THE 44TH ANNUAL CONFERENCE OF THE NATIONAL ASSOCIATION OF ABANDONED MINE LAND PROGRAMS

SEPTEMBER 24 - 27, 2023

Hyatt Regency
151 East Wacker Drive
Chicago, IL

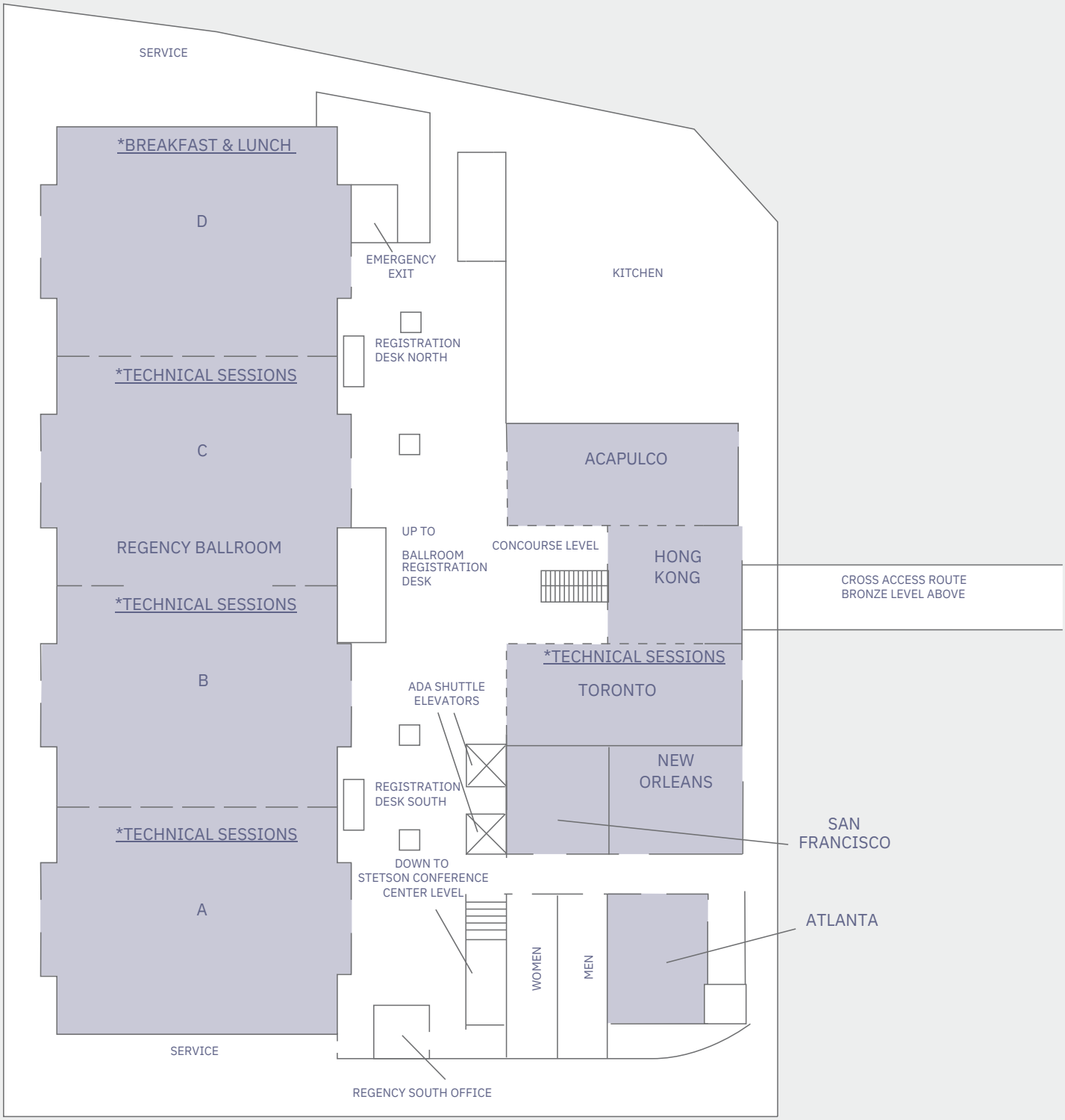
Illinois Department of Natural Resources

NAAMLP

CONFERENCE VENUE MAP

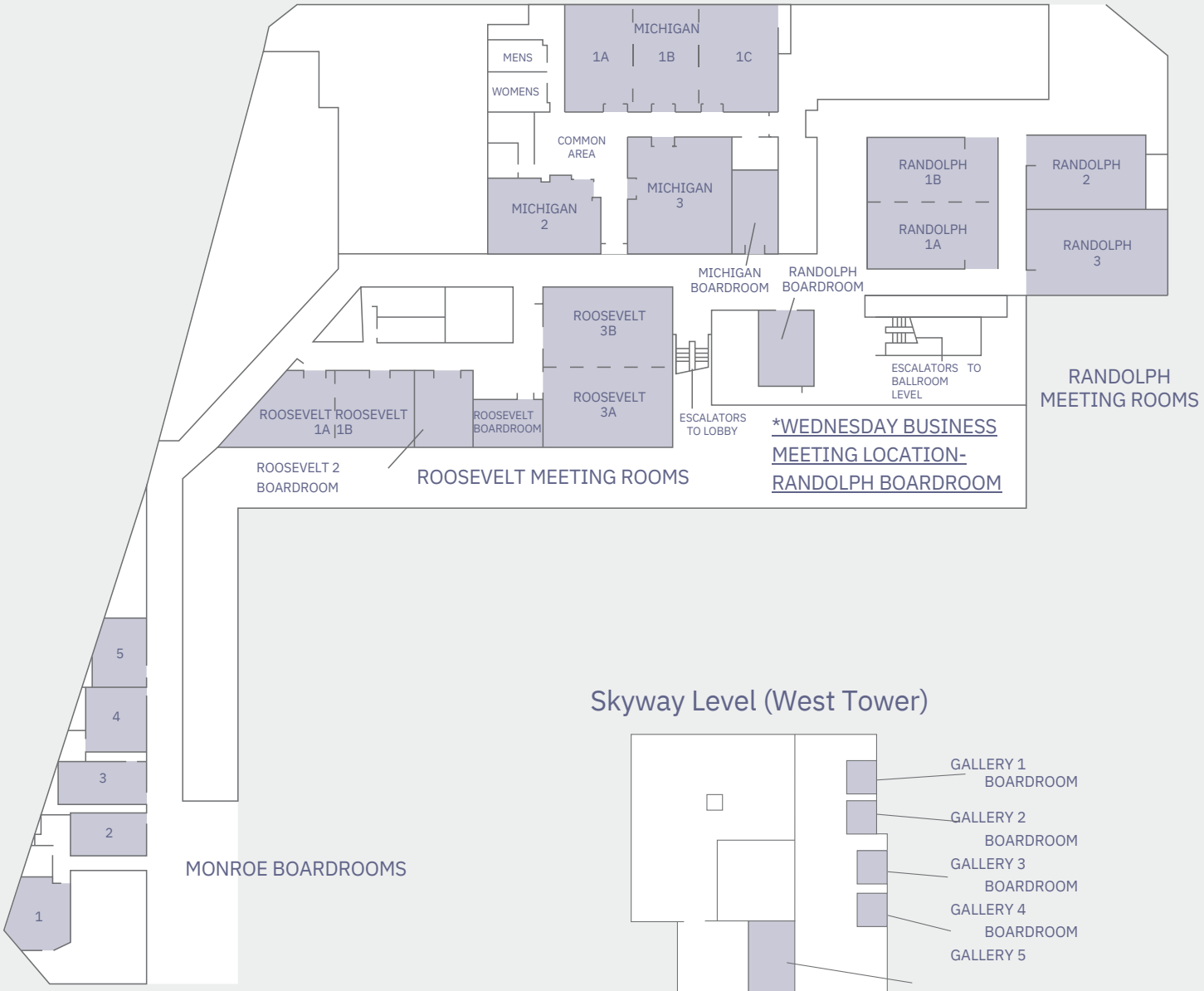
HYATT REGENCY

Ballroom Level (West Tower)

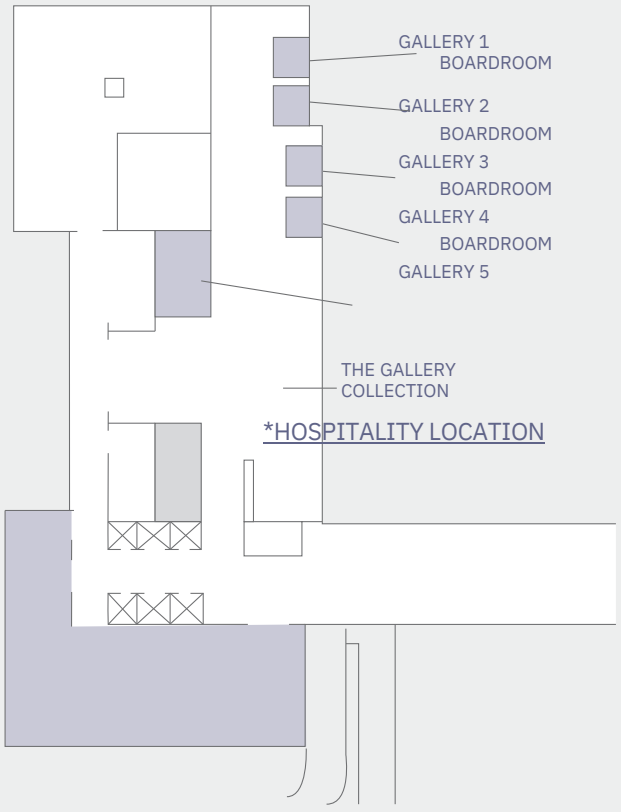


Concourse Level (East Tower)

MICHIGAN MEETING ROOMS



Skyway Level (West Tower)



HYATT REGENCY

FROM THE HOST STATE

Welcome to the Land of Lincoln; where captivating history, vibrant urban atmosphere, and stunning rural landscapes blend seamlessly. The first discovery of coal in all of North America was in Illinois in 1673, however, it was some time before mining took off in Illinois. In 1810 the first shipment of coal reached New Orleans via the Mississippi River, and by the mid-1800's, underground mining had hit its stride. As the fourth top coal-producing state in the nation, nearly two-thirds of the state has coal beneath the population's feet. Coal was found in abundance within 60 miles of Chicago. Coal has been a major energy source for most of Chicago's modern history, especially from the 1850s to the 1950s. Coal enabled steamships and railroads to flourish, heated houses, buildings and factories, drove industrial machinery, pumped water, was utilized in steel production, and was the primary source of gas and electricity.

Nestled along the majestic shores of Lake Michigan, Chicago is known for its rich history, architectural marvels, and distinct culture. This iconic metropolis, known as the "Windy City" has long been a hub of commerce, industry, and progressive urban development. Throughout its history, Chicago has capitalized on Illinois' extensive mining productivity, as a draw for diversity in people seeking employment, and developing famous spectacles of modernity. From the 1893 Chicago World's Fair to the dual towers of the Wrigley Building, Chicago has redefined our nation's vision of the future and acted to spur innovation forward.

The Magnificent Mile, running north from the Chicago River parallel to the shore of Lake Michigan, holds the heart of Chicago. With a rich history of its own, today the Magnificent Mile embodies modern achievement balanced with environmental stewardship. The Magnificent Mile houses the beautiful Jane Byrne Park, and John Hancock Center, where you can view Chicago from 1,000 feet in the air. You will find upscale shopping opportunities, engaging museums, and an enormous array of hospitality options. We've got it all, and it's just a short walk from the sparkling waters of the lakefront.

It may be the electric energy of Illinois' largest city that captivates the imagination, but our mission to reclaim and protect Illinois spans a rich tapestry of captivating landscapes. Again, welcome to Illinois, where from vast prairies to rolling hills and serene lakeshores, from the southern-most village to bustling Chicago, Illinois leaps forward with "Magnificent Miles of Reclamation".

FROM THE NAAMLP PRESIDENT

Welcome to Chicago, Illinois, and the National Association of Abandoned Mine Land Programs' 44th Annual Conference!

There is an unparalleled excitement in the abandoned mine land (AML) world right now with historic levels of funding from the Infrastructure Investment and Jobs Act (aka Bipartisan Infrastructure Law). The location in 2023 provides a perfect backdrop and setting for our conference to talk about reclaiming historic coal mining sites that fueled the industrial revolution in cities like Chicago for over 100 years. What a setting to be discussing our plans and challenges to invest significant resources back into those coal regions to fix the health and safety and environmental problems that have lingered for that same period.

