

Special Thanks

**Rosaire Émond,
Mélanie Roy
Mines Agnico-Eagle**

**Johanne Cyr
MRNF**

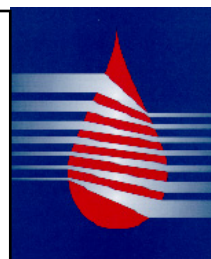
Recent Closure Technologies in Quebec for Acid Generating Sites



Louis Bienvenu, P. eng.

Direction du développement et du milieu miniers

MEND Manitoba Workshop
Challenges in Acidic Drainage
For Operating, Closed or Abandoned Mines
June 4 and 5, 2008 - Winnipeg



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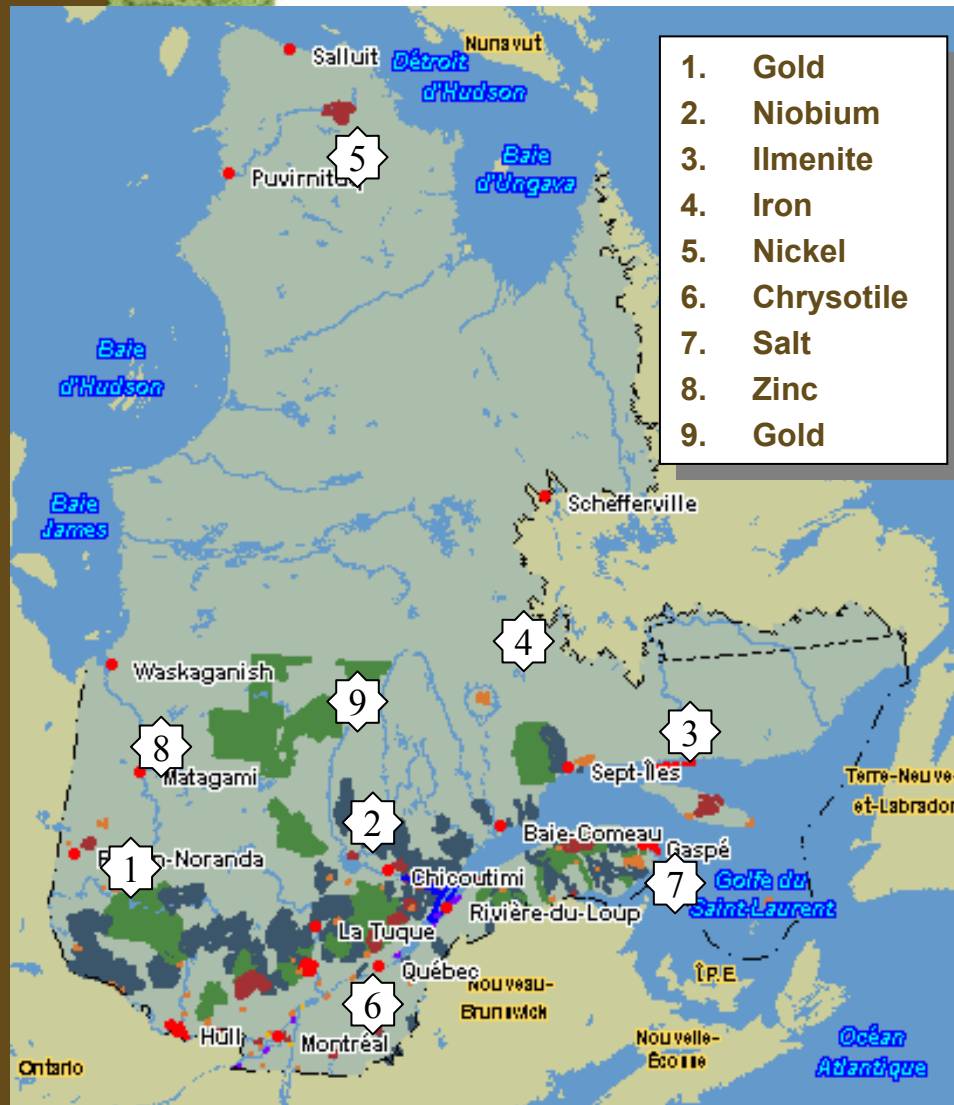
Presentation

1. Mining in Quebec
2. Exploration Sites
3. Some Acid Mine Drainage Solutions
4. « Abandoned » Mine Sites
5. Manitou-Goldex Project
6. Conclusion

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Mining in Quebec



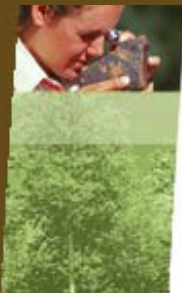
- Quebec area : 1 667 441 km²
 - Mining area : 280 km²
 - tailings : 150 km²;
- 692 tailings areas (365 active).
- 100 Mt/year tailings;
 - 50 % Neutral;
 - 28 % Acidic;
 - 22 % Alkaline.

Mining 2006

- 4.8 G\$
 - 67 % : metal mines
 - 14 % : industrial minerals
 - 19 % : construction minerals
- 15 000 jobs

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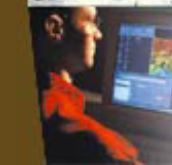


Exploration sites

Inventory

Actual inventory : 275 abandoned exploration sites

Rehabilitation on 18 priority sites > 4.0 M\$



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Exploration sites

Rehabilitation funding

1. A group of companies created a voluntary fund « Fonds Restor-Action Nunavik (FRAN)» to finance the rehabilitation of the 18 priority sites



2. Agreement among MRNF, Makivik and FRAN to rehabilitate the 18 priority sites (2011) :

1. FRAN : 1.5 M\$
2. Makivik : in-kind
3. MRNF : maximum 4 M\$

3. New agreement for other sites

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Winnipeg - 2008

Lorraine Mine Site

Multi-layer cover



- Cu, Ni : 1964 to 1968
- Tailings Area : 10 ha + spill (4 ha)
- Acid Drainage potential

