

Proceedings

of the

16th Annual National Meeting of the American Society for Surface Mining and Reclamation

Proceedings of a conference held on August 13-19, 1999 in Scottsdale, Arizona

Mining and Reclamation for the Next Millennium

Co-editors

**Stuart A. Bengson, ASARCO Incorporated, Copper Operations
and**

**Douglas M. Bland, NM Energy, Minerals and Natural Resources Department-
Mining and Minerals Division**

Coordinators

**Joanna Gonzales, EMNRD-Mining and Minerals Division
John J. Pfeil, EMNRD-Mining and Minerals Division**

Published by

The American Society for Surface Mining and Reclamation

**(made possible by the generous support of the U. S. Department of the Interior,
Office of Surface Mining)**

1999 16th National ASSMR Meeting Arrangements Committee

Program Chair

Doug Bland, Director
Mining and Minerals Division
Energy, Minerals and Natural Resources Department
Santa Fe, NM 87505
Phone: (505) 827-5974
FAX: (505) 827-7195
E-mail: dbland@state.nm.us

Technical Director

Stuart Bengson
ASARCO Incorporated
Copper Operations
Tucson, AZ
Phone: (520) 798-7733
FAX: (520) 798-7783

Local Arrangements/ Registration and Facilities

June Castelhana
Kay Nowatzki
Arizona Mining Association
2702 N. 3rd Street, Suite 2015
Phoenix, AZ 85004-4606
Phone: (602) 266-4416
FAX: (602) 266-4418
E-mail: junec@neta.com



Planning and Program Committee Members

Consuelo T. Chavez
New Mexico Energy, Minerals and
Natural Resources Department
Office of the Secretary

John J. Pfeil
New Mexico Energy, Minerals and Natural
Resources Department
Mining and Minerals Division

Joanna Gonzales
New Mexico Energy, Minerals and Natural
Resources Department
Mining and Minerals Division

Doug Romig
New Mexico Energy, Minerals and Natural
Resources Department
Mining and Minerals Division

Vernon R. Pfannenstiel
Peabody Western Coal Company

Kathy Shores
Shores Destinations

Terry Toy
University of Denver

Joe Galetovic
Office of Surface Mining

Bruce Buchanan
Buchanan Consultants, Ltd.

Bill Sanderford
McKinley Mine
The Pittsburg & Midway Coal Mining Company

Doug Martin
Arizona Mine Inspector

ASSMR Executive Secretary

Richard I. Barnhisel
3134 Montavesta Rd.
Lexington KY 40502-3548
phone 606 335-6529
fax 606 335 6529
E-mail: rbarnhis@ca.uky.edu

The New Era Has Begun

Mining & Reclamation for the Next Millennium

A Challenge from the Executive Secretary

Last year ASSMR completed fifteen years under our current name and twenty-five years altogether. For the most part, we have been associated with the coal mining industry. As your new Executive Secretary, it is my hope that ASSMR will be able to expand into new areas of reclamation and restoration. This is in response to the decline of mining in the east where larger acreages are being disturbed per ton of coal mined, and an increase in coal mining in the thicker deposits of west. This year we have made progress in this effort with a greater emphasis on metal mining. I hope that we will be able to expand our horizons to include other types of disturbed lands as well. You will see several types of reclamation in our program for the 16th annual meeting in Arizona— some old and some new. I challenge the membership to help me seek out new avenues to travel. This certainly does not mean the coal road has ended, but that we recognize significant reclamation is being conducted outside the coal industry.

Technical Division Business Meetings are an important part of our program. I hope each of you will make a special effort to attend at least one. It is my hope that these meetings will address concerns as well as goals of your Division as it moves into the next millennium. We need to brainstorm on how to meet the challenges of the future, and to think of areas not currently being addressed by ASSMR. How can we involve others in the reclamation of disturbed lands within mining, academia, and other areas where expertise exists?

In his letter in last year's program, Mr. William Plass set forth many of the goals and accomplishments of the past. Now, we must consider goals for the future as we approach the year 2000. The National Executive Committee (NEC) met on Sunday, August 15 and will meet again at the close of the technical portion of this meeting on Wednesday. If you have concerns or suggestions, please pass them on to President Terry Toy, myself, or other members of the NEC. I truly seek your counsel for the Society and for ways in which I may better serve you in the future.

