

# **Risk and Regulation in the Mining Industry**

**Carol Cox Russell**

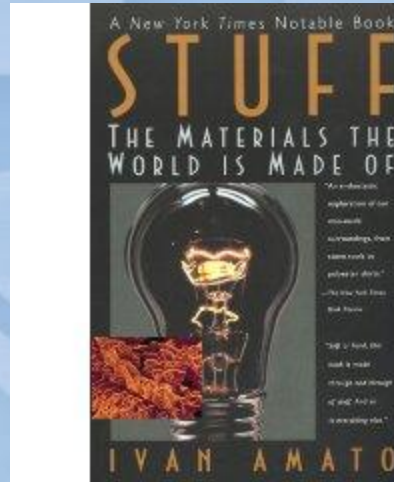
US Environmental Protection Agency Region 8 – Denver, CO

**Understanding the Impacts of Mining in the Western Lake Superior  
region (Minnesota, Wisconsin, and Michigan)**

**September 12-14, 2011**

# Mining and Civilization

- Stone Age
- Bronze Age
- Iron Age
- Nuclear Age
- Age of Silicon
- Age of Rare Earth's?



Stephen L.  
Sass

## The Substance of Civilization

Materials and Human History from the Stone Age to the Age of Silicon

# *Outline*

- Mining Risk
- Environmental Regulation of Mining
- Mining Environmental Risk Assessment
- Example



# Mining is a Risky Business



**Magnitude of loss x Probability of loss = Risk**

# ***RISK***

## **Risk Assessment**

- What can go wrong?
- What is the likelihood that it would go wrong?
- What are the consequences

## **Risk Management**

- What can be done and what options are available?
- What are the associated tradeoffs in terms of all costs, benefits, and risks?
- What are the impacts of current management decisions on future options?

**Available  
Land  
Resources**



**Exploration**  
8-10+ years

**Environmental  
Assessment  
& Approval**  
Ongoing stakeholder  
consultations



**Construction**  
1-3 years



**Operation**  
10-30 years

**Closure**  
1-2 years



**Reclamation**  
1-4 years  
**Monitoring**  
5 years - ∞

# Mining Life Cycle

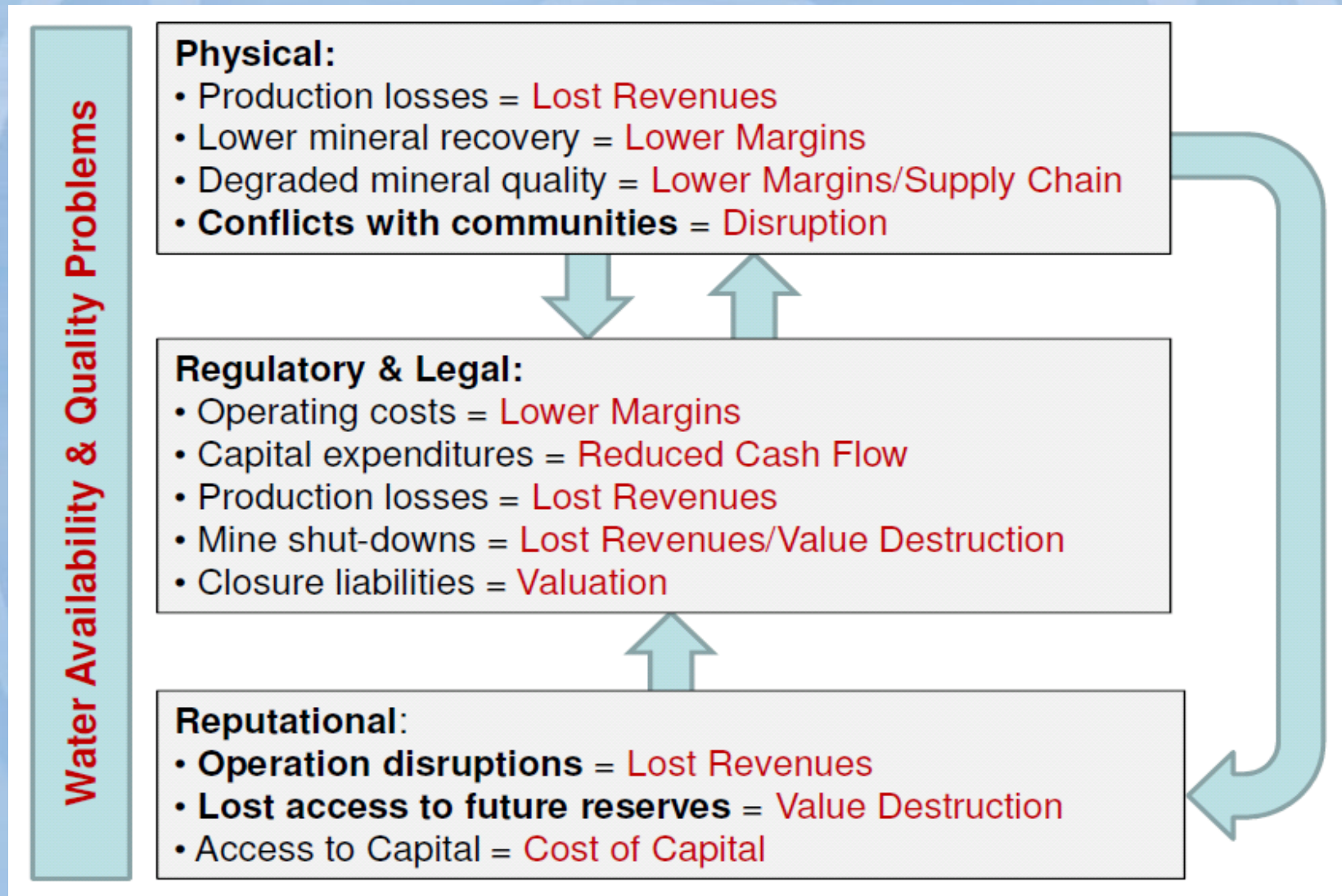


# Water Issues at Different Mining Stages

Stage	Potential Issues
<b>Exploration/ Construction</b> (surveying, drilling, trench blasting, road construction)	<ul style="list-style-type: none"><li>• Sediment runoff, increased suspended sediment load to surface waters</li><li>• Spills of fuels and other contaminants</li></ul>
<b>Operation - Mining</b> (blasting, ore stockpiling, waste piling)	<ul style="list-style-type: none"><li>• Chemical contamination of surface and ground waters</li><li>• Toxicity impacts to organisms (terrestrial and aquatic plants and animals)</li><li>• Altered landscapes from mine workings (e.g., open pits, changes in stream morphology)</li><li>• Increased erosion and siltation</li><li>• Altered patterns of drainage and runoff</li><li>• Water consumption: dust suppression, mine camps, evaporative losses from clean water storage dams, water used to cool equipment</li><li>• Decreased groundwater resources due to dewatering pits</li><li>• Reliance on power from water-dependent sources (hydro and thermal)</li></ul>
<b>Processing</b> (smelting, refining)	<ul style="list-style-type: none"><li>• Discharge of chemicals and other wastes to surface and ground waters.</li><li>• Water consumption: water used in mineral separation and beneficiation.</li><li>• Reliance on power from water-dependent sources (hydro and thermal)</li></ul>
<b>Mine-Closure/Post-Closure</b> (revegetation, fencing, monitoring, long-term water treatment)	<ul style="list-style-type: none"><li>• Persistent contaminants in surface and ground waters</li><li>• Expensive, long-term water treatment</li><li>• Persistent toxicity to organisms</li><li>• Permanent landscape changes</li></ul>



# Mining Company's Perspective on Risk





# Another Mining Company Perspective

“Treating acid drainage once it has occurred, or mitigating environmental impact after it has occurred, is usually an admission that something has gone wrong either in the characterization, planning, design or operation of a mine.”

