



16th Annual BC/MEND ML/ARD Workshop

**Soil, Geomembrane, and  
Non-Traditional Dry Covers**



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**Québec**

Direction de la restauration  
des sites miniers

# Aldermac Mine Site Restoration

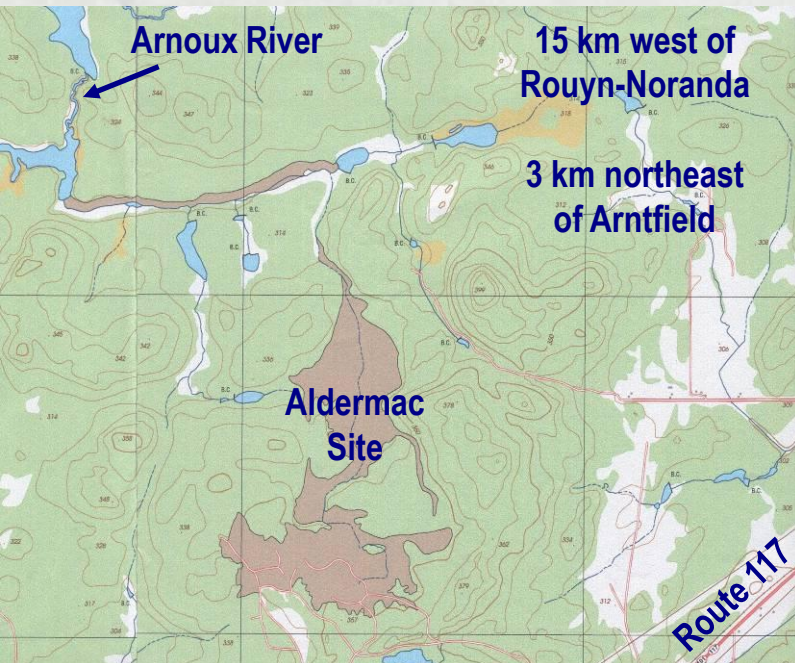


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# Aldermac Mine Site Location and History



- 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

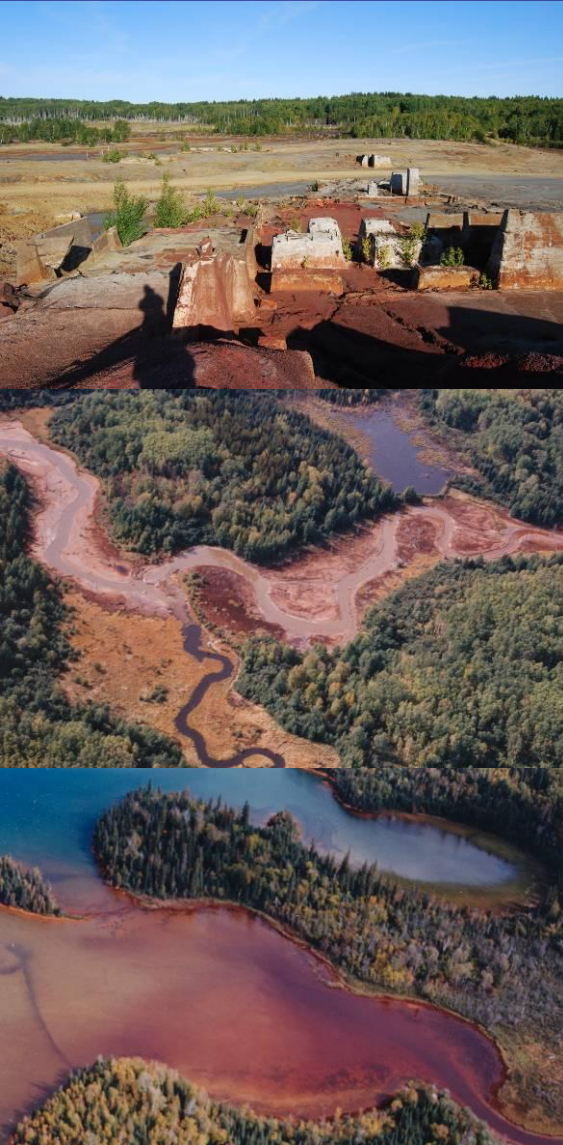


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- 1.5 Mt of mine tailings have resulted in high acid mine drainage (AMD)
- 50 % in sulphurous minerals, significant concentrations of arsenic, cadmium, copper, molybdenum, zinc et sulphur
- Deposited without any containment precautions ⇒ **covering 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



