

Technology Innovation News Survey

Entries for February 16-28, 2019

Market/Commercialization Information

NAVAJO ABANDONED MINE RESPONSE & CONSTRUCTION SERVICES (AMRCS)

U.S. EPA, Office of Acquisition Solutions, Region IX, San Francisco, CA.
Federal Business Opportunities, Solicitation 68HE0918R0014, 2019

U.S. EPA intends to issue a solicitation on or about April 8, 2019, for a competitive acquisition via FedConnect to solicit for Navajo Area Abandoned Mines Response and Construction Services (AMRCS) to provide cleanup, response, and construction services for EPA, primarily at former uranium mining-related sites on or within the Navajo Nation (in Arizona and New Mexico) and within the Grants Mining District (New Mexico). EPA anticipates awarding multiple 5-year fixed-rate IDIQ contracts as total small business set-asides, NAICS code 562910 (Environmental Remediation Services). The anticipated total capacity of all the contracts combined is \$220M. Two pre-proposal conferences are tentatively scheduled for April 16, 2019. <https://www.fbo.gov/spg/EPA/OAM/RegIX/68HE0918R0014/listing.html>

FENCE-TO-FENCE ENVIRONMENTAL SERVICES

Department of the Army, U.S. Army Corps of Engineers, USACE District, Seattle, WA.
Federal Business Opportunities, Solicitation W912DW19R0018, 2019

This project is set aside for 8(a) firms under NAICS code 541620. The USACE Seattle District is assisting the Air Force Civil Engineer Center to procure multi-year, fence-to-fence contracts for environmental services at Mountain Home AFB and Malmstrom AFB to support one or more environmental compliance programs on the bases as needed or as regulated by the Idaho Department of Environmental Quality, Montana Department of Environmental Quality, U.S. EPA, and other state and local regulatory agencies. The programs include Hazardous Waste, Hazardous Materials, Air, Storm Water, Natural Resources Management, EMS, and other environmental compliance programs. Responses are due by 2:00 PM PT on April 15, 2019. <https://www.fbo.gov/spg/USA/COE/DACA67/W912DW19R0018/listing.html>

EMERGENCY PREPAREDNESS RESPONSE AND RECOVERY SERVICES

U.S. Postal Service, Facilities Portfolio, Headquarters Facilities, Washington, DC.
Federal Business Opportunities, Solicitation 4AD-19-A-0002, 2019

The solicitation documents and proposal delivery for this procurement can be accessed only via registration at <https://uspsprod.emptoris.com> as described in the FedBizOpps notice. The U.S. Postal Service is interested in awarding one or more IDIQ contracts for Emergency Preparedness Response and Recovery Services for all postal locations throughout the U.S. including Alaska, Hawaii, Puerto Rico, Guam, U.S. Virgin Islands, Northern Mariana Islands, and American Samoa on a national 24-hr, 7 d/wk basis throughout the year. Contract support services include emergency planning and identification of threat agents; natural and human-made disasters; environmental releases; containment of a threat agent; decontamination of facilities, property, and equipment; transportation and disposal of contaminated materials; laboratory and analytical support for identifying suspected threat agents; and environmental contaminants. Proposals must be delivered through EMPTORIS by 5:00 PM ET on April 19, 2019. <https://www.fbo.gov/spg/USPS/FP/HF/4AD-19-A-0002/listing.html>

Cleanup News

PERFORMANCE REVIEW OF A PASSIVE TREATMENT SYSTEM FOR FE, AS, MN AT THE EMPIRE MINE STATE HISTORIC PARK

Schipper, R., N. Gallagher, T. Rutkowski, S. Lofholm, and G. Leach. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 76, 2019

The Empire Mine State Historic Park contains 367 miles of now-flooded underground workings. Following closure, discharged mining-influenced water (MIW) contained arsenic, iron, and manganese in excess of federal and state standards. A full-scale passive treatment system (PTS), in operation since November 2011, was designed and constructed to treat the MIW and meet the permit limits. The PTS flowrate varies seasonally and has averaged 160 gpm with a peak near 1000 gpm. Metal removal results for the system have improved over time, corresponding with maturation of the PTS. Since February 2013, the PTS has provided effective removal of permitted metals to trace levels. In addition to metals removal, the PTS has also increased pH, increased dissolved oxygen, and reduced turbidity. See slides from a 2017 presentation:

<https://reclaimingthesierra.org/wp-content/uploads/2017/05/Steve-Lofholm.pdf>.

