



## **Welcome to the CLU-IN Internet Seminar**

### **Technology Transfer and Training Resources for Mining Sites**

**Sponsored by:** EPA Technology Innovation and Field Services  
Division (TIFSD)

**Delivered:** June 13, 2012, 1:00-3:00 PM EST

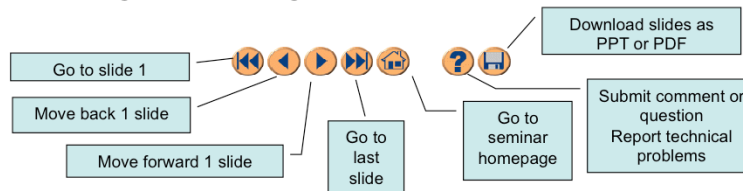
**Instructors:** Michele Mahoney (EPA OSWER), Cherri Baysinger  
(ITRC), Doug Grosse (EPA ORD), Carol Russell (EPA Region 8)

*Visit the Clean Up Information Network online at [www.cluin.org](http://www.cluin.org)*

Slide 1 of 78

# Housekeeping

- Please mute your phone lines, Do NOT put this call on hold
  - press \*6 to mute #6 to unmute your lines at anytime (or applicable instructions)
- Q&A {indicate if there are breaks, or ask whenever, mention ? Submission button/form}
- Turn off any pop-up blockers
- Move through slides using # links on left or buttons



- This event is being recorded
- Archives accessed for free <http://clu.in.org/live/archive/>

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 2 of 78

Although I'm sure that some of you have these rules memorized from previous CLU-IN events, let's run through them quickly for our new participants.

Please mute your phone lines during the seminar to minimize disruption and background noise. If you do not have a mute button, press \*6 to mute #6 to unmute your lines at anytime. Also, please do NOT put this call on hold as this may bring delightful, but unwanted background music over the lines and interrupt the seminar.

You should note that throughout the seminar, we will ask for your feedback. You do not need to wait for Q&A breaks to ask questions or provide comments. To submit comments/questions and report technical problems, please use the ? Icon at the top of your screen. You can move forward/backward in the slides by using the single arrow buttons (left moves back 1 slide, right moves advances 1 slide). The double arrowed buttons will take you to 1<sup>st</sup> and last slides respectively. You may also advance to any slide using the numbered links that appear on the left side of your screen. The button with a house icon will take you back to main seminar page which displays our agenda, speaker information, links to the slides and additional resources. Lastly, the button with a computer disc can be used to download and save today's presentation materials.

With that, please move to slide 3.

# Overview

- TIFSD CLU-IN Webinar Series on Mining Sites
  - Purpose: To provide relevant and current information on abandoned mine land issues, treatment technologies, revitalization options, and technical resources
- Today's webinar – technology transfer and training tools and resources



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 3 of 78

Today's seminar is the first of a new webinar series being launched by [Technology Innovation and Field Services Division](#). The purpose of this new series we are launching today is to provide our audience – site managers, regulatory agencies, consultants, the general public, and others – relevant and current information on abandoned mine land issues and available treatment technologies. Today's seminar is to provide background on some of the resources available through regulatory agencies and organizations that conduct extensive work or research, and provide support for the characterization, cleanup, and restoration/revitalization of abandoned mining sites.

# Overview

- This session will provide an overview of resources available through:

- U.S. Environmental Protection Agency (EPA)

- Technology Innovation and Field Services Division (TIFSD)
- Abandoned Mine Lands Program (AML)
- Office of Research and Development (ORD)



- Interstate Technology and Regulatory Council (ITRC)

- International Network for Acid Prevention (INAP)

- Questions

- Future webinar topics and survey



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 4 of 78

We will cover five topics during today's seminar. We'll begin with an overview of resources available through the U.S. Environmental Protection Agency, or the "EPA." EPA regulates mining activities in the United States in the three general categories of hardrock mining, non-metals mining, and coal mining. However, what we'll discuss here is the different support options available for cleanup and restoration of abandoned mine lands through EPA, including but not limited to technology transfer, such as through its Technology Innovation and Field Services Division or "TIFSD," and its direct work with other federal agencies, states, tribes, communities, and mine operators through its Abandoned Mine Lands Program and the Office of Research and Development. Next, we'll hear about the training and technical resources for mining waste available through the Interstate Technology and Regulatory Council or "ITRC," which is a cooperative organization consisting 50 states, the District of Columbia, multiple federal partners, industry participants, and other stakeholders. Finally, we'll hear about the technical resources – such as the Global Acid Rock Drainage Guide - available through the International Network for Acid Prevention, or "INAP," which is industry group created to help meet the challenge of acid drainage. We'll conclude our seminar with an opportunity to ask any questions that weren't answered during our speakers' presentations. We'll also briefly touch on the next webinar that TIFSD is going to be hosting in September, and would appreciate your feedback on our proposed topic and would like to learn if this is something you would be interested in hearing about.



# TIFSD Resources

## Contaminated Sites Cleanup Information (CLU-IN) Mining Sites Focus Area: **Characterization, Cleanup, and Revitalization of Abandoned Mining Sites**



[www.cluin.org/mining](http://www.cluin.org/mining)



Michele Mahoney, US EPA OSWER

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 5 of 78

We'll begin with the "Characterization, Cleanup, and Revitalization of Abandoned Mining Sites" focus area on the CLU-IN site. This new focus area was launched in January of this year with the aim of being a "one-stop shop" for information on the resources available to assist with characterization, cleanup, and revitalization of abandoned mining sites.

You can access it by going to [www.cluin.org/mining](http://www.cluin.org/mining)

The site gives a general overview of the various U.S. agencies involved in the characterization, cleanup, and revitalization of abandoned mine lands and provides links to their respective web pages on abandoned mine lands.

# CLU-IN Mining Sites Focus Area: Overview

- Most common types of mines found in the United States
  - Background information
  - Responsible agencies
  - Case studies



June 13, 2012

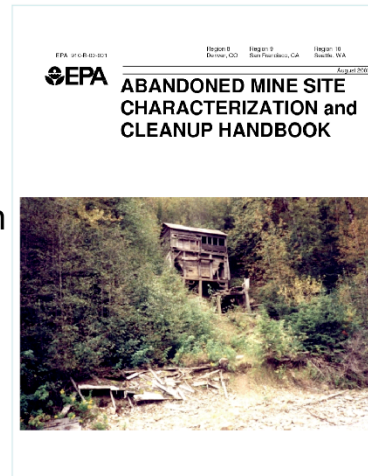
Technology Transfer and Training Resources for Mining Sites

Slide 6 of 78

Next, the site provides some background information on the most common types of abandoned mines found in the U.S., and links to specific case studies where cleanup and revitalization of the site was successful and/or used innovative or notable techniques.

# CLU-IN Mining Sites Focus Area: Characterization

- Characterization
  - EPA Abandoned Mine Site Characterization and Cleanup Handbook
  - Appendix C: Characterization of Ore, Waste Rock, and Tailings (From EPA and Hardrock Mining: A Source Book for Industry in the Northwest and Alaska)



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 7 of 78

The characterization page provides links to two U.S. EPA documents that can be a source of information and ideas for project managers involved in the characterization and cleanup of inactive mine sites. The EPA Abandoned Mine Site Characterization and Cleanup Handbook is a compendium of information gained during many years of experience on mine site cleanup projects and provides information on dealing with issues important in site investigation, cleanup, or long-term management.