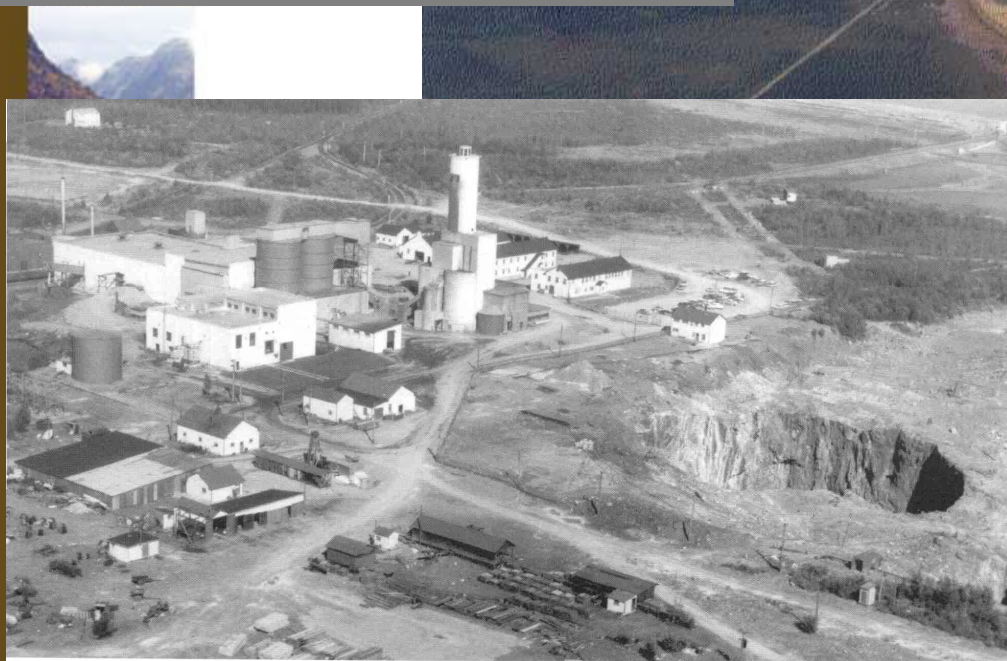




East Sullivan Mine Site

Organic cover

- Cu, Zn : 1949-1969
- Acid Mine Drainage (pH=2.3)
- Tailings Area 136 ha + spill (68 ha)
- Disturbed area : more than 2 km²



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East Sullivan Mine Site

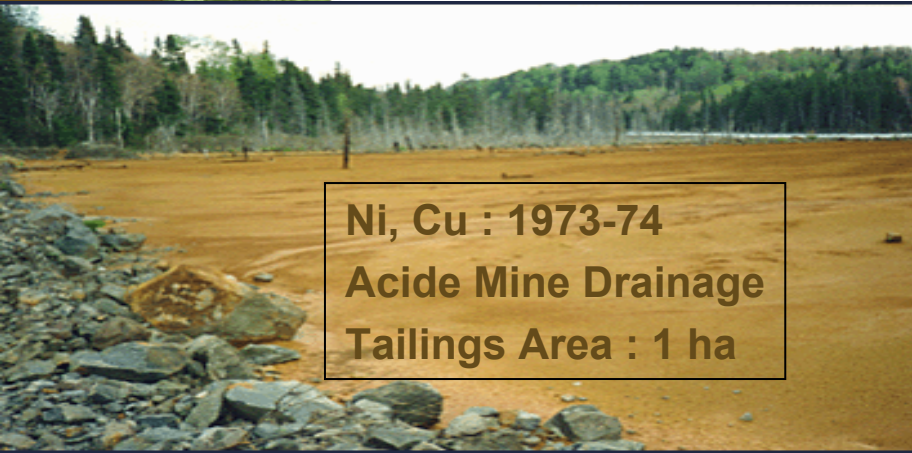
Organic cover



- **Wood waste : 2 meters**
- **Municipal Water treatment waste**
- **Dam : 6 km**
- **Water passive treatment system**

Somex Mine Site

Geomembrane cover



Bentofix Membrane + sand (1 meter) + soil



Poirier Mine Site

HDPE membrane cover

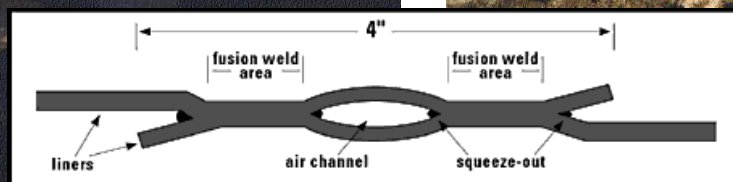
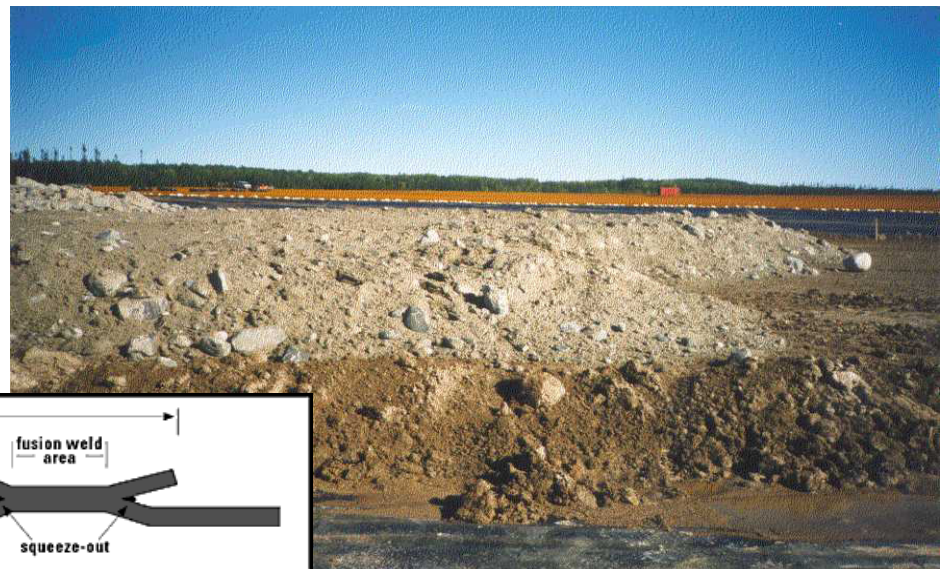
- Rio Algom
- Cu, Zn : 1966-1975
- Acid Mine Drainage
- Tailings Area : 46 ha + spill : 27 ha





