney R Rodrigues Silva, Cathrine Monyake, Gabi Knesel and Renata Mendonca; Locus Mining, Montgomery, Texas, United States*

Cationic reverse flotation is one of the most widely used techniques for iron ore beneficiation. This process yields a clean concentrate with adequate recovery (dependent on liberation, ore type, contaminants, circuit configuration, flotation equipment, process pH and reagents used). The most “established industry” reagents are amine as the collector, and starch as the depressant. In some cases where starch is not applied, the flotation is conducted close to natural pH, generally around 8 and in this case the addition of a frother is necessary. Recent studies (Silva et al., 2008) demonstrated synergies between collectors (e.g., etheramine) and frothers. Depending on the nature of the frother, this interaction could boost or be deleterious to the flotation performance. This research aimed in evaluating the synergies of different classes of eco-friendly biosurfactants and industry standard reagents during the cationic reverse flotation method. We selected an etherdiamine as collector under different pHs, with and without the addition of starch as the depressant, and different biosurfactants. A customized DOE comprised of 145 flotation experiments evaluated 11 reagents (each ranging from 0 to 100%), one numeric factor (pH ranging from 7.5 to 10.5), and a categoric factor with two levels (with starch and without starch). The results are promising and identify for the first time biosurfactants as alternatives to boost the iron ore flotation process.

**9:00 am**

### REFRESHMENT BREAK

**10:00 am**

### Characterization and Evaluation of Biochar as a Green Approach for Rare Earth Elements and Critical Metals Recovery from Aqueous Solutions

*Oluwaseun Famobuwa, Talan Deniz, Hassan Amini, Oishi Sanyal and Shawn Grushecky; West Virginia University, Morgantown, West Virginia, United States*

This study investigates an environmentally benign and low-cost biochar adsorption process for rare element recovery from aqueous solutions. The adsorption performance was systematically studied with biochars produced from Appalachian hardwood (AH), wood chip and chicken litter (WC), and softwood (SW) after being subjected to various pyrolysis temperatures at 675 °C, 700°C, and 450°C respectively. The findings indicated that the most favorable pH level is 5, with an optimal contact time of 24 hours. AH had superior adsorption capabilities with a La(III) adsorption capacity of 126.85mg/g compared to WC and SW. AH also showed similar adsorption for other REEs and critical metals. Hence, biochar exhibits promising potential as an environmentally friendly substance for effectively adsorbing metals from aqueous solutions.

**10:20 am**

### Extending Longevity and Achieving ESG Targets through Modernization of Thickeners with Latest High Performing Technologies

*Andrew McIntosh; Metso, Frenchs Forest, New South Wales, Australia*

Thickeners can become a bottleneck in minerals processing; as plant throughputs increase and feed materials change. Other considerations - including parts availability and aging of structures - also present risks to continued operability. Thickeners play an important role in the success of adjacent processes; and address important ESG concerns including water recovery and tailings management. Reliable, high-performing thickener technology continues to grow in relevance. Meanwhile, society is embracing circularity and waste minimization. This presentation will talk through several upgrades of existing thickeners with latest high performing technology, the motivations behind these upgrades, and the benefits achieved.

**10:40 am**

### Hydrometallurgical Methods for Copper Extraction from the Duluth Complex: Case Studies and Insights from Across the Globe for Base Metal and PGM Processing

*Lisa Rudstrom; University of Minnesota Duluth, Hibbing, Minnesota, United States, Lucas Arndt; University of Minnesota, Duluth, Hibbing, Minnesota, United States*

The changing landscape of mining is driving the industry to consider increased environmentally friendly processing practices. The Duluth Complex in Northern Minnesota is a mafic intrusion deposit containing >4000 Mt of base metal sulfide deposits. This paper investigates how eight different global deposits having similar geologies as the Duluth Complex are processing respective ore deposits. The five principal hydrometallurgical processes are thoroughly explored as they pertain to processing at different deposits. Process streams and utilization, raw yields, risks, environmental impacts, and mitigations are presented. Trends are noted, and suggestions for future statistical analysis in the field of hydrometallurgy are discussed.

## IRON GEOLOGY AND AGGREGATES

*Chair: Austin Siekkinen; United States Steel Minnesota Ore Operations, Mountain Iron, MN*

### French River

**8:00 am**

### Algoma Type and Superior Type Iron Formation

*Frank Pezzutto; NTS, Virginia, Minnesota, United States*

Iron is the most critical component in the manufacture of today's high tech primary steel industry. Worldwide, the vast majority of iron is mined from large Algoma and Superior Type Iron Formations. Iron formations have four facies, but oxide facies, which feature hematite and magnetite are the most important. Algoma Type Iron Formation are associated with submarine bimodal volcanic rocks and marine sediments. Iron was introduced into sea water via hydrothermal vents. Superior Type Iron Formations are generally younger and form from the chemical precipitate of iron from biogenic processes and upwelling of sea water in shallow basins. Most large iron formations have been discovered but exploration drilling is still critical in delineating their size and for ore characterization.