The second document, an appendix to an EPA Hardrock Mining Handbook, presents methods that can be used to determine the physical and chemical characteristics of waste materials, describes the environmental tests used to assess contaminant mobility, outlines the conceptual models used to analyze contaminant fate and transport, and discusses the elements of quality assurance and quality control.

This web page will be populated with additional resources as the site evolves.

## **CLU-IN Mining Sites Focus Area: Cleanup**

- Cleanup Technologies
  - Resources: EPA Office of Research and Development's Engineering Technical Support Center (ETSC); ITRC Mining Waste Treatment Technology Selection
  - List of treatment technologies by affected media - mining solid waste, mining-influenced water, or both (adapted from ITRC)

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 8 of 78

The next section of the CLU-IN Mining Sites Focus Area deals with cleanup technologies. A range of traditional and innovative technologies that may be appropriate for cleanup of mining sites exist. This page directs site users to where they can find information on selecting cleanup technologies – the ITRC Mining Waste Treatment Technology Selection, for example – and where they can receive assistance, such as through the EPA Office of Research and Development's Engineering Technical Support Center. ETSC provides assistance to EPA regional offices, states, and communities on the design, function, and application of treatment technologies.

This page of the focus area also lists currently available treatment technologies, organized by the type of media the technology is generally used to address. The information on treatment technologies on this page was adapted from the ITRC Mining Waste Treatment Technology Selection website; links to the page with the original information are provided.

## CLU-IN Mining Sites Focus Area: Revitalization & Reuse

- EPA's Superfund Redevelopment Initiative  
<http://www.epa.gov/superfund/programs/recycle/index.html>
- EPA's Abandoned Mine Lands Reuse and Revitalization  
<http://www.epa.gov/aml/revital/index.htm>
- EPA's EcoTools for Ecological Revitalization  
<http://www.clu-in.org/ecotools>
- Mine-scarred lands initiative toolkit  
<http://www.epa.gov/aml/revital/msl/index.htm>
- RE-Powering America's Lands  
<http://www.epa.gov/oswercpa/index.htm>

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 9 of 78

The revitalization and reuse page provides links to a variety of EPA resources that contain reports, fact sheets and technical resources related to revitalization of mine lands. These resources describe tools for reuse of former mining sites and various revitalization techniques and projects, such as use of soil amendments for revitalization and the RE-Powering America's Lands initiative that encourages development of renewable energy on current and formerly contaminated land and mine sites.

- Upcoming and archived internet seminars
- Upcoming professional meetings

The events page of the Mining Sites focus area is updated regularly and contains a list of upcoming internet seminars, such as our webinar today, upcoming professional meetings – largely in North America – related to mining sites, as well as links to archived internet seminars. After today’s webinar is over, it will be listed on this page.

## **CLU-IN Mining Sites Focus Area: Links/Presentations**

- Additional resources for:
  - General abandoned mine land information
  - Characterization and remediation technology
  - Revitalization and redevelopment
  - Radioactive materials
- Presentations
  - Relevant presentations from recent workshops/conferences

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 11 of 78

Additional resources complementary to the characterization, cleanup technology, and revitalization and reuse sections, can be found on the “Resources and Links” page. These include links to pages maintained by other agencies, organizations, and academic institutions.

Finally, the “Presentations” page in the mining sites focus area contains sets of presentations from past meetings. We currently have several presentations posted from the EPA Rare Earth Elements workshop that was held last month, however, we anticipate this section of the focus area growing as the site evolves and gains additional users.

## CLU-IN EcoTools Focus Area

- Ecological Revitalization of Contaminated Lands
- Principles for Ecological Land Reuse
- Soil Science and Amendments
- Terrestrial Carbon Sequestration
- Native Plants
- Urban Gardens
- Technical Assistance
- Local Resources, Case Studies, Publications



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 12 of 78

TIFSD also maintains a focus area on tools for ecological land reuse, or “Eco-Tools.” This focus area offers information, resources, and technical assistance related to ecological reuse and revitalization of contaminated lands. Resources include a list of principles proven critical to the success of revitalization and reuse projects; a discussion of soil-related issues such as the use of soil amendments; an introduction to the use of native plants and vegetation; and information on urban gardening and agriculture. The site also contains case studies on successful ecological revitalization projects on contaminated lands, and links, organized by region, to local sources of information and assistance related to ecological land reuse. While EcoTools is not specifically geared toward abandoned mine lands, several of the principles, information, and resources can prove useful to those wanting to bring an abandoned mine site to productive reuse.



# Treatment Technology Research

- Mining Influenced Water Treatment
  - Existing & Innovative Technologies
  - Treatment Effectiveness & Limitations
  - Cost to Implement
  - Treatment Applicability

My division is leading an effort to evaluate mine influenced water treatment technologies and develop materials to support selection of appropriate and cost-effective treatment technologies. Mine influenced water at mine sites comes from mine drainage, process water, and storm water and needs to be characterized to determine regulatory constraints and potential source control, treatment, metals recovery, or other management options. EPA wants to evaluate mine influenced water treatment technologies (existing and innovative), treatment effectiveness and limitations, cost to implement, and applicability of treatments. TIFSD intends for the developed materials to further inform decision makers about the diverse technologies available for mine influenced water treatment as well as better understand the importance of weighing the upfront installation costs with the long-term operation and maintenance of various technologies.

Results of this research will be compiled and made available to decision makers as well as the public. Information could be disseminated through website, webinar or another to-be-determined outlet.

# EPA Mining Initiatives Abandoned Mine Lands Program

Presented by Michele Mahoney, US EPA,  
on behalf of Shahid Mahmud, US EPA  
Abandoned Mine Lands Team

## Background

- The EPA Abandoned Mine Lands (AML) Program is coordinated through the EPA's National Mining Team (NMT) and Abandoned Mine Lands Team (AMLT). These teams:
  - Provide an EPA headquarters and Regional core of expertise on issues at abandoned mine sites
  - Together serve as a focal point for coordinating and facilitating national technical, policy and process issues with stakeholders on abandoned/inactive mine research, characterization, clean-up and redevelopment activities

June 13, 2012


Technology Transfer and Training Resources for Mining Sites

Slide 15 of 78

The goal of EPA's Abandoned Mine Lands Program is to identify ways to protect human health and the environment by using all of the non-regulatory and regulatory approaches available to the Agency. The Abandoned Mine Lands program is coordinated through the Agency's National Mining Team and Abandoned Mine Lands Team. EPA's Abandoned Mine Lands Team was initially created to provide EPA Headquarters and regions access to expertise on issues at abandoned mine sites. The team was created as a subgroup to the already existing EPA National Mining Team, for the purpose of addressing issues related to abandoned mine sites. Together, these two teams provide expertise on issues at abandoned mining sites and serve as a focal point to coordinate and facilitate issues with stakeholders.