Poirier Mine Site

HDPE membrane cover

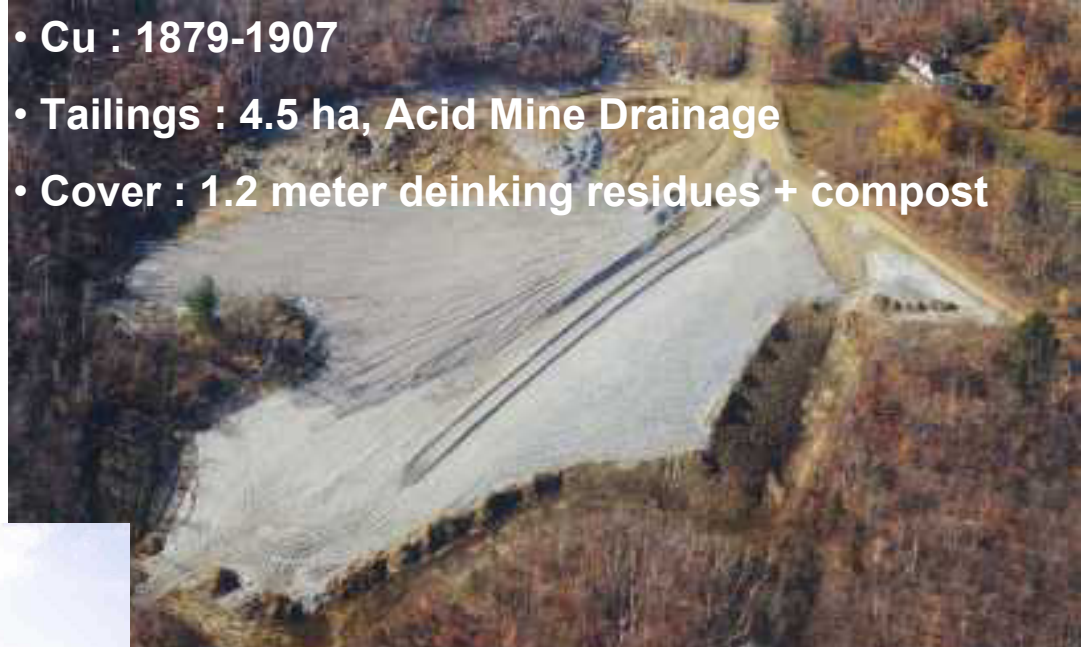




Albert Mine Site

Deinking residues cover

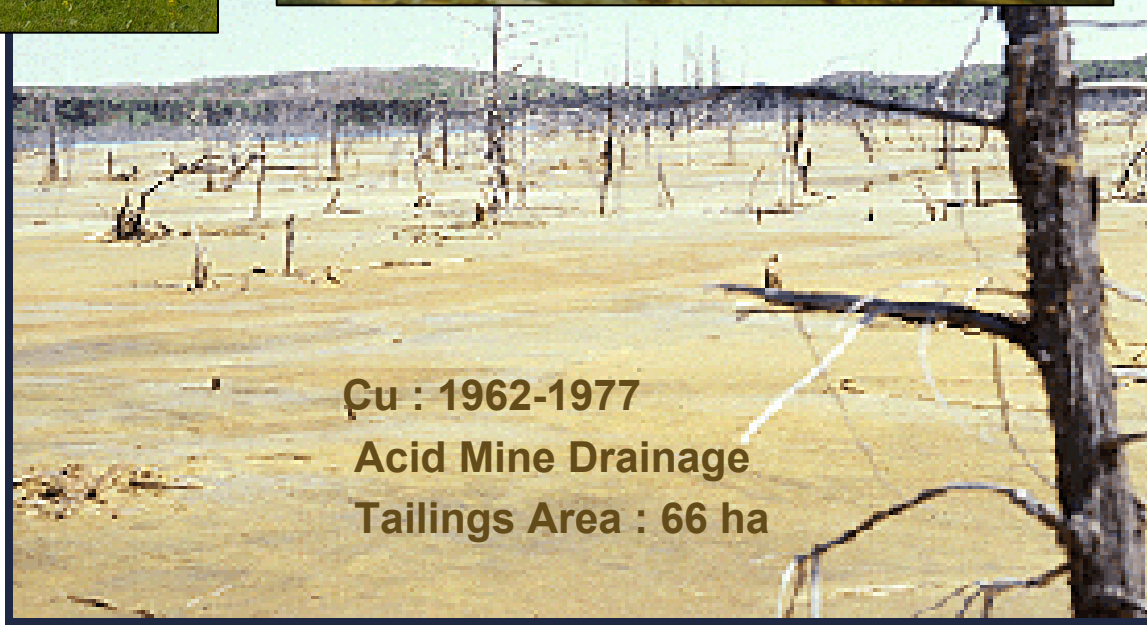
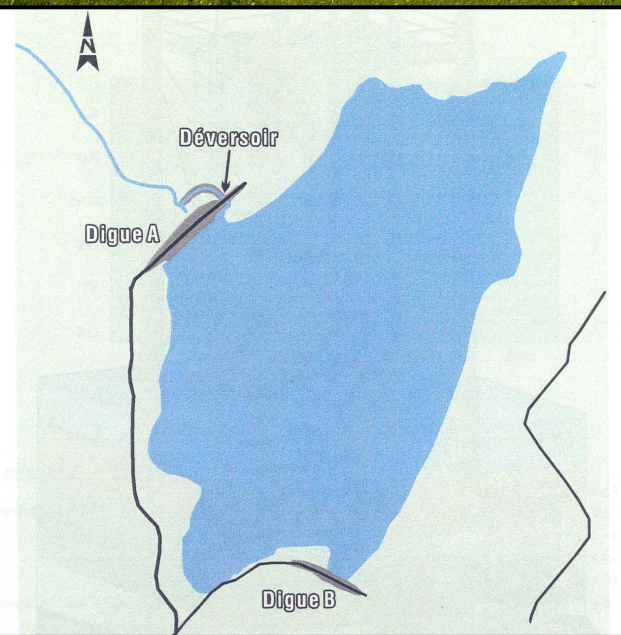
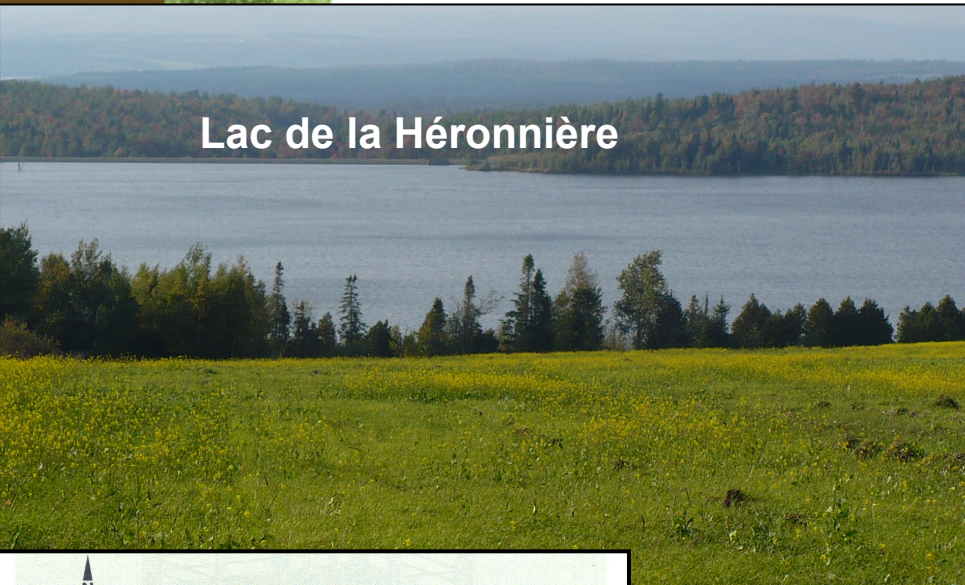
- Cu : 1879-1907
- Tailings : 4.5 ha, Acid Mine Drainage
- Cover : 1.2 meter deinking residues + compost





Solbec Mine Tailings Site

Wet barrier



Abandoned Mine Sites

Mining Act

No legal definition in Quebec Mining Act

Mining Act : Since March 9th, 1995, the responsible party must submit a rehabilitation plan for mines in operation. For other mines, the minister can enjoin the responsible party to do the rehabilitation.

