Aldermac Mine Site Restoration

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Aldermac Mine Site
Location and History

- Cu-Zn deposit
- Discovered in 1925
- Mined from 1932 to 1943
- Concentrator production:
  - 28,014 tons of copper
  - 10,675 ounces of gold
  - 389,100 ounces of silver
  - 63,753 tons of silica
  - 505,600 tons of pyrite
- Estimated 1.5 Mt of tailings produced and released in the environment
- Most recent owner dissolved in January 1946
Environmental Issues

• 1.5 Mt of mine tailings have resulted in high acid mine drainage (AMD)
• 50 % in sulphurous minerals, significant concentrations of arsenic, cadmium, copper, molybdenum, zinc et sulphur
• Deposited without any containment precautions ⇒ covering a 76 hectare area
• Areas affected by AMD
  • Arnoux River and its tributaries
  • Arnoux and Dasserat lakes
  • Areas adjacent to the mine tailings
• Majors environmental damages ⇒ considerable corrective measures required
• Indirect public health risk ⇒ food chain affected (sport fishing)
• No operator can be ordered to restore the site ⇒ abandoned site status
Aspects Considered for Site Restoration

- Significant improvement of the site’s environmental quality
- Integration of the site with its environment
- Return of wildlife
- Compatibility with potential future mining operations on the site
- Simplified maintenance and monitoring
- Site security
Aldermac Mine Site
Geographic Situation

Shallow valley along the
north-south axis

Many rock outcroppings
to the east

2 km long esker
to the west

Tailings footprint extends
1900 m from south to north

25 m elevation difference,
more significant at the
transitions between sectors

Stream 1 Sector
North Sector
Intermediate Sector
South Sector
Gravel pit operated at the
southern tip of the esker
Chosen Solutions

**South Sector**
- Excavation
- Liming
- Impervious covering (mound)
- Revegetation

**Intermediate Sector**
- Excavation
- Liming
- Revegetation

**North Sector**
- Elevated water table
- Liming
- Revegetation

**Stream 1 Sector**
- Excavation
- Liming
- Revegetation
South Sector

Characteristics of sector:

- Upstream of Intermediate Sector
- Rugged terrain with rock outcrops
- Origin of tailings spill, thickness reaches 6 m at former discharge point
- Remains of foundations of former mine buildings and shaft
- Relatively deep groundwater table (except to the east)
South Sector – cont’d

Restoration program:

• Demolition of former mine and concentrator buildings
• Excavation and placement of tailings in a mound over a portion on the sector
• Liming of excavated sector
• Impervious covering of the mound with geomembrane
• Cleaning of rock outcrops
• Construction of small dike for creation of upstream wetland
• Revegetation of excavated and impervious covered sectors, including creation of a wetland

Placement of tailings in a mound

Wetland
Dike
Impervious cover
Excavation
Intermediate Sector

Characteristics of sector:
- Downstream of South Sector and upstream of North Sector
- Relatively small tailings thickness

Restoration program:
- Excavation of all tailings and disposal in North Sector
- Liming and revegetation of the sector
- Creating a pond covering most of the sector
North Sector

Characteristics of sector:

- Downstream of Intermediate Sector and upstream of Stream 1 Sector
- Sector covering the largest area (26.5 ha)
- Spill zone accumulating products of oxidation and showing high concentrations in metals
- Groundwater table near surface
North Sector – cont’d

Restoration program:

- Development of two terrace using dikes
- Disposition of tailings excavated from Intermediate and Stream 1 sectors on these terraces
- Liming of the tailings
- Tailings in both terraces covered with a monolayer of granular material
- Revegetation of the terraces and creation of a settling pond

Images:
- Impermeabilisation of dikes
- Placement of the monolayer
- Liming of the tailings
- Diagram showing dike, terrace, and raised dike.

Diagram:
- Dike
- Terrace 1
- Terrace 2
- Raised Dike
Stream 1 Sector

Characteristics of sector:

- Downstream of North Sector and upstream of Arnoux River
- Extends over 2.6 km and covers an area of 18.5 ha
- Presents two segments with distinct characteristics

First segment

- Runs south to north along a 700 m stretch
- Stream bed composed of rocks and cobbles with a mean slope over 2 %
- Approximately 11 % of total Stream 1 Sector area
- Approximately 4 % of total Stream 1 Sector tailings

Second segment

- Runs from east to west over a 1 900 m stretch
- Floodplain varying from 20 to 100 m
- Mean slope in the order of 0.2 %
- Approximately 89 % of total Stream 1 Sector area
- Approximately 96 % of total Stream 1 Sector tailings
Stream 1 Sector – cont’d

Restoration program:

- Creation of a settling basin at the end of the first segment
- Excavation of all tailings in second segment and disposal in North Sector
- Liming of excavated zones
- Revegetation of the second segment, including the creation of two flooded zones
Characteristics of this Mining Restoration Project

Raised water table for the North Sector

**Objective:**
Maintain tailings saturated at all time in order to cut the supply of oxygen and thus prevent the production of acid mine drainage

**Concept:**
Saturation of the tailings by raising the water table in overlying granular stratum (monolayer) using impervious dikes

Revegetation adapted to the hydrological and hydrogeological conditions

**Interest:**
Efficiency similar to flooding without having to manage risk and monitoring associated with water retention works

[Diagram showing monolayer tailings, dike, and geomembrane]
Exhaustive revegetation

One of the most massive mining site revegetation projects in Quebec to date

Planting:
- 5 225 coniferous trees
- 2 200 deciduous trees
- 15 800 deciduous shrubs
- 10 200 perennial and aquatic plants
- 1 300 bundles of sticks
- 417 600 m² of seeding

Site layout:
- A wetland (South Sector)
- A basin (North Sector)
- 3 ponds (Intermediate Sector and Stream 1 Sector)
**Project Schedule**

- **Start of the program**
  - Restoration plan: September 2008
  - Dike construction: January 2009
  - Mass excavation: April 2009
  - Monolayer construction: May 2009

- **April 2009 to September 2010**
  - Impervious covering of the South Sector
  - Top soil and seeding

- **Sept. 2009 to May 2010**
  - Revegetation of all sectors

- **End of the program**
  - September 2010
Some Recent Photos

North Sector - Spillway

North Sector – Terrace 2

Intermediate Sector

Stream 1 Sector – Seeded area

South Sector - Seeded impervious cover

Stream 1 Sector - Settling basin
Project Partnership

Owner of the work:

Ressources naturelles et Faune
Québec

Restoration plan, project management, construction supervision:

SNC LAVALIN
Journeaux, Bédard & assoc. inc.
écogénie

Execution of the work:

NORASCON