Environmental Impacts of Open Pit/Rare Earth Mining

Water Resources

The most significant environmental impacts are on water resources. As a result of mining surface and groundwater may no longer be safe for human consumption or be adequate to support aquatic and terrestrial organisms.

Acid Mine Drainage

"Acid mine drainage is considered one of mining's most serious threats to water resources. A mine with acid mine drainage has the potential for long-term devastating impacts on rivers, streams and aquatic life" – Earthworks

- Mining exposes bedrock and associated ores (in the open pit, waste rock piles, tailings, etc.) to the elements (water and air), this can lead to acid mine drainage.
- The exposed rock when in contact with water (from precipitation) and oxygen (from the air) undergoes a chemical reaction which produces sulphuric acid (H_2SO_4).
- The acid lowers the pH of nearby waterways making the water unfit for human consumption and unable to support life.
- The acid can also cause the leaching of metals and other contaminants (cadmium, copper, lead, zinc and arsenic to name a few). Many of these may also leach out into nearby waterways even without the presence of acid mine drainage. High levels of ammonia, nitrate, nitrite and cyanide may also be found near mine sites.
- Metals even in minute amounts are toxic to wildlife and humans. Fish are particularly vulnerable. Effects on fish can range from immediate death (fish kills) to effects on growth, development and reproduction.
- Metals can travel long distances in water bodies, they can contaminate rivers, lakes, streams and groundwater. They persist in the environment and do not biodegrade, therefore they are a source of long term pollution.

"Acid mine drainage is virtually impossible to stop once the reactions begin. To permit an acid generating mine means that future generations will take responsibility for a mine that must be managed for possibly hundreds of years" – Earthworks

Tailings

- Tailings are a by-product of metallic ore processing that may contain large amounts of arsenic, lead, cadmium, chromium, nickel and other toxic substances. Rare earth tailings may also contain radioactive substances, usually Uranium and/or Thorium.
- There are several options for tailings disposal, the environmentally preferred option being a dry tailings disposal. The most commonly used disposal method is a wet tailings impoundment or a tailings pond. This involves the placement of tailings in a pond that may or may not be lined with a geomembrane and held back by a dyke or tailings dam.
- Water often accumulates and forms ponds on top of the tailings putting wildlife at risk.
- Tailings may release contaminated water. During storms or heavy rain events water may fill the tailings impoundment above its capacity releasing an overflow of toxic substances. This can contaminate nearby soil, groundwater and local waterways.
- Tailings dam failures are more common than one might think and more common than mining companies may lead you to believe
- Uranium-wise.org has put together a Chronology of major tailings dam failures and their associated impacts

"Dozens of dam breaks at wet tailings impoundments have created some of the worst environmental consequences of all industrial accidents. When wet tailings impoundments fail, they release large quantities of toxic waters that can kill aquatic life and poison drinking water supplies for many miles downstream of the impoundment." –Environmental Law Alliance Worldwide

Soil erosion and water quality

- Large land areas are often disturbed during mining, erosion can be a significant concern.
- During severe storm events, heavy rain fall and high snow melt, large amounts of sediments (and any contaminants they contain) may enter nearby water-ways and severely degrade water quality.
- This elevated particulate organic matter can cause chronic and acute toxicity to fish.
- Sediments may decrease the pH of surface run-off allowing heavy metals to be released and enter nearby water-ways.
- Soil pH may also decrease making it difficult for plants to grow, lack of plant material and roots to hold soils in place, can lead to further issues with erosion.

Mine dewatering

- When the open pit intersects the groundwater table, groundwater will continuously flow into the pit and cause groundwater draw down
- This water is often pumped out while the mine is active. After closure the removal of this water often ceases and an acidic pit lake may form.
- Impacts of mine dewatering and groundwater draw down include:
    - Decreased quality and quantity of surface water flows
    - Habitat degradation (wetlands, springs, riparian zones, and upland habitats)
    - Reduced water supply to domestic wells
    - Water quality problems downstream of discharge points of water pumped from the open pit.

Air quality, noise and vibration

Air pollution occurs during many of the mining phases. Those of greatest concern are:
- The release and transport (by wind) of particulate matter by blasting, excavating, transportation of soils and ores, dust from tailings, stockpiles waste dumps and service roads.
- Gas emissions from explosions, stock piles and fuel combustion
- Air pollutants pose a serious risk to human health and the environment
- The blasting, grinding, crushing, drilling, shovelling and heavy machinery associated with mining can be a significant source of noise pollution affecting nearby residents and wildlife.