You can access the AML program website through the link provided in the presentation.

http://www.epa.gov/superfund/programs/aml/index.htm


United States Environmental Protection Agency

LEARN THE ISSUES | **SCIENCE & TECHNOLOGY** | LAWS & REGULATIONS | ABOUT EPA

ALL EPA | **THIS AREA** | Advanced Search

**Superfund**

Contact Us | Share

You are here: [EPA Home](#) » [Superfund](#) » [Programs](#) » Abandoned Mine Lands

## Abandoned Mine Lands

Abandoned mine lands (AMLs) are those lands, waters and surrounding watersheds where extraction, beneficiation or processing of ores and minerals has occurred. AMLs can pose serious threats to human health and the environment. EPA has a range of resources related to the environmental risks and challenges from AMLs as well as risk management approaches and opportunities to explore innovative reuse opportunities at these sites.

**AML Home**  
Basic Information  
Where You Live  
AML Site Information  
Policy & Guidance  
Technical Resources  
Revitalization & Reuse  
Mineral Processing Sectors  
Related Links  
States  
Tribes  
Glossary

**Basic Information** – basic information about the AMLs and EPA's AML Program.

**AML Site Information** – information about abandoned hardrock mines and mineral processing sites, including sites on the [National Priorities List \(NPL\)](#).

**Policy & Guidance** – EPA policy and guidance documents that have direct applications to the assessment and remediation of abandoned mine lands.

**Technical Resources** – technical reports, studies, and information on [conferences and meeting proceedings](#) related to EPA's Abandoned Mine Lands (AML) Program.

**Revitalization & Reuse** – links and fact sheets pertaining to revitalization and reuse.

**Mineral Processing Sectors** – Gold/Silver, Lead, Iron, Copper, Zinc, Uranium, Phosphate, Extraction, Beneficiation, and/or Processing

**Related Links** – more information about AMLs.

**Where You Live** – information about AMLs near you and provides information from EPA regional offices.

**States** – information on statutory and regulatory authority, policies, site inventories and state technical resources.

**Tribes** – provides information about AML management on Tribal Lands.

**Highlights**

- 2012 Fact Sheet: Renewable Energy on Mine Sites (PDF) (2pp, 1.20K, About PDF)
- Midvale Slag reuse video
- Solar Energy at Mine Sites
- RE-Powering America's Land Initiative
- Identification and Evaluation of Community Involvement Activities in Abandoned Mine Land Communities (PDF) (21pp, 480K, About PDF)
- Mine-Scarred Lands Initiative Tool Kit
- Palmerton Zinc Pile Case Study (PDF) (3pp, 300K, About PDF)
- Composting at Mine Sites
- AML Technology Research

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 16 of 78

AML website

## EPA is seeking opportunities for

- Identifying innovative cleanup technologies to address source areas and mining-influenced waters – including metal recovery from mining-influenced water
- Beneficially recycling/reusing of mining wastes
- Revitalizing/reusing mine sites – including renewable energy development
- Reprocessing mining waste

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 17 of 78

Through its National Mining Team and Abandoned Mine Lands Team, EPA continuously seeks opportunities for: (1) **identifying innovative cleanup technologies to address source areas and mine-influenced waters, including recovering metals from mining influenced water;** (2) **recycling and/or reusing mining wastes in a beneficial way;** (3) **reusing and/or revitalizing mining sites – for example, exploring options for development of renewable energy on current and formerly contaminated lands and mining sites;** and finally (4) **reprocessing mining waste (into other materials)**

## Identifying Innovative Approaches to Mine Site Cleanups

- Conventional Technologies such as capping, on-site disposal, lime treatment selected for mine site remediation
- Seeking opportunities to use innovative technologies such as bioreactors for treatment of mine influenced waters.
- Can metals be recovered from mine influenced waters to offset remediation costs?
- Are there innovative source control technologies?

## Reuse of Mining Waste

- OSWER is currently developing a CERCLA Guidance on the Beneficial Management of Mine Waste
- EPA developed the Chat Rule for the reuse on Chat in Oklahoma
- EPA is interested in considering the reuse of copper slags.

## Renewable Energy Development at Contaminated Lands and Mining Sites

- EPA is seeking ways to facilitate the use of contaminated properties, and active and abandoned mine sites as renewable energy generating areas.
- EPA is taking a multi-prong approach for this initiative as follows:
  1. Working with the Department of Energy's National Renewable Energy Lab (NREL) to overlay renewable energy resources
  2. Working on pilot sites in a number of states
  3. Seeking input to determine the need for additional site redevelopment and reuse tools



## Reprocessing of Mining Wastes

- Evaluate whether specific types of mining wastes can be reprocessed in an environmentally protective manner.
- There are a couple of potential sites being pursued in CO and MT.
- No site has been officially selected but EPA is interested in moving forward.



# U.S. EPA ORD's Engineering Technical Support Center (ETSC) Technical Assistance and Guidance for the Characterization/ Cleanup/ Revitalization of Mining Sites

*CLU-IN Webinar on Mining Sites - June 13th, 2012*



Office of Research and Development

Douglas Grosse  
U.S. EPA/ORD/NRMRL

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 22 of 78

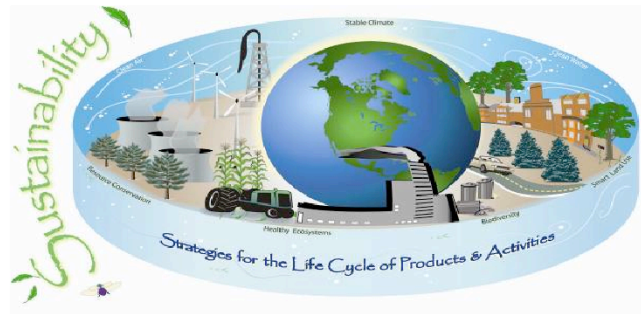
## Objectives

- Present An Overview of Past and Current EPA ORD Mining Remediation Research and Technical Support
- Provide Current Projects & Activities by ETSC & Staff



## Can We Efficiently?

- Extract and utilize resources (including by-products)
- Manage wastes
- Reclamation/restoration
- Produce socio-economic advantages
- Advancing Solutions for a New Legacy



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 24 of 78

Sustainable development that applies to the industrial minerals sector include:

How can we extract and utilize resources (including by-products) more efficiently?

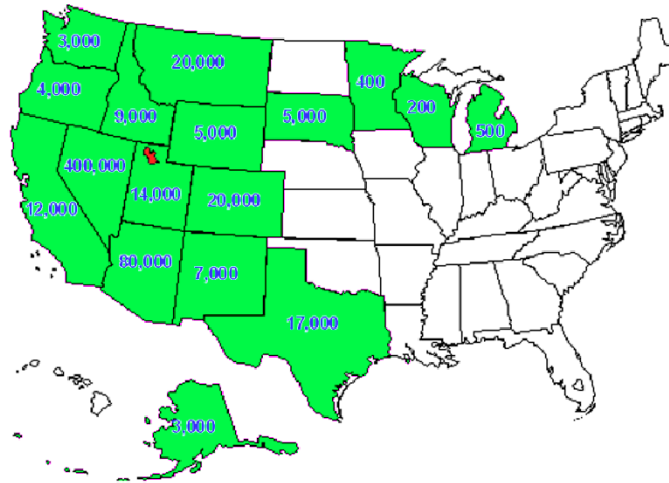
How can we manage wastes more efficiently?

How can we reclaim and restore the lands we used for mining more efficiently?

