Due Diligence, Sustainable Development & Environmental Mining for New and Existing Mines

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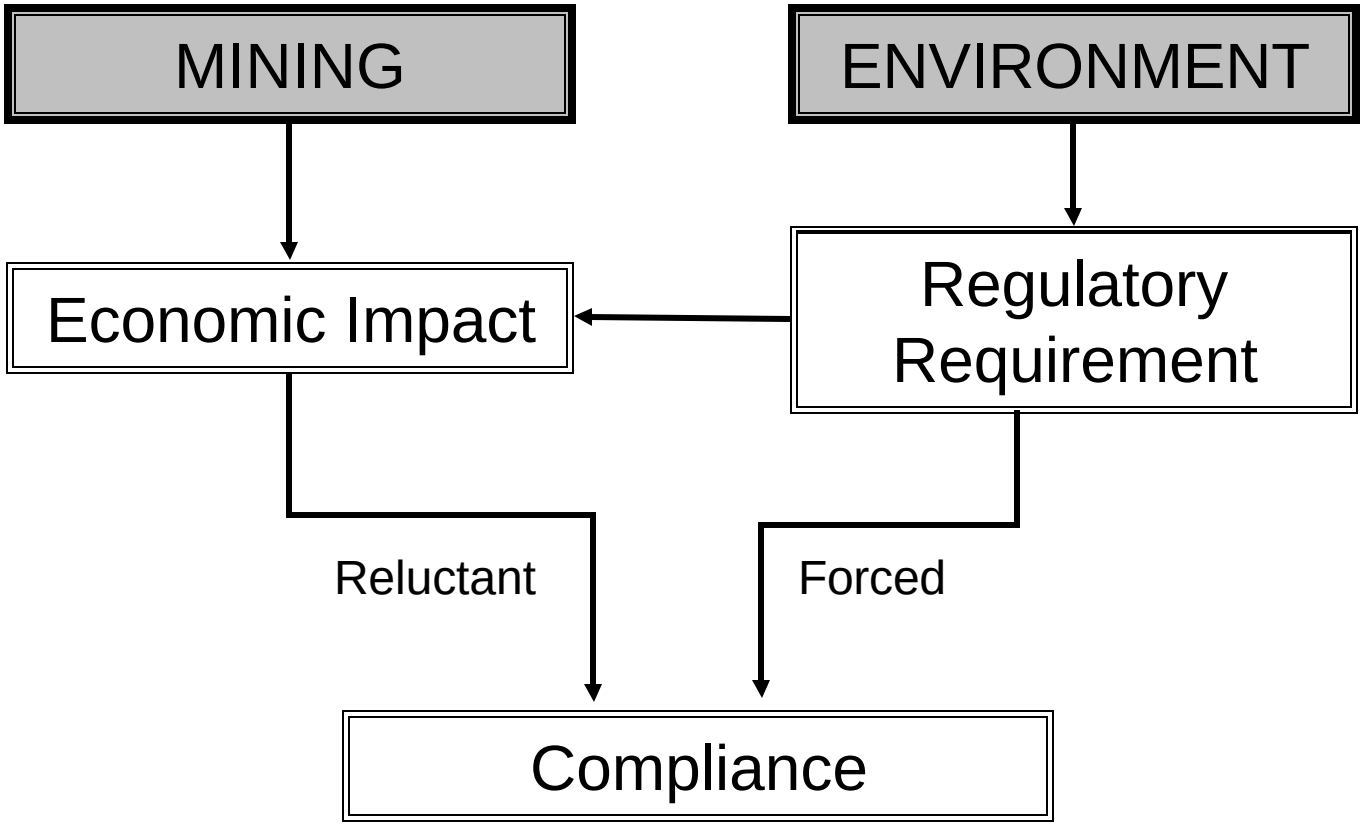
Past Practice



Sustainable / Environmental Mining

FROM

- Reactive
- Negative

TO

- Proactive
- Planning & incorporating at each stage
- Change operations

The Environmental Mining Process = 4 Major Steps

Environmental Mining - The First Step

1. Characterization of the natural environment
   - Characterize background environment and susceptible receivers
   - EBS
   - EA