Paul Dowd, former Managing Director, Newmont Australia  
(Dowd, 2005) <http://www.gardguide.com>)

# Quantifying Risk

## (EPA perspective)

- In 2004 OIG identified 156 CERCLA sites with the potential cost from \$7 - \$24 billion
- NEPA documents for mining were not reliable in predicting water quality problems  
Maest and Kuipers, 2005
- EPA drafts new financial assurance regs

# Environmental Regulation of Mining





# U.S. EPA's mission *to* **protect human health** *and the environment*



# Fire, Earth, Air and Water



**Comprehensive,  
Environmental  
Response,  
Compensation,  
and Liability Act  
(Superfund)**

**Resource,  
Conservation and  
Recovery Act**

**Clean Air Act**

**Clean Water Act**

**Safe Drinking  
Water Act**

# Primary laws administered by EPA related to metals

- **NEPA - National Environmental Policy Act**
- **CWA - Clean Water Act - (NPS) Nonpoint Source**
- **EPCRA - Emergency Planning and Community Right to Know, TRI - Toxics Release Inventory**
- **SDWA - Safe Drinking Water Act**
- **CWA - Clean Water Act**
- **CAA - Clean Air Act**
- **CERCLA - Comprehensive Environmental Response, Compensation and Liability Act**
- **TSCA - Toxic Substances Control Act**