BENCH TO BUILD: DEVELOPMENT OF A NON-BIOLOGICAL SELENIUM TREATMENT TECHNOLOGY

Littlejohn, P. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 40, 2019

Selen-IX™ treatment technology was developed to remove selenium from mine-impacted water. The treatment process combines ion exchange and electrochemistry. Beginning in 2012, development of the technology has entailed four pilot campaigns, thousands of engineering design hours, multiple regulator and third-party technical reviews, and an industrial-scale demonstration. The first full-scale Selen-IX plant currently is under construction at a mine site in British Columbia, Canada, slated to begin operation in 2019. A description of the technology is available in a paper presented in 2014: <https://www.bqewater.com/wp-content/uploads/2014/11/BioteQ-2014-Hydromet.pdf>. Additional information:

<https://www.wateronline.com/doc/bqe-water-signs-operating-metals-for-water-treatment-using-selen-ix-technology-0001>

BRINGING LIFE BACK TO AN HISTORIC MINE

Thompson, T. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 107, 2019

The Swan River has a long history of mining. Using turn of the century methods in the early 1900s, dredge boats unearthed gold that existed 80 ft belowground. An historic mill existed and deposited tailings through the valley. Scars from these practices are glaring as sterile rock dominates the landscape. As a result, the Swan River, its riparian corridor, and surrounding uplands ceased to exist. A large-scale restoration project sought to reestablish the Swan River and reclaim the valley. Studies were conducted to understand groundwater and estimate pre-mining hydrology. The design involved significant site grading to create a new, meandering stream channel, resulting in a stream mimicking natural conditions. Aquatic habitat was created by constructing a natural riffle/pool system. The valley was transformed to create riparian and upland habitat in place of the barren dredge rock. Historic tailings were removed from the corridor, capped, and vegetated. The restoration work reclaimed the valley from an example of mining's historic impacts to an example of what creative reclamation can achieve. *More information:* <https://summitcountyco.gov/1183/Swan-River-Restoration>.

VOLUNTARY RECLAMATION AND REMEDIATION OF THE FORMER GARFIELD VANADIUM MINE SITE, RIFLE, COLORADO PART I: REMEDIAL INVESTIGATION, REMEDY SELECTION, AND RECLAMATION

Nielsen, B., C. Beul, J. Rusch, and L. Santisteban. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 106 [plus Part II, p 107], 2019

The Garfield Mine is a legacy vanadium mine in western Colorado. The site's multiple mine openings, waste rock piles, and adit seepages were voluntarily remediated through the Colorado Voluntary Cleanup Program (VCUP). The remediation process involved performing the site investigation under the supervision of a licensed radioactive materials handler while working with VCUP and the state's Radiation Management Unit. The remedial action objectives (RAOs) under VCUP included preventing direct human or biotic exposure to the waste rock and radiation emitting from the waste rock and maintaining the existing undeveloped character of the surrounding landscape. The site-wide design involved regrading, installation of an infiltration barrier and rock cover, a diversion channel, and a biologically based passive remediation water treatment system. The full-scale biologically based system, operational since 2017, was chosen to reduce metal concentrations and radionuclides in adit seepage (sulfate, Se, Zn, U, Ra, and gross alpha and beta particles) and prevent discharge from the site. The system consists of a sulfate-reducing biochemical reactor and post-treatment aerobic polishing cells that provide year-round operation and zero discharge of effluent. After 12 years of site investigations, the remedial action was completed in 2016 and 2017 with all RAOs met and a no-further-action determination granted in 2018. *See additional information in 85 PowerPoint slides at* <https://nma.org/wp-content/uploads/2018/06/Garfield-NMA-presentation-6-3-18-FINAL-Is.pdf>.