The AML staff in Illinois have put together an amazing lineup for the conference with unique and interesting technical presentations, intriguing and inspiring conference speakers, and amazing venues for the conference and banquet. The conference would not be possible without much effort and time from Illinois staff as the host, so I want to thank them for all their efforts to make this year's event a success. Also, I want to thank all the sponsors and exhibitors for joining us in making this conference possible!

The states and tribes of NAAMLP are dedicated to providing a forum to address current issues and share new technologies to benefit everyone. This conference provides the setting to foster positive and productive relationships amongst members, federal partners, contractors, vendors, citizens, and more to achieve the goals of reclaiming abandoned mine lands. With passage of the Infrastructure Investment and Jobs Act, the challenges of implementing at such a scale are real and evident, so this conference is critical to learn from each other and become more efficient and effective to meet our goals.

Serving as president of the Association the past year has been both a privilege and a learning experience. The people involved in the association are dedicated professionals who are in this career to make a difference and it's evident by their passion and drive. I am honored to serve the Association alongside the other officers, committee chairs and members, and work-group volunteers. Please take advantage of all that has been planned by our host Illinois and enjoy the conference!

Ben McCament

Ben McCament
NAAMLP President

ABOUT THE KEYNOTE SPEAKER

President Biden designated Mitch Landrieu as senior advisor orchestrating the historic Bipartisan Infrastructure Law legislation in 2021.

In this capacity, Landrieu supervises extensive investment in the infrastructure of the United States, including the abandoned mine reclamation work that is so integral to the health, economic viability, and biodiversity of our nation.

Mitch Landrieu's background includes a prominent stint as the 61st Mayor of New Orleans. During his time as mayor, the city was grappling with Hurricane Katrina recovery and the repercussions of the BP Oil Spill.

Landrieu's leadership played a pivotal role in the remarkable resurgence of New Orleans, which has since been hailed as a standout story of recovery. His accomplishments amassed recognition, such as being named "Public Official of the Year" by the magazine Governing in 2015, and a 2016 Politico survey of mayors voted him "America's top turnaround mayor." He also assumed the position of President of the U.S. Conference of Mayors.

The decision made by Landrieu to remove four Confederate monuments in New Orleans also garnered him the esteemed John F. Kennedy Profile in Courage Award. His book, titled "In the Shadow of Statues: A White Southerner Confronts History," delves into his personal journey as he confronted the complex issue of race and institutional racism that persists in the United States.

In 2018, Landrieu launched E Pluribus Unum, an initiative with a regional focus in the South. The initiative aims to fulfill America's commitment of justice and equal opportunity by dismantling the barriers of race and class division. Prior to his mayoral role, Landrieu served two terms as lieutenant governor and 16 years in the state legislature. He and his wife Cheryl live in New Orleans, where they raised their five children.

SATURDAY SEPTEMBER 23

Afternoon	Pre-Conference Chicago Cubs Game

SUNDAY SEPTEMBER 24

Noon - 5:00	Registration and Hellos
1:00 - 5:00	Committee Meetings
6:00 - 9:00	Welcome Reception, Regency Foyer
9:00 - 11:00	Hospitality Room, Gallery Lounge

MONDAY SEPTEMBER 25

6:30 - 8:00	Breakfast, Regency D
8:00 - 9:30	Welcome Remarks and Plenary Session, Regency A, B, and C Natalie Phelps Finnie, IDNR Director; Ben McCament, NAAMLP President; Office of Inspector General
10:00 - 12:30	Technical Session 1, Regency A, B, C, and Toronto
12:30 - 1:30	Lunch
1:30 - 4:00	Technical Session 2, Regency A, B, C, and Toronto
5:00 - 7:00	Reception and Tour, Soldier Field
7:00 - 8:00	Banquet, Soldier Field
8:00 - 9:00	Awards Ceremony, Soldier Field

TUESDAY SEPTEMBER 26

6:30 - 8:00	Breakfast, Regency D
8:00 - 10:00	Technical Session 3, Regency A, B, C, and Toronto
10:30 - 11:00	Keynote Address, Regency A, B, and C
Afternoon	Tours

WEDNESDAY SEPTEMBER 27

8:00 - 4:00	Business Meeting, Randolph Boardroom

TUESDAY TOURS

Architectural Lunch Cruise on the Chicago River

Experience the best of Chicago with a Premier Plus Architectural Lunch Cruise and spend your afternoon on the Chicago River with dining, picturesque views, and a narrated architectural tour of the city. While onboard, you'll enjoy our chef-prepared plated lunch, distinctive service, and breathtaking views from our climate-controlled interior and open-air outdoor deck. Our Architectural Lunch Cruises offer the most breathtaking views of Chicago with an accompanying narrated tour highlighting the history of the city from the water.

Chicago Tunnel and Reservoir

The Tunnel and Reservoir Plan (abbreviated TARP and more commonly known as the Deep Tunnel Project or the Chicago Deep Tunnel) is a large civil engineering project that aims to reduce flooding in the metropolitan Chicago area, and to reduce the harmful effects of flushing raw sewage into Lake Michigan by diverting storm water and sewage into temporary holding reservoirs. The megaproject is one of the largest civil engineering projects ever undertaken in terms of scope, cost and timeframe. Commissioned in the mid-1970s, the project is managed by the Metropolitan Water Reclamation District of Greater Chicago. Completion of the system is not anticipated until 2029, but substantial portions of the system have already opened and are currently operational. Across 30 years of construction, over $3 billion has been spent on the project.

Museum of Science and Industry

Spend the afternoon exploring the Museum of Science and Industry. This will also include a tour of the coal mine exhibit. Since 1933, Coal Mine has taken MSI guests down the mineshaft, along the rails, and through the walls of a true-to-life coal mine. It was the Museum's very first exhibit, and it's been a guest favorite ever since. You'll dig this descent into a "working" coal mine, an engaging tour of mining methods and machinery through the years. Step on the hoist and ride down into an experience with atmosphere so real, you may start wondering where to punch your time card.

Free Time

Explore Chicago and The Magnificent Mile at your leisure.

Hospitality room will be open Sunday and Monday from 9 to 11pm in the Gallery Lounge.

SUNDAY: WELCOME RECEPTION

The Welcome Reception will be held in Regency Ballroom Foyer area from 6pm to 9pm. Reconnect with friends and associates. Visit with exhibitors. Cash bar from 6pm to 9pm with provided drink tickets.

MONDAY: AWARDS BANQUET

The Awards Banquet will be held at Soldier Field, home of the Chicago Bears. Buses will load at 5pm. Tours of the facility will be available starting every 15 minutes. Dinner will be served at 7pm. Cash bar will begin at 8pm.

The Office of Surface Mining Reclamation and Enforcement will present the 2023 Abandoned Mined Land Reclamation Awards. OSMRE, in partnership with NAAMLP, recognizes outstanding reclamation techniques and projects. OSMRE will present the following AML awards:

National Award presented to the state or Tribe with the best overall reclamation project;

Small Project Award presented to the state or Tribe receiving less than $6 million annually in AML funding and completes a project costing less than $1 million; and

Regional Awards presented to the state or Tribe with the best project within each of the following regions: Appalachian States, Interior States, and Western States and Tribes.

NAAMLP will present the Hardrock Abandoned Mine Land Reclamation Awards for a project which exhibits exemplary remediation of contamination affecting environmental or human health and an exemplary project that reclaims physical safety hazards.

The Stan Barnard Memorial Award is given to an individual who exhibits outstanding dedication, commitment, and hard work that enhances NAAMLP.

The Dave Buckman Outstanding Instructor Award will be presented to an instructor who shows dedication, leadership, compassion, and commitment in training state, tribal, and federal employees.

The Tom Henderson Award is given to an individual or team that used technology to enhance the implementation of SMCRA to achieve excellence.

SCHOLARSHIP WINNERS

EASTERN

ELYSSA ALLEN

West Virginia University

Elyssa Allen is a rising senior from Ohio studying environmental geoscience and viola at West Virginia University. After her undergraduate career, she plans on getting a masters in geology. During the school year, she works as a GIS intern for the West Virginia GIS Technical Center and over the past summer, she interned for the Bureau of Land Management in Casper, WY as an environmental protection specialist in the field of oil and gas reclamation. Elyssa is very passionate about environmental protection and wants to focus on mitigating the impacts that mining has on climate change and aquatic ecosystems. Going to school in West Virginia has allowed her to see the effects of mine pollution on local ecosystems first-hand. In her summers and spare time, Elyssa teaches science and music to children from kindergarten to high school and believes very strongly in educational outreach.

WESTERN

MARIAM KOANDA

New Mexico Tech

Mariam Koanda, a senior at New Mexico Tech, is pursuing a Bachelor of Science in mineral engineering. She likes hiking and discovering other cultures. She earned a degree in mathematics from Hostos Community College/CUNY and was recognized for her Outstanding Research Presentation at the 2021 CUNY Symposium. She was also the winner of the Vanguard Award as a woman in a non-traditional career, due to her background as a dumper and excavator operator back in West Africa, Burkina-Faso, where she is originally from. Mariam is actively involved in shaping the mining engineering landscape and serves as the vice president of the Cooney Mining Club. Mariam secured an internship at Morenci in 2022, working on optimizing truck utilization for consistent planning. For the summer of 2023, she enjoyed a return internship at Sierrita Mine, Arizona, with the Long-Range Department, working on mitigating the haulage cost in mine operation. She is excited to explore emerging technologies and sustainable practices to enhance industrial efficiency and mitigate environmental impacts. Mariam is determined to contribute to society's growth while prioritizing environmental sustainability in the mining industry.

MID-CONTINENT

ELIZABETH BEAUMONT

Samford University

Liz is a third-year student, double majoring in marine science and geography, with a minor in biology and a GIS certification at Samford University. She was raised in Jacksonville, Florida. When she moved to Alabama she was blindsided by the biodiversity in Alabama rivers and has since been thrilled by all of the unique facets of Alabama biodiversity. She has done research on planktonic and aquatic invertebrate communities in settlement ponds around Winston County, Alabama, researching the disastrous effects of abandoned mines. Liz presently works with the AML program doing reclamation project mapping. She hasn't found much in the environmental sector that she isn't intrigued by and is driven to protect the biological communities that are at the mercy of human-caused pollutants and disturbances. Liz feels it is vitally important for humans to take responsibility for the environments that existed long before us, that we are gifted and depend on, and for the people who come after us. She wants to pursue a fulfilling career that involves research, conservation, or advocacy for fragile ecological communities so that humans can give back to this land we live on.

GRADUATE

ANNIKA DUDIK

Kent State University

Annika Dudik earned her Bachelor of Science in geology and minor in biology from Kent State University in Ohio. Throughout her undergraduate, she has worked on research pertaining to anthropogenic environmental contamination. In the summer of 2022, she completed an REU focusing on microplastic contamination in urban stream systems and presented that research at multiple events at Kent State, as well as at the 2022 American Geophysical Union Conference. At the beginning of 2023, her research interest switched over to acid mine drainage (AMD), and she began assisting with the collection of water samples discharging from abandoned coal mines. In the fall of 2023, she will begin her master's degree in environmental geology at Kent State University. Her thesis project will focus on acid mine drainage in streams and the impact that metallic colloids can play in transporting that contamination outside of treatment systems, with the hopes that this work can aid in the development of future AMD treatment systems.