Richard (Dick) Barnhisel
Executive Secretary

CONTENTS

SESSION NO.

1.	2nd Annual Western Region Ash Group (WRAG) Forum – Coal Combustion Products (CCP) Utilization in Mining Applications Special Session:	1
1.	Coal Combustion Product (CCP) Production, Use & Variability; Barry R. Stewart; American Coal Ash Assoc.	2
2.	Current Practices & Issues for Placement of Coal Combustion By-Products in Mine Settings; David J. Hassett, Daniel J. Daly & Debra F. Pflughoeft-Hassett; Energy & Environment Research Center.	17
3.	U.S. Department of Energy Projects Involving the Use of Coal Combustion By-Products in Mining Applications; William W. Aljoe, & Scott Renninger; U.S. Dept. of Energy Federal Energy Technology Center.	25
4.	The USDI Office of Surface Mining Initiatives Related to Coal Combustion Products (CCPs) & By-Products (CCBs); Kimery C. Vories; USDI - OSM Mid-Continent Regional Coordinating Center.	38
5.	*Acid Mine Drainage; Joseph Schueck; Pennsylvania Dept. of Environmental Protection.	
6.	*Alternate Placement Strategies for Fly Ash; Ron Jorgenson; Golder Assoc., Inc.	
7.	*CCPs in Road Stabilization; Patrick Shields; Brown & Brown Contracting.	
8.	*Underground Mine Filling for Subsidence Control; Kent Simon; Wyoming Dept. of Environmental Quality.	
9.	*Coal Ash Use in Hard Rock Mining; Brian Cook; Rocky Mountain Concrete Products.	
2.	General Technical Session:	43
1.	The Changing Face of Mining in Arizona; James D. McBride; Arizona St. Univ.	44
2.	National Association of State Land Reclamationists History & Mission; Dean R. Spindler; IL Dept. Natural Resources.	50
3.	Field XRF Analysis of Arsenic & Lead in Soils at a Former Smelter Facility; C. Mark Wallis, Mark T. Walker; Hydrometrics Inc., Tucson, AZ.	52
4.	Environmental Permitting Strategies for the Twenty-First Century; Brian Munson, C. Mark Wallis; Hydrometrics Inc., Phoenix, AZ.	60
5.	Early Grass Seedling Growth Stage Improves Explanation of Future Stand Success; R. E. Ries; USDA-ARS, N.Great Plains Research Lab.	66
6.	Standard Criteria & Methods to Assess the Reclamation of Native Vegetation on Mined Land; R. N. Humphries & Paul R. Benyon; Humphries Rowell Assoc.	72
7.	An Analysis of Manganese as an Indicator for Heavy Metal Removal in Passive Treatment Using Laboratory Spent Mushroom Compost Columns; B. A. Jacobson, R. F. Unz, & B. A. Dempsey; Penn. State Univ.	81
8.	Environmental Management Considerations and Rehabilitation at a Saline Minesite in Arid Western Australia; M. C. Beavis & K. E. Lindbeck; Acacia Resources-Sunrise Gold Mine	91
9.	Mountaintop Removal Mining: One Coal Company's Response to the Public Debate; L. D. Emerson; Arch	99
10.	*Coal Closure & Minesite Rehabilitation at an Open-Pit Copper Mine on Vancouver Island; Erick C. Schwamberger; BHP Copper.	
11.	The Use of Geographical Information System (GIS) Technology in Surface Mine Reclamation Monitoring; Craig Dixon; PCI Geomatics.	103
12.	The Reaction of Acid Mine Drainage With Fly Ash from Coal Combustion; Ann G. Kim; Federal Energy Tech. Center.	111
13.	*Developing Pipeline Reclamation Standards in Alberta (Canada); A. W. Fedkenheuer & J. D. Burke; TC West	118