SIXTH FIVE-YEAR REVIEW REPORT FOR IRON MOUNTAIN MINE SUPERFUND SITE, SHASTA COUNTY, CALIFORNIA

U.S. EPA Region 9, 107 pp, 2018

From the 1860s through 1963, the 4,400-acre Iron Mountain Mine site was mined for iron, silver, gold, copper, zinc, and pyrite. Though mining operations were discontinued in 1963, underground mine workings, waste rock dumps, piles of mine tailings, and an open mine pit still remain at the site. Exposure of the mine workings, waste rock piles, and the open pit mine to oxygen and water have produced acid mine drainage management issues. The Richmond Mine of the Iron Mountain copper deposit contains some of the most acid mine waters ever reported. Values of pH have been measured as low as -3.6, combined metal concentrations as high as 200 g/L, and sulfate concentrations as high as 760 g/L. The installation and operation of a full-scale neutralization system, the capping of areas of the mine, and the construction and operation of the Slickrock Creek Retention Reservoir to collect contaminated runoff for treatment have significantly reduced acid and metal contamination in surface water at the site. <https://semspub.epa.gov/work/09/100010569.pdf>

Demonstrations / Feasibility Studies

'DEAD' RIVERS BROUGHT BACK TO LIFE

Engineering Designer 44(4):12-15(2018)

Swansea-based Power & Water (P&W), commissioned by Natural Resources Wales at the Cwm Rheidol mine, demonstrated the innovative and patented Sonoco (Sono-electrochemical) technology for effective treatment of acid mine drainage. A trial of the technology was conducted at one of the UK's top 5 most-polluting abandoned metal mines, where very high metal concentrations enter the River Rheidol in the mine's discharge water. P&W successfully removed up to 99.5% of Zn, Pb, Fe, and Cd while simultaneously reducing other metal concentrations with high reduction rates. *See pages 12-15 at* <http://www.ieddigital.co.uk/noindex/Redirect.aspx?id=2360&type=9&pdf=edr01jul2018fulledr.pdf>. *See also the BBC video interview at* https://www.youtube.com/watch?v=xzF-1vz8C_Y.

OPTIMIZATION OF COMBINED PHYTOREMEDIATION FOR HEAVY METAL CONTAMINATED MINE TAILINGS BY A FIELD-SCALE ORTHOGONAL EXPERIMENT

Li, X., X. Wang, Y. Chen, X. Yang, and Z. Cui. *Ecotoxicology and Environmental Safety* 168: 1-8(2019)

The combined application of plant, microorganism, and amendment on the phytoremediation of heavy metals was optimized as a remediation technique for mine tailings by a field-scale orthogonal experiment aimed to achieve the maximum phytoremediation effect. Soybean, *Mucor circinelloides*, and A3 amendment were used as the plant, microorganism, and amendment materials. With the application, effective fractions of copper, zinc, lead, cadmium, and manganese were immobilized for decreased bioavailability, indicating the phytostabilization served as a major repair pathway. Plant length and biomass in the treatments were significantly higher than that in the control, indicating their phytoremediation potentials were enhanced. The final contents of heavy metals in soil were decreased, and the removal rates of soil heavy metals were in the order of Pb > Cd > Cu > Zn > Mn. Temporal variations of soil microorganism populations indicated that the abundance of soil microorganism in the treatments was significantly higher than that in the control, and bacteria became the dominant microbial species.

DYNAMICS OF BACTERIAL COMMUNITIES MEDIATING THE TREATMENT OF AN AS-RICH ACID MINE DRAINAGE IN A FIELD PILOT

Laroche, E., C. Casiot, L. Fernandez-Rojo, A. Desoeuvre, V. Tardy, O. Bruneel, et al. *Frontiers in Microbiology* 9:3169(2018)

Bacterial diversity was characterized in a field-pilot bioreactor treating extremely arsenic (As)-rich acid mine drainage (AMD) in situ over a 6-month monitoring period. Over the monitoring period, iron (Fe)-oxidizing bacteria dominated the biogenic precipitate. Parameters that exerted a control on the bacterial communities potentially involved in the water treatment process included dissolved oxygen, temperature, pH, dissolved sulfates, arsenic and Fe(II) concentrations and redox potential. The ubiquity and the physiological diversity of the bacteria identified, as well as the presence of bacteria of biotechnological relevance, suggested that this treatment system could be applied to the treatment of other AMD. *This article is **Open Access** at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6309452/>.*

Research

INTEGRATING LABORATORY AND FIELD STUDIES TO ASSESS IMPACTS OF DISCHARGE FROM A URANIUM MINE AND VALIDATE A WATER QUALITY GUIDELINE VALUE FOR MAGNESIUM