Environmental Mining - The Second Step

2. Identification of the potential environmental risks and impacts
   - Predictive methods aimed at determining environmental impacts
   - Lab testing (ARD & NAMD)
   - Mineralogy
   - Physical / computer modeling
   - Impact assessments, EEMs, TIREs

The Third Step

3. Ranking of risks and potential impacts
    3. Probing back through process operations and mine design to identify significant issues
    - Waste / materials management
    - Do we need it? Are there substitutes? Can we recycle? If we change a step in the processing operations, can we reduce or eliminate an environmental risk?
    - Goal = reduce risk

The Fourth Step

4. Integration of sustainable mine and process designs
   - i.e. corrective action
   - Economics will play a large role

Case Studies

- Sustainable Mine Planning
- Risk Management
- Water Management
- Planning for Closure

Sustainable Mine Planning

Barrick Gold – Bulyanhulu, Northern Tanzania

- Environmental Constraints to mine development
  - Limited water supply
  - Topography not suited to traditional tailings disposal
  - Tailings potentially acid generating
- Solution = total paste tailings management
  - 25% of tailings blended with rock and used as paste backfill
  - Remaining paste deposited at surface
  - Allows maximum water recover for reuse in circuit

Sustainable Mine Planning (cont'd)

Barrick Gold – Bulyanhulu, Northern Tanzania

- Benefits realized at Bulyanhulu
  1. Reduced risk of tailings dam failure
  2. Less area impacted
  3. Reduced surface impact
  4. Water conservation
     - Recycling & reuse
     - Reduced runoff & seepage
     - Reduced treatment requirements
  5. Concurrent reclamation

Waste and Risk Management

Falconbridge – Raglan, Northern Quebec

- Mine Plan developed following EM Process
- Subsequent Testing identified NAMD
  - Sufficient risk to look at alternative plans
- Solution
  - Reduction of stripping ratio in one pit
  - Plans for underground operations were advanced 2 years ahead of original mine plan (and budget)

Waste and Risk Management (cont'd)

Falconbridge – Raglan, Northern Quebec

- Resulting benefits realized at Raglan
  1. More than 10 million tonnes of potentially problematic waste eliminated from surface exposure
  2. Modification of mine plan to incorporate new waste handling protocols for surface mining activities
  3. These are belived to be among the most stringent in the industry and are being applied to other orebodies and their plans modifed to meet the criteria

Water Management

Falconbridge – Raglan, Northern Quebec

- Milling effluent met all quality criteria but did not meet toxicity requirement
  - Typical approach would be to treat / dilute
- Solution
  - No easy solutions – looked at long term
  - “Zero discharge operation”
  - Underground recycle reservoir with 100% recycle of mill process water

Water Management (cont'd)

Falconbridge – Raglan, Northern Quebec

- Benefits realized at Raglan
  1. Still in commissioning stage but over a 2 year construction period
     - ~25% reduction in freshwater consumption
     - ~20% increase in milling production
  - Volume of effluent to be treated reduced by ~1 billion litres/year
    - Reduction in associated loadings

Planning for Closure

Falconbridge – Strathcona Mill, Sudbury

- 2 separate tailings streams
  - Low sulphur tailings (0.6% – 0.7% total sulphur)
  - Pyrrhotite tailings (~30% sulphur)
  - Tailings discharged from common point prior to 1994
    - Average 15% sulphur
    - 110 hectares, max. depth 20 metres
  - Generation of ARD and ML
- Solution
  - Low sulphur tailings cover
  - Investigation into potential tailings cover options

Pilot plant testing	Chemical & physical tailings
Static & kinetic testing	Computer modeling

Planning for Closure (cont'd)

Falconbridge – Strathcona Mill, Sudbury

- Benefits realized at Strathcona Mill
  1. Revised Management Plan
     - Cover 2 tailings areas with thickened low sulphur tailings slimes
     - 3rd tailings area (largely pyrrhotite) will be flooded to minimize ML/ARD generation using permanent water retaining closure dams

Environmental Mining

- Waste management
- Risk management
- Water management

It's everybody's business

It is "doable"