SESSION SCHEDULE FOR MONDAY

	ROOM A	ROOM B	ROOM C	TORONTO
SESSION 1	Coal AML	Projects	Subsidence & Development	Partnerships
10:00 - 10:30	Flooded with Complexity: Low-Impact Stormwater Design in Madrid, New Mexico - A Case Study	So, you want to drill into a mine pool? [Directional Drilling Projects]	Resourceful Approaches to Mine Infill Design	AML Economic Revitalization in Coal Impacted Communities
10:30 - 11:00	Pennsylvania Anthracite Region Investigations and Emergencies	Beneficiation of Mine Waste - An Approach to Critical Minerals	Developing Solar on Former Mine Lands	Building an Inventory of Abandoned Mine Features Partnerships - USMIN Project
11:30 - 12:00	Mine Fire Projects in the Anthracite Coal Region of Pennsylvania	Challenges in Reactivating a Hardrock Mine with Extensive Historic Underground Mine Workings	Subsidence of the Springfield Lutheran High School	Navajo AMLRD Partnerships
12:00 - 12:30	Drilling and Grouting Methods in the Context of Underground Mine Fire Projects	Stay Out Stay Alive – Digital Marketing PSA	Mitigating a Centuries Old Abandoned Coal Mine Under the Trans-Continental Railroad	A National Program Strategy and Management of AML on National Forest Systems Lands

SESSION SCHEDULE FOR MONDAY

	ROOM A	ROOM B	ROOM C	TORONTO
SESSION 2	Reclamation/ Bat Conservation	Streams & Groundwater	Acid Mine Drainage	Technology & GIS
1:30 - 2:00	Solving The Long-Term TDS Problem in Legacy Surface Mine Sites in the Central Appalachian Region	Wildlife use within Swastika Stream Restoration Project Area	Crabtree Creek AMD Restoration Study	Expanding Inventory in the Era of BIL
2:00 - 2:30	It's Been a Decade – What Have We Learned? [Geomorphic Reclamation Techniques]	Evaluation of Leachate Source in Lined Repository and Leachate Reduction Strategies	Lab- and Pilot-Scale Sulfate-Reducing Bioreactors Treating Acid Mine Drainage from an Abandoned Nevada Gold Mine	Using Geospatial and Geostatistical Models to Visualize Site Data and Features, Estimate Waste Extents, and Inform Remediation Design
2:30 - 3:00	Advantages in Using Native Plant Species for Reclamation	Stream Restoration Solutions for Challenging Environments	Rehabilitation of the Old Bevier Passive Treatment System	Collaborative GIS Solutions to Support Abandoned Mine Data Collection
3:00 - 3:30	How Successful has Reclamation at the New World Mining District Been?	Dewatering of Iron Sludge for Pigment Production	Tioga River Watershed Restoration / Consumptive Use Mitigation Through an Active Mine Drainage Treatment Plant Project	Implementation of Enterprise GIS Solutions to Improve Efficiencies of AML Project Management
3:30 - 4:00	The North American Bat Monitoring Program (NABat) and Mine Lands	Federal and State Efforts to Clean Up Historical Abandoned Mines in Central Arizona Reduce Copper in Vital Stream	A Tale of Two Mine Water Treatments	Creating a Geospatial Tool that uses Data to Track Reclamation and Assessments of Potential Hazards Caused by Mined Lands

SESSION SCHEDULE FOR TUESDAY

	ROOM A	ROOM B	ROOM C	TORONTO
SESSION 3	OSMRE Awards	OSMRE/ NAAMLP Hardrock Awards/ Acid Mine Drainage	Technology & GIS	Bat Conservation
8:00 - 8:30	National Award Presentation (TBA)	Western Region Award Presentation (TBA)	The Merging of GIS and Remote Sensing; Disciplines Used in Monitoring, Analyzing, and Detecting Subsidence Features	The White Hat World of AML and How It's Fighting A Changing Climate / Colonial Roosting Bats, Partnerships, and Getting $!@# Done
8:30 - 9:00	Small Project Award Presentation (TBA)	Remediation Contamination Award Presentation (TBA)	Virginia Department of Energy Coal Waste Inventory Project	Updated Best Practices for Safeguarding Mine Openings in Wyoming
9:00 - 9:30	Appalachian Region Award Presentation (TBA)	Remediating Safety Hazards Award Presentation (TBA)	LiDAR to Identify and Characterize AML	USFWS Bat Listing Updates (VIRTUAL PRESENTATION)
9:30 - 10:00	Interior States Award Presentation (TBA)	Optimizing Growth of Acidophilic Iron-Oxidizing Bacteria for Acid Mine Drainage Remediation	Leveraging Machine Learning, Artificial Intelligence, and Augmented Reality for Use in AML	Effectiveness of Current AML Mitigation for Maintaining Use of Mines by Bats

(TBA = To Be Announced)

Schedules are subject to change

Flooded with Complexity: Low-Impact Stormwater Design in Madrid, New Mexico - A Case Study

Leeland Murray, New Mexico Abandoned Mine Land Program Energy, Minerals and Natural Resources Department

Located in the historic Cerrillos Coal Field, the town of Madrid, New Mexico has presented a unique challenge for the New Mexico AML Program over the last 30 years. Since its founding in 1895, the coal mines surrounding Madrid produced approximately 10 million tons of anthracite and bituminous coal until the mine's closure in 1954. After the closure, the town and nearby mines were mostly abandoned, however, during the 1970s-1980s, Madrid attracted a new group of rugged individualists and artists. This combination of eccentric residents living and working in an abandoned coal mining community, along with its designation on the National Register of Historic Places, has created community and compliance complexities not seen on other AML Program projects. Since 2009, the AML Program has been working in Madrid toward addressing large stormwater and erosion control issues prevalent throughout the area using a community-wide approach. Over time, the extensive coal gob piles located along the steep hillsides have contributed to large-scale flooding impacts to private property and the main highway through town, and have caused significant coal waste accumulation. Today, most Madrid residents deal with variable flooding and erosion issues with every rainfall, particularly during monsoon season. Opinions regarding how these problems should be addressed differs vastly amongst residents. This presentation will examine the complexities and lessons learned from New Mexico's most complex AML coal project to share valuable experiences with other AML Programs and to assist in their project development.

Pennsylvania Anthracite Region Investigations and Emergencies

Daniel J. Werner, P.E., Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation Pennsylvania

Anthracite coal, located almost entirely in five counties, has been mined for nearly 200 years. Anthracite coal has historically been a unique and valuable resource, however its unusual geography consistently leads to environmental problems and dangerous surface subsidence. Personnel from the Wilkes-Barre Bureau of Abandoned Mine Reclamation District Office investigate up to 300 complaints each year related to concerns with abandoned anthracite coal mines. This presentation will highlight several investigations, both mine-related and those not mine-related.

Mine Fire Projects in the Anthracite Coal Region of Pennsylvania

John J. Curley, P.E., Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation

What makes coal such a valuable resource is its ability to burn. Unfortunately, at times, unwanted burning occurs in abandoned coal mines. In northeastern Pennsylvania lies the anthracite coal region where several coal mine fires exist. This presentation will discuss how a number of these mine fires were addressed by the Pennsylvania Department of Environmental Protection (PA-DEP), Bureau of Abandoned Mine Reclamation (BAMR) in the recent past and how they will be addressed in the future. The anthracite coal region has an atypical geology with strata varying from flat to steeply pitched and even beyond vertical. Because of this, mine fires are different than those elsewhere. The presentation will detail how this uniqueness plays a part in how these fires burn and how they may spread. All fires have a start, whether known or unknown. Many having been burning for multiple generations and are linked with their community. These communities have been greatly impacted by being neighbors to these hazards. In the recent past, the BAMR has performed a number of successful projects to extinguish these fires. The BAMR is planning on performing additional projects in the future to extinguish or isolate these fires. The presentation will detail these projects and the positive impacts that performing this work accomplishes.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 1: Room A - **Coal AML**

Drilling and Grouting Methods in the Context of Underground Mine Fire Projects: A Case Study with Practical Design and Implementation Considerations

Michael Lazorcik, P.E. and Jeremy Byler, P.E., P.G., Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation

Drilling and grouting methods are a common approach to treating underground mine fires, particularly in some emergency situations and when overburden thicknesses diminish the feasibility and/or cost effectiveness of excavation and quenching methods. The overall efficacy of drilling and grouting projects in controlling or even "extinguishing" underground mine fires is widely considered to be highly variable in practice and depends heavily on site-specific variables and considerations (e.g., allowable project costs and/or material quantity limitations) as well as the designer's ability to accurately model the actual subsurface conditions in a sufficient manner using the available resources and data. This presentation will discuss recent experience that the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Abandoned Mine Reclamation (BAMR) has had implementing a phased drilling and grouting approach deploying both low-mobility grout (LMG) mixes and balanced, stable high-mobility grout (HMG) mixes in prescribed sequence at a project site to treat an underground mine fire in the bituminous coal region of Pennsylvania. The presentation will detail the process by which BAMR planned and scoped the drilling and grouting program and will discuss lessons learned throughout the construction process as well as the results of targeted non-invasive geophysical studies and temperature monitoring efforts over time, both pre- and post-grouting. The presentation will conclude with a number of practical considerations that might be incorporated into project designers' planning and design of future underground mine fire treatment projects on a more general basis, particularly with respect to the selection of means and methods.

SESSION 1: Room B - **Projects**

So, you want to drill into a mine pool?

Christoph Goss, PhD, P.E. and Morley Beckman P.E., Schnabel Engineering

Wells may need to be constructed into mine pools for a variety of reasons – to measure mine pool elevations, sample impounded water, conduct tracer tests, or perform treatability studies. Eventually, such wells may be used to drain mine pools for treatment. These projects present interesting challenges for surveyors, geologists, drillers and engineers. Targeting mine workings, often from a distance of several hundred or more feet, requires precision mapping and directional drilling. Schnabel Engineering has expertise in designing and managing these projects, and will highlight three examples: construction of wells into the American Tunnel and Terry Tunnel in the Bonita Peak Mining District (outside of Silverton, Colorado) and an unnamed adit in central Idaho. For the American Tunnel project, an angled boring was successfully drilled in 2019 to a depth of 646.5 feet, intercepting the American Tunnel behind Bulkhead #3. This project required directional steering of the drill string, gyroscopic survey, and sacrificial drill rods through highly fractured volcanic rock. For the Terry Tunnel project, a vertical boring was successfully drilled in 2021 to a depth of 153 feet, intercepting the Terry Tunnel between the collapsed portal and the bulkhead. The vertical boring was surveyed with downhole geophysical tools to confirm adit geometry, cased, used to pump out impounded mine water, and eventually converted into a ventilation shaft for the rehabilitated adit. For unnamed Adit, our team designed a gravity drain system that would tie into the existing mine treatment system. The drain pipe was successfully installed via horizontal drilling in late 2018.

Key items to consider when planning these projects include accurately sourcing and confirming coordinate systems for maps of mine workings, enlisting the assistance of qualified drilling subcontractors with directional drilling capability, and carefully evaluating available data to determine the maximum possible mine pool elevation so drilling efforts do not result in uncontrolled releases. Risk assessment and fluid hazard analyses are required for projects that have the potential to intercept pressurized mine pools. The presentation will finish with a sneak preview of results and lessons learned in the Lake Emma basin outside Silverton, where three deep wells, over 800 feet each, are planned for construction during the summer of 2023.

Beneficiation of Mine Waste - An Approach to Critical Minerals

Mark A Travers, Principal and Founder, Malachy LLC

Critical minerals provide the building blocks in a transition to a more circular economy which will be based in a more sustainable, low carbon, and resource-efficient economy. Concurrently, the US and Europe are increasingly dependent on foreign sources for many critical minerals. For example, globally, China controls a large part of the market for processing and refining for cobalt, lithium, rare earths and other critical minerals. Since taking office, President Biden has outlined a whole-of-government approach to ensure that U.S. mining activity is sustainable, responsible, and efficient. Understanding that resilient supply chains are necessary to revitalize and rebuild domestic manufacturing capacity while maintaining America's competitive edge in research and development. In February 2021 the President issued Executive Order (EO) 14017, "America's Supply Chains." The EO directed a government-wide approach to assess the vulnerabilities in, and strengthen the resilience of, critical supply chains of various goods, including critical and strategic minerals essential to the economic and national security of the United States. In response, the US Department of Defense released a plan for securing defense-critical supply chains. Similar focus on securing supply chains have been advanced elsewhere in the world. As reported by the ITRC Committee on reuse of solid mining waste, there are more than 500,000 abandoned mine sites nationwide, containing various volumes of mining waste from the act of mining or the beneficiation process. The wastes include mine water, waste rock, spent ore, and mill tailings. Many materials considered waste when initially processed may still contain recoverable mineral concentrations, including rare earth elements, given today's advancements in mining and the beneficiation. Further, research is documenting how waste can be used to produce products while achieving a lower carbon footprint than the alternatives. This presentation will focus on experience in recovery of value from waste at mining and mineral processing/beneficiation sites. The focus will be legacy sites, however operating sites will also be discussed. Examples of how research and experience globally could bring value from sites current considered a potential risk to human health and the environment reviewed.