Trenfield, M.A., A.J. Harford, T. Mooney, M. Ellis, C. Humphrey, and R.A. van Dam.
Integrated Environmental Assessment and Management 15(1):64-76(2019)

The purpose of this study was to investigate the protectiveness of the magnesium water quality guideline values for the Ranger Uranium Mine (north Australia) by conducting an integrated laboratory and field study. A direct toxicity assessment of the groundwater and creek showed affirmed the proposed environmental rehabilitation standard of 3 mg/L Mg for surface waters with a Ca concentration typical of water from this mine site. *This article is **Open Access** at <https://doi.org/10.1002/ieam.4098>*

PHYTOREMEDIATION OF SELENIUM-IMPACTED WATER BY AQUATIC MACROPHYTES

Natgrass M., N.R. McGrew, J.I. Morrison, and B.S. Baldwin.
Journal American Society of Mining and Reclamation 8(1):69-79(2019)

The bioavailability of selenium (Se) chemical form and concentration on plant uptake were evaluated to determine the potential of aquatic macrophytes to improve water quality in a constructed wetland. The experiment was arranged as a 2x2 factorial nested within a split-split plot design replicated three times. Selenium treatments were applied to cattail (CT), duckweed (DWD), fanwort (CAB), soft rush (SR), muskgrass (MG), and unplanted controls (UNP) as a 4-L solution of either sodium selenite or sodium selenate to a total volume of 30 L at 0, 500, or 1000 µg/L Se. After six days, CT and MG-planted microcosms significantly decreased aqueous Se by 75 and 74%, respectively, compared to 61% for UNP. The aqueous fraction of microcosms planted to CAB, DWD, and SR were similar to UNP controls. Plant tissue Se content in CT was significantly less than CAB, DWD, or MG, suggesting CT has the potential to volatilize Se. Given its abundance and efficacy, CT is likely a suitable species for Se removal in constructed wetlands supplied with either selenite or selenate-impacted waters. *This article is **Open Access** at <https://www.asmr.us/Portals/0/Documents/Journal/Volume-8-Issue-1/Natgrass-MS.pdf>*

A COMBINED CHEMICAL AND PHYTOREMEDIATION METHOD FOR RECLAMATION OF ACID MINE DRAINAGE-IMPACTED SOILS

RoyChowdhury, A., D. Sarkar, and R. Datta.
Environmental Science and Pollution Research [Publication online 13 March 2019 prior to print]

This study utilized the metal-binding and acid-neutralizing capacity of an industrial by-product, drinking water treatment residuals (WTRs), and the extensive root system of a metal hyper-accumulating, fast-growing, non-invasive, high-biomass perennial grass, vetiver *Chrysopogon zizanioides* L.) to prevent soil erosion. Aluminum-based and calcium-based WTRs were used to treat acid mine drainage (AMD)-impacted soil collected from the Tab-Simco coal mine in Carbondale, IL. A 4-month greenhouse column study performed using 5% and 10% w/w WTR application rates showed that soil erosion decreased in the soil-WTR-vetiver treatments. A scaled-up simulated field study was performed using 5% WTR application rate and vetiver. Soil pH increased from 2.69 to 7.2, and soil erosion indicators such as turbidity (99%) and total suspended solids (95%) in leachates were significantly reduced. *See more on this study in A. RoyChowdhury's dissertation at <https://digitalcommons.montclair.edu/etd/86/>.*

ANAEROBIC TREATMENT OF MINE WASTEWATER FOR THE REMOVAL OF SELENATE AND ITS CO-CONTAMINANTS

Tan, L.C.
CRC Press/Balkema, Leiden, the Netherlands. ISBN: 978-1-138-32841-9, 322 pp, 2018

Selenium (Se) pollution has led to several cases of severe aquatic ecosystem deterioration due to Se poisoning caused by bioaccumulation over time. Research was conducted to address the effect of wastewater characteristics (i.e. co-contaminants such as nitrate and sulfate, heavy metals, and pH) on the biological reduction of sulfate and to evaluate process integration for Se-laden wastewater treatment with co-contaminants. The study showed that the presence of co-contaminants can benefit Se removal provided that the concentrations are carefully monitored and appropriate operating conditions and process configurations are used. The Se removal (total Se and selenate) efficiency increased by ~30% in the presence of nitrate and/or sulfate compared to systems with selenate alone. Additionally, an integrated ion-exchange column and bioreactors process showed improved overall removal capacity for sulfate and total Se. *The dissertation upon which this text is based is available at <https://repository.tudelft.nl/view/ihe/uuid:747b182a-6e90-4de3-a69e-fa859185b726>.*

