ME551/GEO551 Introduction to Geology of Industrial Minerals
Spring 2014

Sustainable Development and Industrial Minerals
"We do not inherit the earth from our ancestors, we borrow it from our children."

Native American Proverb
What is sustainable development?
Sustainable development

- Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Sustainable development is not about sustaining the life of a mine.
- Instead it is about sustaining the flow of materials for this and future generations and maintaining viable communities now and in the future, even after mine closure.
What does this definition imply?
What does this definition imply?

• Future generations have rights to the resources
• The Current generation has a duty to include future generations’ needs in its decision-making

Is this a “Freeze-frame” projection into the future? A no growth or slow growth definition? Or may the current generation assume there will be future technological advances and economic growth?

• An accounting of social and environmental impacts

» Who makes the call? Government, industry or the free market?
What is Mining’s Role in Sustainable Development?
Mining’s Role in Sustainable Development

- Creator of New Wealth
  - Jobs, taxes and economic growth
  - Foundation for eliminating poverty
  - Make a profit -- Shareholder return
  - Enhanced standard of living

- Providing Mineral-based Products to Meet Society’s Basic Material and Energy Needs and Demands
  - Building blocks of economic growth
Mining’s role ... continued

- Advances in Civilization
  - All successful societies have encouraged, and will continue to encourage, mining
  - Metallurgical and technological advances have defined advances in civilization

- Mitigation of Society’s Impact on the Environment
  - Mineral products make environmental protection technology possible
  - Modern mines are designed and built for closure
  - Recyclable mineral products
Mining’s role... continued

- Providing Lasting Benefits after an Orebody Is Exhausted
  - Mining’s legacy to the community – a sustainable rural economy
  - Avoiding the boom/bust cycles of the past – How do we keep the party going? Requires planning and cooperation
  - Metals are durable and continue to be used by society

- Efficient use of resources – energy, water, land and minerals
  - Technological advances promote resource conservation, efficiency, and extend mine life
Continued supply of natural resources to manufacture and produce products that society demands

- Recycling
- Re-use
- Less use
- Materials replacement
- Alternative product design
- Mining of new resources
Sustainable Development in the Context of Mineral and Energy Development Encompasses:

- Economic Responsibility -- shareholders, employees, community, society
- Environmental Responsibility -- society is more concerned with mining’s impacts and behavior than its products
- Resource Stewardship -- wise and efficient use
- Community Engagement -- shared objectives
- Product Stewardship
- Social License and Public Accountability– we mine with the consent of the public
Sustainability applied to any industry requires four general considerations (Richards, 2002):

♦ Economic  ♦ Environmental  ♦ Social  ♦ Governmental

Sustainable *does not* mean:

→ renewable

→ zero environmental impact

→ “green”

Note affects of renewable business on the environment:

→ agriculture, farming: much greater land area, regionally much greater negative environmental impact

→ golf courses: occupy surface area greater than state of Delaware - 5270 km² (herbicides, fertilizers)
It is not easy to meet society’s needs without changing the landscape somewhere and affecting local communities.
Increase in population and the desire to maintain the lifestyle that we have here in America has led to an unprecedented change in the landscape locally.
The challenge is to provide society with its needs, protect future resources, and alter the landscape and affect local communities as little as possible.
Mining is compatible with environmental protection and social responsibility, and difficult challenges can and must be faced by the industry. Those who fail to meet this challenge are the likely losers. Society and the environment are also losers, and must also step up to the plate to meet the challenges.
Seven Questions to Sustainability

- How to assess the contribution of mining activities
- Maintain social license to operate
#1 - Engagement

✔ Are engagement processes in place and working effectively?

✔ Have community relationships been established?

✔ Is there adequate feedback from the community?
Cleaning Up Mining Messes

Long gone are the days when metals like gold were mined with picks and axes. Modern mines are enormous operations that leave behind enormous messes.

Unfortunately, there is no federal program requiring all of these mining messes to be cleaned up in a way that protects communities, public health and water resources. The 1872 Mining Law still governing hardrock mining today, contains no water quality or clean standards. Other applicable statutes and regulations, such as the CERCLA Act, either focus on pollution containment (rather than pollution prevention) or have huge holes (e.g., groundwater is not protected by federal law), or both.

But what about state-level mining regulations, especially in the West?