In practice, the site is qualified as « abandoned » if :

- ***There are no legal owners; or***
- ***The actual owners are not responsible for the pollution; or***
- ***The actual owners do not have the financial resources to do the work***

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Abandoned Mine Sites

Cost Evaluation and Funding

1. Evaluation:

- ♦ Actual abandoned sites: 97 M\$ (~ 50 mine sites)
- ♦ Future abandoned sites: 106 M\$ (70 % probability)

2. Funding:

- ♦ 203 M\$ in the government debt
- ♦ 10 years

3. Control mechanisms:

- ♦ Beginning of year: evaluation of the amount to be spent
- ♦ Monitoring committee
- ♦ Audit committee

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Abandoned Mine Sites *Program*

1. Rehabilitation plans made by experts
 - ◆ Bidding procedure
2. Requirements not different from active mines :
 - ◆ Rehabilitation plan selected by MRNF with advice from MDDEP
 - ◆ Permits required from MDDEP to do the work
 - ◆ MMER and MDDEP requirements for effluents

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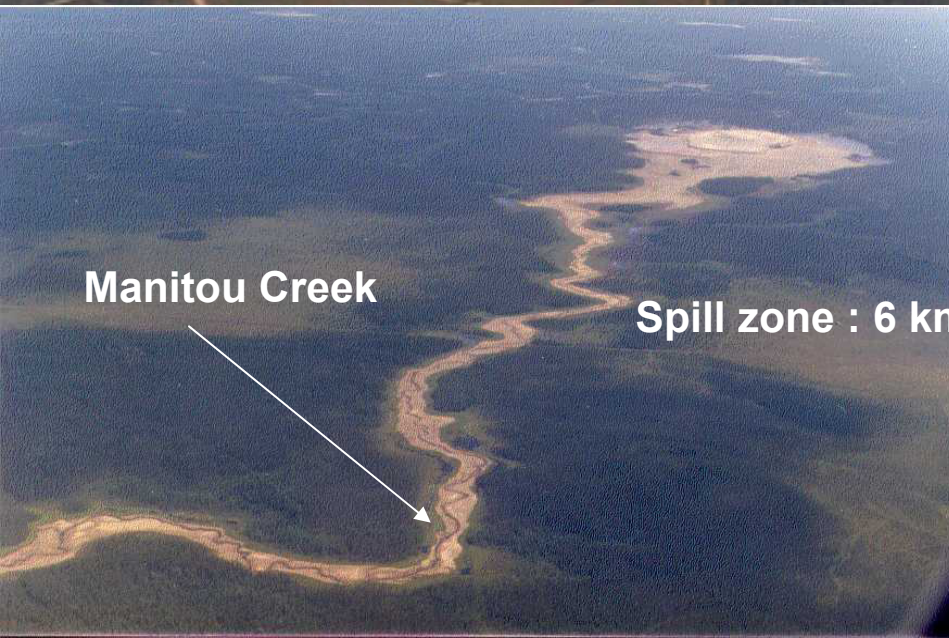
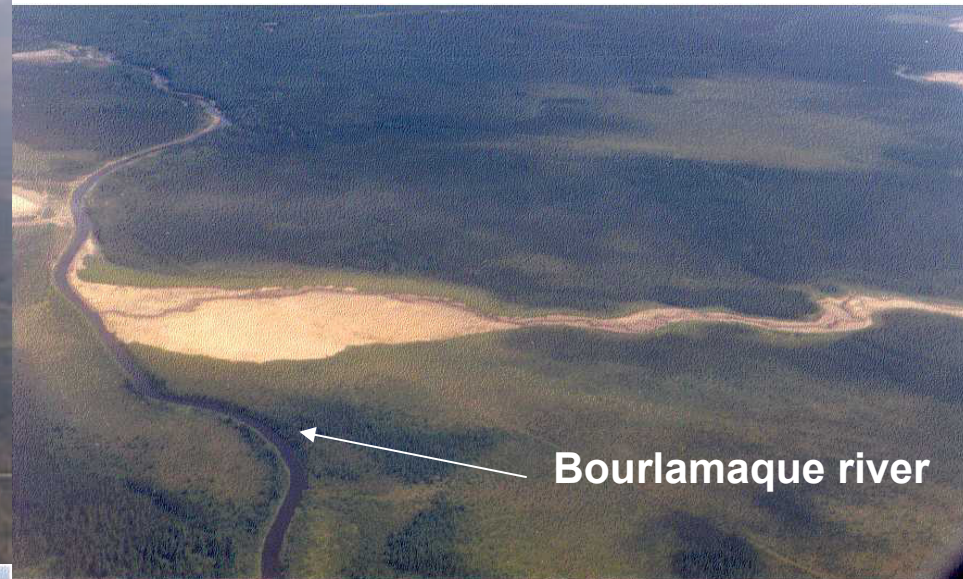
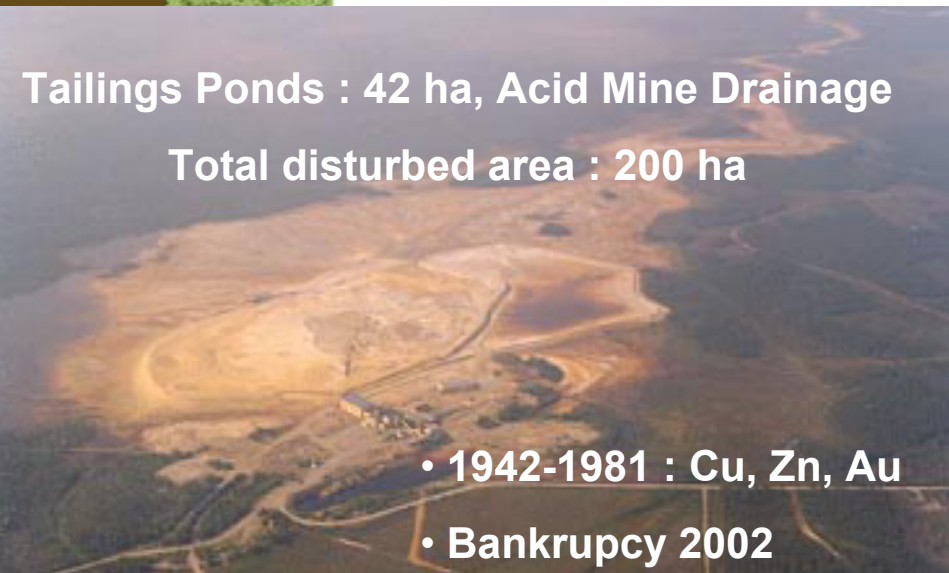
Manitou Mine Site