SATELLITE-BOUND MONITORING OF ABANDONED MINE SITES

Moellerherm, S., P. Goerke-Mallet, and C. Melchers. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 69, 2019

In the Ruhr area in Germany the old mining sector creates special risks for the safety of the ground surface, the population, and the environment owing to the presence of unstable abandoned mine openings and subsurface mine workings, uncontrolled methane emissions, and acid mine drainage. The Research Institute of Post-Mining is working on the application of satellite data from the European Copernicus project for remote sensing and monitoring of current post-mining processes. Particular emphasis is placed on the hydrochemistry of water bodies, soil water content, land use, and land coverage. With respect to the potentials of the Copernicus program and the reliability of data provision,

the connection between information provided by the satellites and terrestrial expertise will lead to an innovation in monitoring, reduce post-mining risks, and increase post-mining opportunities, such as the valorization of mining infrastructures for the recovery of renewable energy **Research Institute of Post-Mining:** <https://www.thga.de/en/research-and-transfer/research-facilities/research-institute-of-post-mining/profile/>
Copernicus Program: <https://www.copernicus.eu/en/about-copernicus>

FROM WASTE TO RESOURCE: EXTRACTING VALUABLE ELEMENTS FROM MINING SOLUTIONS USING BIO-BASED SURFACTANTS

Hogan, D., C. Boxley, and R. Maier. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 135, 2019

Mining and mining-impacted solutions are often enriched in non-target metals during typical operations. These solutions must be treated or managed to ensure elevated metal concentrations do not pose human or environmental health risks. One management option is metal recovery using ion flotation. The green, bio-based surfactant rhamnolipid is known to be selective for valuable elements, including the rare earth elements, but has not been screened for efficacy in ion flotation of mining solutions. Rhamnolipids were examined as a collector in ion flotation for the treatment of mining solutions to achieve environmental and economic benefits. *See more on this study in a paper [Colloids and Interfaces 2(4):43(2018)] at <https://www.mdpi.com/2504-5377/2/4/43/pdf>*

ENDLESS ONSITE-MANUFACTURED PIPE FOR REMOTE MINING SITES AND IN-SITU LEACHING

Ehsani, M. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 11, 2019

A technique has been developed that allows on-site construction of an endless fiberglass reinforced thermosetting plastic pipe, named InfnitPipe®. The project has been supported through funding from the National Science Foundation and the U.S. Department of Agriculture. A compact Mobile Manufacturing Unit (MMU) is shipped to the site. Layers of resin-saturated carbon or glass fabric are wrapped around a heated mandrel, and within a few minutes the pipe is fully cured. As the MMU travels, it leaves a continuous pipe behind. For in situ leaching applications, the MMU is positioned on top of the well and as the pipe is built, it is pushed into the well. *See also presentation slides: <https://static.tti.tamu.edu/conferences/tamu-engineering/nsf-3dp-workshop/day1/idea-presentations/ehsani.pdf>*

ENHANCED EVAPORATION FOR IMPROVED FLUID MANAGEMENT OF LOW PH/SUPER SATURATED DRAIN DOWN FLUIDS

Bonner, D. and T. Phelps. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado, 2019

At the Yerington Mine, a fluid management system (FMS) is operated and maintained to control drain-down fluids associated with several heap leach pads (HLPs). Fluids in the FMS ponds are low pH (typically ranging from 1.9 to 2.7) and show high total dissolved solids (with average values up to 381,000 mg/L). To improve removal of fluids from the system without off-site disposal, an enhanced evaporation system was installed on top of one of the HLPs with operation occurring during the summer months of 2017 and 2018. Fluids are routed to one of several evaporation ponds where they are removed via active evaporation, which is reasonably effective given the climatic conditions present at the site. *More information:* https://ndep.nv.gov/uploads/land-aml-docs/20180205_ACMS_IAOC_App_E_ROD-1.pdf

ACID ROCK DRAINAGE PASSIVE REMEDIATION USING ALKALINE CLAY: HYDRO-GEOCHEMICAL STUDY AND IMPACTS OF VEGETATION AND SAND ON REMEDIATION