Tour the Mine

Open Pit
Waste Rock Dumps

Hard-rock Mining Issues in New Mexico

Mining, long a major industry in New Mexico, has had a severe environmental impact on public and private lands and rural communities in the state. Modern mining involves:

- Contamination of land and water with toxic leachate elements such as cyanide and mercury
- Acid Rock Drainage, a perpetual water-pollution problem if left untreated
- Dangerous high walls and mine pits on public lands
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About Mineral Information Institute
505 Violet St. - Golden CO 80401 - Ph: 303/277-9190 - Fax: 303/277-9198 - E-Mail: mii@mii.org

THE Source for FREE Teaching Materials

<table>
<thead>
<tr>
<th>Our Mission</th>
<th>Objectives</th>
<th>Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support</td>
<td>Staffing/Directors</td>
<td>Teacher Comments</td>
</tr>
</tbody>
</table>

MII's Mission

The Mineral Information Institute (MII) is a national 501 (c)(3) not-for-profit organization dedicated to educating youth about the science of minerals and other natural resources, and about their importance in our every day lives.

Each year MII works with interested professional and scientific associations, and various government and education agencies, to help classroom teachers develop materials that are directly usable by teachers in a variety of subjects and a multitude of grade levels. All programs require updating and maintenance to ensure their continuing value and use in the classroom. MII will provide that and will distribute those programs that merit continued use.

Supported by corporations, foundations, scientific associations, and individuals from across the nation, MII distributes these materials free to classroom teachers to supplement existing curricula. More than 29,000 K-12 classroom teachers in all 50 states, several Canadian provinces, and foreign countries receive teaching materials each year from MII.

MII is supported solely by donations. If we have helped you or you believe in what we do, please send a donation.
What’s New at NMA?

> Secretary Norton Was an Exemplary Public Servant and Valued Trustee of the Nation’s Resources
> Regulating Mining Dust as Health Hazard Unwarranted
> MSHA Headed in Right Direction with Emergency Temporary Standard
> March 17th Edition of Mining Week

Facts About...

Learn more about: Mine Safety

NMA is the voice of one of America’s great basic industries. Our primary mission is helping the nation realize the contribution of resources derived from mining to our economic well-being and quality of life.

THE SAGO MINE ACCIDENT
Contribute to the Sago Mine Fund. Support Lost Miner’s Families
NMA Statement on Sago Mine Accident
Mining Safety Statistics
Molycorp proudly sponsors:

The Molycorp Little Miners baseball.........and the Road Runners soccer team:

Open House at Lafarge North America

Communication is key to any good relationship, and that goes for neighbors too. As a fixture in hundreds of communities in the United States and Canada, Lafarge North America realizes the importance of sharing information about our operations with those who live and work near us. Whether it’s a barbeque for the adults or games for the kids, Lafarge North America’s open houses are opportunities for us to develop relationships with our neighbors in the community.
#2 - People

Will people’s well being be maintained and/or improved during and after the mining venture?
St. Cloud zeolite mine in Sierra County was first converted from a silver mill into a crushing plant for production of zeolites. Then the company diversified into reclaiming AML sites throughout NM as well as mining aggregate for roads and railroads. They now grow trees using their zeolite for reclamation plots throughout the state.
New technologies to improve worker safety

MILLING/GRINDING

GCC of America, Inc., Rio Grande Plant Tijeras, New Mexico

The Mill Maintenance Team at GCC's Rio Grande plant developed a system to minimize personnel exposure every time a ball mill requires a new charge or the addition of balls to the existing charge. Previously, after the mill shell access door was removed, barrels of balls were handled one at a time and carried overhead using the mill building bridge crane. Since the metal ball barrels are sometimes stored outside, they can develop unseen rust on the inside and bottom. The rusted barrels can burst when they are handled. The new system uses a concrete placement bucket with a clamshell gate. Barrels are now hoisted by a forklift with a barrel-gripping attachment and dumped into the concrete bucket. The mill building bridge crane hoists the bucket to the top of the ball mill. The bucket handles four barrels of balls at a time, eliminating the overhead conveyance of barrels in the work area. An unexpected benefit was realized when the time required to charge a mill was reduced by approximately 40%. Future ball mill charging projects will include a second concrete bucket to be loaded while the other is hoisted by the mill crane.
Our New Mexico Coal operation in the USA initiated a behavioural-based safety leadership program in 2002. Led by the full management team, the program was developed with the aim of driving improvement in safety performance, which had been static for several years. In order to achieve Zero Harm, it was determined that the safety culture at New Mexico Coal needed a change. Training of the entire workforce was planned and completed.
Health and safety programs are important for happy healthy miners

'Let's get physical'
Intrepid Potash announces health initiatives

Erin Green/Current-Argus

At Tuesday's Intrepid Potash HealthCounts press conference at Carlsbad Medical Center, Dr. Jeffrey Boone, a doctor for Ute Denver Broncos Alumni, Jim Whyte, vice president of Intrepid Potash, and former Dallas Cowboy and Denver Broncos football player Wade Manning try out some treadmills.
Mining companies are proud of their health and safety programs, with many awards being won for H&S.