** denotes papers not published in Proceedings, but available at presentation.*

3. Tailing Technical Session:	119
1. High Altitude Mine Waste Remediation -Implementation of the Idarado Remedial Action Plan; A. J. Hardy, J. V. Redmond, R. A. River & C. S. Davis; Montgomery Watson	120
2. Waste for Wastelands - Reclaiming Taconite Tailings Basins with Organic Amendments; Paul Eger, Glen Melchert, & Steve Dewar; MN Dept. Natural Resources-Division of Minerals	132
3. Reclamation of Prime Farmland Following Mineral Sands Mining in Virginia; W. L. Daniels, P. D. Schroeder, S. M. Nagle, L. W. Zelazny & M. M. Alley; VA Tech., Dept. Crop & Soil Environmental Science	146
4. Construction and Preliminary Evaluation of Copper Tailings Reclamation Test-Plots at Cyprus Miami Mining Corporation; Guy Chammas, Douglas R. McCaulou & Gary L. Jones; HydroGeochem	157
5. Application of Ameliorative and Adaptive Approaches to Revegetation of Historic High Altitude Mining Wastes; M. W. Bellitto, H. T. Williams & J. N. Ward; Golder Assoc.	165
6. Vegetation Success, Seepage & Erosion on Tailings Sites Reclaimed with Cattle & Biosolids; Joe Vinson, Brian Jones, Michael Milczarek, Dale Hammermeister & John Word; Geosystems Analysis	175
7. Tailings Basin Reclamation Atlantic City Iron Mine, Wyoming; James J. Gusek & Timothy C. Richmond; Knight-Piesold	184
8. Conversion of a Tailing Impoundment to a Freshwater Reservoir, the Eagle Park Reservoir Project, Climax Mine, Colorado; Bryce R. Romig, Jay L. Cupp & R. C. Ford; Climax Molybdenum Co.- Climax Mine	192
9. Reclamation of Kyanite Mine Tailings with Surface Reconfiguration; Gwendelyn Geidel, Frank T. Caruccio & E. Ray Dotson; Dept. of Geological Science, Univ. of SC	198
4. Soils & Overburden Technical Session:	208
1. Is It Topsoil or Overburden? Case Study of a Small Mine in Wyoming; George F. Vance & Lowell K. Spackman; Soil Science Dept. Range Resources, U. of WY	209
2. Dynamics and Characterization of Soil Organic Matter in Mine Soils Sixteen Years After Amendment with Native Soil, Sawdust and Sludge; E. S. Bendfeldt, J. A. Burger, W. L. Daniels & C. M. Feldhake; Coll. of Forestry, VA Tech.	225
3. A Concise Method for Mine Soil Analysis; Scott Winkler, Thomas Wildeman, Robert Robinson & James Herron; Div. Envir. Science & Engr., CO Sch. of Mines	236
4. Changes in Minesoil Physical Properties over a 9-Year Period; J. M. Gorman & J. C. Sencindiver; WV Univ. Div. of Plant & Soil Science	245
5. A Comparison of Vegetation Development on Coarse Coal Reject and Replaced Topsoil on an Open-Cut Coal Mine in Central Queensland, Australia; David R. Mulligan, Andrew H. Grigg, David Bowen, Matthew S. Orr & L. Clive Bell; Center for Mined Land Rehab., Univ. of Queensland	254
6. The Role of a Fertilizer Trial in Reconciling Agricultural Expectations & Landscape Ecology Requirements on an Opencast Coal Site in SouthWales, United Kingdom; C. E. L. Humphries, R. N. Humphries & H. Wesemann; Humphries Rowell Assoc.	262
7. Evaluation of Reclaimed Abandoned Bentonite Mine Lands; K. D. Edinger, G. E. Schuman, & G. F. Vance; USDA-ARS High Plains Grasslands Research Station	273
8. Waste Rock Revegetation: Evaluation of Nutrient & Biological Amendments; Tim W. Meikle, Lu & John P. Barta; Bitterroot Restoration Inc.	287
9. Reclamation of Waste Rock Material at the Summitville Mine Superfund Site Using Organic Matter & Topsoil Treatments; M. E. Winter & E. F. Redente; CSU, Rangeland Ecosys. Science Dept.	292
10. Pyritic Shale Integration into Waste Rock Management, Mt. Whaleback; M. O'Kane, D. Porterfield & A. Wier; O'Kane Consultants	299
11. Establishment of Vegetation on Mined Sites by Management of Mycorrhizae; Len F. Mars, Donald H. Marx & Charles E. Cordell; PHC Reclamation	307
12. Initial Growth of Leguminous Trees and Shrubs in a Cut Gold Mined Area in Minas Gerais State, Brazil; Luis E. Diaz, Eduardo F. C. Campello, Emerson S. Ribeiro, Jr. & Jaime W. V. Mello; Dept. of Natural Resource Science & Landscape Architecture, U. of MD	316
13. Mineland Reclamation and Soil Organic Carbon Sequestration in Ohio; V. A. Akala & R. Lal; OH St. Univ.-Sch. of Natural Resources	322