How can we produce more socio-economic advantages (i.e profitability, closure, liability, etc)?

How can we accomplish best practices with maximum economical effects while still incorporating a life cycle approach?

## Estimate of Mining Sites in the USA



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 25 of 78

Mining waste generated by active and inactive mining production facilities and its impact on human health and the environment are a growing problem for government entities, private industry, and the general public.

## ORD's Mining Programs



- Mine Waste Technology Program
- Engineering Technical Support Center
- Technology Transfer Program



Two big mining efforts in ORD are the :1.) Mine Waste Technology Program and 2.) Engineering Technical Support Center

## Collaboration



- EPA Program & Regional Offices
- NRMRL/ORD
- Industry Partners
- Western Governors Association
- Academia
- BLM
- Forest Service
- DOE/DOD
- USGS

The MWTP has multiple partnerships industry, academia, BLM, Forest Service, DOE, Western Governors Association. It is critical to the MWTP's success to collaborate with others. It is also been critical to identify a certain personality type that is willing to try new things:

- Bill Adams, EPA Region 10
- Ken Wangerud, EPA Region 8
- Mike Bishop, EPA region \*
- Shannon Dunlap and Bill Upton all with Placer Dome

Over the history of the MWTP, we have collaborated with dozens of entities

- Constructed Wetlands
- Bioremediation
- MIW Treatment Processes
- Liquid/Solid Partitioning
- Electrolytic Processes
- Sequestration
- Capping



In an era of shrinking funding, treatment technologies must be cost-effective, with low operating and maintenance costs, and be sustainable treatment technologies. ETSC researchers are testing low-cost and innovative biochemical reactors that combine bacterial reactions with chemical processes (lime dissolution)

to increase the pH of the acidic mine water.

Constructed Wetlands with Bioreactors – Peerless Jenny Mine in Montana

Sulfate Reducing Bioreactors – Leviathan Mine Site in California

Biochemical Reactors – Luttrell Repository in Montana



## Mine Water Treatment Options

- Active treatment
  - Expensive, Labor-intensive, Power Needs
- Passive treatment
  - Lower Cost, Reduced Maintenance, Gravity
- Combination active/passive (hybrids)
- Recycle systems

## Historical Technical Support Efforts

- Big 5 and Burleigh Tunnels
- Lime, Alkaline Channels, Lagoons
- Summitville Tests – Early 90's Aquafix



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 30 of 78

## Biochemical Reactors

*Luttrell Repository, MT*



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 31 of 78

**Gravity-fed Substrate Reactor : This BCR was built in 2001 to treat leachate from the repository in comparison with active treatments completed on the same water**

## Colorado Mines



*Standard Mine, Crested Butte*



*Burleigh Tunnel*



*Aquafix*



*North Fork Clear Creek*

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 32 of 78

Chitorem

## Cement Creek RCTS Demonstration (IWT)



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 33 of 78

This photo shows the equipment used during the demonstration. From right to left, key components include the lime makedown tank, the reaction tank (big white tank), and the RCTS unit.



## Completed Projects by ETSC Staff

- Developed Treatability Study Plan for Scientific Testing
- Conducted Bench and Field-Scale Studies
- Tested Different Substrates for BCRs
- Compared Solid Substrate vs. Liquid Reactors
- Researched Lab / Field Measurements for Sulfates & Sulfides
- Sampled, Analyzed and Identified Bacteria Inside BCR
- Developed a Year 'round Sustainable Treatment System (with renewable energy and gravity-feed)
- Refined and Developed WASP Meta4 Model for Metals Loading

## Completed Projects by ETSC Staff (*cont.*)

- Tested Remote Remedial Data Delivery (R2D2) Systems
- Conducted Pilot Studies for Mine Water Remediation > 10,000 feet amsl
- Researched Changes in Stressed MIW Bacterial Communities
- Created Problem-Solving Workshops on Real Mine Drainage Issues
- Held Conferences for Technology Transfer and Development Purposes
- Built Larger & Sustainable Gravity-Fed BCRs
- Tested Low Power Mobile Treatment Systems
- Establish Performance Guidance for BCRs (ITRC)
- Effluent Toxicity Studies and Treatment Methods

## Peerless Jenny Constructed Wetlands







## Peerless Jenny Chemistry

(average values; mg/L)

Metal or Measure	Year 1		Year 2		Year 3	
	<i>Adit</i>	<i>BCR Effluent</i>	<i>Adit</i>	<i>BCR Effluent</i>	<i>Adit</i>	<i>BCR Effluent</i>
Al	.16	.05	.04	.03	.06	.03
Ca	.36	35	42	37	36	36
Cd	.02	.004	.001	BDL	.007	.003
Cu	.03	BDL	.03	.04	.03	.04
Fe	.48	.007	.32	.012	.42	.44
Mg	8.62	8.21	9.32	7.11	7.8	7.6
Mn	5.63	2.38	4.2	.08	3.6	1.3
S	36	33	53	42	32	33
Zn	1.88	.71	.93	.2	1.1	.51
pH	6.3-6.9					
Flow	116,000 (L/day)					

## Current ETSC Mining Projects

### Region 1

- Callahan
- Elizabeth
- Elly

### Region 4

- Copper Hill
- Barite Mine

### Region 6

- Molycorp
- Homestake

### Region 7

- Big River
- Doe Run
- Tri-State Mining District

### Region 8

- Ten Mile Creek
- Park City, Utah
- Basin area Crystal / Bullion Mines
- Captain Jack Standard Mine
- Gladstone

### Region 9

- Sulfur Bank
- Sheldon
- Blue Ledge
- Anaconda Yerington

### Region 10

- Formosa
- Black Butte
- Coeur d' Alene / Bunker Hill / Canyon Creek
- Midnite / Blackbird / Bucktail

## LRPCD & ETSC Mining Technology Transfer

- Hard Rock Mining Conferences
- Mining Workshops
- RARE, ReSERV current projects
- CRADA 3M under development
- ITRC 2 TEAMS, Web Site
- Engineering Issue Paper
- Rare Earth Elements Document
- Training



## ORD Technology Transfer and Outreach

1998 Heavy Metals Contamination Workshop - 150  
1998 Mining Workshop - 300 attendees  
1999 Heavy Metals Contamination Workshop -180 Attendees  
1999 Pit Lakes Workshop -240 attendees  
2000 Mercury Workshop – 275 attendees  
2001 Arsenic Workshop – 70 attendees  
2002 Hard Rock Mining Conference – 375 attendees  
2003 Workshop on Mining Impacted Native American Lands – 275 attend.  
2004 Pit Lakes – 250 attendees  
2005 Abandoned Mine Lands Workshop – 100 attendees  
2006 Hard Rock Mining Conference – 350 attendees  
2007 Abandoned Mine Lands Workshop – Coeur d'Alene, Idaho;  
1993-2006 Mine Operations, Design, and Closure Conferences;

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 40 of 78

These are the major meetings that have come out from ORD.....they are mostly Mine Waste Technology Program sponsored but you don't need to say that.