Challenges of Reactivating a Hardrock Mine with Extensive Historic Underground Mine Workings

Josh Zimmermann, P.E., G.I.T. and Dave Hibbard, P.G., Brierley Associates

In the early 20th century, hard rock mining operations utilized underground excavation techniques, such as stope mining to excavate potentially lucrative ore bodies to surface for processing. These mining and historic processing techniques were typically inefficient by modern standards, or were inefficient at economically retrieving a majority of desirable metals. Historically, processed ore would typically be reused as backfill to help stabilize the excavated underground workings, while mining operations continued deeper underground until the ore body appeared to be exhausted. With the prices of many metals dramatically increasing over the past several decades, some companies are looking at these historic sites as proven reserves that can now be viably mined with modern techniques. However, these sites pose unique risks due to being historically abandoned and structurally unsound. These mines that can pose a variety of risks to future onsite operations, including sudden sinkhole development, large settlement, highwall failure, and a variety of other hazards. One of these historic sites is located at an abandoned gold mine in southwestern Nevada. With mining operations in the area mostly halted in the early 1920's, its underground stopes, tunnels, shafts, pits, and highwalls provide a unique challenge to modern day open pit mining techniques, in addition to current exploratory efforts to confirm the quality and quantity of the historically mined ore body. With historic exploratory data panning back to the 1960's and a multitude of geologic interpretations, it was difficult for the new owner to determine the true nature of these existing hazards. Therefore, Brierley Associates was tasked to help identify potential areas of high risk pertaining to the abandoned underground workings. Through the incorporation of GIS solutions, data sleuthing, modeling, and extensive background research, Brierley was able to plan and execute a focused geological investigation and geotechnical campaign to determine geohazardous risk for further exploration and mining operations.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 1: Room B - **Projects**

Stay Out Stay Alive – Digital Marketing PSA

Sean Derby, C.P.G., Abandoned Mine Land Program, Nevada Division of Minerals

The Nevada Division of Minerals is legislatively mandated to conduct the State's AML program to identify inactive mines, rank their degree of hazard, and carry out activities to secure these sites, be it through owners or Division staff, and work to educate the public to recognize and avoid those hazards resulting from mining practices which took place at a mine that is no longer operating. Over the past 10 years AML program staff have noted a sharp increase in online content strongly promoting exploration of abandoned mines and in some cases, individuals loudly disparaging the Division and its mission. Staff have also received feedback from federal and state agency partners as well as the public that such content has been directly related to damage at AML sites including vandalism of cultural resources, harm to wildlife habitat, and a general increase in visitation to abandoned mines in Nevada and across the west. The Division's AML outreach has remained consistent throughout the life of the program, focusing on in-person presentation aided by online video content. However, an initial analysis of content promoting AML visitation showed that such content was being viewed at least 100 times more frequently than the Division's public safety messaging. In August of 2021, AML staff proposed implementing a digital marketing campaign and began researching methods for maximizing outreach of the Division's classic "Stay Out, Stay Alive" moto. This research resulted in a scope of work recommending the creation of a public safety awareness campaign featuring a variety of content appropriate for distribution on social media, targeted web pages, and most importantly YouTube. The scope of work also recommended that this content be distributed using a software platform specifically designed to engage viewers of sites promoting AML visitation based on a wide range of observable datapoints generated by the software. Production and media contractors used feedback from the Division to develop target demographics to shape messaging style and guide online engagement. Concept development suggested that the target audience would likely respond best to comical storytelling focusing on a character alike to the audience's demographic. The character of Jimmy King "King of Bad Ideas" was proposed to inhabit a series of brief and disastrous misadventures shown in juxtaposition to abandoned mine visitation. Each of these misadventures is narrated by the characters "Voice of Common Sense" which encourages the audience not to be like Jimmy and reinforces the Divisions current Stay Out Stay Alive message. Content creation and filming was completed in September 2022 resulting in a variety of content options. The online content engagement strategy was as follows: viewers engaged with the content visiting social media sites, targeted websites, YouTube, or by searching for AML visitation content via an internet browser search. After viewing the content, the user was prompted to visit a landing page hosting further content and facilitating content sharing and direct engagement with the Division. During this interaction the Division was able to collect data including user demographics, geolocation (at county level), conversion rates (how often an initial view results in a visit to the states landing page or homepage), and how often the content was being shared. This process was active for 4 weeks from late-November through December. The Division learned a great deal about how the message was received and ultimately reached 2.3 million viewers.

Resourceful Approaches to Mine Infill Design

Joel James, P.E., Taylor Sommerfeld, E.I.T., Dave Hibbard, P.G, and Melissa Bautz, P.G., Brierley Associates

This presentation covers advantages of site specific mix designs by enabling the use of locally resourced materials for underground mine infilling. A comprehensive subsurface mine mitigation project involves many considerations, such as overburden rock and soil material, underground mine conditions, mine geometry, presence of groundwater, overlying infrastructure, and readily available infill materials. In the wake of increasing cement costs, decreased fly-ash production, and complexities in supply chain issues, the challenge to limit infilling costs while maintaining desired specifications and material properties often remains difficult. Because large volumes of infill material are often required for effective subsidence mitigation, it generally comprises the majority of project related expenses. By incorporating locally available materials into the mix design process with a keen understanding of underground mine characteristics, a balance can be achieved to reduce unit rates while still maintaining infill material performance properties that are specific to localized conditions. Mix design considerations to be discussed arepozzolan alternatives (perlite, scoria, zeolite, kiln dust, foam sand, metakaolin, slag, etc.), sand aggregate gradations, non-potable mine water, and flowability and strength properties.

Developing Solar on Former Mine Lands

John Jones, R3 Renewables

R3 Renewables develops and builds large-scale solar+storage projects centered on reclaimed or abandoned mine land to bring reliable power to areas with known grid capacity and jobs and tax revenue to communities that have helped power the grid for generations. Clean energy projects on mine land provide an attractive alternative to using undisturbed natural, agricultural, and other greenfield land for development. Mine land is often located near critical infrastructure that makes it suitable for clean energy development, including electric substations, transmission lines, and access roads or rail lines
R3 has developed a robust GIS-enabled tool for prospecting that identifies (1) these areas of intersection and (2) buildable land by applying a proprietary constraints analysis. Geotechnical analysis required much earlier than typical greenfield development. Borings, pile load testing and InSAR analysis all play a role in assessing geotechnical risk. Focus is placed on understanding the timing of land use, allowing for the analysis of buildable area to reflect future predicted conditions accurately. Conditions surrounding any ongoing mine activity, primarily dusting, may be present for energy production calculations. Building solar on reclaimed and abandoned mine land is achievable and reasonable from an environmental and permitting perspective. Clean energy projects on current and former mine land create opportunities for direct community benefit, resulting in economic growth. R3 and its shareholders understand the importance of energy transition, and work closely with communities and stakeholders to ensure the continued reliability of the grid.

SESSION ABSTRACTS

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SESSION 1: Room C -

Subsidence & Development

Subsidence of the Springfield Lutheran High School

Bruce Schottel, P.E., and Dipanjan Ghosh, L.P.G., Illinois Department of Natural Resources, AMLRD

On June 29, 2022, Illinois Department of Natural Resources (IDNR) staff were called to investigate damages to a building from potential mine subsidence at the Lutheran High School. Upon investigation, it was confirmed that the school was indeed experiencing sag type mine subsidence. Survey data collected during the following days suggested the school had subsided approximately 2 feet and settlements were ongoing. An investigation of the safety of the building was initiated by IDNR personnel with the assistance of a consulting structural engineer. Because of the severity of the distortions to the building and uncertainty with the future serviceability, school officials chose to move the fall classes to a different facility, and eventually made the decision to abandon and demolish the facility. IDNR, using newly allocated BIL monies, took on the project to demolish the structure. At the same time, a forensic investigation was initiated by IDNR to examine the structure's response to the deformations imposed by the sag subsidence.

Mitigating a Centuries Old Abandoned Coal Mine Under the Trans-Continental Railroad

Josh Zimmermann, P.E., G.I.T., and Dave Hibbard, P.G., Brierley Associates

Beginning in 1888, coal mines in the historic town of Dana, Wyoming were delivering coal to the Trans-Continental Railroad. 1890 saw its peak with 142 miners mining underground to supply thousands of tons of coal to the railroad. Located in south central Wyoming, Dana Mine No. 1 was one of many mines at the end of that century supplying coal to this famous 1,700 mile long track. By 1891, the town would essentially be abandoned for the much larger (and higher quality) coal reserves in nearby Hanna, Wyoming. Over the coming decades, nature would slowly reclaim the area, and the tracks would be relocated over the abandoned coal mine to bypass the now useless rail spur for Dana. However, the mine itself would not stay forgotten forever. Due to the presence of shallow mine workings, sinkholes have slowly developed to the north and south of the relocated rail line, induced by the gradual failure of the mine roof. On behalf of the Wyoming Department of Environmental Quality's Abandoned Mine Land Division (AML), Brierley utilized high angle exploratory boreholes to investigate conditions beneath the railroad tracks and determined the presence of voids as shallow as 30-ft below the historic rail line. Additionally, the strength of the overlying rock was identified to be very poor and insufficient for adequately bridging the underlying mine workings. In 2022, Brierley implemented a grout mitigation program and design to protect the existing rail line which sees an average of 36-trains a day worth of cargo for destinations across the country. In coordination with the railroad, Brierley installed a monitoring system consisting of over 50 prisms utilizing a cloud-based Automatic Total Station System (AMTS). This system allowed for the near real-time monitoring (to detect any ground movement along the railroad while performing mitigation operations within the UPRR Right-of-Way. Through a stringent monitoring program, usage of custom GIS solutions, innovative staging of grouting methods, and maintaining flexibility throughout the project duration, over 4,700 cubic yards of grout were injected under the rail lines greatly reducing the risk of subsidence to this critical piece of infrastructure.

AML Economic Revitalization in Coal Impacted Communities

Cassidy Riley, Coalfield Development Corporation

Traditionally, southern West Virginia's economy has been dominated by the coal industry. ACT Now, or Appalachian Climate Technology, is an opportunity to diversify the region's economy and make it more sustainable. Doing so will help ensure a just transition to a better economy with more good-paying jobs and broader community improvement than what has been realized in years past. This just transition ensures that coal-affected communities are the first to sow the benefits of a new economy, while honoring their foundational efforts in the economy of the past. ACT Now will transform the struggling southern West Virginia region with economic investments and job creation in the solar industry, expansion of technology businesses, upgrades of buildings to be more energy efficient, redevelopment of industrial spaces and "brownfields" for 21st century manufacturing, and the transformation of abandoned minelands into new sustainable assets.

Building an Inventory of Abandoned Mine Features Partnerships - USMIN Project

Jeffrey L. Mauk Et Al., U.S. Geological Survey

The U.S. Infrastructure Investment and Jobs Act of 2021 requires the Secretary of the U.S. Department of the Interior to establish a program "to inventory, assess, decommission, reclaim, respond to hazardous substances release on, and remediate abandoned hardrock mine land based on conditions including need, public health and safety, potential environmental harm, and other land use priorities" on state, federal, and tribal lands. The Office of Environmental Policy & Compliance in the Department of the Interior has funded the U.S. Geological Survey's mineral deposit database project (USMIN) to help build a national inventory of mine features of non-coal sites that were abandoned or left in an inadequate reclamation status before the enactment of the Act in November 2021. Our goal is to supplement this information with data from coal sites from the Office of Surface Mining Reclamation and Enforcement, so the final database will include mine features from all types of mining, including hardrock, industrial minerals, and coal mines. The vision is that the database will be populated by data from state, federal, and tribal agencies, with the underpinning data held in an inward-facing database, and outward-facing maps that aggregate data at various levels (e.g., counties, Congressional districts, and 12-digit hydrologic unit codes). Due to concerns about vandalism and health and safety, granular data, such as the precise locations of individual mine features, will not be available to the public. Source data will be held by individual agencies. The USMIN team collaborated with members of the Bureau of Land Management and the Interstate Mining Compact Commission to define the data structure for capturing abandoned mine land features. USMIN then designed the GIS, received feedback on the GIS structure from state and federal agencies, modified the GIS based on that feedback, and received approval from the Office of Environmental Policy and Compliance to share the GIS with state, federal, and tribal agencies. USMIN is now collaborating with state, federal, and tribal agencies who are providing data on abandoned mine features so that we can begin to build a comprehensive and authoritative national inventory of abandoned mine features. The database contains 725,688 point and polygon features for the conterminous United States, Alaska, Hawaii, and Puerto Rico. Mine features related to coal deposits and prospects were removed from the database in four documented steps. The final non-coal database has 633,181 point features and polygon centroids, which is a reduction of 92,507 points. Therefore, approximately 13% of the mine features in the USMIN Topo database are associated with coal deposits, and the remainder are at hardrock and industrial mineral deposits.

SESSION ABSTRACTS

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SESSION 1: Toronto - **Partnerships**

Navajo AMLRD Partnerships

Melvin H. Yazzie, Navajo Abandoned Mine Lands Reclamation Department

The Navajo Abandoned Mine Lands Reclamation Department (NAMLRD) has been in existence since 1988, under the provisions of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. NAMLRD has addressed hundreds of coal, uranium, copper, limestone and sand & gravel Abandoned Mine Land (AML) features. Reclamation techniques have developed over time from the basic cut & fill technique to a more stable geomorphic reclamation. In our self-development and self-improvement ideas, NAMLRD has researched new reclamation ideas and improved our techniques. This has led to numerous new Partnership opportunities with other local, tribal, state, federal and outside stakeholders. These Partnerships have led to funding opportunities with the U.S. Department of Energy (US DOE), U.S. Environmental Protection Agency (US EPA) and U.S. Army Corp of Engineers (US ACE). NAMLRD will recap the progression of our reclamation activities into these new partnership opportunities.