Carlsbad Current-Argus (LOCAL NEWS)
December 4, 2003

Mine gets top safety award
- By Jason P. Montoya: Current-Argus Staff Writer

CARLSBAD – A U.S. Labor Department official presented Mississippi Potash Inc.’s West Mine with the 2002 Sentinels of Safety Award on Thursday for the mine’s safety record in 2002.

“My experience tells me that safety and health should be part of your business plan. It should be a core value of your organization’s business components,” said David Lauriski, assistant secretary of labor for mine safety and health.

“For us to be able to come out and promote this kind of event and promote the accomplishments of an organization like Mississippi Potash helps us show people that these types of things can be accomplished,” he said.

Lauriski called the award the most prestigious honor of all industries in the United States.

Mississippi’s West Mine earned the award in the underground nonmetal group with 263,371 employee hours without an injury that resulted in lost workdays. It was the fourth time since 1990 that Mississippi Potash Inc. has won the 77-year-old award.

The Sentinels of Safety Award – the oldest occupational safety award – is given out by the Mine Safety and Health Administration and the National Mining Association. Randy Foote, general manager of Mississippi Potash, attributed the honor to his employees’ attitudes and efforts.

“It’s really a recognition of the hard work our employees have put forth. By winning this award, we are recognized by our peers as having superior programs with employees who go out there and actually perform these programs,” he said.

January 28, 2005

United Salt Corp Safety Recognition
October 5, 2004

Our Hockley, Texas underground mine achieved 400,000 work hours without a lost time injury while our Carlsbad, New Mexico solar salt facility achieved a record 2,100,000 work hours without a lost time injury. Congratulations to both plants!
Safety pays in New Mexico

Albuquerque, New Mexico

Lafarge officials frequently tell associates that "safety pays." The catch phrase took on new meaning when Lafarge was selected to supply the concrete for a large job in New Mexico because of their outstanding safety record.

Details:

Sandia National Laboratories (SNL), a high tech, high-security company located at Kirtland Air Force Base in New Mexico, places a high priority on the safety performance of its suppliers. After a series of safety violations, including a mixer rollover accident, the company decided to seek a replacement.

SNL chose Lafarge because of the company's consistently high reputation for safety. The New Mexico AC&A Division spent more than five years developing a top notch safety program and training drivers and support personnel to develop and maintain safe work habits. The effort paid off—literally!

Last Update: 03/16/2006 07:39
#3 - Environment

- Recognize environmental management as a high priority
- Establish environmental accountability
- Encourage employees at all levels to recognize their responsibility for environmental management
- Adopt environmentally sound technologies
- Adopt risk analysis and risk management.
St. Cloud received state reclamation awards for reclaiming AML at Lake Valley and other mine sites.
Located in Waterflow, New Mexico, the San Juan Coal Company has been presented with the Department of the Interior, Office of Surface Mining's 2004 National Reclamation Award, as well as the 2004 Best of the Best Award, for exemplary reclamation successes.

The grading techniques and channel design used at the San Juan Mine have represented the most innovative reclamation technology that has been developed for western coal mining during the past 25 years. Slopes have been created with the same characteristics as the undisturbed lands. San Juan used a design process based on fluvial geomorphic principles, so the reclaimed topography is more stable, diverse, and resistant to damage from flash flooding than traditional reclaimed land in this arid environment.

The Best of the Best Award recognizes that outstanding reclamation is always a balance between production schedules, costs, and desire for the best possible reclamation. The ability to make it all work while achieving award-winning reclamation was best exemplified by the team responsible for the innovative regarding at the San Juan Mine. The group showed foresight, initiative, and creative implementation, attributes that make this group a model in both the coal industry and government regulatory environments.
Copper, Cows And Flycatchers Coexist In New Mexico
(July 2000)

In the quiet Gila River Valley in southwestern New Mexico, on Phelps Dodge property adjacent to the Tyrone mine, you’ll find the world’s largest population of the Southwestern willow flycatcher, a bird designated as endangered in 1995 under the Endangered Species Act.

The tiny bird is thriving amid the very conditions that a U.S. Fish and Wildlife Service report said would be most threatening to the species: water diversion, livestock grazing and floodplain agriculture. These activities occur extensively within the area. Yet, of the 500 pairs of flycatchers that remain in the world, more than 200 pairs are on the Phelps Dodge property. It’s no fluke.