# EPA's Continuum of Activities Based on Risk

Certification/  
Registration

Disincentives

Standards

Incentives

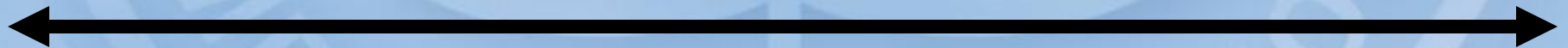
Information/  
Education

Permits

Mandatory Cleanup

Prohibition

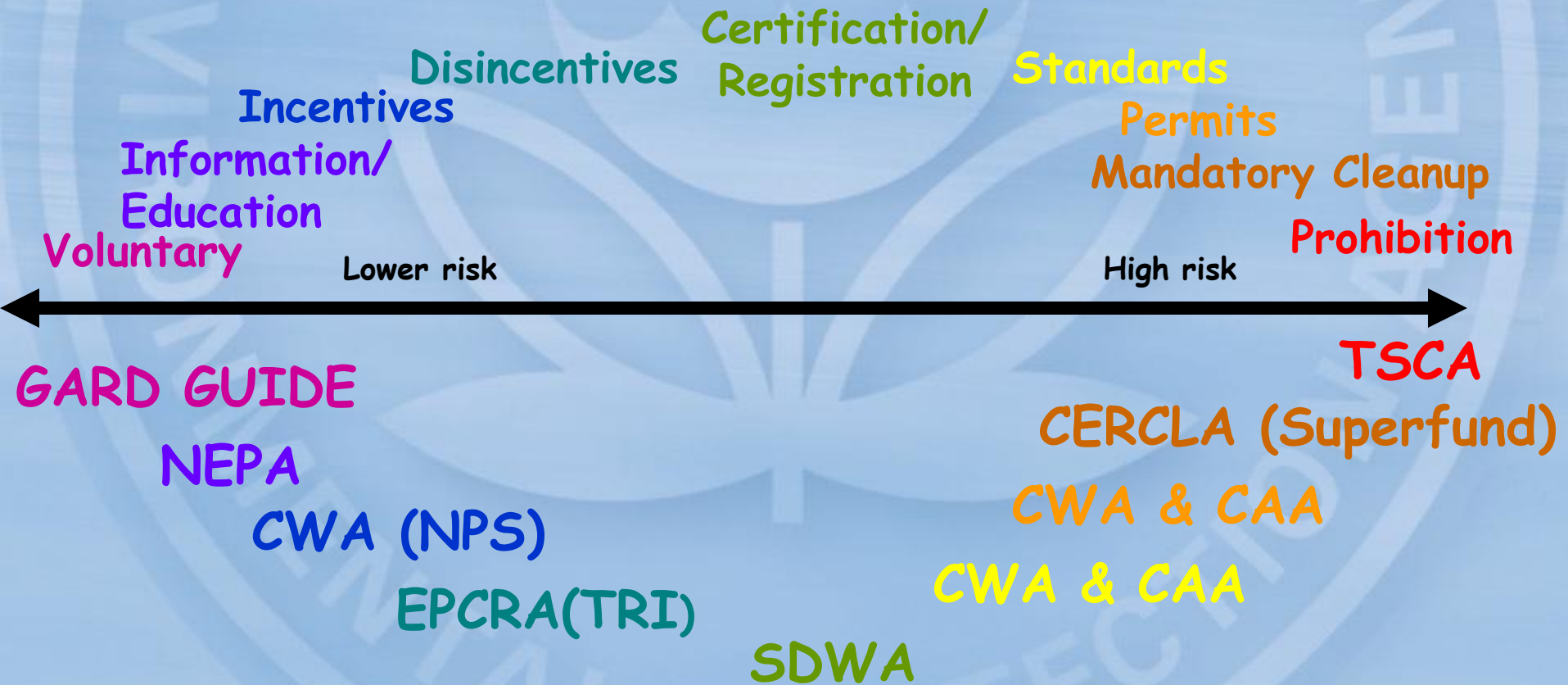
Voluntary



Lower risk

Higher risk

# Risk continuum - Regulatory options and U.S. environmental laws

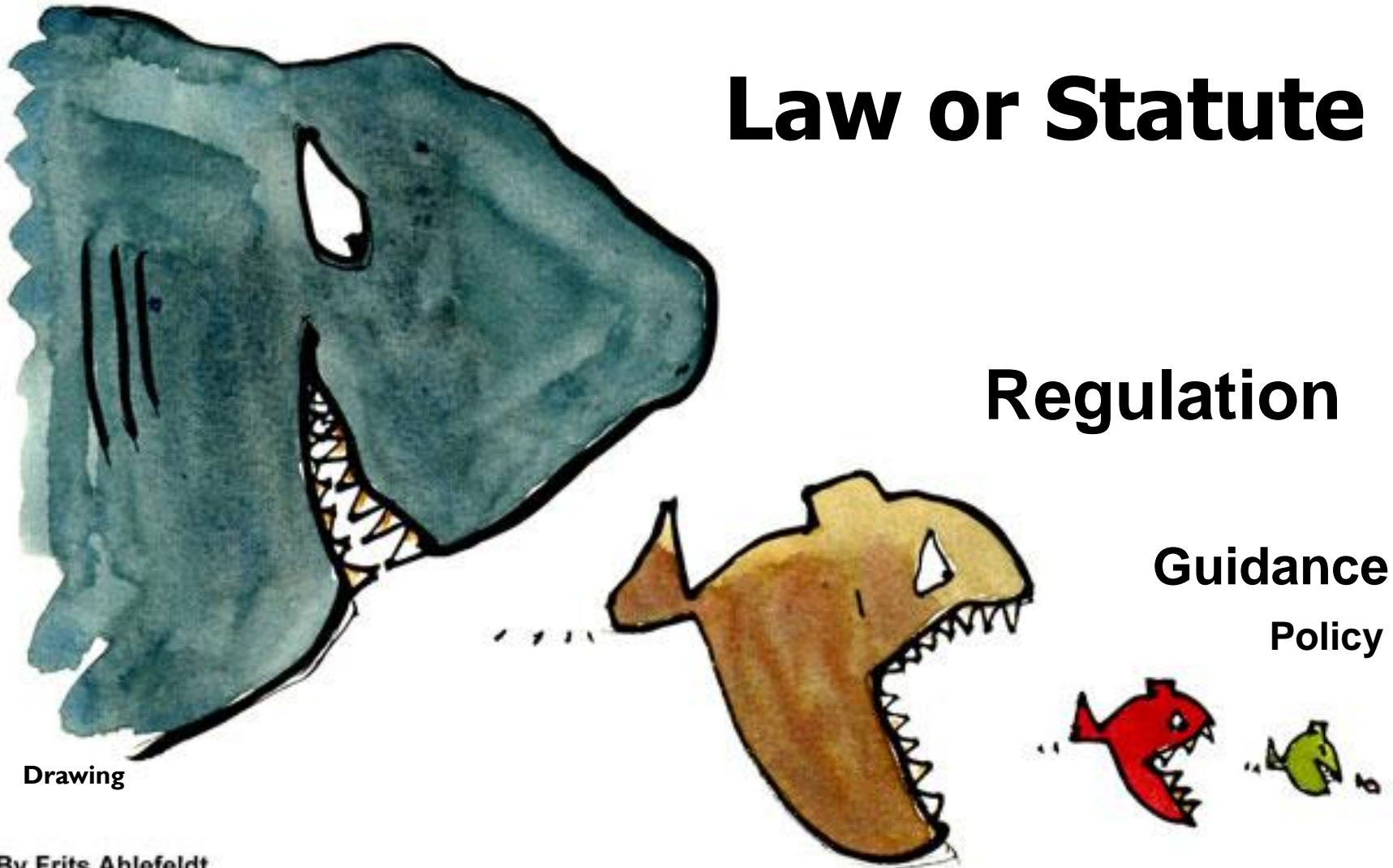


# Regulatory Hierarchy

**Law or Statute**

**Regulation**

**Guidance  
Policy**



Drawing

By Frits Ahlefeldt



# National Environmental Policy Act - NEPA

- *“to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man”* by providing information to the public
- Federal decision – evaluate alternatives
- EPA reviews environmental documents to determine if the environmental alternative chosen will impact the environment and to determine if the agency provided this information to the public

# Safe Drinking Water Act - SDWA

- EPA sets legal limits on the levels of certain contaminants in drinking water 40CFR142 (note: compliance is at the tap for Public Drinking Water Systems)
- Based upon Maximum Contaminant Levels (MCLs)
- Labs must be certified

# Clean Water Act - CWA

- 304a – EPA provides guidance to States and Tribes on the concentrations of metals that will not harm aquatic life or human health – Criteria (note: The States and Tribes set standards not EPA)
- 303d – Impaired waters and anti-degradation
- 402 and 404 permits
  - (NPDES and Fill permits)
- 401 certification by States or Tribes



# EPCRA – Toxic Release Inventory - TRI

- The TRI requires reporting by the companies of metals discharged to the environment (note: these include permitted releases)
- Selecting chemicals for the Agency's Toxicity Characteristic regulation (40 CFR 261.24) that defines hazardous wastes

# Resource Conservation and Reclamation Act - RCRA

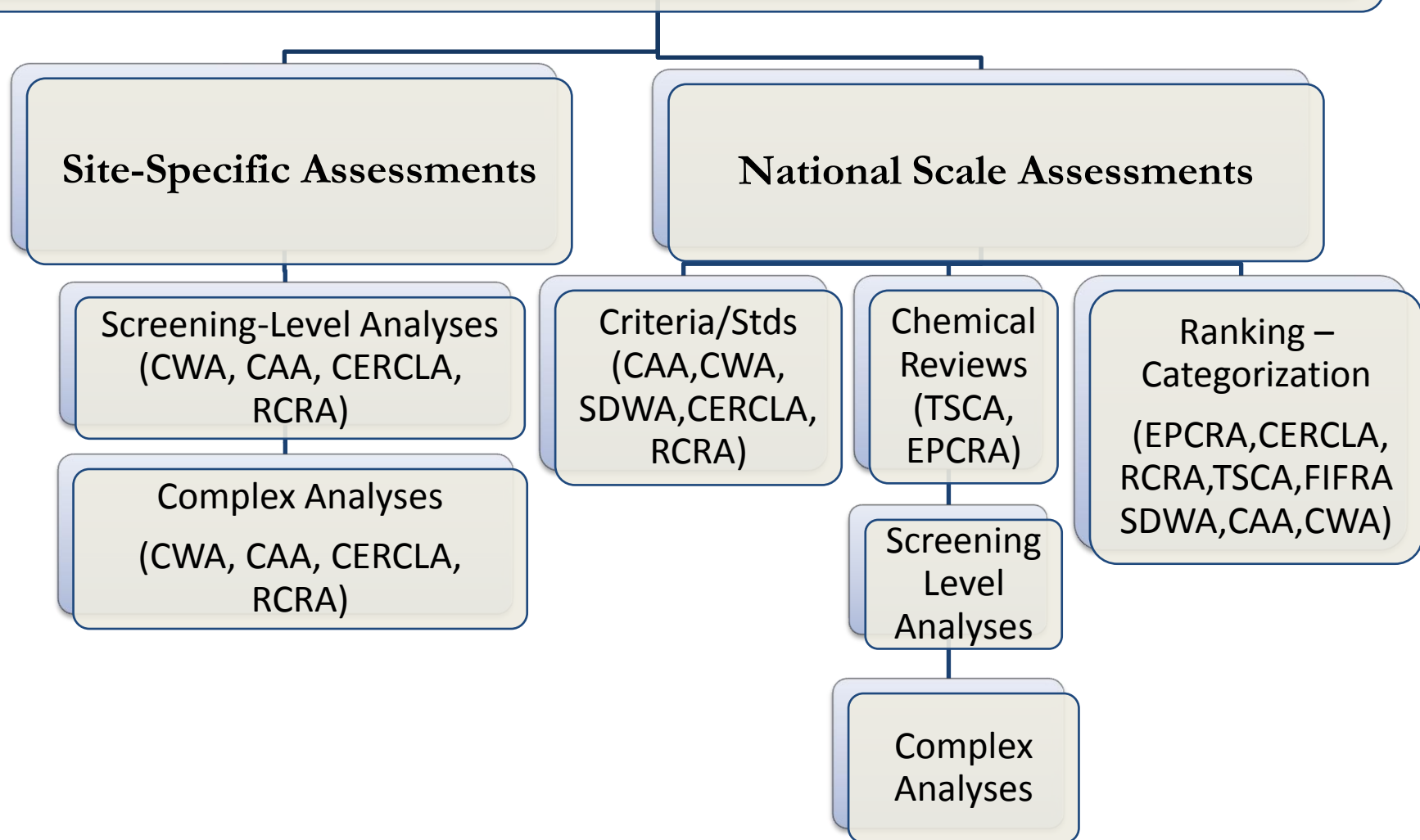
- Bevill Amendment restricts the application of RCRA to mining activities
- The Bevill Amendment does not apply to nonmining activities such as:
  - Laboratories
  - Machine shops
  - Electrical substations