5. Forestry & Wildlife Technical Session:	332
1. OSM's Reforestation Initiative; J. Scott Boyce; OSM.	333
2. Woody Vegetation and Succession on the Fonde Surface Mine Demonstration Area, Bell County Kentucky; G. L. Wade & R. L. Thompson; USDA-FS, NE Research Station.	339
3. Spatial Variation in Spoil and Vegetative Characteristics of Pastures on Reclaimed Surface Mined Land; C. D. Teutsch, M. Collins & D. C. Ditsch; U. of KY, Dept. of Agron. & Ag. Science.	352
4. *Considering Wildlife at the Landscape Level in Mine Planning & Restoration; Craig W. Johnson; Dept. Landscape Architecture & Environ. Planning, UT State University.	
6. Geotechnical Engineering Technical Session:	365
1. Pressurized Grout Remote Backfilling at AML Sites Near Beulah and Zap, North Dakota; Edward J. Weiner & William E. Dodd; TCDI.	366
2. Closure Plan Evaluation for Risk of Acid Rock Drainage; Diane L. Dwire, Alan J. Krause & Luke J. Russell; Montgomery Watson.	381
3. Rock Slope Stability Analysis of the Seven-Cataracts Vista Road Cut of the Mt. Lemon Highway, Tucson, Arizona; Pinnaduwa H.S.W. Kulatilake, Jeongi-Gi Um, Greg Crum & Graham Irvine; Coll. of Engr. & Mines, Dept. Mining & Geol. Engr., Univ. of AZ.	393
4. Abandoned Deep Mine Subsidence Investigation & Remedial Design, Interstate-70, Guernsey County, Ohio; A. G. Hoffmann, D. M. Clark & T. D. Bechtel; Gannett Fleming Inc.	408
5. Stability of Reclaimed Ore Heaps with Geomembrane Lining Systems; Mark R. Twede; Vector Engr.	423
6. Foundation Construction in Abandoned Quarries; Nasser Massoudi; Woodward Clyde.	431
7. Biotic & Abiotic Factors Influencing the Long-Term Stability of Covers on Waste Rock Piles in the Uranium Mining District of Saxony & Thuringia (Germany); Martin Hienze, Mirko Kohler & Hartmut Sanger; Crimmitschau Univ.	435
8. Application of Geochemical Modeling and Hydrologic Techniques to Interpret Sources, Mixing and Evolution of Mine Drainage; Eric F. Perry & Robert S. Evans; OSM.	444
9. Salt Mine Subsidence & Associated Damage: A Case History; Gennaro G. Marino; Marino Engr. ...	453
10. Slope Stability to Rectify Coal Waste Embankments on Mining Areas; Kazimierz (Casimir) Klossek; Technical Univ. of Silesia Gliwice.	462
11. Investigation of Subsidence Event Over Multiple Seam Mining Area; Kewal Kohli; OSM.	472
12. Geotechnical Considerations in Surface Mine Reclamation; Alan K. Kuhn; AK GeoConsulting.	481
13. Implementation of Subsidence Control Regulatory Requirement; Daniel Barkley; IL Dept. Natural Resources, Office of Mines & Minerals, Land Reclamation Div.	490
14. Long Term Subsidence Movements & Behavior of Subsidence-Damaged Structures; J. W. Mahar & G. G. Marino; Geotechnical Consultants Inc.	495
15. Well Injection Depth Extraction (WIDE) Soil Flushing for Remediation of a Low Level Uranium Groundwater Plume in Glacial Till Soil; J. D. Quaranta & M. A. Gabr; N.C. St. Univ., Dept. of Civil Energy; No paper available.	
16. Application of Unsaturated Zone Hydrology at Waste Rock Facilities in Dry Climates: Design of Soil Covers and Prediction of Seepage; Darren Swanson & Mike O'Kane; SAVCI Environmental Technologies, LLC.	517
17. A Comparison of Simulated Unsaturated Flow Through Waste Rocks Using Two Commonly Used Computer Models; Bibhuti B. Panda, Tony J. Freiman & Chandrika Manepally; AGRA Earth & Envir.	527
7. Wetlands Technical Session:	539
1. Design & Implementation of a Leach Field to Remove Metals, Nitrate, Selenium & Sulfate; J. M. Harrington, D. B. Levy & J. G. Harrington; Shepard Miller.	540
2. A New Process for Sulfate Removal from Industrial Waters; Mark A. Reinsel; Hydrometrics.	546
3. Sulfur-Modified Iron (SMI) Process for Arsenic Removal; Mark A. Reinsel & Peter F. Santina; Hydrometrics.	551
4. Anoxic Biotreatment Cell (ABC) for Removal of Nitrate & Selenium from Mining Effluent Waters; Mark A. Reinsel & Maxwell K. Botz; Hydrometrics.	556