A National Program Strategy and Management of Abandoned Mine Lands on National Forest Systems Lands

Sarah Martinez, U.S. Forest Service

The USDA Forest Service (Forest Service) Abandoned Mine Lands (AML) program reclaims abandoned mines through interagency collaboration with US Department of Interior's Abandoned Hardrock Mine Reclamation and the US Department of Energy's Defense Related Uranium Mining Programs. Our national program strategy includes inventory, assessment, and mitigation of both physical safety and environmental hazards on National Forest Systems (NFS) lands. One of the Forest Service's ongoing programs is a highly successful partnership is with the State of Colorado Department of Reclamation and Mine Safety. Under the Good Neighbor Authority, both agencies collaborate reclamation of NFS lands to support restoration of our natural resources; a model the Forest Service is working to expand nationwide.

Solving The Long-Term TDS Problem in Legacy Surface Mine Sites in the Central Appalachian Region

Amir Hass, Ph.D., West Virginia State University Agricultural & Environmental Research Station

Levels of total dissolved solids (TDS) of stream water in watersheds affected by surface coal mining in Central Appalachian Region remains elevated and at harmful levels decades after mine closure and reclamation. An extensive study by the USEPA from 2011 suggests specific conductance of 300 µS cm-1 (SC; used as proxy for TDS), as a chronic aquatic life benchmark value "…below which 95% of the observations of the genus occur and above which only 5% occur" (EPA/600/R-10/023F, 2011). While optimistic at first that TDS levels in leachate from non-acid forming spoils will 'drop quickly', field studies on the topic in the last decade failed to document consistent decline in SC to below the chronic aquatic life benchmark (300 µS cm-1) or the ecoregion background levels (< 100 µS cm-1) in the preponderance of the region tested sites. To date, no practice exists to directly ameliorate the long-term elevated SC problem; with most effort being aimed at implementing prevention measures (i.e. limit exposure of TDS-generating material to water and hydrologic pathways; promote high ET vegetative cover to limit subsurface drainage and leaching, etc.). In this study, we present an approach to solve (not prevent) the long-term high SC problem in stream water associated with surface mining affected headwaters; specifically, that of mountaintop removal valley fill operation - the most common surface mining operation in the Central Appalachian Region. The conceptual framework of the practice will be described and discussed, and empirical observation from a paired-watershed study use to demonstrate it.

It's Been a Decade – What Have We Learned?

Kelby Wilkison, TriHydro Corporation

2023 marks the 10-year anniversary of two Abandoned Mine Land (AML) reclamation projects designed using Carlson Natural Regrade and geomorphic reclamation techniques. The Teach AML (Iowa) and the Rosebud Pit (Wyoming) are located 730 miles apart in vastly different climatic and geological areas. However, both were designed and reclaimed using landform grading techniques to mimic native topography using varying slope aspects, concave and convex slopes, and varying channel types. Now a decade later did this technique work and how has observation of these sites impacted design decisions on other AML reclamation projects? This presentation will provide a project history of these two sites, lessons learned, and the evolution of geomorphic designs for the reclamation of AML sites. Lessons learned will include the importance of understanding landscape dynamics and regional conditions, ecological recovery and biodiversity, soil management and stability, hydrological processes and water resources management, stakeholder and contractor engagement, and adaptive management strategy implementation. Despite the progress made, challenges and limitations persist that impact site selection, design features, post-reclamation goals, and overall project success. The presentation will explore future directions using geomorphic reclamation and the importance of integrating new ideas such as multiple land uses within a project site and consideration of climate change adaptation. Collaboration and knowledge sharing will also be highlighted as essential factors for successful reclamation projects.

SESSION ABSTRACTS

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SESSION 2: Room A -

Reclamation/ Bat Conservation

Advantages in Using Native Plant Species for Reclamation

Jim Kooser, Atlas Technical Consultants

Mine reclamation often results in the establishment of a plant community dominated by non-native grasses and forbs. While such communities may be established quickly, they generally offer little in the way of productive wildlife habitat. Establishing meadows or prairie like stands of native grasses and forbs is a sustainable way to establish cover after initial reclamation efforts. Native meadows support habitat for a variety of native birds and other wildlife. There is growing interest in steps to support native pollinator populations. Native grasses and forbs provide food, nesting and escape habitat for bees, butterflies, and other insect pollinators. Designing a self-sustaining native plant community for abandoned mine lands requires knowledge of the topography and hydrology of the site, the physical condition of the soil and soil nutrient status. Native meadow species are often adapted germinating and growing in relatively nutrient poor conditions; soils amendments may not be required in some applications. Effective designs should be based on clear goals and objectives, defining the target species and the ecosystem processes that will be supported. It is often helpful to model a reclamation design after a local reference site. The use of native plants and seeds requires the same site preparation as that used for "traditional" reclamation mixes. Native seeds can be applied using the same equipment and techniques used for traditional methods. In general, the establishment phase runs longer for native plant communities generally taking two to three years for all seeds to germinate and establish, as opposed to one year for more traditional seed mixes. Once established though, native communities tend to be much more resilient than non-native communities and require little maintenance. Reclamation based on establishing native plant communities helps establish food webs that are more complex, and therefore more resilient and sustainable, than those supported by non-native plant communities. In this presentation, we will discuss species appropriate for mine reclamation, the benefits of such approaches, and techniques used to establish and maintain native meadow/prairie stands.

How Successful has Reclamation at the New World Mining District Been?

Annica Brown, US Forest Service

The New World Mining District is located in Montana, northeast of Yellowstone National Park, within the Custer Gallatin National Forest. In 1996, the US Government entered into a settlement agreement with Crown Butte Mining, Inc. to buy out their interest in the lands and $22.5 million was set aside to reclaim historic mining disturbances within the New World Mining District. Three river systems contaminated by acidic, metal laden mine waste material flow into Yellowstone National Park. Waste dumps, tailings, and ore stockpiles from the massive sulfide ore deposits exposed at the surface and underground are found throughout the District. The US Forest Service is using its CERCLA authority to clean up the site. Major reclamation activities were performed between 2001 and 2008 which included relocating mine waste to a central repository, capping other mine waste in place, and establishing a self-sustaining vegetative cover over the reclaimed areas. Monitoring has been performed since 2012 to evaluate site conditions in response to reclamation actions and will continue until at least 2032. In June 1999, temporary water quality standards for Fisher Creek, Daisy Creek, and a portion of the upper Stillwater River were approved by the State of Montana Board of Environmental Review. The objective of the temporary water quality standards was to provide site specific temporary water quality standards to be met during reclamation activities with the intention that once reclamation was complete, water quality will improve to meet beneficial uses for water classified as B-1 under State of Montana classification standards. Surface water quality improvements are most evident during high flow conditions and have been maintained following completion of reclamation activities. Exceptions to this include McLaren Pit area groundwater and station FCT-11 within the Como Basin. Fifteen years on, not all water meets the human health and aquatic water B-1 standards. Therefore, what are the next steps for the project?

The North American Bat Monitoring Program (NABat) and Mine Lands

Andrea Schuhmann, Fort Collins Science Center, U.S. Geological Survey

Abandoned mines offer valuable habitat for numerous bat species, although there are still significant gaps in our understanding of this relationship. To address the lack of information on bat species status and trends, the North American Bat Monitoring Program was launched in 2015. Since its inception, the program has experienced remarkable growth in engagement, resource availability for data collection and contribution, and data compilation. As a result, valuable analyses and information products have been developed to aid in the management of bat populations facing various threats. Join us to explore the program, discover ways to participate, and understand the benefits it can offer to your work.

Wildlife use within Swastika Stream Restoration Project Area

Laurence D'Alessandro, and Linda DeLay, New Mexico Abandoned Mine Land Program Energy, Minerals and Natural Resources Department

The Swastika stream restoration project took place in 2021 on the Vermejo Park ranch owned by Turner Enterprises, in the far northern reaches of New Mexico. This project was completed by NM Abandoned Mine Land Program and encompassed one stream mile of restoration work which ranged from bank stabilization and riparian planting to j-hooks and stream manipulation measures. The project has shown positive improvement in wildlife habitat compared to pre-construction activities. At the beginning of the project, an internal monitoring study in cooperation with Vermejo Park Ranch was started to document not only the changes from reclamation work but also any wildlife activity in the construction area. A total of 8 trail cameras have been deployed throughout the project area to capture the diverse habitat coverage found in the project area and document what type of wildlife is using it, frequency of use, and total number of specimens. Presence of wildlife was also recorded with video and acoustic recorders. From the data collected, a story map has been created by Linda DeLay (MMD Geospatial Specialist, Biologist) to be used for future reference studies on similar projects. This project is still in motion with plans to continue monitoring through 2023.

Evaluation of Leachate Source in Lined Repository and Leachate Reduction Strategies

Ross Monasmith, Pioneer Technical Services Inc.

In a lined mine waste repository in Montana, annual leachate pumping and treatment demand indicates degradation of the leachate liner system. Identification of the source of infiltration is critical to reducing treatment demand and annual operating costs. This presentation will describe the repository construction, the surrounding geological environment, available information for evaluating the infiltration leachate source, outline strategies and techniques for identification of the infiltration source and preliminary approaches for engineering intervention. Using a conceptual lithological model, groundwater hydrographs, pumping records, and other methods, the likely source area and timing of infiltration resulting in leachate production was identified. Preliminary design of a cost-effective leachate interception and dewatering system will be discussed. This presentation highlights the challenges presented by the complex and highly variable groundwater system surrounding the repository, including nearby geothermal features, as well as developing cost-effective and suitable solutions given the uncertain subsurface environment.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 2: Room B -

Streams & Groundwater

Stream Restoration Solutions for Challenging Environments

Mary Elizabeth Berkes, M.S., P.E., GAI Consultants

This presentation will highlight both challenges and benefits of using stream restoration techniques across a variety of landscapes as applicable to reclaimed lands. The goals of stream restoration include creating a stable, natural channel that promotes transport of sediment and provides fish habitat, both of which result in improved water quality and ecological uplift. Project challenges and lessons learned for a variety of stream types and topographic constraints will be presented. Attention will be given to how each presented measure can be applied to different landscapes and where each measure was found to be the most effective. The presentation will exhibit how site conditions such as steep wooded terrain, contaminated soil, or confined environments can hinder the ability to restore stream systems. Each challenge will be met with a solution to provide maximum uplift while limiting disturbance and considering long term stability, constructability, and cost. The presentation will showcase the multi-disciplinary nature and required collaboration across all phases of restoration projects from field investigations, design, construction, and monitoring. The solutions will include incorporation of natural channel design methodologies, use of in-stream structures for grade control, and value engineering of designs using hydraulic modeling. High level design concepts and photos from different phases of development will be presented to make the solutions relatable and understandable. Projects having vary levels of effectiveness will be presented, and the presentation will conclude by presenting lesson learned and benefits of successful projects. The benefits will cover environmental uplift through promotion of sediment transport, revegetation with native species, and increasing aquatic habitat across a range of landscape types and conditions.

Dewatering of Iron Sludge for Pigment Production

R. Guy Riefler, Ohio University, Department of Civil and Environmental Engineering

Acidity and iron precipitates continue to pollute streams in southeast Ohio from acid mine drainage (AMD) released from abandoned coal mines. We have developed a method to intercept AMD as it leaves the mine and treat it in an engineered water treatment plant to neutralize the acid and precipitate the iron and restore the receiving stream. If processed correctly, the iron oxyhydroxide sludge can be sold as a pigment offsetting costs for plant operation. In this presentation, we will report on the feasibility of different dewatering, washing, and drying technologies and their impact on the final pigment quality. Because pH < 4.5 is required for high quality pigment, new testing was required for this unusual condition. Vacuum filtration and filter pressing were both tested to dewater the 3-6% solids thickened sludge. Vacuum filtration with a range of fabrics was unsuitable due to long cake filtration time and high suspended solids in the filtrate. Filter pressing was effective producing cakes with up to 28% total solids and runs times of < 5 hr. Anionic polymer flocculants improved settling and thickening of the iron solids, however they also had a negative impact on final pigment resulting in darkening and hardening of the final solids with water dosage rates as low as 2 mg/L (<0.5% of the final solid). Careful selection of polymer that perform at low pH and low dose was necessary for a high quality final product. A dose of 0.2 mg/L (<0.05% in the final solid) improved dewatering and did not affect pigment quality. When airdrying the 3-6% sludge, high salt content in the final product greatly reduced final iron purity and required extensive washing with reverse osmosis water. However, pressing to 25% removed enough salts that the air dried pressed solids was adequately pure without washing. Using these techniques we were able to produce iron pigment from AMD that was similar in quality to market standards.