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- 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

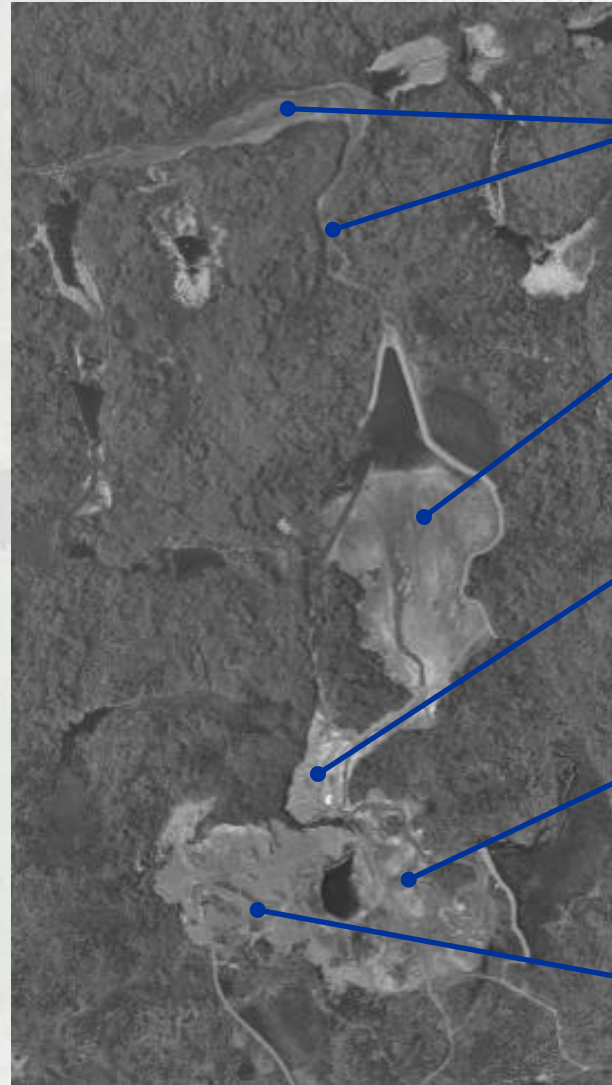
Shallow valley along the  
north-south axis

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

## North Sector



- Elevated water table
- Liming
- Revegetation

## Intermediate Sector



- Excavation
- Liming
- Revegetation

## Stream 1 Sector



- Excavation
- Liming
- Revegetation

# South Sector



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## 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)