"Shocks and vibrations as a result of blasting in connection with mining can lead to noise, dust and collapse of structures in surrounding inhabited areas.
The animal life, on which the local populations may depend, might also be disturbed"-European Union, 2000

Human Health and Wildlife Impacts

Wildlife refers to all plants, non-domesticated animals and other 'wild' organisms. Wildlife is affected by mining in many ways, including:

- Vegetation and topsoil removal
- Displacement (habitat loss or fragmentation)
- Soil, air and water contamination
- Noise and vibration
- Release of pollutants
- Fish and aquatic organisms are particularly sensitive effects can range from chronic toxicity to acute toxicity and death. There are many impacts on human health. The most common are chronic toxicity and associated illnesses as well as elevated cancer rates from exposure to heavy metals and radioactive substances.

"Mining not only exposes uranium to the atmosphere, where it becomes reactive, but releases other radioactive elements such as thorium and radium and toxic heavy metals including arsenic, selenium, mercury and cadmium. Exposure to these radioactive elements can cause lung cancer, skin cancer, bone cancer, leukemia, kidney damage and birth defects." - Earthworks

Harmful substances released during Rare Earth Mining and their effects

Substance	Effects on the environment and human health
Rare Earth Elements	Toxicity and effects on the environment and human health still not understood
Sulfide Minerals	Creates sulfuric acid – acid mine drainage, decreasing the pH of water, which aids in the further release of sulfide minerals further decreasing the pH (positive feedback loop) decreased pH allows more metals and acid to be released into the environment
Aluminum	Can enter air, soil, water. Aquatic organisms are sensitive to aluminum. Toxic to fish. In humans elevated levels cause developmental problems in children and pulmonary issues.
Arsenic	Can enter air, soil, water. Very mobile – travels long distances in the air before settling. Toxic to humans, human carcinogen. Increases risk of skin cancer. Low levels cause nausea, change in heart rhythms, low white blood cell count. Chronic exposure causes gastrointestinal issues, fatigue, blood disorders, and neuropathy. At high levels will cause death. All mammals experience same effects as humans. In aquatic organisms causes genetic mutations and cancer. In plants causes wilting, dehydration and death.

Lead	Once released will accumulate in soils. In plants, it decreases photosynthesis rates and water absorption. Major health concern for humans, especially children under 7 years of age. Causes negative effects on the cardiovascular, endocrine, muscular, nervous, reproductive and respiratory systems, may cause death. Likely a carcinogen. Same effects are seen in mammals, birds and fish.
Manganese	Can impair gastrointestinal, muscular and neurobehavioral function.
Zinc	Toxic in large amounts. In aquatic plants and animals causes decreased growth and reproduction and increased mortality. In mammals (including humans) impairs the nervous and cardiovascular systems. At elevated levels will cause liver and kidney issues.
Barium	Can enter groundwater. Harmful effects on the muscular system, disruption of heart rhythms and paralysis. Ingestion results in gastrointestinal irritation and kidney damage. Toxicity of barium to aquatic and terrestrial organisms is unknown.
Beryllium	Very mobile, can travel in the air and able to enter soil and water. Inhalation causes acute beryllium disease (reddening and swelling of the lungs). Human carcinogen (lung cancer).
Copper	Toxic to plants and animals at high levels. Aquatic organisms are extremely sensitive to copper exposure – causes death in aquatic organisms. Slowed growth and development in terrestrial organisms. Irritant to nose and throat when inhaled. Causes nausea, vomiting, diarrhea when ingested. Can lead to kidney and liver damage or death at high levels.
Radionuclides	Thorium-232 and Uranium-238 are radioactive substances that persist in the environment for thousands of years. They produce over 30 other radioactive substances as they undergo decay. Ability to alter biologic molecules and cause mutations and cancer.

Many of the wastes and by-products of rare earth mining and processing are radioactive. The two isotopes of concern are **Uranium-238** and **Thorium-232**. They have the ability to contaminate air, soil and water. They are often taken up by plants and are then able to bioaccumulate and bioconcentrate up the food chain. Uranium, thorium and their decay products persist for thousands of years and pose serious risks. Radioactive decay releases energy particles which can dislodge electrons in biologic molecules such as water, protein and DNA. This can cause mutations and cancer. The Uranium -238 decay chain includes

Radon-222 and Bismuth-214 both of which are dangerous radioactive substances. Radon-222 is carcinogenic to all organisms, when inhaled it settles in the lungs and there is great risk of developing lung cancer.

"Modern mining's legacy is more than 10,000 miles of polluted streams, hundreds of contaminated lakes, mountains reduced to craters and landscapes devoid of life where thriving forests and fragile deserts once existed. The effects of mining's impact on the earth are magnified in their effects on human health. Most of the people living in impacted communities don't know their health is at risk until their families, relatives or neighbors begin showing signs of illness. Dozens of communities across the Western U.S. have been affected, but few people outside these areas understand the extent of the damage" – Earthworks

Websites of interest to learn more:

Earthworks
https://earthworks.org

Mining Watch Canada
https://miningwatch.ca

Coalition pour le Quebec ait meilleure mine
http://www.quebecmeilleuremine.org

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