** denotes papers not published in Proceedings, but available at presentation.*

5.	*Passive Treatment Using Coal Combustion Products: An Innovative Vertical Flow Constructed Wetland Field Study; R. W. Nairn, M. N. Mercer & J. W. Everett; U. of OK, Sch. of Civil Engr. & Envir. Sci.	561
6.	*Analysis of Substrate Leachate from an Innovative Vertical Flow AMD Passive Treatment System; M. N. Mercer & R. W. Nairn; U. of OK, Sch. of Civil Engr. & Envir. Science.	562
7.	Fate and Transport of Metals in a Natural Wetland Receiving Mine Drainage; Monica Pavlik, Thomas Wildeman, Kenneth Kolm, John Emerick, & Robert Robinson; Dept. Chem. & Geochem., CO Sch. of Mines.	563
8.	Hydric Soils and the Relationship to Plant Diversity within Reclaimed Stream Channels in Semi-Arid Environments; Brenda K. Schladwieler, Scott Rextroat & Scott Benson; BKS Envir.Assoc.	579
9.	Evaluation of a Limestone Channel and Wetland System for Treating Acid Mine Drainage; Fred J. Brenner & Patrick Pruent; Grove City Coll., Dept. of Biology	584
10.	Laboratory Experiments Designed to Test the Remediation Properties of Materials; J. S. Gilbert, T. R. Wildeman & K. L. Ford; Dept. Chem. & Geochem., CO Sch. of Mines.	592
11.	Chemistry & Kinetics of Calcite Dissolution in Passive Treatment Systems; Arthur W. Rose; Dept. Geosci., Penn. St. Univ.	599
12.	Iron Removal from Acid Mine Drainage by Wetlands; A. J. Sexston, J. G. Skousen, J. Calabrese, D. K. Bhumbla, J. Cliff, J. C. Sencindiver & G. K. Bissonette; W. VA Univ.	609
13.	Acid Mine Drainage Treatment with a Combined Wetland/Anoxic Limestone Drain: Greenhouse & Field Systems; J. Skousen, A. Sexston, J. Cliff, P. Sterner, J. Calabrese & P. Ziemkiewicz; W. VA Univ.	621
14.	Microbial, Algal and Fungal Strategies for Manganese Oxidation at a Shade Township Coal Mine - Somerset County, Pennsylvania; Eleanora I. Robbins, David L. Brant & Paul F. Ziemkiewicz; USDI-USGS.	634
15.	A Method for Detecting Dewatering Effects of Underground Mining Activities on Surface Wetlands; Larry D. Hayden-Wing, John R. Baldwin, Kenneth Webber & Jeffery B. Winstead; Hayden-Wing Assoc.	641
16.	Steel Slag in Acid Mine Drainage Treatment & Control; Paul Ziemkiewicz & Jeff Skousen; National Mined Land Reclamation Center, W.VA Univ.	651
17.	Treatment and Prevention of ARD Using Silica Micro-Encapsulation; Paul Mitchell, James Rybock & Amy Wheaton; KEECO.	657
8.	Ecology Technical Session:	662
1.	*Ecological Engineering Alternatives for Remediation and Restoration of Drastically Disturbed Landscape; R. W. Nairn, L. Hare, M. Mercer, K. Dresback, K. Pepple, A. Kirchner, D. Cseak, J. Lossing, C. Durham & B. Chen; U.of OK, Sch.of Civil Engr. & Env. Science.	663
9.	Landscape Architecture Technical Session:	664
1.	Surface Mine Planning & Design Implications and Theory of a Visual Environmental Quality Predictive Model; J. B. Burley; MI St. Univ.	665
2.	Ten Years of Computer Visual Simulations on Large Scale Projects in the Western United States; John C. Ellsworth; Ellsworth Assoc.	674
10.	Hydrology Technical Session:	678
1.	The Rio Tinto Mine - A Volunteer Clean-Up Success Story; D. P. Schwaegler, P. G. Corser & G. D. Aho; Montgomery Watson.	679
2.	*Watershed Enhancement Plan Development for Leading Cr. after Dewatering of the Meigs 31 Coal Mine in Southeast Ohio; D.S. Cherry, J.E. Babendreier, H.A. Latimer & Rebecca J. Currie; VA Tech., Biol.Dept.	
3.	A Comparison of Two Models for Simulating the Water Balance of Soil Covers Under Semi-Arid Conditions; Guy A. Chammas, Michael Geddis & Douglas R. McCaulou; HydroGeochem.	688
4.	*The Manipulation of Water for Individual Project Needs; Debra Stokes-Haglund; DriWater.	