## Acknowledgements

- Doug Grosse, ORD
- David Reisman, ORD
- Ed Barth, ORD
- Barbara Butler, ORD
- Michele Mahoney, OSWER
- Glen Campbell, Region 8
- Souhail Al-Abed, ORD
- Pat Clark, ORD
- Rob Weber, Region 7
- Todd Luxton, ORD
- Kirk Scheckel, ORD
- Robert Ford, ORD
- Jennifer Goetz, ORD
- John McCready, ORD
- Brian Dyson, ORD
- Diana Blesses, ORD

**Supervisors:** Scott Jacobs, John McKernan, Randy Parker, Dennis Timberlake and Dave Carson



## U.S. EPA Websites

EPA's Abandoned Mine Lands Program:

[\*http://www.epa.gov/superfund/programs/aml\*](http://www.epa.gov/superfund/programs/aml)

Mine Waste Technology Program:

[\*http://www.epa.gov/nrmrl/std/mwt/\*](http://www.epa.gov/nrmrl/std/mwt/)

NRMRL:

[\*www.epa.gov/nrmrl\*](http://www.epa.gov/nrmrl)



Some of the mine related websites

## Mine Waste Treatment Technology Selection Guidance

### **Cherri Baysinger**

Missouri Department of Health and Senior  
Services

### **Paul Eger**

Minnesota Department of Natural  
Resources, retired  
(currently with Golder Associates)

**Co-Team Leaders**  
**ITRC Mine Waste Team**



# The ITRC is . . .

---

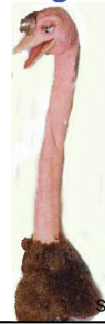


- ▶ State-led, national coalition
  - State Agencies
  - Federal Agencies
  - Industry Representatives
  - Public Stakeholders
- ▶ Started in 1995



## Goals

- ▶ Achieve better environmental protection through innovative technologies
- ▶ Reduce the technical/regulatory barriers to the use of new environmental technologies
- ▶ Build confidence about using new technologies



June 13, 2012

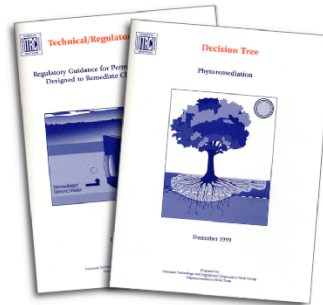
Technology Transfer and Training Resources for Mining Sites

Slide 45 of 78

# What ITRC Does



- ▶ Technical and Regulatory Guidance
- ▶ Technology Overviews
- ▶ Case Studies
- ▶ Peer Exchange
- ▶ Classroom Training Courses
- ▶ Internet-Based Training Sessions



# Training



## ► Internet-based Training Through Clu-In

- June 26, Development of Performance Specifications for Solidification/Stabilization
- July 19, Green and Sustainable Remediation
- July 24, Integrated DNAPL Site Strategy
- July 26, Project Risk Management for Site Remediation
- **August 14, Mine Waste Treatment Technology**

## ► Classroom

- Light Nonaqueous-Phase Liquids: Science, Management and Technology

## ► For more information:

<http://www.itrcweb.org/ibt.asp>

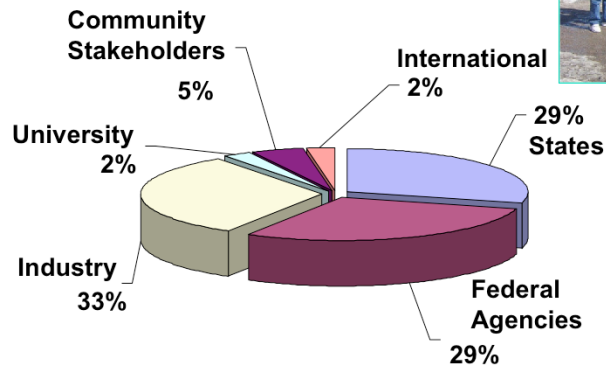
[training@itrcweb.org](mailto:training@itrcweb.org)

402-201-2419

# ITRC Mining Waste Team



- Team was diverse  
(35 participants)



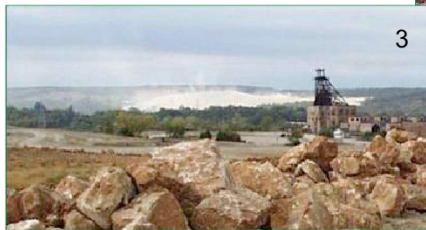
June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 48 of 78

# Mining

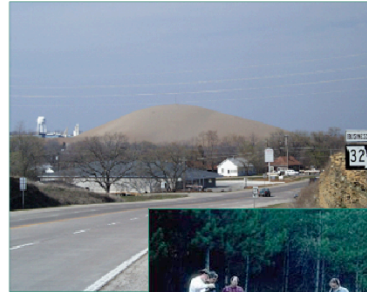
- ▶ Mining is important
  - Need materials
  - Lack of mined land reclamation and restoration laws
- ▶ Sites tend to be large
- ▶ All media affected



# Mining Waste

## ► Solid Mining Waste

- Contain residual metals or other chemicals
- Hundreds of square miles Affected
- May affect residential areas



## ► Mining Influenced Water

- Low pH
- Residual metals
- Over 10,000 stream miles impacted
- Groundwater impacts



## Objectives of the Guidance

- ▶ Select applicable technology(s)
- ▶ Provide information on technologies
- ▶ Remediate mine waste contaminated sites



Flambeau Mine, WI  
During mining



Flambeau Mine, WI  
After reclamation

# Content of Guidance



[www.itrcweb.org/miningwaste-guidance](http://www.itrcweb.org/miningwaste-guidance)



- ▶ Overview
- ▶ Decision Trees
- ▶ Technology Overviews
- ▶ Case Studies
- ▶ Regulatory Issues
- ▶ Stakeholders Concerns
- ▶ Additional Resources

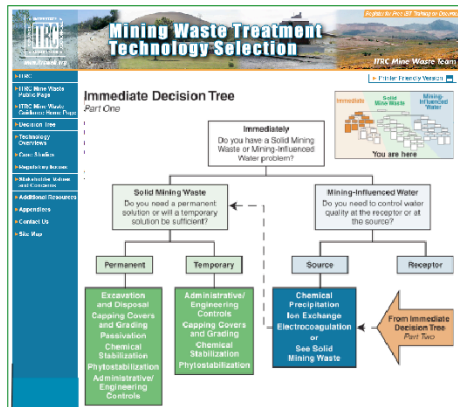
June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 52 of 78

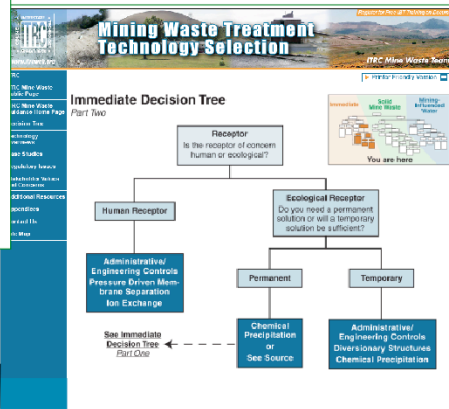


# Decision Trees



## Navigation aids

- Labels
- Color
- "You are here"



- Links to Technology Overviews
- Links to other Decision Trees

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 53 of 78

# Technology Overviews

## ► Overviews of 22 technologies

- Newer technologies
- New uses of conventional technologies

## ► Provide case studies and additional references

**Mining Waste Treatment Technology Selection**

Technology Overview as part of a Web-based Technical and Regulatory Guidance

**Ion Exchange**

**1.0 Introduction**

[Click Here to View Case Study Table at the end of this document](#)