# Comprehensive Environmental Response, Compensation, and Liability Act - CERCLA

- EPA sets the concentrations of contaminants that can remain at Superfund sites (US Coe, 1980)
- These levels are based upon ARARs\* and site specific risk assessments
- Background, baseline and ambient conditions

\*Applicable or Relevant and Appropriate Requirements (ARARS)

# Metals Assessments and Regulatory Framework



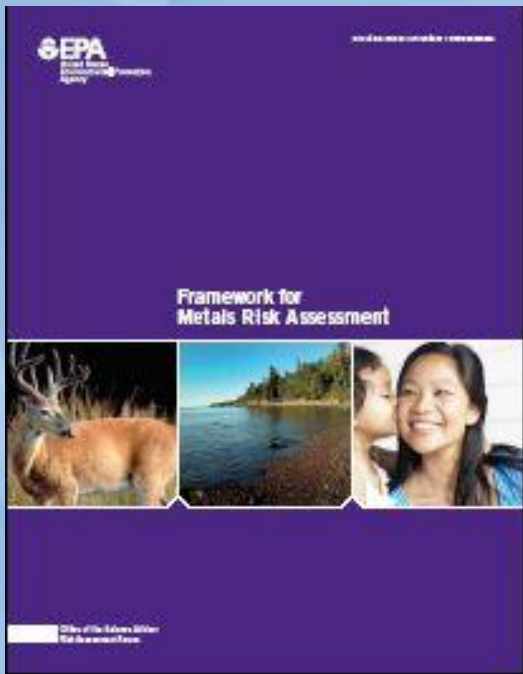


# **Mining Environmental Risk Assessment**



# EPA Framework for Metals Risk Assessment 2007

- **Metals are naturally occurring**
- **Metals often occur as mixtures**
- **Some metals are essential nutrients**
- **Metals are neither created nor destroyed**
  - **But can be transformed (valence states) or can be associated by bonding (compounds)**
- **Metals toxicity depends on many things**