Bourlamaque river watershed





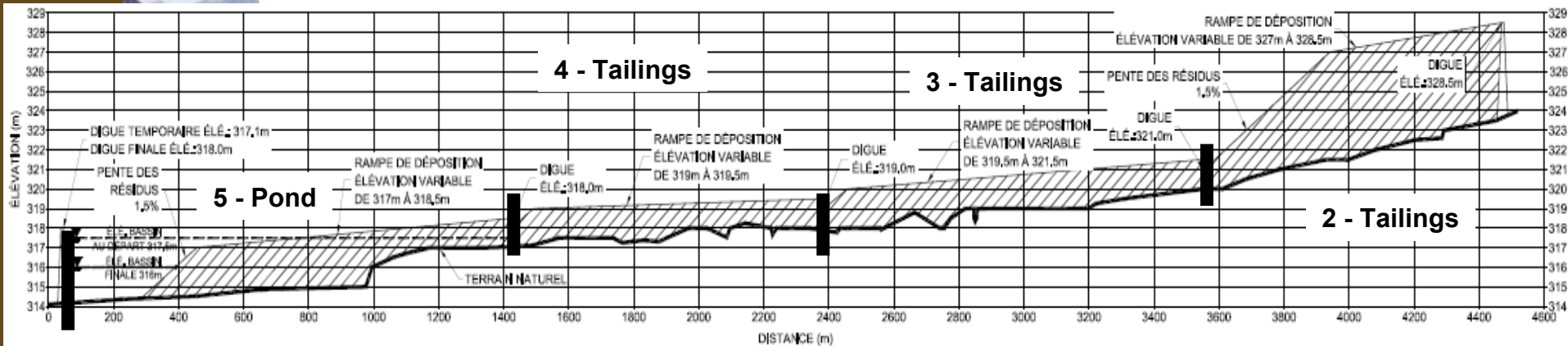
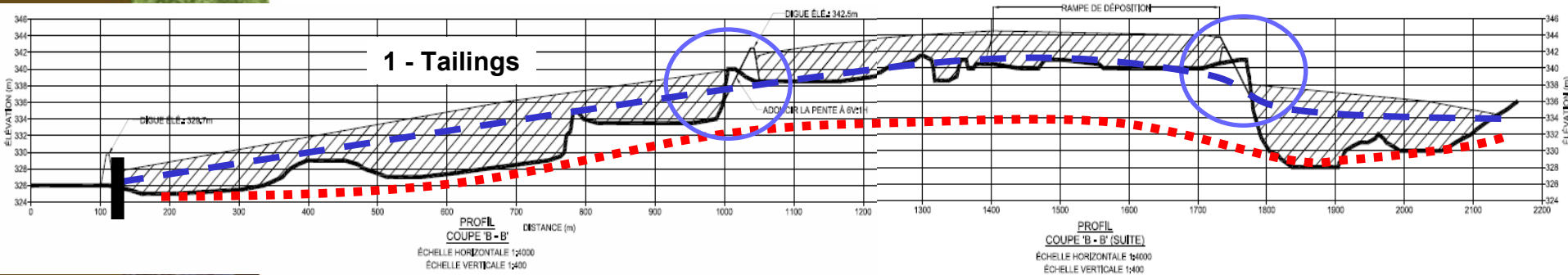
Manitou Mine Site