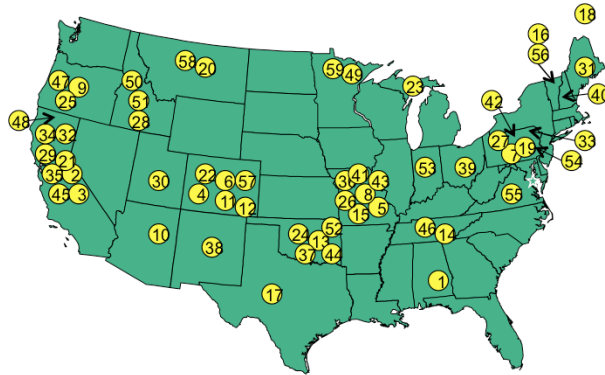
Ion exchange involves the interchange (or exchange) of ions between a solid media and an aqueous solution. The solid media can be commercially produced or made from natural occurring substances (e.g. peat or zeolites). Various resin forms are available to remove either cations or anions. Synthetic organic resins are the pre dominant type since their characteristics can be tailored to specific applications.

The capacity of any resin is limited and is a function of the resin, the number of available exchange sites and the input water chemistry. Capacity is generally estimated for the contaminant removed per cubic foot of resin. Once all the available sites are used, the resin must be regenerated. This can either be done on or off site. Depending on the type of water that has been treated selective metal recovery may be an option.

**2.0 Applicability**

- Dissolved contaminants
- Cations or Anions
- Can treat mine discharges with various flow rates
- Stand Alone Technology or in Combination with Others

# Case Studies



**Total of 59 Case Studies**  
(as of August 2010)

# Mining Case Studies

- ▶ Site Information
- ▶ Remedial Actions and Technologies
- ▶ Performance
- ▶ Cost
- ▶ Regulatory challenges
- ▶ Stakeholder Challenges
- ▶ Other Challenges/ Lessons Learned
- ▶ References

## Additional Sections

---



- ▶ Regulatory Issues
  - Water quality
  - Solid mine waste
- ▶ Stakeholder Concerns
  - Competing values may slow the cleanup
  - Full vs. partial cleanup
  - Economics
- ▶ Additional Resources

# Biochemical Reactors Team



*Engineered treatment systems that use an organic substrate to drive microbial and chemical reactions to reduce concentrations of metals, acidity, and sulfate in mining-influenced water.*

- ▶ Team started in 2011
- ▶ Guidance should be complete late 2013/early 2014

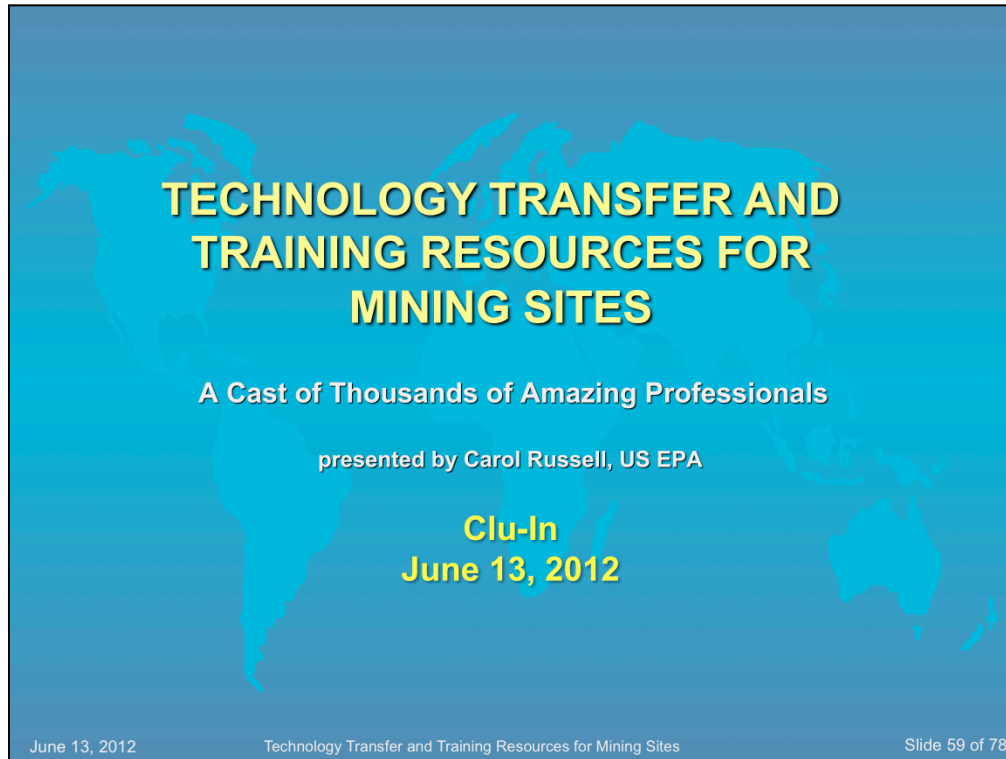


# Got Mine Waste?



Cherri Baysinger  
Missouri Department of Health and  
Senior Services  
[Cherri.baysinger@health.mo.gov](mailto:Cherri.baysinger@health.mo.gov)  
573-751-6206

Paul Eger  
Golder Associates  
[paul\\_eger@golder.com](mailto:paul_eger@golder.com)  
(651) 697-9737



I would like to acknowledge my co-authors and organizations, INAP Terry Chatwin, Keith Ferguson (who was one of the visionaries who conceived the GARD Guide), the ADTI volunteer organization, and Many other dedicated professionals.

# Summary

- Who are these people and what are they trying to do?
  - ADTI, MEND, PADRE, SANAP, CNAMD, INAD, SMIKT, Water Research Commission
- International Network for Acid Prevention (INAP)
- What is the Guide Global Acid Rock Drainage (GARD) Guide and other resources available through INAP
- Using the GARD Guide





# The Global Alliance



Acid Drainage Technology Initiative



CNAMD

INAD



SANAP



Water Research Commission



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 61 of 78

## ARD Issues Recognized by INAP

- International Network for Acid Prevention ([www.inap.com.au](http://www.inap.com.au))
- Consortium of mining companies that “...exists to fill the need for an international body which mobilizes acid drainage information and experience.”
  - Networking and information-sharing
  - Technology transfer
  - Gap-driven research
- Recognized the need for global technical approach to ARD management (Global Alliance)

In keeping with the mining industries commitment to our stakeholders and the environment, the International Network for Acid Prevention was formed in 1998 to mobilize acid drainage knowledge and experience and to coordinate global research on the management of sulphide mine wastes.



In keeping with the mining industries commitment to our stakeholders and the environment, the International Network for Acid Prevention was formed in 1998 to mobilize acid drainage knowledge and experience and to coordinate global research on the management of sulphide mine wastes. Present members of INAP include Anglo American, Antofagasta Minerals, BHP Billiton, Barrick Gold, Freeport McMoRan Copper & Gold, Kinross Gold, Newcrest Mining, Newmont Mining, Rio Tinto, Vale Inco and Xstrata. One of the key activities of INAP during the last two years has been the development of the GARD Guide.