# Risk Assessment

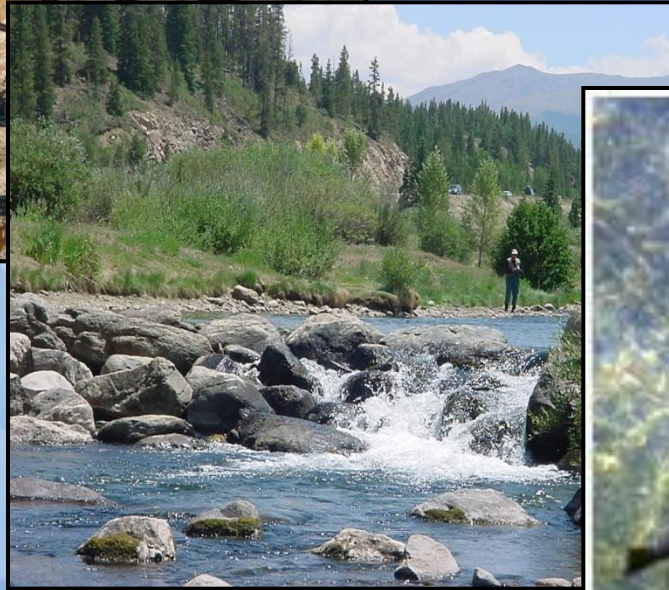
- **Source**

- nature
- extent



- **Pathway**

- air
- water
- ingestion



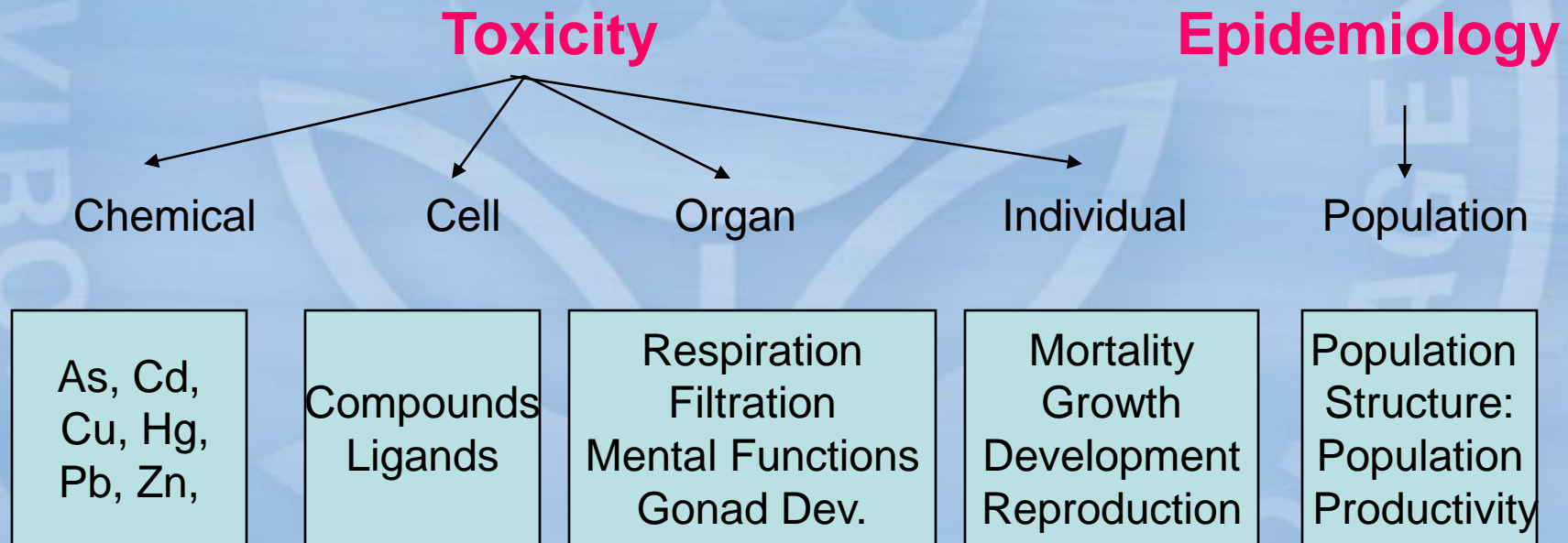
- **Receptor**

- people – children
- animals – plants – endangered species





# Environmental Scales of Risk

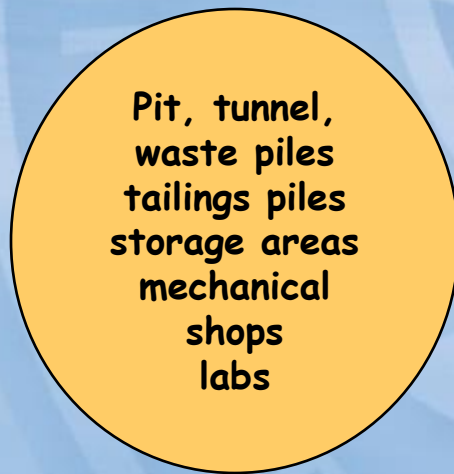




## Source

## Pathway

## Receptors



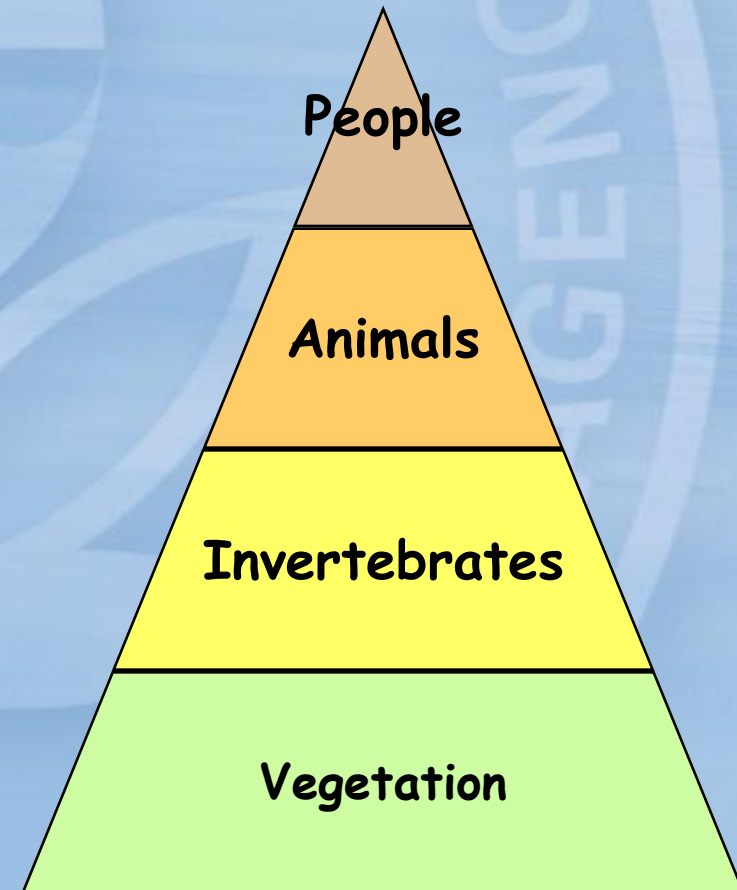
**Mine or Mill**

Water, surface or  
groundwater

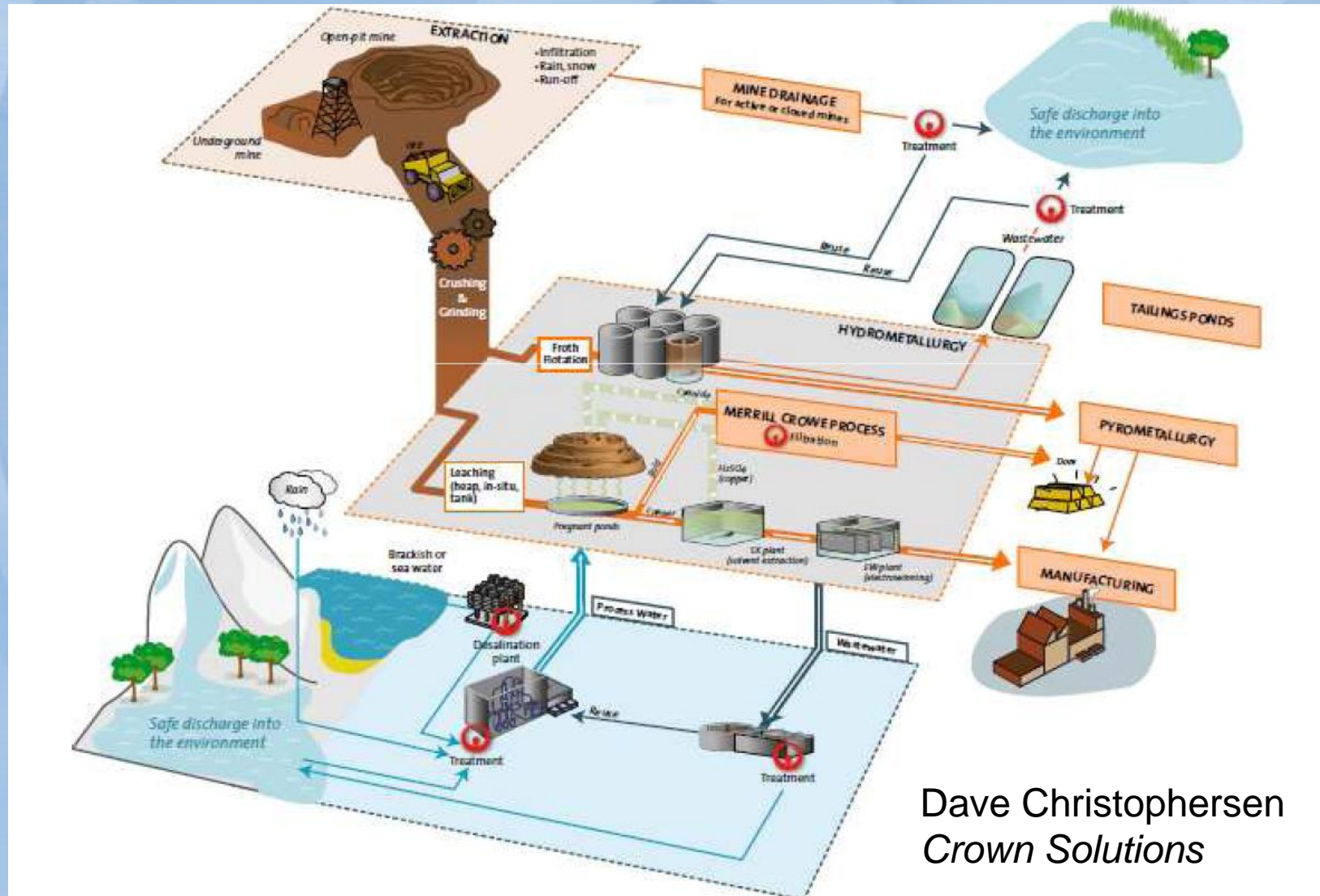
Air - dust,  
precipitation

Soil, directly or  
indirectly

Biota

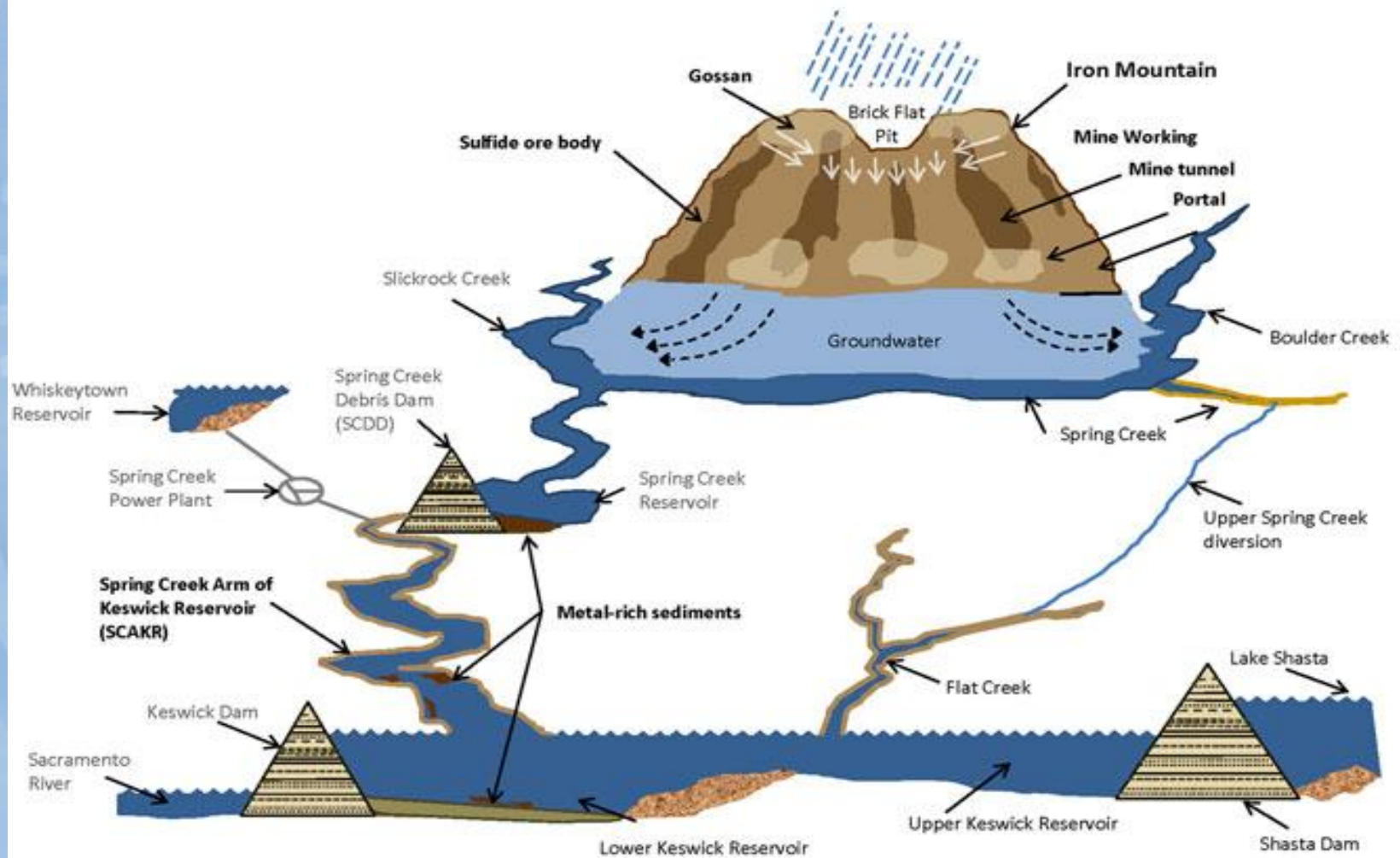


# Conceptual Model

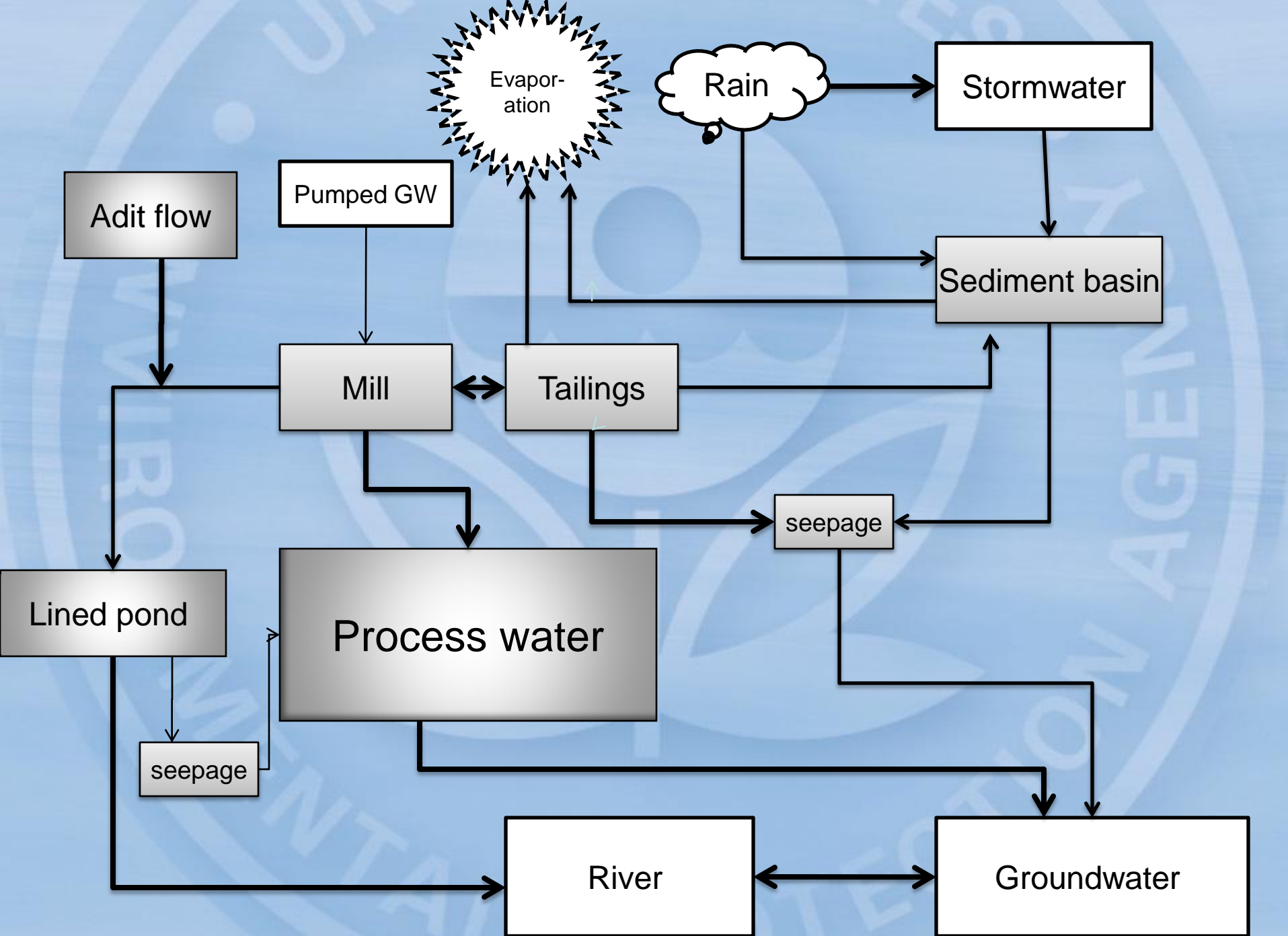


Dave Christophersen  
Crown Solutions

# WATER BALANCE !!!

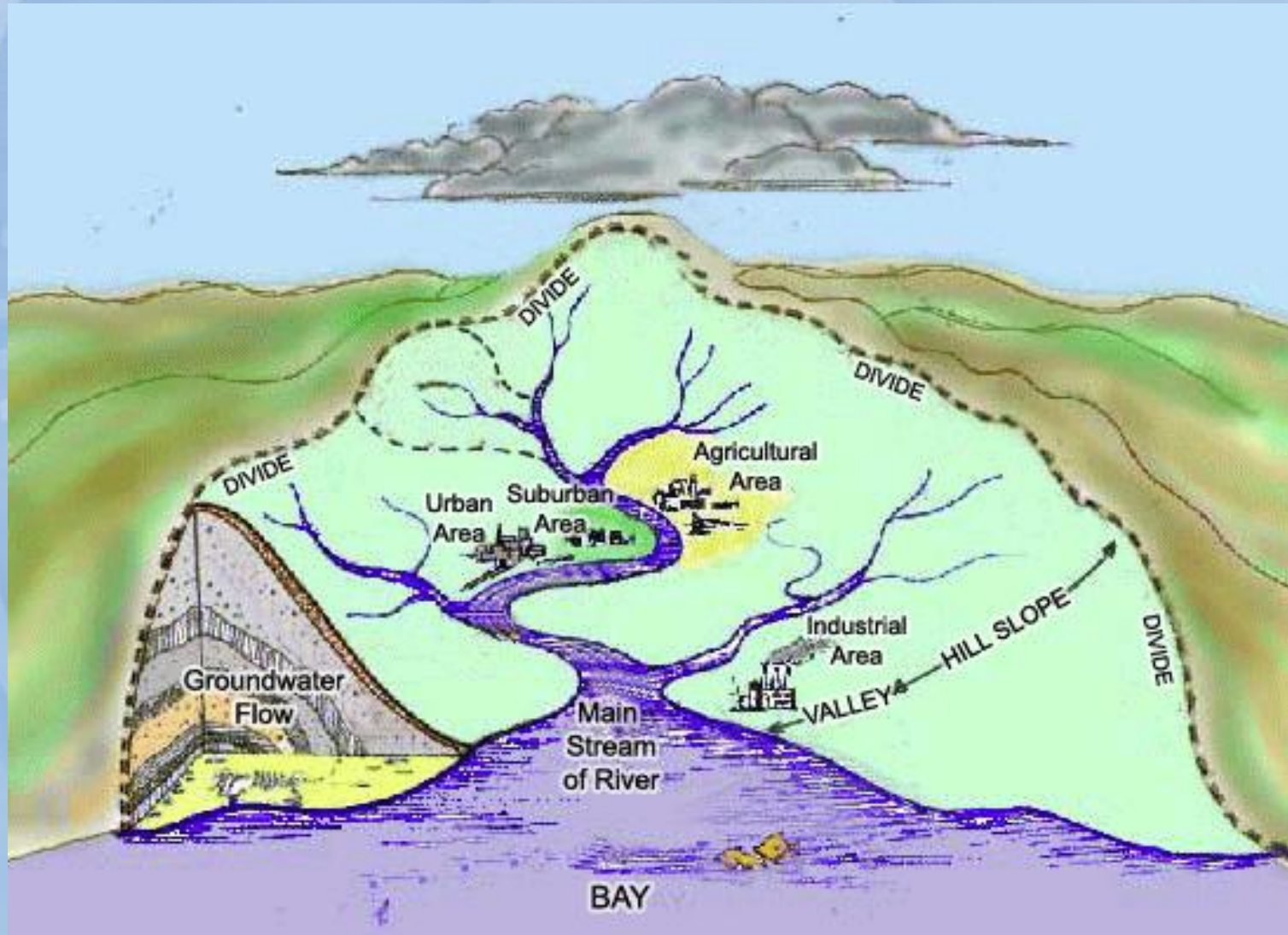




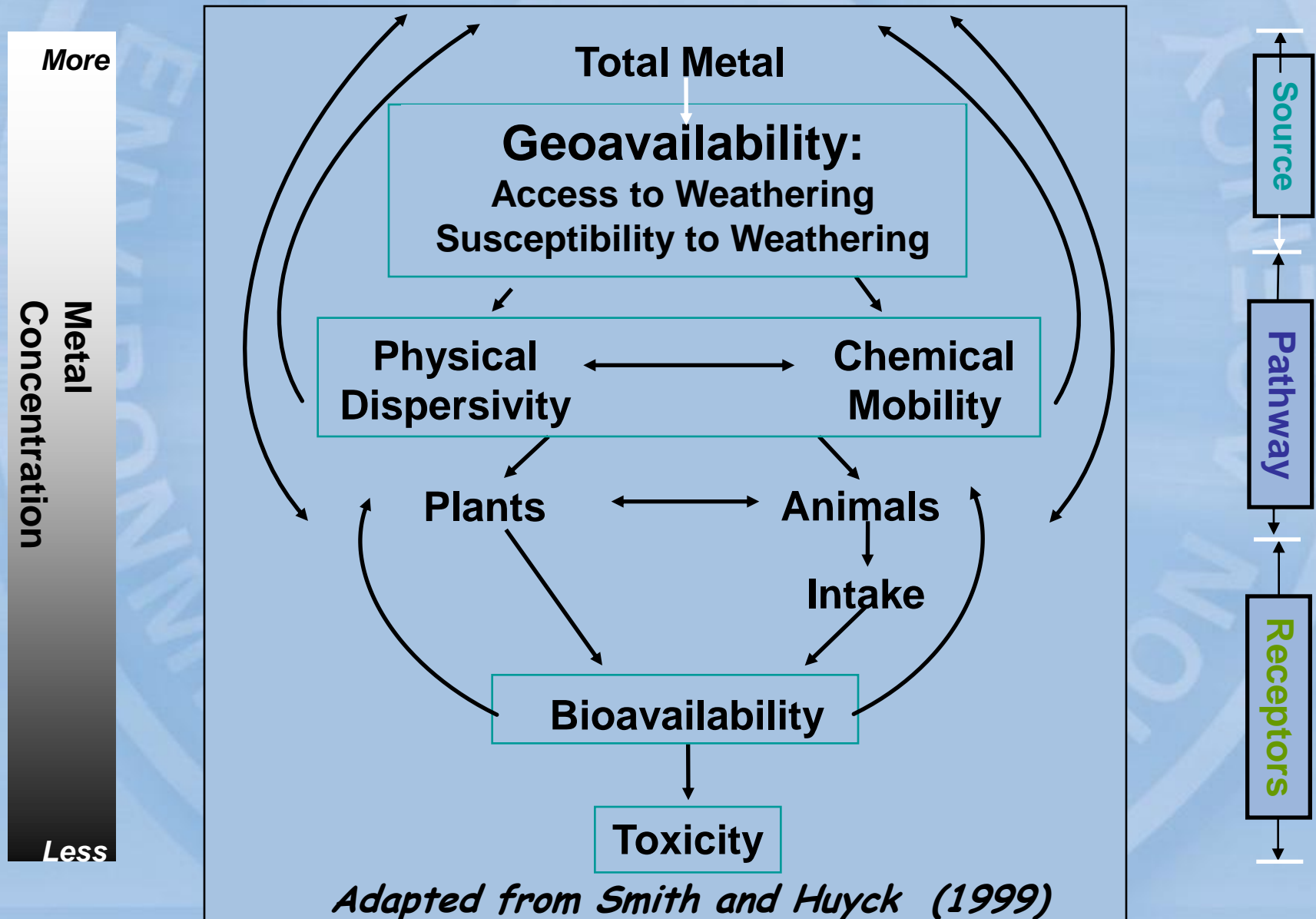




# Cumulative Impacts



# Metals Toxicity



# Example – Tale of Two Projects

- Proposed mine
- Two T&E species in the area
- Most water data older than 20-years
- Water quality standards in question - 303d
- Limited access to obtain new data
- Mine expansion
- Good T&E evaluation no mitigation needed
- Up to date sampling and analysis
- Assisting in writing site specific standards
- Data provided by the local environmental group to support EIS



# Mining Water Risk Assessment

- Does the company assess the water flows, usage, and water balance?
- Has the company evaluated the water risks within a local context?
- Does the risk-time period far exceed the potential life span of the mining company.