Plaza, F., Y. Wen, and X. Liang.
The Science of the Total Environment 1637-1638:1262-1278(2018)

A passive remediation method using alkaline clay (AC) was tested through a series of static and long-term kinetic laboratory experiments (over three years) complemented with field measurements and geochemical modeling to determine its effectiveness as a passive remediation method for acid rock drainage (ARD). Both the field measurements and the samples used for the experiments came from a local coal waste site. Through the analysis of the field measurements and the outcome of the laboratory experiments and the geochemical modeling, AC proved to be an effective remediation material for ARD, in terms of achieving a neutral pH in the leachate and immobilization of sulfate and metals. Vegetation acted as a phytoaccumulation/phytoextraction agent, causing an additional immobilization of metals. The saturated sand barrier blocked downward the oxygen and water diffusion, reducing pyrite oxidation rates.

MG/AL LAYERED DOUBLE HYDROXIDE ANIONIC CLAY AS A POTENTIAL MATERIAL FOR THE REMEDIATION OF ACID MINE LEACHATE

Santosa, S.J, E.S. Kunarti, Karmanto, and N.A. Iksan.
Asian Journal of Environmental Technology 2(1):(2018)

Magnesium/aluminum hydrotalcite (Mg/Al HT) with interlayer anionic species of nitrate and carbonate has been synthesized and applied to neutralize acidity and remove sulfate, fulvic acid (FA) and humic acid (HA) commonly present in acid mine leachate. Sulfate and deprotonated FA and HA are removed by Mg/Al HT through anion exchange with interlayer nitrate and carbonate to decrease acidity. At optimum removal condition, the removal of sulfate, FA and HA followed the second order kinetic model and the maximum amount of those species removed by Mg/Al HT was 12.38, 7.83 and 1.18 x 10⁻⁴ mol/g or equivalent to 264, 183 and 70 mg/g, respectively. *This article is **Open Access** at <http://journal.bioremediation-forum.org/index.php/ieb/article/view/16/14>*

REMEDICATION OF TEXTILE AND MINING INFLUENCED EFFLUENTS USING NOVEL HETEROGENEOUS PAN CATALYST AND MODIFIED PAN MESH

Upreti, Pushpa Datta, Ph.D. Thesis, De Montfort University, Leicester, UK. 373 pp, 2018

The effectiveness of a modified polyacrylonitrile (PAN) catalyst and hydrogen peroxide system in the treatment of textile effluent and a modified ion exchange PAN mesh in the remediation of non-coal mine drainage was investigated. Continuous flow treatment in a prototype showed 99.2%, 73%, 64.4% and 50% removal efficiencies for

decolorization, loss of aromaticity, chemical oxygen demand, and mineralization at optimum conditions, and breakthrough after 50 days. The system was successfully regenerated in situ three times and the lifetime of the catalyst extended to 103 days in total, decolorizing 25.3 g of reactive orange16 dye from 546.7 L solution. A pilot-scale field trial removed 5.59 kg, 8.53 g and 18.18 g of Zn-total, Cd-total and Pb-total from 131.46 m³ of mine effluent as well as suspended solids, Fe, Cu, As, Ni, Al, B, Mn and nitrate. <https://www.dora.dmu.ac.uk/handle/2086/16390>

EVALUATING SEDIMENT PRODUCTION FROM NATIVE AND FLUVIAL GEOMORPHIC RECLAMATION WATERSHEDS AT LA PLATA MINE

Bugosha, N. and E. Epp. | Catena 174:383-398(2019)

The San Juan Coal Company reclaimed 743 hectares at its La Plata Mine using the GeoFluv fluvial geomorphic reclamation design method to achieve long-term stability against erosion, reduce maintenance, and increase biodiversity. In the fall of 2011, research quantified the sediment production rate from geomorphic landforms and surrounding undisturbed native lands. Temporary check-dam-type sediment control structures designed to impound runoff from a 2-yr, 1-h storm were installed at three similar subwatershed outlets. Precipitation at the end of the 2012, 2013, and the beginning of the 2014 water years provided direct relationships between sediment production and precipitation. The sediment yield from the undisturbed native site was 9.53 t/ha/yr, while the fluvial geomorphic design with topdressing and poorly established vegetation site averaged 13% lower than the native site, and the fluvial geomorphic design with topdressing and significant vegetation establishment averaging 41% lower sediment yield than the native site. *This article is **Open Access** at* https://cdn2.hubspot.net/hubfs/123057/Bugosh%20and%20Epp_2019_CATENA.pdf.