Acid Drainage Technology Initiative - Windows Internet Explorer  
<http://ese.mines.edu/adti/workbooks.html>  
 File Edit View Favorites Tools Help  
 Acid Drainage Technology Initiative

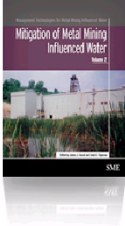
## Acid Drainage Technology Initiative

### Metal Mining Sector

- [Home](#)
- [About Us](#)
- [Membership](#)
- [Committees](#)
- [Workshops](#)
- [Annual Reports](#)
- [Workbooks](#)
- [Consensus Review](#)
- [Projects](#)
- [Presentations](#)
- [Publications](#)
- [Research](#)
- [Links](#)
- [News](#)
- [Contact Us](#)

**ADTI-MMS Workbook Volumes that have completed Consensus Review:**

The Pit Lakes Committee's *Mine Pit Lakes: Characteristics, Predictive Modeling, and Sustainability*, edited by D. Castle and E. Eary, will be published by SME in 2009. Twenty-seven authors from four countries contributed papers to this volume. Castle and Eary summarized the principle findings of this volume at the 8th ICARD.



The Mitigation Committee's *Mitigation of Metal Mining Influenced Water*, edited by L. Figueroa and J. Gusek, was published in 2009 and is available for purchase [here](#). This volume addresses both prevention and treatment of metal mining influence.

June 13, 2012      Technology Transfer and Training Resources for Mining Sites      Slide 64 of 78

Acid Drainage Technology Initiative - Windows Internet Explorer

http://ese.mines.edu/adt/committees.html

File Edit View Favorites Tools Help

Acid Drainage Technology Initiative

## Acid Drainage Technology Initiative

### Metal Mining Sector

**Committees**

Representing	Name	Affiliation
Chair	Doug Peters	Peters Geosciences
	Charles H. Bucknam	Newmont Metallurgical Services
Vice Chair	Linda Figueroa	Colorado School of Mines
Secretary	Dennis Turner	Arizona Department of Environmental Quality
Industry	Charles H. Bucknam	Newmont Metallurgical Services
	David Williams	Bureau of Land Management
Federal	Mark Cowles	US Army Corps of Engineers
	Dennis Turner	Arizona Department of Environmental Quality
State	David Bird	Colorado Department of Natural Resources
	Linda Figueroa	Colorado School of Mines
Academic	Terry Chelwin	University of Utah
	Dirk van Zyl	University of Nevada, Reno
	Glen Miller	Desert Research Institute
Non-Governmental Organizations	Doug Peters	Peters Geosciences
	David Williams	Bureau of Land Management
Production Committee	Bill White	Trinidad
	Andrew Nicholson	Dominica
Modeling Committee	Rona Vorburg	Solder Associates
Pit Lake Committee	David Castondyk	State University of New York
	Ted Eary	MWH Americas, Inc
Mitigation Committee	Jim Gusek	Solder Associates
	Linda Figueroa	Colorado School of Mines
	Virginia McLemore	New Mexico School of Mines and Technology
Sampling and Monitoring Committee	Carl Russell	US Environmental Protection Agency
	Kathy Smith	US Geological Survey
Review Committee	Charles H. Bucknam	Newmont Metallurgical Services

June 13, 2012

Slide 65 of 78



www.mend-nedem.org



www.abandonedmines.gov

Abandoned Mine Lands | Superfund | US EPA - Windows Internet Explorer

www.epa.gov/aml/

US EPA http://www.epa.gov/aml/

File Edit View Favorites Tools Help

US EPA Abandoned Mine Lands | Superfund | US EPA

**EPA** United States Environmental Protection Agency

LEARN THE ISSUES | SCIENCE & TECHNOLOGY | LAWS & REGULATIONS | ABOUT EPA

ALL EPA THIS AREA

**Superfund** [Contact Us](#)

You are here: [EPA Home](#) » [Superfund](#) » [Programs](#) » Abandoned Mine Lands

## Abandoned Mine Lands

Abandoned mine lands (AMLs) are those lands, waters and surrounding watersheds where extraction, beneficiation or processing of ores and minerals has occurred. AMLs can pose serious threats to human health and the environment. EPA has a range of resources related to the environmental risks and challenges from AMLs as well as risk management approaches and opportunities to explore innovative reuse opportunities at these sites.

**Basic Information** - basic information about the AMLs and EPA's AML Program.

**AML Site Information** - information about abandoned hardrock mines and mineral processing sites, including sites on the [National Priorities List \(NPL\)](#).

**Policy & Guidance** - EPA policy and guidance documents that have direct applications to the assessment and remediation of abandoned mine lands.

**Technical Resources** - technical reports, studies, and information on conferences and meeting proceedings related to EPA's Abandoned Mine Lands (AML) Program.

**Mineral Processing Sectors** - Gold/Silver, Lead, Iron, Copper, Zinc, Uranium, Phosphate, Extraction, Beneficiation, and/or Processing

**Related Links** - more information about AMLs.

**Where You Live** - information about AMLs near you and provides information from EPA regional offices.

**States** - information on statutory and regulatory authority, policies, site inventories and state technical resources.

**Tribes** - provides information about AML management on Tribal Lands.

**Highlights**

- 2012 Fact Sheet: Renewable Energy on Mine Sites (PDF, 120K, About PDF)
- Midvale Slag reuse video
- Solar Energy at Mine Site
- RE-Powering America's Initiative
- Identification and Evaluation Community Involvement Activities in Abandoned Land Communities (PDF, 490K, About PDF)
- Mine-Scarred Lands Initiative Tool Kit
- Palmerton Zinc Pile Case (PDF) (9pp, 900K, About PDF)
- Composting at Mine Site
- AML Technology Research

June 13, 2012

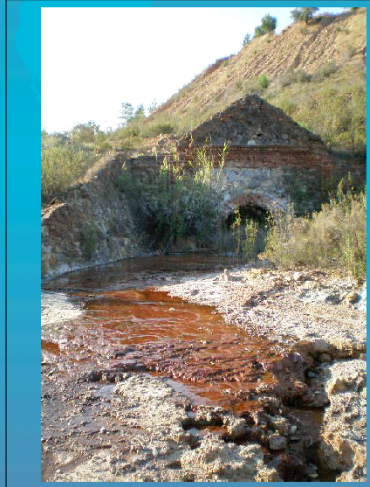
Slide 68 of 78

www.epa.gov/aml/



# Global ARD Guide (GARD Guide)

[www.gardguide.com](http://www.gardguide.com)



“An international guide for facilitating world-wide best practice in prediction, control, and mitigation of acid rock drainage.”

“The guide will become a reference document for all stakeholders involved in ARD and waste management issues.”

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 69 of 78

The GARD Guide is world-wide best-practice guide to assist in the prevention and mitigation of Acid Rock Drainage.

Since the Roll Out of the GARD Guide at the 8<sup>th</sup> ICARD in Sweden, INAP has focused on promoting the GARD Guide to all stakeholders: industry, regulators, financiers, communities, NGOs, academics. We believe that the GARD Guide has value to all.