- Compliance with existing regulatory requirements may be exceeded by the legal risks long after the mine is closed.



Table 2: WRI's Water Risk Framework for the Mining Sector

		Surrounding environment	Type of commodity	Type of operation	Corporate Policy/ Approach	Disclosure/ Engagement	Regulatory Climate	
Questions for Companies*		Operating in water scarce regions?  Competing with other users? Seismic hazard?	Grade of ore and ratio of ore to final product?	Extraction method, waste disposal, water management procedures?	Does the company conduct water footprint analyses?  How are water risks assessed?	Does the company disclose water risks?  Engage with stakeholders?	How will prices, water quality regulations, or other permits affect the company?	
	Risk Level	High	<ul style="list-style-type: none"><li>Arid/semi arid environments</li><li>Presence of other competing uses (agriculture, ranching)</li><li>High seismic hazard</li><li>Very high rainfall and/or frequent, major storm events</li><li>High permeability aquifers</li></ul>	<ul style="list-style-type: none"><li>Low grade ore</li><li>Precious metals</li><li>Diamonds</li><li>Copper</li><li>Nickel</li><li>Oil shale/sands</li></ul>	<ul style="list-style-type: none"><li>Open pit that reaches below water table</li><li>Dewatering required</li><li>High acid drainage potential</li><li>Tailings disposed in rivers</li><li>Energy derived from hydropower</li><li>Large water withdrawals</li><li>Large mixing zone for discharges</li></ul>	<ul