Spill zone : 6 km long - 50 to 300 m wide

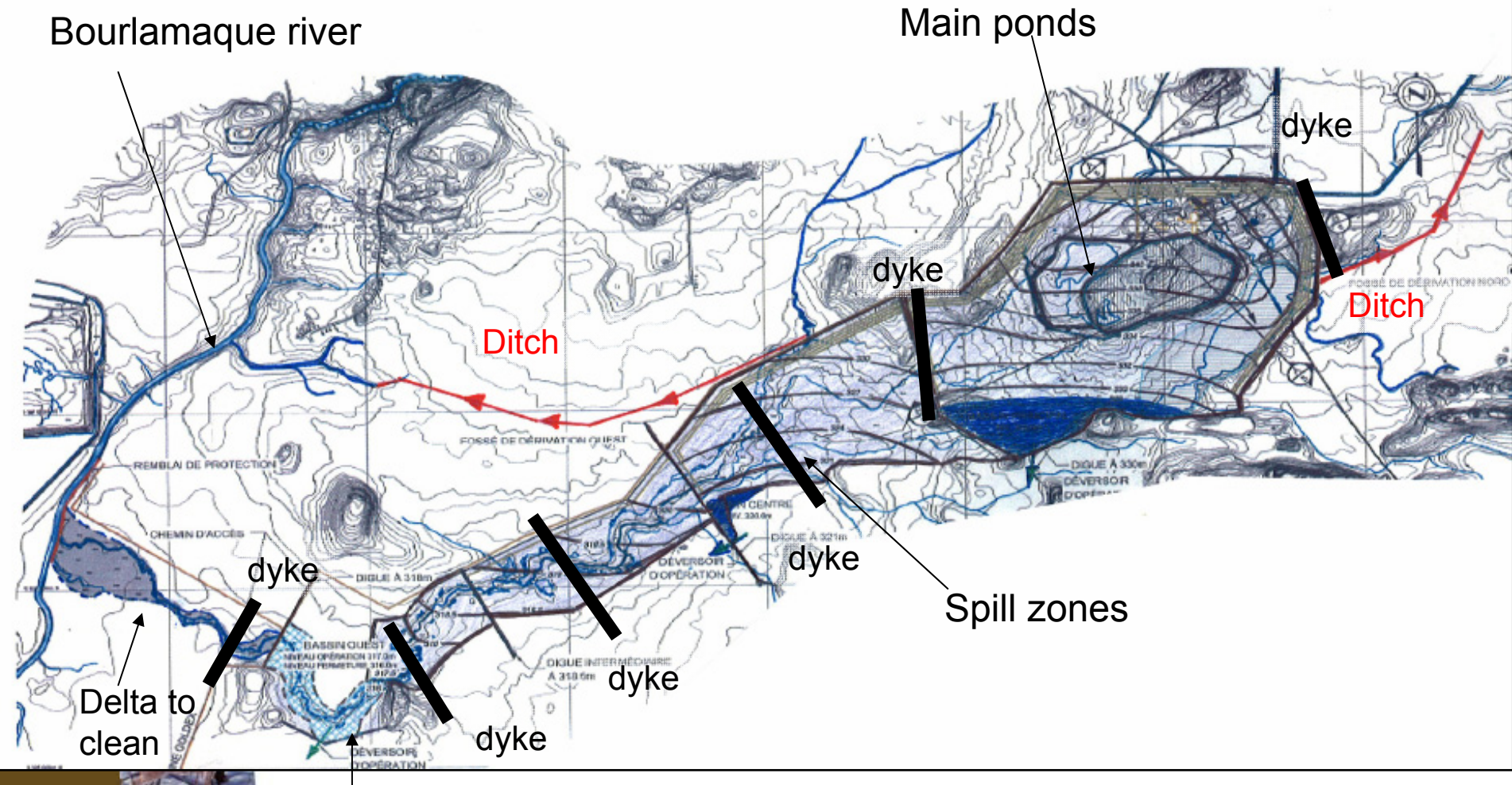


Manitou Mine Site Rehabilitation Concept





Manitou Mine Site *Rehabilitation Concept*

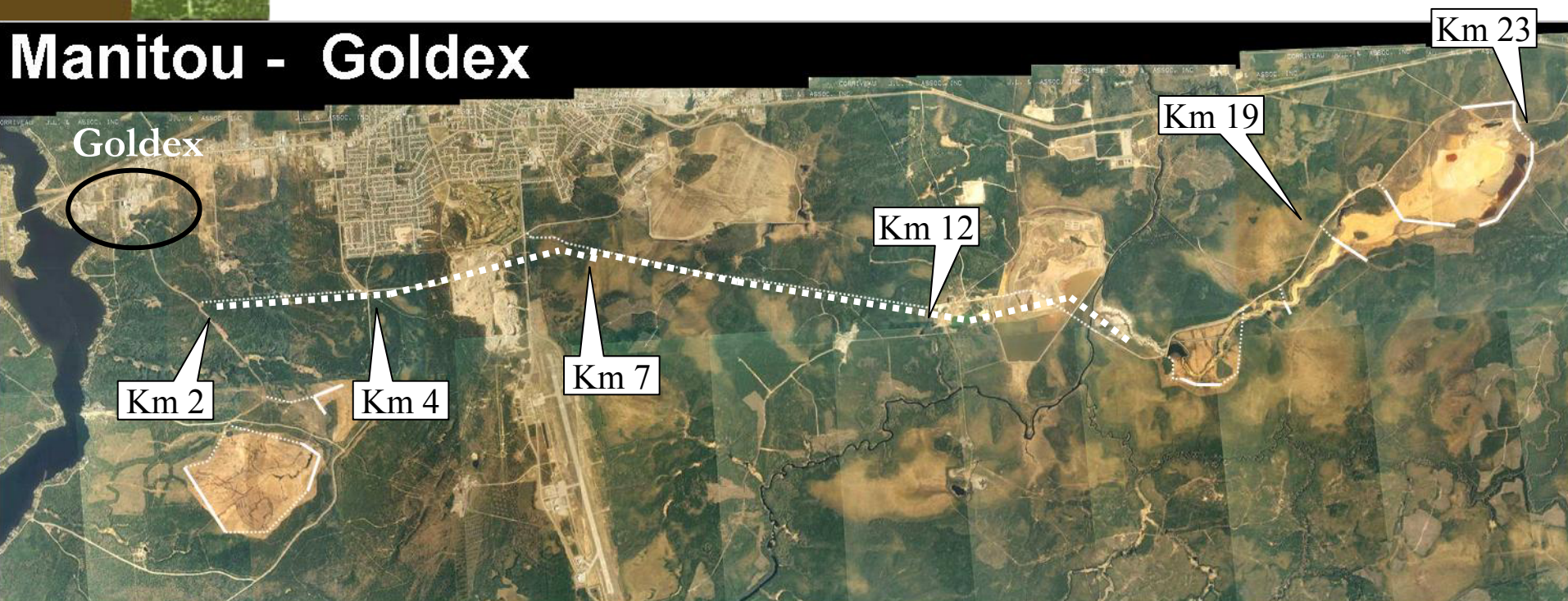


Pond to control TSS
5 days sedimentation time

Manitou-Goldex Project

Total cost 48 M\$

Manitou - Goldex



- Pipeline : 23 km
- Tailings : 7 000 t/day = 1.8 Mm³/year
- Pulp : 45 % solid
- Duration : 10 years

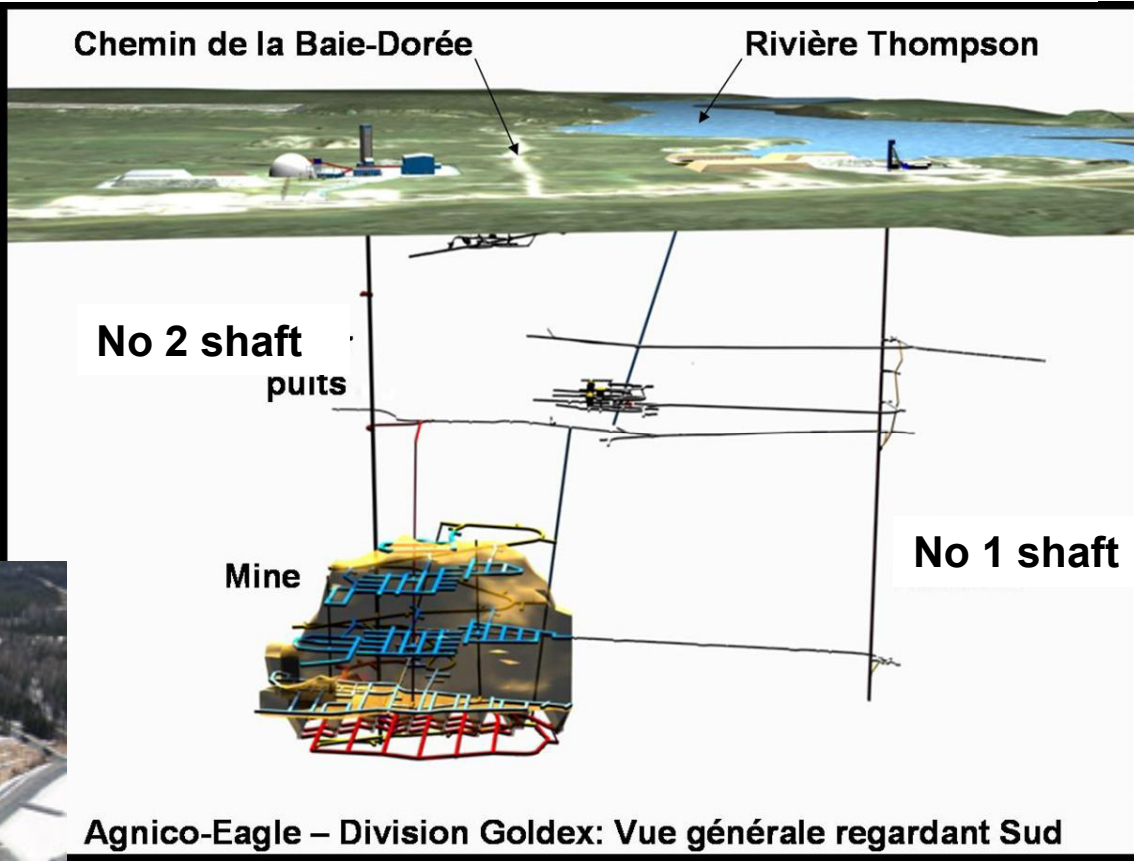
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Goldex Mine Project

- Agnico-Eagle Mines Ltd
- 23 Million tons Au 2.3 g/t
- 175 000 oz gold annually - 10 years
- 183 M\$ investment
- production : April 2008