Shortly after the flycatcher was designated as endangered, Phelps Dodge began to work with independent biologists, Western New Mexico University, and the Gila National Forest to study environmental impacts on the bird’s habitat on our property. In recent years, the company has funded restoration projects and leased water at no cost to the National Forest Service to help develop a habitat along the river.

And most recently, in a further demonstration of environmental stewardship, Phelps Dodge’s New Mexico Operations funded a grant for additional study of the bird. The Rocky Mountain Research Station, a research division of the Forest Service, will continue to identify habitat, nesting and parasite concerns for the flycatcher in the Gila River Valley.

The Phelps Dodge funded study will collect data and incorporate it into several habitat models. These models will be used to identify areas for future riparian (river and riverside) restoration and flycatcher conservation.
Mining, recycling, and conservation are important to provide the continued flow of commodities required to continue our way of life.

Companies are in the business to make a profit.
**Intrepid aims to bring Carlsbad 100 jobs**

*by Clay Holtzman, NMBW Staff*

A Denver mining company that has been investing big bucks around Carlsbad says it soon hopes to add 100 jobs and breathe more life into the state’s resurgent potash industry.

Since early 2004, **Intrepid Mining LLC** has hired 250 Carlsbad workers furloughed from a bankrupt competitor – essentially doubling the company’s workforce. Intrepid also has invested about $60 million in acquiring and expanding mining and processing operations near the southeast New Mexico town. Intrepid says it will open a $12 million plant to process a similar mineral, also near Carlsbad, within a month.

“We’ve been doing it quietly,” says Robert Jornayvaz, principal with the **Intrepid Companies**, which owns Intrepid Mining LLC.

In late June, Intrepid received the support of the Eddy Country Commission in its quest to secure $21.5 million in state-backed Industrial revenue bonds. The company intends to use those bonds to fund a $27 million solution-mining project, similar to the company’s existing operations in Moab, Utah, that could generate 100 more jobs for Carlsbad.

Once expansion plans are complete in about 18 months, its principals says Intrepid will have invested about $90 million in the Carlsbad operations, have a local workforce of more than 600 and increase production at the nation’s largest potash production complex by more than 50 percent.

**Po-waht?**
Pumice-crete is a low density concrete made from pumice aggregate, portland cement, and water. It is a mix that succeeds in providing structural strength and insulation in one material. Typically it is poured on site in wall thicknesses of 14" or greater and no additional insulation or structural components are necessary. Wall surfaces are finished by applying plaster coats on the interior and exterior which further aid the thermal performance by trapping air within the honeycomb pumice-crete mix. The walls are very durable, fireproof, have good noise resistance, and are very aesthetically pleasing because they can be formed to fit many architectural appearances and styles. Being lightweight pumice-crete is relatively easy to install and is cast on site out of not highly manufactured ingredients making it a very resource efficient material. Pumice-crete buildings are warm and easy to heat in the cold of winter and stay cool and comfortable in the heat of summer. Pumice is a lightweight volcanic rock that is found in many parts of the world where volcanoes are present. It is a sponge like material formed by expansion of gases while molten lava rapidly cooled. It is a porous glass froth that is found in very shallow deposits in such places as New Mexico, Arizona, California, Oregon, Washington, and Idaho. Due to its toughness and durability it has been used as a lightweight aggregate in concrete for over two thousand years. It is an inert material and therefore has
Intreped Ltd. (potash) and HRI Inc. (uranium) are investing in new technologies to determine if they can use *in situ* or solution mining.
#5 - TRADITIONAL AND NON-MARKET ACTIVITIES

- Are traditional and non-market activities in the community and surrounding area maintained or improved with the operation?
- Protective of indigenous cultures
Lafarge donated a reclaimed aggregate pit to the Laguna Tribe
Feb. 2 was Phelps Dodge Day in Albuquerque, N.M. (February 2002)

Albuquerque Mayor Martin J. Chavez gave Phelps Dodge its own day in the New Mexico city. The mayor proclaimed Feb. 2, 2002, as Phelps Dodge Day in Albuquerque to commemorate the 20th anniversary of Phelps Dodge’s sponsorship of the Rio Grande Bio-Park’s Zoo-to-You program. Zoo-to-You is sponsored by the company’s Chino and Tyrone mining operations in New Mexico.

Chavez commended Phelps Dodge Corp. for its "strong community relations program that reaches out graciously to offer and promote such things as community arts, education, scholarships and grants, civic development, environmental awareness, safety training and volunteerism to many people."