UNEXPECTED NON-ACID DRAINAGE FROM SULFIDIC ROCK WASTE

Gerson, A.R., P.J. Rolley, C. Davis, S.T. Feig, S. Doyle, and R.S.C. Smart. Nature: Scientific Reports 9:Article 4357(2019)

This paper demonstrates that standardized acid-base accounting (ABA) tests may not always provide the correct acid mine drainage (AMD) classification for commonly occurring waste rocks containing low-pyrite and -carbonate due to mineralogic assumptions inherent in their design. The application of these standard ABA tests at a copper mine site in South Australia resulted in the classification of a portion of its waste material as potentially acid forming in apparent contradiction to long-term field measurements. Full definition of the sulfide and silicate minerals enabled re-evaluation of the weathering reactions. The overall rate of neutralization due to silicate dissolution was found to always exceed the rate of acid generation, in agreement with field observations. Consequently, the waste rock was redefined as non-acid forming. *This article is **Open Access** at* <https://www.nature.com/articles/s41598-019-40357-4>.

MOBILITY OF METALS IN SEDIMENTS CONTAMINATED WITH HISTORICAL MINING WASTES: EXAMPLE FROM THE TRI-STATE MINING DISTRICT, USA

Gutierrez, M., Z.J. Collette, A.M. McClanahan, and K. Mickus. Soil Systems 3(1):22(2019)

The Tri-State Mining District (TSMD) of Kansas, Missouri, and Oklahoma was a world-class Zn and Pb producer. Mining ceased in the 1950s, leaving behind a large amount of mine wastes. Although much of the affected area has been remediated, stream sediments may still contain toxic levels of metals. The mobility of the metals was determined for sediment samples from Turkey Creek, Missouri. The median values of the metal content were 2700 mg/kg Zn, 161 mg/kg Pb, and 10.8 mg/kg Cd. These concentrations marginally surpass the sediment quality guidelines that differentiate between toxic and nontoxic conditions. Mobility was determined by sequential extraction of two phases: bioavailable and Fe-oxides. The fraction of the metal available to biota roughly agrees with the values reported for other areas of the TSMD. The methodology emphasizes ecosystem health and can be applied to other areas where Zn-Pb concentrations in soils and sediments are a concern. *This article is **Open Access** at* <https://www.mdpi.com/2571-8789/3/1/22/htm>.

General News

DEVELOPING DIVERSE, EFFECTIVE, AND PERMANENT PLANT COMMUNITIES ON RECLAIMED SURFACE COAL MINES: RESTORING ECOSYSTEM FUNCTION

Vasquez, E.A., and R.L. Sheley. Journal American Society of Mining and Reclamation 7(1):77-109(2018)

This article focuses on lands to be reclaimed back to rangelands similar to pre-mine ecosystem in terms of plant composition/diversity, structure, and ecosystem function. Because plant functional groups can differ in their spatial and temporal acquisition of resources, improving functional diversity may be a method to more fully utilize soil nutrients in reclaimed soils and improve resilience to weed invasion. Strategically combining species with different seed/seedling traits in seed mixtures can increase chances of achieving adequate plant establishment during revegetation. Monitoring program design should be an integral part of the reclamation planning process, and indicators reflecting landscape-scale processes can be adapted to monitor reclamation project success. Effective reclamation plans are process-oriented, seek to initiate self-repair, and address landscape interactions. The probability of achieving successful reclamation is enhanced by pursuing a broader goal of improving ecosystem vigor, organization and resilience utilizing novel assemblages of species that perform desired functions and produce a range of ecosystem goods and services. Reclaiming mined land requires realistic objectives that consider the ecological potential of the site, land-use goals, and socioeconomic constraints. *This article is **Open Access** at* <https://www.asmr.us/Portals/0/Documents/Journal/Volume-7-Issue-1/Vasquez-CO.pdf>.