Main Page - GARDGuide - Windows Internet Explorer

http://www.gardguide.com/index.php/Main\_Page

File Edit View Favorites Tools Help

Main Page - GARDGuide

---

Visit the Main Page [2]

## Main Page

### INAP: The International Network for Acid Prevention

INAP is an organization of international mining companies dedicated to reducing liabilities associated with sulphide mine materials.

The International Network for Acid Prevention (INAP) is an industry group created to help meet the challenge of acid drainage. INAP exists to fill the gap which mobilizes acid drainage information and experience. The network was founded in 1998. Since then INAP has become a proactive, global leader in acid drainage prevention.

If you would like an abbreviated introduction to the GARD Guide, there are Executive Summaries in English and Español.

- [Executive Summary in English](#)
- [Resumen Ejecutivo en Español](#)
- [Sommaire français](#)

### Development of the Global Acid Rock Drainage Guide

The development of the Global Acid Rock Drainage (GARD) Guide is sponsored by INAP with the support of the Global Alliance. The GARD Guide is the result of the contributions of many individuals and organizations. A team lead by Golder Associates prepared a draft of the Guide.

The GARD Guide deals with the prediction, prevention and management of drainage produced from sulphide mineral oxidation, often termed "acid rock drainage". It addresses metal leaching caused by sulphide mineral oxidation.

The GARD Guide is intended as a state-of-the-art summary of the best practices and technology to assist mine operators and regulators to address acid rock drainage.

The GARD Guide currently has 11 Chapters:

- [1. The GARD Guide](#)
- [2. The ARD Process](#)
- [3. Corporate, Regulatory and Community Framework](#)
- [4. Defining the Problem - Characterization](#)
- [5. Prediction](#)
- [6. Prevention and Mitigation](#)
- [7. Drainage Treatment](#)

navigation

- [Main Page](#)
- [Recent Changes](#)
- [Help](#)

gard guide chapters

- [Disclaimer and Restrictions on Use](#)
- [Executive Summary](#)
- [Resumen Ejecutivo en Español](#)
- [Sommaire français](#)
- [History and Acknowledgments](#)
- [Table of Contents](#)
- [1. The GARD Guide](#)
- [2. The ARD Process](#)
- [3. Corporate, Regulatory and Community Framework](#)
- [4. Defining the Problem - Characterization](#)
- [5. Prediction](#)
- [6. Prevention and Mitigation](#)
- [7. Drainage](#)

Slide 70 of 78

## GARD Guide Characteristics

- Flexible to accommodate site-specific issues
- Founded on a risk-based approach
- Encourage reduction and control at the source
- A “how to” guide and not a regulatory tool or a design manual
- Based on proven, field-tested technologies
- Avoids duplication and builds on existing guidelines and compendia
- Web-based – navigate via links, linked to references, ease of up-dates

Here is a list of some of the characteristics that were integrated into the Guide:

Flexibility to accommodate site-specific issues -- Inclusive – building on existing guidelines

Founded on a risk-based approach -- Pro-active encouraging reduction and control at the source

A how to guide -- Based on proven, field-tested methods

Address the full life-cycle of a mine – from cradle to cradle

# GARD Guide Structure and Authors



1. **GARD Guide - INAP**
2. **ARD Process** – Dr. Rens Verburg
3. **Corporate, Regulatory and Community Framework**  
– Mr. John Wates (Fraser Alexander, Jo'burg)
4. **Defining the Problem – Characterization**  
– Dr. Devin Castendyk (SUNY Oneonta)  
Ms. Cheryl Ross (Golder, Redmond)
5. **Prediction**  
– Dr. Kirk Nordstrom (USGS Denver)  
Dr. Rens Verburg
6. **Prevention and Mitigation**  
– Dr. Ward Wilson (UBC, Vancouver),  
Dr. Ben Wickland (Golder, Vancouver)

# GARD Guide Structure and Authors

## 7. Treatment

- Dr. Andre van Niekerk (Golder, Jo'burg)



- Chapman (Golder, Vancouver),  
Ross

## 8. Assessment and Performance Assessment



## 11. ARD Management in the Future

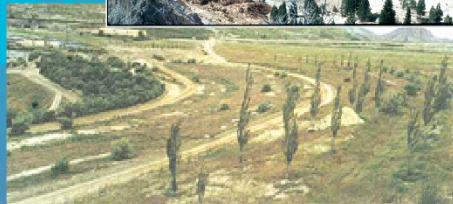
- Keith Ferguson (Sustainability Engineering)





# How to Get Value from the GARD Guide

- **Prevent ARD rather than treat it**
  - Minimize and characterize disturbed material
  - Plan and design for closure from the start
  - Integrate the GARD into operations
  - Update closure costs regularly
- **Engage all stakeholders in the process – shared responsibility**



June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 74 of 78

## Conclusions



- ARD or **MIW** management is critical to the success of a mine and the reputation of the mining industry as a whole
- Measurement and ongoing improvement of the ARD management are required throughout the life of mine
- Successful implementation of an ARD management relies on commitment from company management and the systematic use of ARD management tools including engaging all stakeholders

June 13, 2012

Technology Transfer and Training Resources for Mining Sites

Slide 75 of 78

Lake Ore-be-gone near Gilbert, MN is the result of natural flooding of three iron ore mines: the Gilbert, the Schley, and the Pettit.

# Next Webinar

- Next webinar is scheduled for September 12, 2012, 1:00-3:00 PM EST
- Theme – Mining-Influenced Water: Issues and Remediation Techniques
- Potential presentations: (1) PCBs, mining, and water pollution; (2) Case study on acid rock drainage remediation

**We want your feedback!**

**Are these topics interesting to you?**

**Do you want to hear about them on the next webinar? Any other suggestions?**

**[Leave us your comments on this webinar's feedback form.](#)**



# Resources & Feedback

- To view a complete list of resources for this seminar, please visit the [Additional Resources](#)
- Please complete the [Feedback Form](#) to help ensure events like this are offered in the future

U.S. EPA Technical Support Project Engineering Forum  
Green Remediation Opening the Door to Field Use Session C (Green Remediation Tools and Examples)  
Seminar Feedback Form

We would like to receive any feedback you might have that would make this service more valuable.  
Please take the time to fill out this form before leaving the site.

First Name: \_\_\_\_\_  
Last Name: \_\_\_\_\_  
Mailing Address: \_\_\_\_\_  
City/State/Zip: \_\_\_\_\_  
E-mail Address: \_\_\_\_\_  
Date of Seminar: December 15, 2009  
Delivery Method: \_\_\_\_\_

☐ Please send a copy of my feedback confirmation as a thank you to my participation to this address

Need confirmation of your participation today?

Fill out the feedback form and check box for confirmation email.

Thank you again for your attention and comments. I want to remind each of you that we are looking for your specific responses to many of the issues discussed today in our feedback form following this session.

Also, there are several resources and related documents included in the links to more resources on this page.

If you have any additional questions or comments, please feel free to contact me or fill out a comment form on CLUIN.

Thank you and have a great afternoon.

## New Ways to stay connected!

- Follow CLU-IN on Facebook, LinkedIn, or Twitter



<https://www.facebook.com/EPACleanUpTech>



<https://twitter.com/#!/EPACleanUpTech>



<http://www.linkedin.com/groups/Clean-Up-Information-Network-CLUIN-4405740>