style="list-style-type: none"><li>No water accounting or footprint analysis</li><li>Does not consider water risks</li></ul>	<ul style="list-style-type: none"><li>No reporting against existing frameworks (e.g. GRI)</li><li>Does not report tailings effluents</li><li>Minimal engagement w/ stakeholders</li></ul>	<ul style="list-style-type: none"><li>Operating in countries with uncertain regulatory climate</li><li>Water scarcity a major concern for policy makers</li><li>Effluent releases and water withdrawals exceed permits</li></ul>
		Medium	<ul style="list-style-type: none"><li>Moderate seismic hazard</li><li>Moderate rainfall with distinct dry season</li></ul>	<ul style="list-style-type: none"><li>Coal</li><li>Uranium</li><li>Crude oil</li><li>Zinc</li><li>Lead</li><li>Iron ore</li></ul>	<ul style="list-style-type: none"><li>Open pit above water table</li><li>Dewatering water recycled</li><li>Potentially acid generating material capped and controlled</li><li>Tailings stored in impoundment</li><li>Energy derived from coal/ natural gas</li><li>Moderate water withdrawals</li><li>Small mixing zone for discharges (1-2 miles)</li></ul>	<ul style="list-style-type: none"><li>Water balance/ accounting at mine site</li><li>Stated policy to reduce water consumption</li><li>Developing additional water metrics</li></ul>	<ul style="list-style-type: none"><li>Reports some water indicators (e.g. GRI EN8, EN10, MM3)</li><li>Regularly consults with stakeholders at site and global levels</li></ul>	<ul style="list-style-type: none"><li>Company is taking steps to anticipate changes in regulations</li><li>Effluent releases and water withdrawals are well within permits</li></ul>