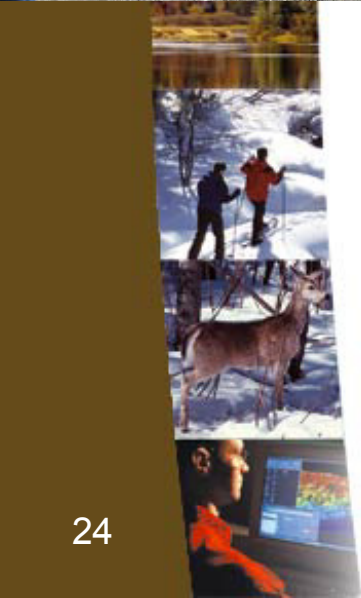




Goldex Mine *Emergency pond*

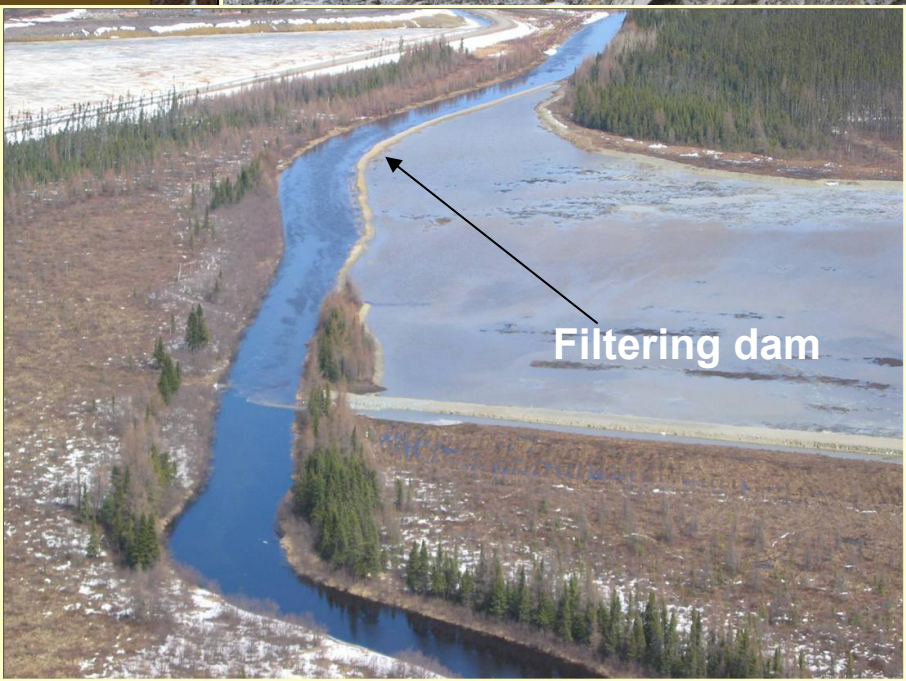


Manitou-Goldex Project *Pipeline*



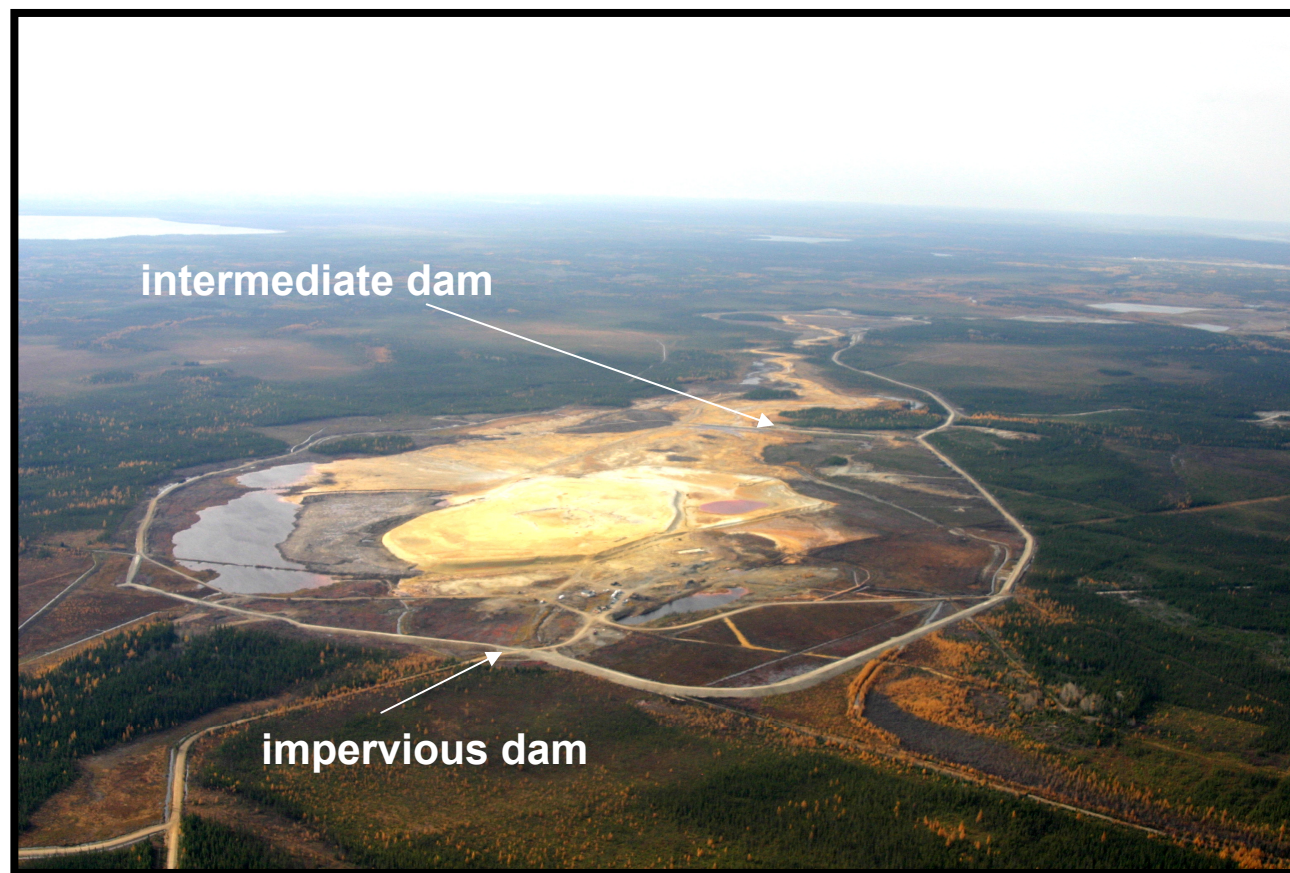
Manitou Mine Site

Spill zone preliminary activities



Manitou Mine Site

Tailings ponds preliminary activities



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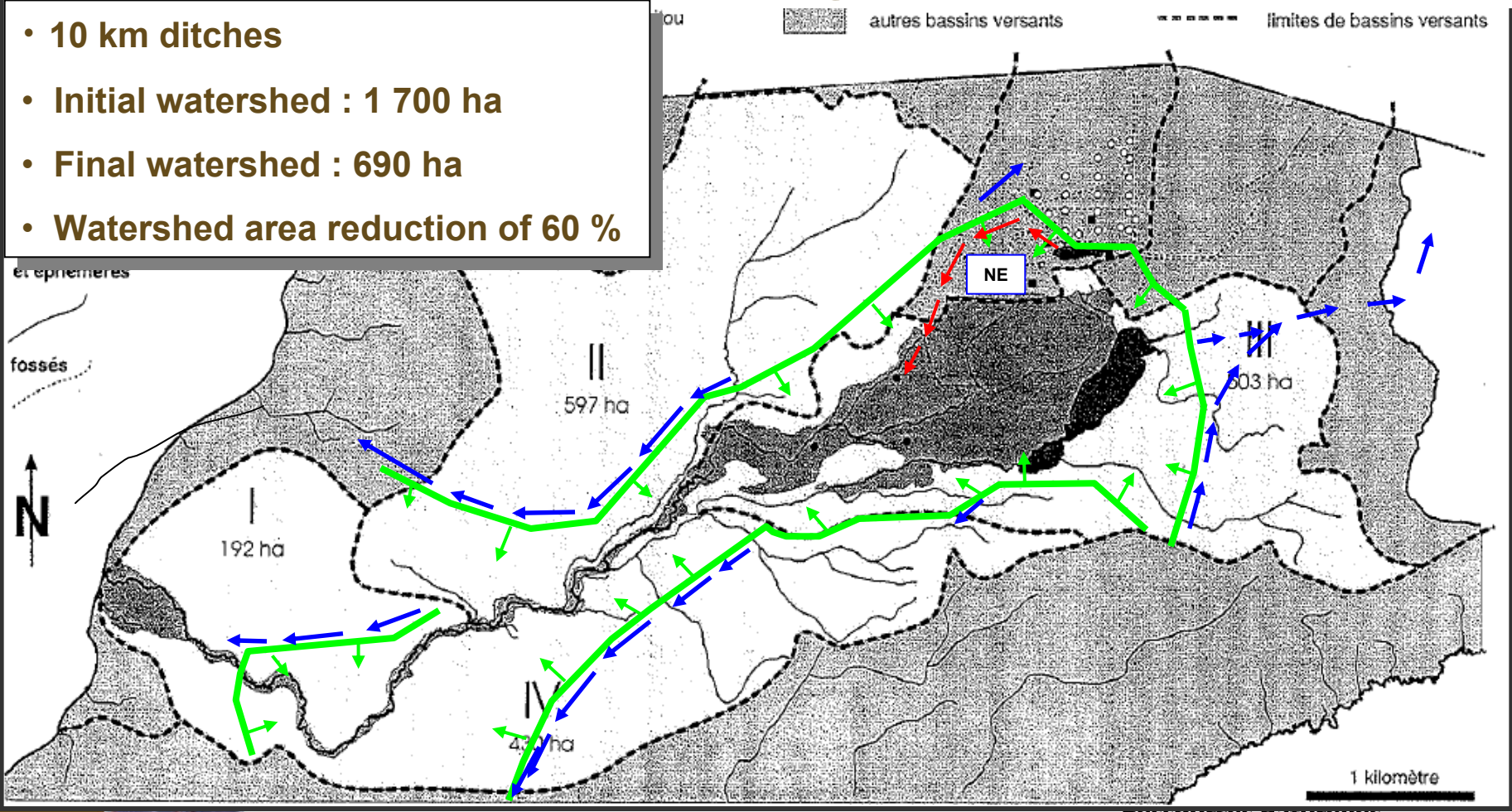