Federal and State Efforts to Clean Up Historical Abandoned Mines in Central Arizona Reduce Copper in Vital Stream

Kelly Hermanson, R.G., Arizona Department of Environmental Quality, Watershed Improvement Unit

A 15-mile segment of Pinto Creek in Gila County, Arizona, was designated as impaired for dissolved copper in 1998 on the Clean Water Act Section 303(d) list of impaired waters. This segment of Pinto Creek is primarily located in Tonto National Forest. The woodland and patchy shrubland and is home to plants, animals, and a handful of ranchers. Undisturbed areas of the forest include the endangered Arizona hedgehog cactus and provide critical habitat for the endangered Mexican Spotted Owl. Disturbed areas of the watershed surrounding Pinto Creek include both active mines and inactive abandoned historic mines. Between 2007 and 2022, the Arizona Department of Environmental Quality (ADEQ) and the United States Forest Service (USFS) implemented remedial actions at six abandoned mines that drain into this segment of Pinto Creek. The USFS remediated five abandoned mine sites that included on-site consolidation of mine-impacted waste and closure of 10 adits, 12 shafts, and 5 onsite consolidation cells that hold a total of 8,000 cubic yards of waste rock. The Gibson Mine, identified as the largest copper source in Pinto Creek, was remediated in phases by ADEQ. ADEQ's first remediation effort at Gibson Mine in 2007 removed 100,000 tons of mine-impacted soils from the site. This reduced dissolved copper concentrations by 50 percent, but surface water samples were still not meeting dissolved copper water quality standards. The second remediation effort in 2016 included stormwater controls where the site was divided into undisturbed and disturbed areas. Undisturbed lands diverted clean stormwater to a bypass culvert and into the ephemeral tributary to Pinto Creek, whereas disturbed lands channeled stormwater to impoundments to be retained on site. This reduced dissolved copper concentrations by 75 percent, but surface water samples were still not meeting dissolved copper water quality standards. The final remediation effort began in October 2022 and consisted of the excavation and onsite consolidation of "hot spot" areas where an x-ray fluorescence site assessment identified elevated concentrations of copper; backfilled hot spots with clean cover and vegetation; improvements to the bypass culvert headwall and installation of a standpipe to prevent clogging; improvements to the v-ditch to convey clean stormwater; and installation of a turf-reinforced mat to prevent erosion into the copper-rich bedrock. As of today, surface water samples in Pinto Creek are meeting water quality standards and a provisional delisting of dissolved copper from the Clean Water Act's Section 303(d) list of impaired waters has been recognized by ADEQ. This improvement to the water quality can only be attributed to the efforts of the USFS and ADEQ to identify, prioritize, and remediate discharging abandoned mines in the watershed.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 2: Room C -

Acid Mine Drainage

Crabtree Creek AMD Restoration Study

William D. Neider, P.E., Michael Baker International

AMD discharges continue to impact the Loyalhanna watershed with the largest remaining bituminous discharge at Crabtree Creek, there is a need to accurately characterize the underground workings and their hydraulic connectivity to the discharge point to evaluate solutions to capture, convey, and treat the AMD in a cost-effective manor for the Loyalhanna Watershed Association (LWA). A geologic literature and mine map review were conducted to review soils, geology, mining activities, landslide susceptibility, and groundwater. A geophysical survey was also performed to help connect field conditions to historical data found during due diligence and determine if there are any other unknowns. Seven test borings were performed with four of them being shallow open standpipe monitoring wells. Dye tracer testing was performed to obtain data to characterize the hydraulic connectivity of the mine workings, into which the monitoring wells were installed, with the discharge point at Crabtree Creek. Site planning and engineering design needs to include a detailed evaluation of the impacts of proposed works on the existing abandoned underground mine shafts. Placement of a collection system to capture AMD discharge should be as close to Crabtree Creek as feasible to limit potential adverse impacts to the existing mine workings.

Lab- and Pilot-Scale Sulfate-Reducing Bioreactors Treating Acid Mine Drainage from an Abandoned Nevada Gold Mine

Thomas Kaps, Chemical and Materials Engineering University of Nevada-Reno

In this work, four pilot-scale SRBR were installed as in-field bioreactors in Perry Canyon, NV near the abandoned Jones-Kincaid adit. In parallel, eight lab-scale SRBRs were operated at the University of Nevada, Reno. Each SRBR contained organic substrate (corn stover, pine shavings, and dairy manure), pea gravel to maintain porosity, and a microbial inoculum. The inoculum was obtained from either the anoxic soil of a nearby lake environment (the Sparks Marina) or from the AMD-impacted ephemeral stream of Perry Canyon, with both demonstrating high sulfate-reducing performance in past work. The pilot-scale SRBR were fabricated as 115-L upflow drums and were installed below ground to modulate environmental conditions and were fed AMD directly from the adit. The lab-scale SRBR were 2-L upflow columns fed synthetic AMD mimicking the Perry Canyon AMD composition. Sulfate and metals concentrations of feed and effluent from each SRBR were monitored temporally. Although results to date indicate limited sulfate reduction occurring in the field-scale SRBR during the first six months of the in-field operation, corresponding to October through April, the reactors inoculated with the marina soil have slightly greater sulfate reduction than those inoculated with AMD-impacted soil. We believe the colder temperature averages (O to 10 °C) in these months are responsible for the lower performance thus far, and we expect performance to increase with increasing spring and summer temperatures to levels comparable to those observed in the lab. The concurrent operation of field and lab SRBR in this work will provide valuable knowledge of the scale-up process of the treatment technology, as well as insight into how environmental operating conditions may impact the SRBR performance. If designed and operated properly, SRBR have the potential to be a cost-effective option for AMD remediation at locations around the world.

Old Bevier Passive Treatment System – Reconstruction and Performance in Treating High-Acidity AMD

Daniel Wedemeyer, Missouri Department of Natural Resources Land Reclamation Program and Paul Behum, PhD, Office of Surface Mining Reclamation and Enforcement, Mid-Continent Region

The Old Bevier Passive Treatment System (PTS) is an abandoned mine lands (AML) site located near Ardmore in Macon County 55 miles north of Columbia, Missouri. The current Old Bevier PTS was developed by Missouri DNR Land Reclamation Program with the assistance of the Office of Surface Mining Reclamation and Enforcement, Mid-Continent Region (OSMRE-MCR). This treatment system employs a network of French drains to collect underground mine discharge and shuttle this net acidic drainage (AMD) to the 4.6-acre passive system. Iron and acidity of the inlet AMD is high with medians of 254 mg/L and 579 mg/L CCE, respectively. The French drain acts like an anoxic limestone drain (ALD) that produces a median of 201 mg/L CCE alkalinity to pretreat the AMD. An original treatment system was constructed in 1990-1991 that required a large amount of alkaline dilution water to produce a net alkaline discharge. Operational difficulties with the dilution water source limited the effectiveness of the original system. An enhanced PTS employing two vertical flow ponds (VFPs) in conjunction with two oxidation ponds and three aerobic wetlands was constructed in 2001 by the state and federal team. After the 2001 reconstruction, the enhanced PTS successfully removed most of the iron and acidity contained in the AMD. However, by 2019 the flow though the VFPs diminished and there is a considerable accumulation of iron hydroxide sludge that required removal. A rehabilitation of the two VFPs which removed precipitates and replaced the treatment media was completed in 2020. This presentation will discuss the 2020 rehabilitation of the system, water quality trends and functionality of the enhanced Old Bevier PTS, as well as lessons learned by the reconstruction and operation with high-acidity AMD.

Tioga River Watershed Restoration/ Consumptive Use Mitigation Through an Active Mine Drainage Treatment Plant Project

Tom Clark and Sami Pretzel, Kleinfelder

The Tioga River Watershed, a major tributary to the Upper Susquehanna River Basin, has been impacted significantly by Northern Bituminous Coal Field abandoned mine drainage stemming from legacy coal mining that began in the mid-1800s. These impacts, centered around the Borough of Blossburg and the village of Morris Run in Tioga County, Pennsylvania, has rendered over 20-miles of the Tioga River and several tributaries as fishless due to acidity, iron, and aluminum loading. This impact mainly emanates from five deep mine discharges that are relatively close to one another, which will allow for their conveyance to a centralized active plant that will treat all five flows in total. Strategic placement of the treated flow into two impacted tributaries will also allow for the restoration of additional stream mileage that has cold water fishery potential. In addition, water quality restoration of the Tioga River will also lead to the similar restoration of the Tioga Lake portion of the United States Army Corp of Engineers Tioga-Hammond Dam Complex. Water quality restoration of Tioga Lake could lead to a significant consumptive use mitigation / low-flow augmentation project that would safeguard adequate water quality /quantity for downstream industrial, commercial, and agricultural water users.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 2: Room C -

Acid Mine Drainage

A Tale of Two Mine Water Treatments

David Heinze, Ramboll

There are a variety of active and passive treatment alternatives for mining influenced water (MIW). No single treatment technology works in every situation or with every type of mine water chemistry. The applicability and effectiveness of a particular mine water treatment technology depends on many site-specific factors including but not limited to: site location and available area, access, climate and weather, pH, oxidation state, flow, heavy metals to be treated, regulatory requirements, public acceptance and potential ecological concerns. A broad range of technologies is available for the treatment of AMD. These technologies utilize one or a combination of chemical, physical and biological processes, including pH control, adsorption/absorption, complexation, chelation, biological mediation, oxidation/reduction, electrochemistry, sedimentation, flocculation/filtration/settling, ion exchange and crystallization. By far the most common process for treating AMD is via pH control and chemical precipitation. Depending on the volume of water to be treated, some of these require large treatment plants, which have high initial capital expenditure costs and significant operation and maintenance costs. These treatment operations require maintenance and staff (e.g., power input for pumps, controls, or chemical input and operators for the treatment operations). Ramboll has operated the Eagle Mine Water Treatment Plant Site since 2010. The plant is a lime and settling plant that includes addition of lime and polymer to promote settling of solid particles containing metals. Acid is added to reduce the alkalinity of the treated water to acceptable discharge limits. At the other end of the technology spectrum, there are treatment systems that use natural processes to treat mining-impacted water. These systems are generally designed to work without power and are designed to have low operation and maintenance requirements. There is no completely passive system (low maintenance ≠ no maintenance). Although treatment is provided using passive systems, strict compliance with all water quality standards may not always be able to be achieved. The most common bioreactors currently employed use sulfate-reducing bacteria to raise pH and remove metals. Sulfate is reduced to sulfide, which can react with metals to form relatively insoluble metal sulfide precipitates. Biochemical reactors were designed and installed at the Bully Hill and Rising Star Sites consisting of a compost substrate relying upon sulfate-reducing bacteria to treat the mine water containing dissolved metals to form insoluble metal sulfides that are precipitated in the passive treatment system. The Site is generally accessible by boat year-round and by 4-wheel drive vehicle between mid-April mid-November. The Site has no utilities (electricity, sewer, or water) and cell phone service is unreliable. Ramboll will present a summary of each mine water treatment system with challenges associated with each site and lessons learned in both and active and passive water treatment.