		Low	<ul style="list-style-type: none"><li>Moderate rainfall</li><li>Low seismic hazard</li></ul>	<ul style="list-style-type: none"><li>Cement</li><li>Other industrial minerals</li><li>Natural Gas</li></ul>	<ul style="list-style-type: none"><li>Energy derived from renewable sources</li><li>Old mine workings capped and covered</li><li>Low acid generating potential</li><li>Water flows carefully controlled at site</li><li>Water discharges meet ecosystem requirements</li><li>All water consumed is reused/ recycled</li></ul>	<ul style="list-style-type: none"><li>Comprehensive direct/indirect footprint analysis</li><li>Water risks have been measured and taken into account</li><li>Company sets targets to reduce water footprint</li></ul>	<ul style="list-style-type: none"><li>Company discloses data on waste characteristics, flows, water risks</li><li>Seeks input and participation of stakeholders</li></ul>	<ul style="list-style-type: none"><li>Company is operating beyond compliance</li><li>Zero discharge facility</li></ul>

Source: WRI.

# Mining and Sustainability





# References

- Acid Drainage Technology Initiative Workbooks prediction, mitigation, sampling and monitoring
- Good Practice Guidance for Mining and Biodiversity – CIMM
- GARD Guide
- **CAFTA – EIA Technical Review Guideline: Non-Metal and Metal Mining** Guía Técnica CAFTA-DR EIA - Minería