MINE CLOSURE 2018: PROCEEDINGS OF THE 12TH INTERNATIONAL CONFERENCE ON MINE CLOSURE, 3-7 SEPTEMBER 2018, LEIPZIG, GERMANY

Drebenstedt, C., F. von Bismarck, A. Fourie, and M. Tibbett (eds). Technical University Bergakademie Freiberg, Freiberg, Germany. 779 pp, 2018

Reclamation of mining sites is an interdisciplinary topic that deals with technical questions about soil, water resources, vegetation and wildlife, handling of contamination and brownfields, geotechnical safety, and geochemical processes in

tipping, heaps, and tailings ponds. Specific features of legal, financial, and organizational issues are also recognized. The proceedings of this conference provide an overview of the complex interrelations and specific recultivation issues that attend the process of mine closure. <http://mineclosure2018.com/proceedings/>

GLOBAL REVIEW OF PIT LAKE CASE STUDIES

Canada's Oil Sands Innovation Alliance, Report No. 1777450, 91 pp, 2017

The use of pit lakes for long-term containment of tailings and mine waste is recognized as best practice by the mine closure community in many jurisdictions and in global guidance documents. Various sectors of the mining industry consider water-capped, in-pit mine waste disposal to be a best practice in terms of geotechnical stability, geochemical stability, and protection of regional aquifers (either by directing contaminated groundwater to the pit or by engineering a preferential pathway around the pit to minimize contact with mine waste). Presented in this report are 12 examples of successful pit lakes (6 of which were used to sequester tailings and/or mine wastes), 16 examples of pit lakes that are being extensively managed toward success (14 of which were used to sequester tailings and/or mine wastes), and 5 unsuccessful pit lakes (all of which were used to sequester tailings and/or mine wastes).

https://www.cosia.ca/sites/default/files/attachments/Literature%20Review%20of%20Global%20Pit%20Lakes_0.pdf

See also 29 illustrating slides from the 2018 British Columbia MEND Metal Leaching/Acid Rock Drainage Workshop: <http://bc-mlard.ca/files/presentations/2018-8-VANDENBERG-MCCULLOUGH-review-pit-lake-case-studies.pdf>.

GOING TO WASTE? THE POTENTIAL IMPACTS ON NATURE CONSERVATION AND CULTURAL HERITAGE FROM RESOURCE RECOVERY ON FORMER MINERAL EXTRACTION SITES IN ENGLAND AND WALES

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Journal of Environmental Planning and Management [Published online 7 Feb 2019 prior to print]

Mine waste sites are often perceived as degraded and of little value; however, many sites are protected for their ecological, geological, or historical significance. This article examines the scale of the association between these designations and former mineral extraction sites in England and Wales. Around 69,000 mines (44%) are co-located with some form of designation, ranging from 27% of sand and gravel quarries in Wales to 84% of metal mines in England. Some designations are coincidental to mining and may benefit from resource recovery combined with remediation activities, whereas others exist due to previous mining activities and show adverse effects. This paper recommends reconsideration of both existing restored and abandoned sites in terms of the benefits that they provide, particularly the potential for and desirability of resource recovery in long-term management of former mineral extraction sites. *This article is **Open Access** at*

<https://www.tandfonline.com/doi/full/10.1080/09640568.2018.1490701?af=R>.

USING FMEA TO MANAGE RISKS IN ABANDONED AND FLOODED UNDERGROUND WORKINGS: A CASE STUDY FROM THE VERMONT COPPER BELT

Hadj-Hamou, T., A. Boeckeler, and E. Hathaway. | Technical Sessions: Smart Mining: Resources for a Connected World, 24-27 Feb 2019, Denver, Colorado. p 107, 2019

Failure Mode and Effect Analyses (FMEAs) were performed at three abandoned copper mines within the Vermont Copper Belt in Orange County, Vermont, to evaluate the potential for uncontrolled and catastrophic releases of mine-impacted water associated with flooded underground workings that could subsequently affect the downstream environment/community or pose other health and safety risks. A multi-disciplinary team was used for the FMEA, including a mining historian with expertise in the Vermont Copper Belt, a rock mining geologist familiar with the site lithologies and fracture regimes, a hydrogeologist with expertise in groundwater flow within the abandoned mines, and other mining experts, geotechnical engineers, and government agencies representatives. The FMEA outcome was a document that identified the potential failure modes, assigned a general probability, and assessed the potential consequences. This document is a site planning tool to support an evaluation of future monitoring and cleanup actions. *More information:* <https://semspub.epa.gov/work/01/587373.pdf>

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