Expanding Inventory in the Era of BIL

Matt Trousdale, Matt Coe, and Sara Bell, Alabama Department of Labor, Abandoned Mine Land Reclamation Program

The focus of this presentation will be to explore innovative and cutting edge ways to expand AML inventory in the era of BIL. It will look at the use of apps, high accuracy GNSS units, drones, etc. and how this technology can be utilized to quickly build a deeper inventory, a necessity with BIL funding. There will be a tech talk about all these devices and apps. This presentation will cover the benefits and necessity of cross-disciplinary project evaluations on initial and preliminary visits to potential project sites. It will examine why it is important to have GIS/environmental, engineering, and inspection staff all visit a site for preliminary evaluation. It will examine why different perspectives and experience levels are vital for project evaluation and documentation. A strong and up to date eAMLIS inventory is vital. It is important to have a mastery of eAMLIS to keep your inventory up to date and to draw on for new projects. We will talk about strategies for finding new projects and the strategy of focusing on your core counties but giving those peripheral counties a deeper look. We will evaluate the question of whether you should look at quality or quantity or find a median between the two. What do you evaluate when looking at potential projects? We all know that proximity and visitation are the two primary factors. But, what about other things? Does the site contain an attractive nuisance? Would reclamation alleviate the problem at hand if there is not an attractive nuisance on site? Should reclamation be done as a preventative measure to prevent a future gob fire, for example? All these questions and more, will be looked at. In anything, communication is key. We will examine why early communication with landowners is so important. We will examine notification methods for projects whether they be citizen complaints or AML staff finds. We will examine the different types of property owners, whether they be private, corporate, public, or non-profit/religious and strategies on how to communicate with different entities. From an engineering perspective, this presentation will examine the question of when evaluating a site, is it a project to be designed in-house or would it a better idea to contract the design out to a firm. An engineering perspective would look at the size and scope of the site as a potential project. It would evaluate the proximity to sensitive waterbodies. These considerations help with the project selection and evaluation process. The engineering perspective will also look at the software that is utilized such as Carlson CAD software and integrating Esri ArcPro and ArcGIS Online into the engineering process for things such as property and parcel geospatial data. This presentation will evaluate how technology can be integrated into the inspection process. Field data collection apps and survey grade GNSS units can be utilized to accurately set project and clearing limits. This technology can be utilized mark the location of dams, down drains, and terraces. It can also be used to check and set elevations on active construction sites. In short, using GNSS technology from the beginning to the end of a project will be explored. How can drone imagery be of use in expanding inventory and during the construction process? Drone imagery can be used as a visual timeline of a potential project from a pre-construction to post-construction status. Drone imagery can also be utilized to identify areas in need of maintenance on a project, post-construction. This presentation will look at the specific apps/software and hardware that have been utilized by the Alabama AML Program and our experiences with them. It will also examine the future of the Alabama AML drone program.

SESSION ABSTRACTS

MONDAY, SEPTEMBER 25

SESSION 2: Toronto -

Technology & GIS

Using Geospatial and Geostatistical Models to Visualize Site Data and Features, Estimate Waste Extents, and Inform Remediation Design

Maria Pomeroy, Pioneer Technical Services

Reviewing and analyzing data gathered from remedial investigations at historical mine sites can sometimes feel like reading a great mystery novel. The myriad of interconnected pieces makes it difficult to tie them all together without a visual aid. The complex and often undocumented site activities and features at historical mine sites can create multiple contaminant sources. Abandoned infrastructure and site geology can form preferential pathways for contaminant migration. Sometimes the source of the contamination is not located where expected, and the expected source is not contributing to the contaminant plume. Understanding how the site features, geology, groundwater, and contaminant sources interact can be essential in designing a sustainable and enduring remedy. Geospatial and geostatistical models provide an interactive and three-dimensional visual aid that can help engineers and scientists solve the mysteries presented by the historical mine sites. The modeling programs provide a platform to visualize the data gathered during remedial investigations in three dimensions to better understand how the site geology, hydrology, historical infrastructure, and contaminant sources interact. This presentation provides an overview of how the Leapfrog Works1 software was used to create a robust conceptual site model that was integrated into the remedial design at a historical mine site. The presentation details how the design team used the program to visualize the site data, model site geology, contaminant concentrations, and leachability potential, and how the model outputs were used to inform the remedial design.

Collaborative GIS Solutions to Support Abandoned Mine Data Collection for Investigation, Documentation, Closure, and Monitoring

Staci Dratler and Pam Moeller, P.G., Jacobs Engineering Group

Many challenges must be addressed to manage the myriad data collected during the investigation of historical mining claims and openings. A vast number of claims and mining features combined with an even greater number of data categories and data points collected create data management constraints. Some of these worth highlighting from eight years of research into approximately 15,000 historic mining claims include digitizing mining claim locations from historical documentation while reconciling various data input and managing consistency across datasets. Through the creation of custom:
(1) tools within ArcGIS,
(2) survey forms utilizing Esri's data collection platforms FieldMaps and Survey123, and
(3) GIS technology,
we have successfully mapped and inventoried over 12,000 historical mining claims and 1,600 historical mine openings while maintaining integrity and consistency of data from multiple sources and across multiple field surveys. This presentation demonstrates a multi-party team utilizes technology to address these challenges and how the two organizations have collaborated to refine the process and share data access for synchronized field data collection, evaluation, and reporting.

Implementation of Enterprise GIS Solutions to Improve Efficiencies of AML Project Management

Cory Ott and Dave Hibbard, P.G., Brierley Associates

The Architecture, Engineering & Construction (AEC) industry has been rapidly evolving, prompting consultants to embrace new technologies to improve all facets of project management throughout the life cycle of a project. Abandoned Mine Land (AML) projects require the integration of complex geospatial solutions in order to improve upon and evolve the existing framework that consultants, contractors, and clients operate on today. Brierley Associates' (BA) has developed a suite of integrated GIS and Remote Sensing solutions to improve efficiencies of project management that apply to various types of AEC projects which include but are not limited to geotechnical drilling investigations, geohazard mapping & characterization, and subsidence mapping and mitigation. As a partnering firm with the Environmental Systems Research Institute (ESRI), BA leverages and customizes powerful ESRI GIS technologies to help improve project management efficiency for various AEC projects. These solutions are created and provided in the form of products and services for clients, internal team members, and additional stakeholders. Providing web-based GIS and Remote Sensing products and services to clients enhances transparency with the data that is being collected and how it is being managed. BA has deployed a robust Multi-Machine ArcGIS Enterprise ecosystem that includes customized ESRI Software as a Service (SaaS) and Platform as a Service (PaaS) solutions that are designed to address requested criteria specific to each individual project. AML projects are becoming more common across the United States due to the most recent increase in federal funding, which will require that GIS and Remote Sensing be employed on a regional scale to improve the efficiency of project management for these new programs from the start. Brierley Associates has remained on the forefront of harnessing cutting edge geospatial technology to create a more interactive and transparent project management environment for all stakeholders involved. Embracing GIS and other technologies to help evolve AML project management throughout the life cycle of a project has proven to bolster relationships with existing clients and open doors to relationships with new partners and clients throughout the country.

Creating a Geospatial Tool that uses Data to Track Reclamation and Assessments of Potential Hazards Caused by Mined Lands in the Continental United States

Serena Seawolf, Utah Water Science Center, U.S. Geological Survey

Mined lands, both surficial and underground, present unique environmental and socioeconomic challenges. Therefore, there is a strong concern in accurately assessing hazards surrounding mines as well as systematically approaching remediation and reclamation of active and abandoned mined lands. While disparate datasets exist to address these challenges, to date there is no centralized resource that incorporates mine characteristics, reclamation status, environmental features, human health concerns, and potential hazards for stakeholders and decision-makers to evaluate and prioritize remediation efforts. To address this, the USGS is developing a decision support tool combining national and regional data in an online, accessible, and easy-to-use geospatial application for Department of Interior users. The application's aim is to aid decision makers in identifying mine activities near vulnerable communities, as well as prioritizing and tracking remediation efforts in a versatile and transparent manner. Additionally, this tool will generate risk metrics which will guide users in the planning stages and progress of mine reclamation and hazard assessment. Field activities in 2024-2025 will apply application-derived metrics to prioritize locations for study in the Colorado River Basin and Appalachian region. This project is a partnership between the USGS, Bureau of Indian Affairs, Bureau of Land Management, Bureau of Reclamation, National Park Service, and the Fish and Wildlife Service. Co-development with partners will guide informed decision-making.

SESSION ABSTRACTS

TUESDAY, SEPTEMBER 26

SESSION 3: Room A -

OSMRE Awards

OSMRE National Award Presentation

OSMRE Small Project Award Presentation

OSMRE Appalachian Region Award Presentation

OSMRE Interior States Region Award Presentation

SESSION 3: Room B -

OSMRE/ NAAMLP Hardrock Awards/ Acid Mine Drainage

OSMRE Western Region Award

NAAMLP Hardrock Remediating Contamination Award Presentation

NAAMLP Hardrock Remediating Safety Hazards Presentation

(NOTE: AWARD PRESENTATIONS ARE TO BE ANNOUNCED)

Optimizing Growth of Acidophilic Iron-Oxidizing Bacteria for Acid Mine Drainage Remediation

Anan Almomani, Ohio University

A failure in the seal of a pumping station of an underground abandoned mine in 1983 caused the discharge of AMD into the Sunday creek 7 miles downstream into the Hocking River in southeast Ohio with a discharge rate of 2.16 cfs (5.3 million L/day) containing 252 mg/L of dissolved ferrous iron and an acidity of 430 mg/L. The remediation goals are to remove the heavy iron loading, increase the alkalinity, and as a result, restore the biodiversity in Sunday Creek. The adopted treatment method relies on the oxidation, precipitation, and removal of iron by pumping the discharge into a treatment facility. The novel part in this project is the recovery of ferric hydroxides to be sold as paint pigment. The recovery of this resource will offset the operational costs and overcome the financial burdens of this project. The possibility of adopting the biological treatment pathway by using acidophilic iron-oxidizing bacteria was investigated. The goal of this research was to test the effects of pH, nutrients, and organic carbon on naturally occurring acidophilic iron-oxidizing bacteria and iron oxidation rates. Three cultures were collected from abandoned mines in Ohio (WR and FR) and Pennsylvania (PA). The culture found at WR site resulted in the highest oxidation rates. The best pH level, ammonium concentration, and phosphate concentration were found to be 2.5, 0.1 M, and 5 mM, respectively. The organic carbon had no beneficial effects on iron oxidation. Applying these results on Truetown AMD resulted in 93% increase in iron oxidation rates (from 0.029 hr-1to 0.398 hr-1). With further economical optimizations, treating acid mine drainage with acidophilic iron-oxidizing bacteria can become the optimal solution.

The Merging of GIS and Remote Sensing; Disciplines Used in Monitoring, Analyzing, and Detecting Subsidence Feature

Cliff Simmons and Cory Ott, Brierley Associates

The monitoring of subsidence features is an ever-evolving process with remote sensing playing an integral part in investigation. The subsidence features generally investigated are surficial depressions, historic mine shafts, portals, shallow groundwater, and overlying infrastructure. Use of photogrammetry, LiDAR, and thermal image mapping are integral in the during the investigation process. GIS is utilized to store, analyze, share, display, and convert remotely sensed data into usable format and product, which are provided to an extended team of engineers and geologists to enhance investigation and analysis. This remote sensing program runs entirely on the use of sensors mounted onto unmanned aerial systems (UAS) that incorporate the use of ground control points and RTK precision for enhanced vertical and horizontal accuracies. ESRI technology is utilized to build web-based field collection applications which draw data from a custom GIS Enterprise geodatabase built exclusively for Wyoming's AML program. 3-D products are generated using ESRIs Site Scan and are used in 3rd party modeling software in conjunction with LiDAR data to enhance the geomorphological environment. The benefits of using remote sensing products infused into an Enterprise GIS, allow for a full suite of products that can be used to assimilate and decipher not only subsidence features, but all collected spatial mapping data. Use of this technology has greatly contributed to bridging the gap between the two disciplines – aerial mapping and GIS.

Virginia Department of Energy Coal Waste Inventory Project

Jesse Whitt, Virginia Department of Energy

In 2022 the Virginia State Legislature enacted House Bill 657 which required "the Department of Energy, in cooperation with public institutions of higher education serving the coalfield region of the Commonwealth, to identify the approximate volume and number of waste coal piles present in the area and options for cleaning up such waste coal piles, including potential use in electricity generation." The Virginia Department of Energy (Virginia Energy) coordinated with a local consulting firm and academic researchers to complete a study outlining coal waste reclamation and utilization in Virginia. This presentation focuses on the site location and volume assessment aspects of the study, as well as the development of data collection and visualization applications for the project. The creation of the data set and volume estimates were considered a desktop exercise with minimal opportunities to ground check data points due to the narrow timeframe of the project. This aspect of the study is considered the preliminary phase of a more long-term effort to locate and assess coal waste sites in Virginia. To satisfy the requirements of the state lawmakers, Virginia Energy's AML group developed a plan to assess locations for coal waste piles in the coalfield region using historical data, existing AML inventory data, and input from current and former AML staff. From the existing data, the team created a master dataset and developed methods to estimate gob pile volumes using LiDAR derived elevation data sets to create assumed historical elevation data sets for cut/fill analysis. Virginia Energy contracted with Marshall Miller and Associates (MM&A) to verify methods, estimate site volumes, and to identify waste coal sites in Buchanan, Tazewell, and Russell counties while Virginia Energy completed work for Dickenson, Lee, and Wise counties. Virginia and MM&A compared methods and audited a sample of each other's data to ensure accuracy and consistency between data sets produced by both groups. Using the inventory data Virginia Energy created publicly available webmaps and dashboards to share with those interested in coal waste reclamation along with a story map application to explain the methods used to create the data sets and calculate volume estimates. The outlined project work is a first step in creating a robust coal waste inventory that can be utilized by public and private entities that are interested in coal waste reclamation, AML enhancement projects, critical mineral research and environmental issues associated with coal waste sites.