The mayor’s proclamation states that the company’s contribution is appreciated by the second generation of New Mexicans who have learned about wildlife conservation and environmental issues.

Zoo-to-You is a traveling education program that takes zoo animals and animal-science programs to schoolchildren throughout New Mexico. The Zoo-to-You programs are presented by Bio Park docents who volunteer to travel with the zoo van and various small animals throughout the school year. Presentations are also made during the summer at public libraries and other educational facilities.

Over its 20-year history, the Phelps Dodge’s Zoo-to-You van has visited more than 700,000 children throughout New Mexico.

"Phelps Dodge is our longest-standing community partner," said Ray Darnell, executive director of the Rio Grande Bio-Park, which consists of the Rio Grande Zoo, the Albuquerque Aquarium and the Rio Grande Botanic Garden.

"The company has supported Zoo-to-You in good times and bad, and its commitment to this education program and to the schoolchildren in New Mexico has never wavered," Darnell said. "I hope more companies will soon realize the benefits of including community improvement into business practice."
#6 - Governance

- Are the rules and incentives in place and as long as required to address operational consequences?
- Communication
Caterpillar holds Global Forum on Sustainable Development in Mining at MINExpo 2004

Pit & Quarry, Nov, 2004

Caterpillar held a Pre-MinExpo show at Caesar’s Palace in Las Vegas for its family of global miners. Held Friday through Sunday before the start of the expo on Monday, the event featured a global forum on sustainable development in mining, a products and services briefing and a nightly Mine Site @ Night.

The Global Forum on Sustainable Development in Mining was a global gathering of miners for a day of exchange with industry leaders, real-time opinion polling, case studies and team-based, hands-on experiential learning. Ideas were shared and exchanged, from mining companies on the front line, on mining’s triple bottom line--social, environmental and economic. Discussion on how safety initiatives fit into the business model was also discussed.
From Anglo American:

“To secure a continuing license to operate, the mining and resources industry will have to frame its future in economically viable, socially beneficial and environmentally sound practices that are negotiated with communities within which it works.”
"We believe we can only continue to generate value for our shareholders over the long run if we excel in our performance on environmental and social issues. Sustainable development ...manages all the business risks to earn a license to operate from all stakeholders."
#7 – Synthesis and Continuous Learning

- Is the project a net positive or negative for people and ecosystems?
- Is there a process in place to synthesize and assess the continued progress towards sustainability?
- Is there executive support from the company?
Many companies have educational materials in their web sites for teachers.
New Mexico Bureau of Geology and Mineral Resources in cooperation with New Mexico Energy, Minerals, and Natural Resources Department hosted the 2005 Decision Makers Field Conference on Mining in New Mexico.
Rio Grande Cement honored with Quality Award

Jan 1, 2004 12:00 PM

GCC Rio Grande Cement's plant in Tijeras, N.M. was honored earlier this month with Quality New Mexico's highest accomplishment — Quality New Mexico's ZIA Award for Performance excellence, recognizing the company's commitment to progress toward excellence in business, education, government, and health care. Rio Grande was co-recipient of the honor along with Western New Mexico University.

Rio Grande, a past Roadrunner recognition recipient, is New Mexico's only cement manufacturer. The award process and criteria are patterned after the Malcolm Baldridge National Quality Award.
Successful sustainable development involves the mining industry, government, and the community.
Is it possible to have sustainable development, sustainable economic growth, sustainable communities and a sustainable society without mining?
What are some Roadblocks to Sustainable Development?
Roadblocks to Sustainable Development

- **NIMBY, BANANA and NOPE**
  - Locking up access to our resources is not sustainable, nor is it environmentally or socially responsible
  - Fails to recognize that poverty, not development, is the worst polluter
  - Arrogant--limits future generations’ choices
  - Environmental imperialism – exporting the impacts of our consumption

- **Ineffective inter-agency cooperation**
Roadblocks to Sustainable Development continued

- Over Regulation
  - The Babbitt 3809s
  - The Roadless Rule and similar attempts to create *de facto* wilderness
  - Solicitor opinions (millsite, excess reserves, etc.)
  - Court and agency interpretation of ESA, CWA, CAA
  - EPA

- The Permitting Process (NEPA)
  - The perpetual litigation machine
  - The never-ending story
SUMMARY

- Mining is a major form of creating wealth by providing the raw materials needed to sustain our way of life.
- Mining companies need to make a profit in order to remain sustainable.
- Mining companies have numerous opportunities to contribute to their communities and provide a sustainable future.
ASSIGNMENT

❖ Midterm