**8:20 am**

**The Mineralogical Characterization of Low Value Iron Formation and Their Effects on Metallurgical Response**

*Lysa Chizmadia; University of Minnesota, Coleraine, Minnesota, United States, Jestos Taguta; University of Minnesota, Coleraine, Minnesota, United States, Sara Post; University of Minnesota, Duluth, Minnesota, Matt Mlinar; University of Minnesota, Coleraine, Minnesota, United States, Rodney Johnson; University of Minnesota, Duluth, Minnesota, United States*

The aim of this study was to investigate the role of mineralogy on the metallurgical response of low value iron ore formation. Bulk samples of siderite-rich iron formation, partially-oxidized iron formation, and fully-oxidized iron formation were characterized using X-ray diffraction, reflected-light optical microscopy and scanning electron microscopy (with both EDS and WDS). The metallurgical responses of the samples were investigated using various laboratory beneficiation methods e.g., gravity separation, magnetic separation, and flotation. The results of this study will provide insight into the design of customized flowsheets to produce value-added products from each of these traditionally non-ore types of iron formation.

**8:40 am**

**Feasibility Analysis of Green Ore Production from Hematite Stockpiles and Dams in Minnesota Using High-Intensity Magnetic Separation**

*Fernanda Hoffmann, Claudio Ribeiro and Gentil Sobrinho; Gaustec America LLC, Ellicott City, Maryland, United States*

High-intensity magnetic separation is a resource capable of efficiently processing hematite ores, and it has been used for this purpose since the 1970s. Hematite, an abundant mineral in Minnesota that has already undergone partial processing, holds significant potential for green steel production. This study provides a comparative analysis of mining and processing of in-situ taconite and the processing of previously mined and stockpiled hematite deposits in Minnesota, considering the energy, economic, and carbon emission aspects of harnessing these resources for green steel production.

**9:00 am**

**REFRESHMENT BREAK**



**2024 SME Minnesota Conference**

**10:00 am**

**Geological Controls on Direct Shipping Iron Ore Genesis, Mesabi Range, Minnesota: Insights from Historic Drilling Data from the Mahoning Group 1 Mine**

*Phillip Larson; Cleveland-Cliffs Hibbing Taconite Company, Hibbing, Minnesota, United States*

Aspects of high grade (>55% Fe) martite-goethite iron ore genesis on the Mesabi Range remain enigmatic despite over a century of production. Historic assays (n~7000) recovered from a single property firmly support ore formation by supergene enrichment. A paragenetic sequence of congruent carbonate dissolution, incongruent Fe-carbonate and Fe-silicate dissolution, and magnetite oxidation to martite generated secondary porosity and positive feedbacks, intensifying supergene enrichment along seemingly minor structural or lithologic discontinuities. Maximum residual Fe enrichment (~67% Fe) corresponds to 100% of residual Al<sub>2</sub>O<sub>3</sub>+SiO<sub>2</sub> in kaolinite. Localized residual Al<sub>2</sub>O<sub>3</sub> enrichment suggests congruent Fe-oxide+hydroxide dissolution by the most advanced supergene weathering.

**10:20 am**

**New Exploration and Discovery in the Manganiferous Iron Formation in the Emily District of the Cuyuna Iron Range, Minnesota**

*Rick Sandri; North Star Manganese Inc & Electric Metals (USA) Ltd., Woodbury, MN, United States, Alex Steiner and Dan Peterson; Big Rock Exploration LLC, Duluth, MN, United States, Gabriel Sweet, Teddy Berg, and Jacqueline Solie, Big Rock Exploration LLC, Minneapolis, MN, United States*

In 2023, North Star Manganese/Electric Metals, with the assistance of Big Rock Exploration, Timberline Drilling, Barr Engineering, Radotich Enterprises, Traut Companies and other local contractors, conducted the first comprehensive exploration effort of the Emily Manganese Deposit since US Steel and Pickands Mather drilled in the 1950's. This recent program drilled 29 new core holes into the deposit, greatly improving the geological understanding of the deposit. These drill cores revealed up to five manganese-iron ore lenses, ranging from low-grade manganese and iron to intervals containing more than 45% manganese, in manganite and other manganese minerals, and up to 50% iron, in hematite and other iron minerals. A new NI 43-101 Resource Estimate is being completed and will be available in early 2024.

**10:40 am**

**Addressing Aggregate Needs**

*Heather Arends and Chad Crotty; Minnesota Department of Natural Resources, Saint Paul, MN, United States*

Federal and state initiatives will drive an unprecedented demand for local sources of aggregates. Minnesota Department of Natural Resources (DNR) is involved with several activities to address this need. The DNR's Aggregate Resource Mapping Program provides local governments with maps and associated geospatial information on the distribution of aggregates. The DNR also continues to lease state lands for aggregates, with projected revenues tripling since 2018. Coordinating with stakeholders, the DNR is discussing how to move forward with updating the Seven-County Metropolitan report on aggregate availability as well as organize a state-wide aggregate conference.