SESSION ABSTRACTS

TUESDAY, SEPTEMBER 26

SESSION 3: Room C -

Technology & GIS

LiDAR to Identify and Characterize AML

Brooke Erreger and Trenton Walker, Tennessee Department of Environment and Conservation, Division of Mineral and Geologic Resources, Land Reclamation Section

The prevalence of Light Detection and Ranging (or lidar) imagery has revolutionized remote sensing operations and provided previously unimagined insight into the shape of the Earth's surface. Fine fluctuations in topography can be noted with resolutions of just a few feet per pixel, and the shape of the bare Earth, digitally shorn of her foliage, can be readily discerned to the scale of cinderblocks, plow furrows, and potholes. In particular, the use of lidar in identifying and characterizing abandoned mine lands (AML) allows for near-perfect imaging of strip mining and mine opening features prior to site visitation, significantly increasing the efficiency of field activities and maximizing the use of program resources. Using lidar acquired in conjunction with the United States Geological Survey (USGS), the State of Tennessee's Strategic Technology Solutions (STS), and public partners at various levels of local government, the Land Reclamation Section of the Tennessee Department of Environment and Conservation (TDEC) has remotely identified nearly every remaining acre of AML in the Tennessee coalfield, with a current total of more than 47,000 acres of potentially eligible AML and more than 9,000 open or previously open mine portals, vertical openings, and similar point features. The application of lidar-based remote sensing techniques has guided the in-person investigation of many of these features, and almost without exception the ground-truthing of these features has matched expectations based on in-office interpretations of lidar data. Familiarity with the appearance of these features on lidar and the use of basic 3-D modeling – already packaged by default in many popular GIS programs – makes AML identification easier, quicker, and more accurate than ever before. The review of available lidar data should be treated as a fundamental precursor to any AML investigation activity, and developing familiarity with the appearance of AML features on lidar should be a top priority for any team member involved in identifying, cataloging, and investigating potentially eligible sites.

Leveraging Machine Learning, Artificial Intelligence, and Augmented Reality for use in AML

Shane Zumpf and Kelby Wilkison, Trihydro Corporation

Abandoned Mine Land (AML) program sites face several challenges that hinder effective reclamation and restoration efforts. Some of the key challenges include limited funding, site prioritization, data management and analysis, and long-term stewardship. Addressing these challenges requires a multidisciplinary approach, collaboration between stakeholders, and leveraging innovative technologies such as Machine Learning and Artificial Intelligence to optimize decision-making, prioritize sites, and streamline reclamation processes. The emergence of technologies such as ChatGPT, Virtual and Augmented Reality can allow agencies additional tools to run more efficiently. This presentation will start by unpacking these cutting-edge technologies and presenting explanations that demystify their operation and utility. We'll highlight accessible technologies that agencies can immediately leverage to their advantage. Following that, the discussion will delve into the ways the Trihydro software development team has already developed that leverage Machine Learning (ML), Artificial Intelligence (AI), and Augmented Reality (AR) technologies. Drawing inspiration from Trihydro's successful development of ML models for transportation, we will showcase how this expertise can be extended to the AML field. Finally, we will discuss the requirements needed for these technologies to be successfully developed and deployed in a production environment. The incorporation of new technologies in AML can lead to enhanced data analysis, more precise risk assessment, and streamlined decision-making processes. Through relatable real-world examples, attendees will garner valuable insights into the potential of ML, AI, and AR in revolutionizing the Abandoned Mine Land reclamation efforts.

The White Hat World of AML and How It's Fighting A Changing Climate / Colonial Roosting Bats, Partnerships, and Getting $!@# Done

Jason Corbett, Bat Conservation International

Abandoned Mine Land(s) programs across the country are doing their good work out on the various landscapes in which they operate each and every day. Inventory, remediation, reclamation. While typically seen as White Hat work due to the reduction of safety hazards commonly associated with AML sites, I want to shine a light on another highly positive aspect of how AML programs across the country are helping many animals, and in this case, bats, persist in changing landscapes. Come along with me on a journey that will show you how and why AML programs are so important in the ongoing conservation efforts for bats in the United States. / What do colonial roosting bats, AML partnerships, and getting tasks accomplished have in common? Great question! With over a decade of working in AML, I have seen and experienced a positive correlation when agencies form tight partnerships with a diverse array of partners. Either funding constrained, or flush with funding, the can-do attitude inherent to AML practitioners can result in outstanding results. I will highlight two separate examples and detail some of the tactics used to keep work moving forward. And bats! We can't forget the bats. Yes, I'll tie it all together, don't you worry!

Updated Best Practices for Safeguarding Mine Openings in Wyoming

Brett Drake, P.E., RESPEC

Effective mine safeguarding is an essential component of abandoned mine land hazard mitigation. At first glance, safety closures seem simple, but mature programs like the Wyoming AML Division have learned that many variables impact the long-term success of mine entry safeguards, including access for wildlife, mineral claimants, biologists, hydrological considerations, and rock mechanics. The Wyoming AML and RESPEC have worked together for decades to mitigate hundreds of coal and non-coal mine hazards across Wyoming, including horizontal openings, vertical openings, and subsidence-related features. RESPEC and the Wyoming AML have created dozens of different designs and specifications for closures, informed over time by updated recommendations from Bat Conservation International and addressing federal and state land managers' needs. In 2023, RESPEC worked with the Wyoming AML to create and formalize standard drawing templates and procedures that will consistently provide the State of Wyoming with effective, affordable, and defensible abandoned mine land safeguards.

SESSION ABSTRACTS

TUESDAY, SEPTEMBER 26

SESSION 3: Toronto -

Bat Conservation

USFWS Bat Listing Updates (Virtual Presentation)

Melinda Turner, U.S. Fish and Wildlife Service

USFWS staff will review listing status and updates for the Indiana bat (Myotis sodalis), northern long-eared bat (Myotis septentrionalis), tricolored bat (Perimyotis subflavus), and little brown bat (Myotis lucifugus). The presentation will cover brief life histories, threats, and species-specific protection and enhancement measures to support recovery.

Effectiveness of Current AML Mitigation for Maintaining Use of Mines by Bats

Rick Sherwin, PhD, Christopher Newport University

Land managers have long recognized the relationship of many species of bats with abandoned mines. As a result, Abandoned Mine Land (AML) programs typically mitigate wildlife needs through the identification and protection of key roosting habitat, primarily using bat gates as the closure method. For mines which have not been identified as needing conservation, or in cases where important roosting habitat cannot be conserved (ex., structural instability), exclusions are recommended to ensure that no bats are roosting in underground features at time of closure. The legacy of AML programs includes safeguarding dangerous landscapes while also preserving subterranean bat habitat throughout North America. Important roosting habitat is typically identified prior to closure through surveys of mine workings searching for direct evidence of bat use and/or assessing type and quality of internal habitat from which to infer potential use by bats. While pre-closure surveys are standard for most AML projects, limited work is typically done at closure sites following reclamation. As a result, much of our understanding of bat responses to closure projects and gate installation is ad hoc and typically derived from opportunistic observational accounts collected outside of any standardized research design. This study presents data collected over 20 years at the Lake Valley mine-complex in southwest New Mexico. We studied the ecology of roost use by bats for 10 years prior to reclamation and are continuing to study the response of bats to the AML reclamation project over 10 years following these efforts. Lake Valley offers a unique opportunity to assess the overall effectiveness of AML mitigation strategies, and potential differential responses of bats to various gate designs for several reasons. First, it is used by several species of bats; Second, it is used during all biological use periods; Third, underground workings are accessible through many opening types (ex., adit, shafts, stopes) of varying dimensions; Fourth, securing of these various opening types and sizes required a variety of bat compatible closures; and Fifth, other mines were available in the landscape that bats could move to if reclamation efforts were biologically unsound. Basically, bats have a choice of opening size, type, and gate method to access the same workings, and they also have the option to move to other nearby mine workings if need be. We studied the behavioral responses of bats to gates, changes in colony size, and changes in patterns use of available roosting habitat within a landscape. We compared these data with those collected over a five-year period prior to reclamation. Gates included various construction materials, designs, and those with and without culvert stabilization. We found no evidence of wholesale rejection of gates for any type of roost use (ex., maternity, hibernation, swarming, bachelor). It is quite possible that anecdotal accounts of site abandonment are a result of insufficient monitoring intensity or failure to identify critical mine roosts during pre-closure surveys. The most critical aspect of maintaining bat use in AML projects comes from understand bat use of the mines through quality of the pre closure surveys using appropriate data collection tools and a focus on underground habitat within each mine, rather than relying on presence of bats at time of survey as the sole indicator of habitat use.

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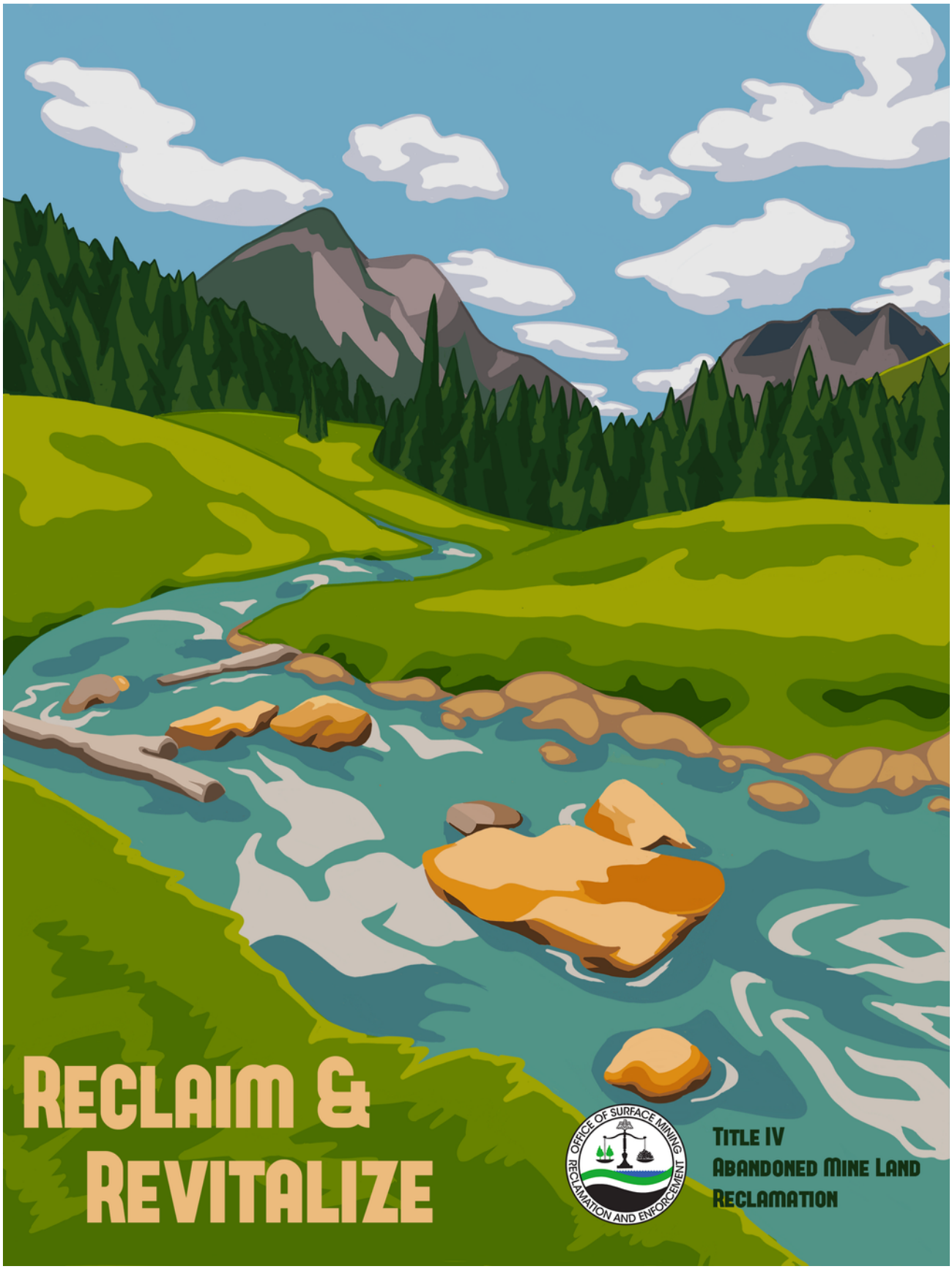


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