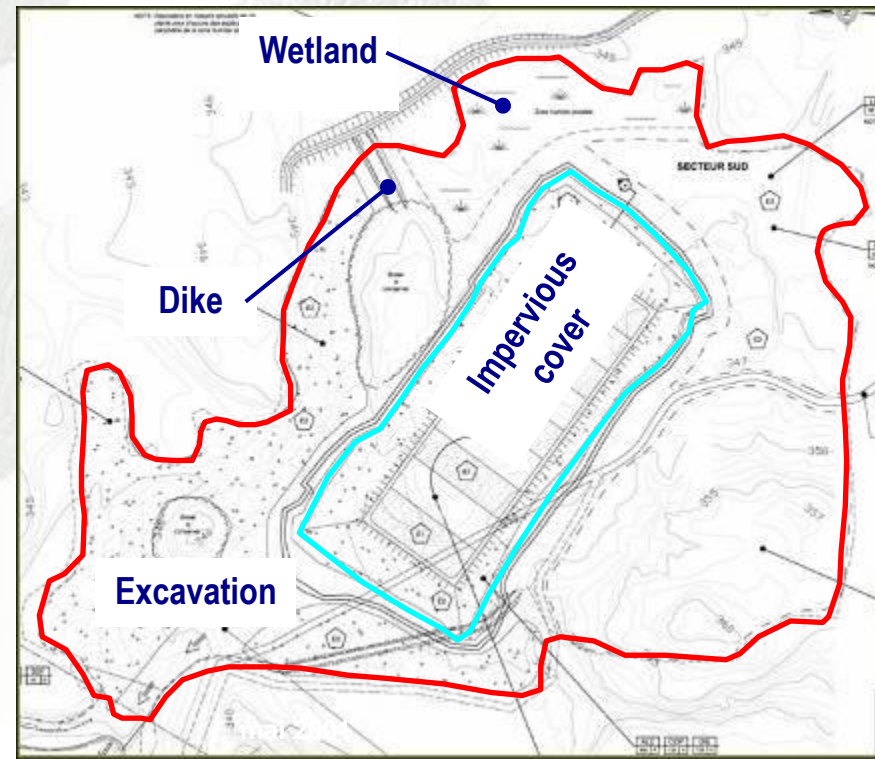
# South Sector – cont'd

## 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





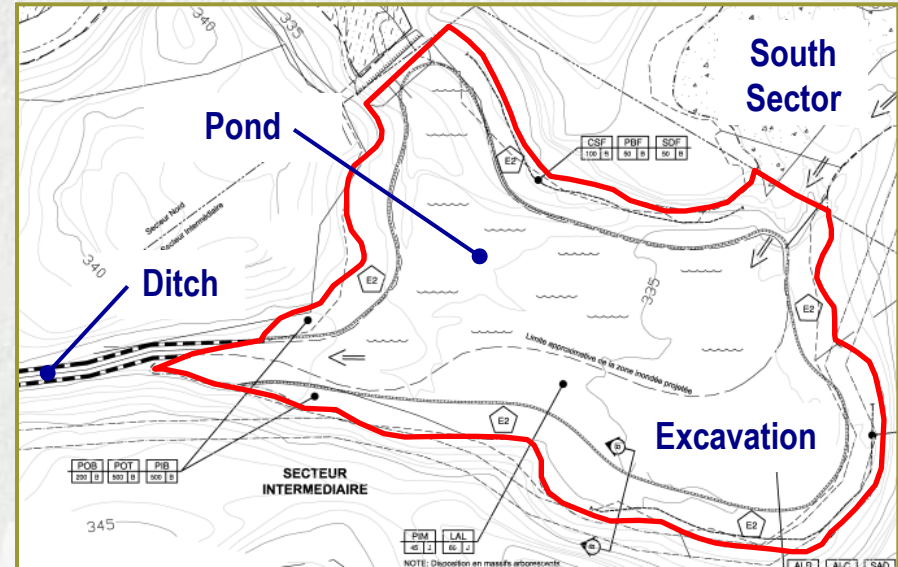
# Intermediate Sector

## Characteristics of sector :

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



Excavated Intermediate Sector



## 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



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## 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 :