** denotes papers not published in Proceedings, but available at presentation.*

11. Cattle for Reclamation Special Session:	696
1. Hoof, Mouth & Manure - Livestock and Mine Land Rehabilitation: "Sustainable Mine Land Reclamation - the Overview"; Shannon A. Horst; Center for Holistic Management.	697
2. *Overview of Tailings & Waste Rock Reclamation at BHP Copper; Robert Breen & Eric Schwamberger; BHP Copper.	
3. Twenty-To-One: the Nevada Experience; Tony Tipton & Jerrie Tipton; Public Land Management Contractors to BLM.	700
4. The Use of Livestock As A Tool for Reclamation of Copper Tailings in Southern Arizona; S. A. Bengson; ASARCO Incorporated - Copper Operations.	704
12. Poster Presentations:	707
1. A Spatial Application of a Vegetation Productivity Equation for Neo-Sol Reconstruction. J. B. Burley; MI St. University	708
2. Establishment of Vegetation in Constructed Wetlands Using Biosolids & Quarry Fines; Timothy P. Danehy, Robert Zick, Fred Brenner, Jerry Chmielewski, Margaret H. Dunn & Charles D. Cooper; BioMost.	715
3. Spoil Sodcity Standards: Reconciling Science & Regulation; Douglas Romig, Lewis P. Munk & Michael D. Coats; NM Mining & Minerals Division. Abstract only	716
4. Alternative Organic Substrates in Constructed Wetlands: Preliminary Results of Batch Examination; M. N. Mercer & R. W. Nairn; U. of OK. Abstract only	717
5. Vegetative Propagation of Kura Clover on Mine Spoils; Micheal Collins, David C. Ditsch, Chris D. Teutsch; U. of KY, Dept.of Agron.	718
6. Regeneration of Kaolin Mined Lands to Maximize Loblolly Pine Growth & Wildlife Habitat; K. E. McEvoy, L. A. Morris, R. L. Hendrick & E. A. Ogden; U. of GA, Warnell School of Forest Res.	724
7. The Use of Mine-Development Models to Support Mine Closure & Reclamation Planning; R. W. Newcomer Jr. & C. P. Wolf; Daniel B. Stephens & Assoc. Abstract only	733
8. Closed Mines Reclamation; Tomas Hernandez, Gabriel Macias; Servicios Industriales Penoles, S.A. de C.V.; Poster available at poster presentation	
9. A Humic Acid Extract from Lignite for Reclaiming Contaminated Soils; Richard I. Barnhisel; Agron. Dept., U. of KY. Abstract only	734
10. Design Factors and Performance Efficiencies of Successive Alkalinity Producing Systems; Christopher R. Jage & Carl E. Zipper; Dept. Crop & Soil Envir. Science, VA St. Univ. Abstract only	735
11. Effectiveness of Wetland-Riparian Vegetation in Remediation of a Disturbed Seleniferous Environment; C. P. Skinner & G. F. Vance; U. of WY, Dept. Renewable Natural Resources. Abstract only	736

** denotes papers not published in Proceedings, but available at presentation.*