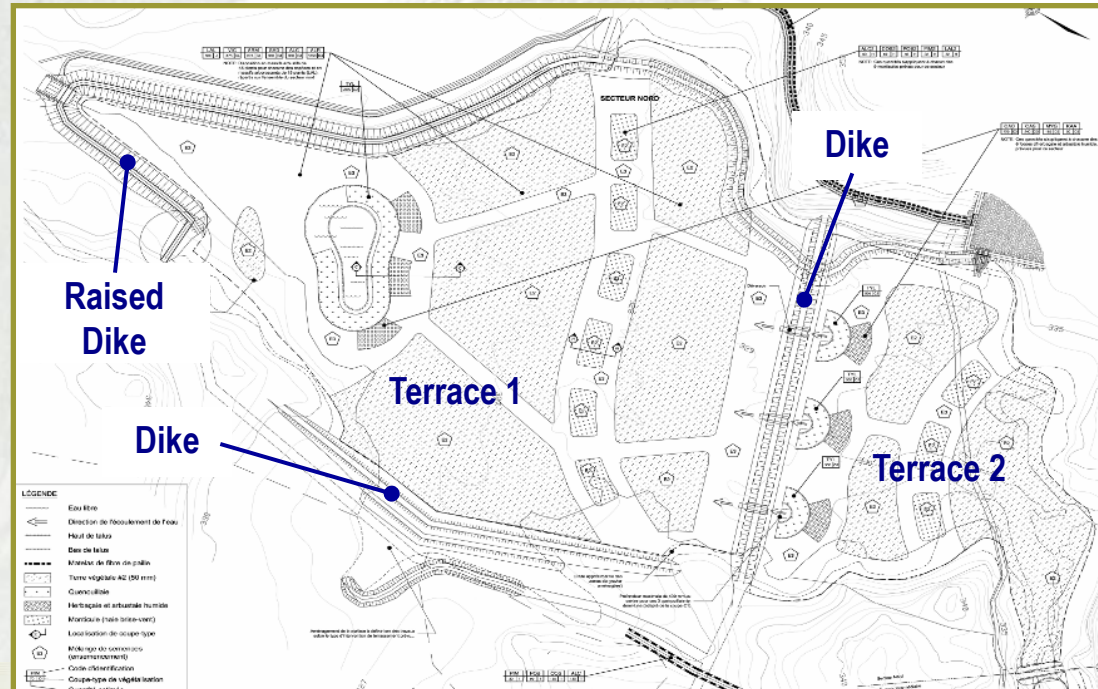
- Development of two terraces using dikes
- Disposition of tailings excavated from Intermediate and Stream 1 sectors on these terraces
- Liming of the tailings
- Tailings in both terraces covered with a monolayer of granular material
- Revegetation of the terraces and creation of a settling pond



Impermeabilisation of dikes



Placement of the monolayer



Liming of th tailings

# Stream 1 Sector



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## 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



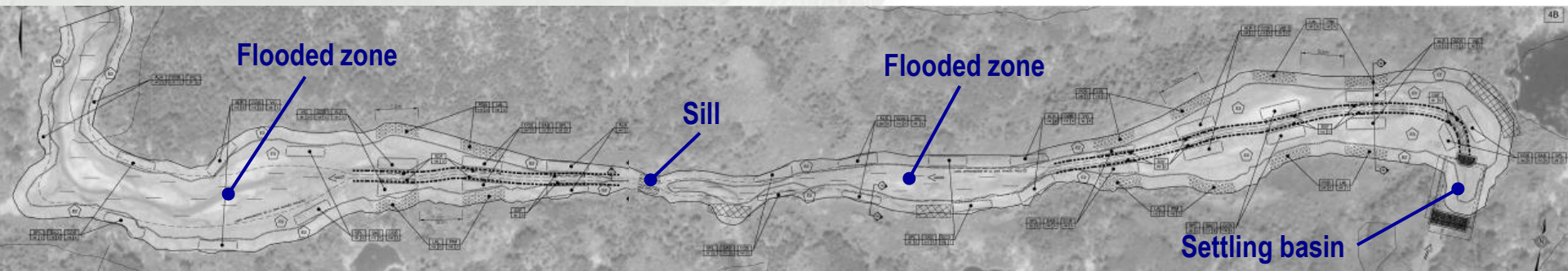
# Stream 1 Sector – cont'd

## 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



Stream 1 cleaned of its tailings



# 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

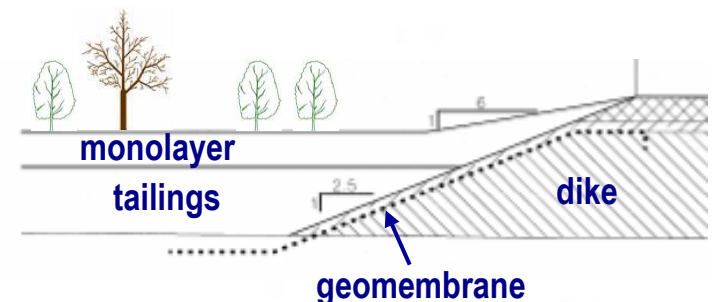
### Concept:

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



# Characteristics of this Mining Restoration Project – cont'd

## 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 m<sup>2</sup> of seeding



### Site layout:

- A wetland (South Sector)
- A basin (North Sector)
- 3 ponds (Intermediate Sector and Stream 1 Sector)



# Project Schedule

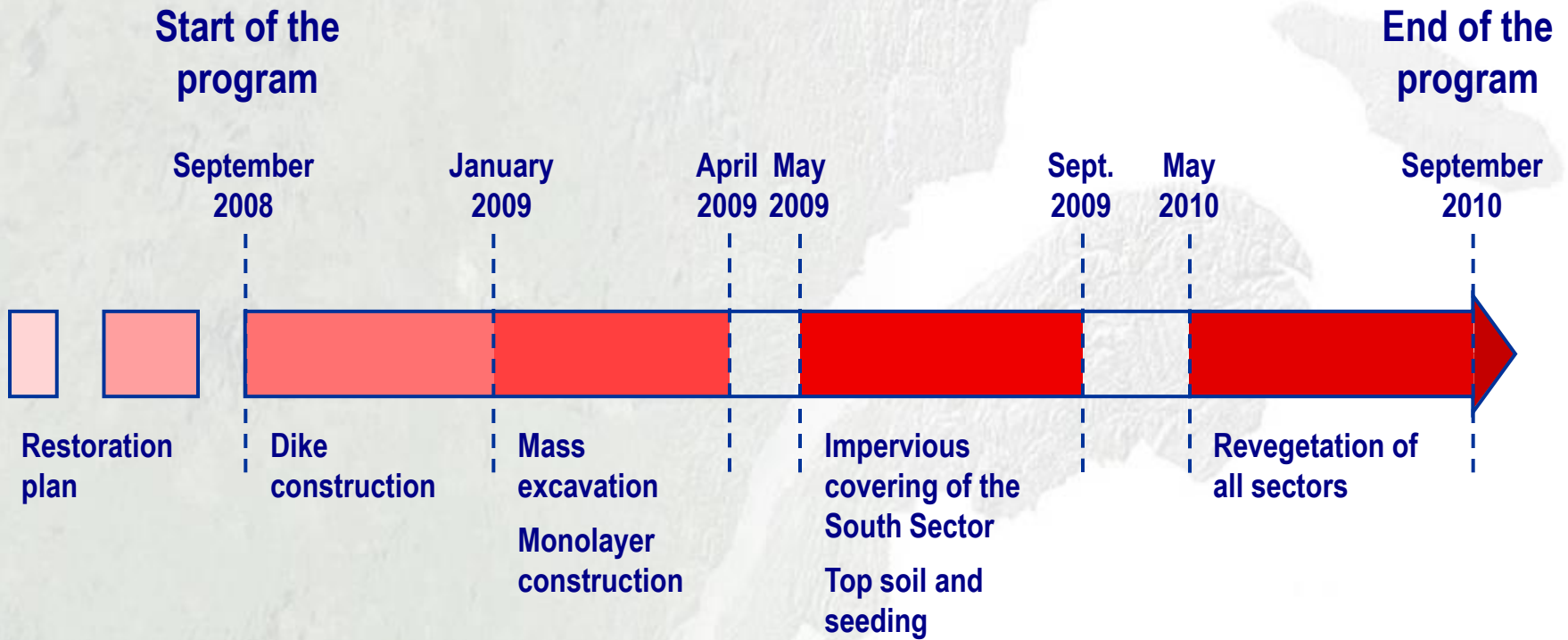


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# Some Recent Photos



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South Sector - Seeded impervious cover



North Sector - Terrace 2

North Sector - Spillway



Stream 1 Sector - Settling basin

Stream 1 Sector -  
Seeded area



Intermediate Sector



# Project Partnership



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Owner of the work :



Restoration plan, project management, construction supervision :



écogénie

Execution of the work :