Manitou Mine Site

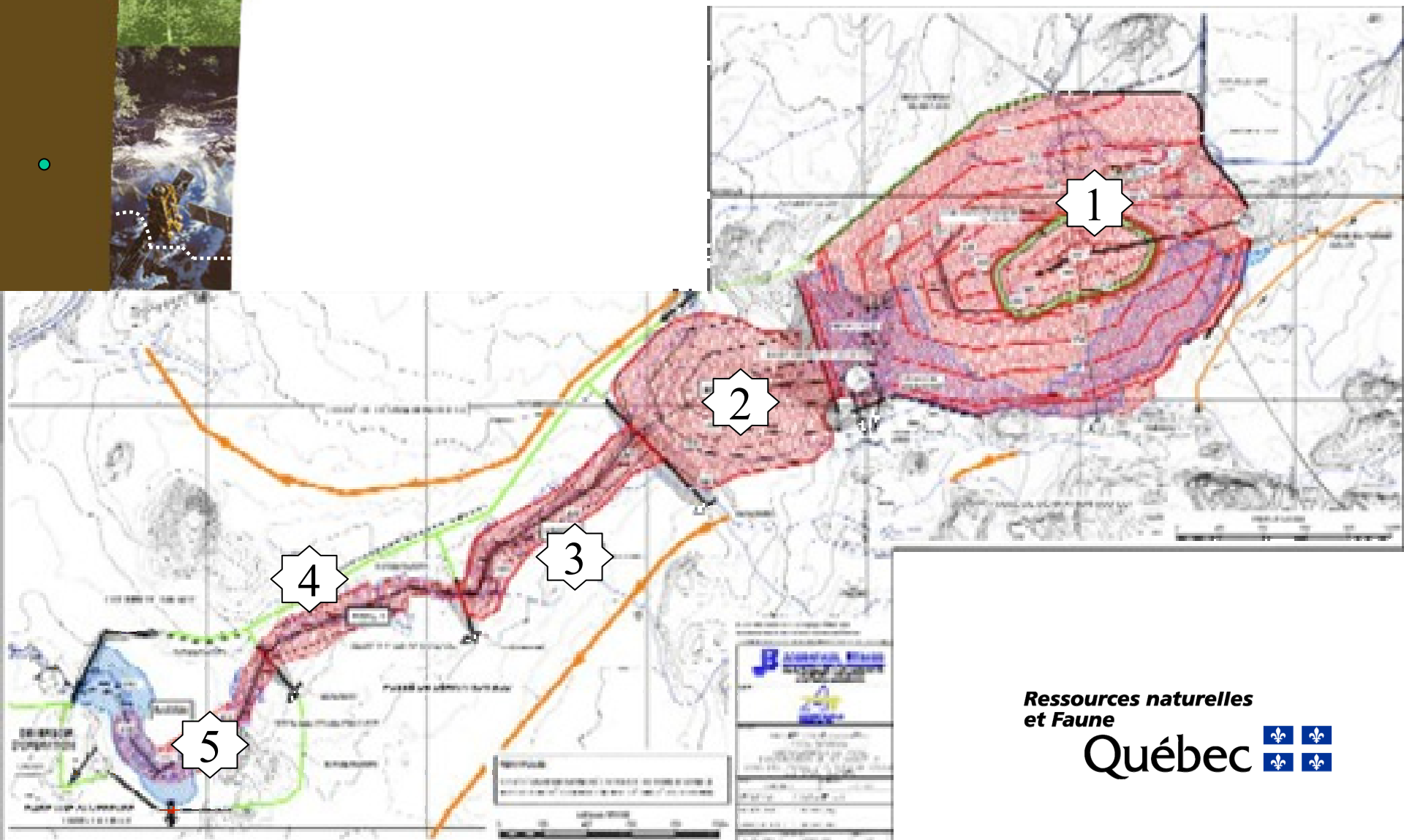
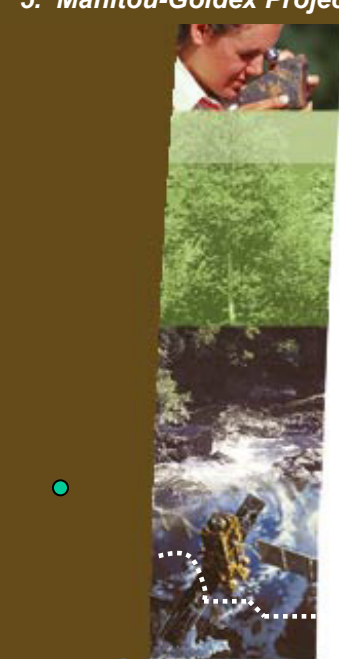
Drainage control

- 10 km ditches
- Initial watershed : 1 700 ha
- Final watershed : 690 ha
- Watershed area reduction of 60 %



Manitou Mine Site

Cover building sequence



Manitou Mine Site

Closing the site

1. Vegetation
2. Stabilization of river banks
3. Marsh construction
4. Rehabilitation of fish habitat
5. Monitoring
6. « Abandonment » of this abandoned mine site

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Manitou Mine Site *Advantages*

1. Government estimated savings : 12 M\$
2. No delays to bring Goldex mine into full production
3. Reduction of the natural resources required to rehabilitate the site
4. Avoid construction of large tailings site for Goldex Mine
5. No additional cost to Agnico-Eagle Mine
6. No additional environmental responsibilities for Agnico-Eagle Mine

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Conclusion

1. All actual abandoned sites will be rehabilitated by 2020
2. Quebec will continue to promote partnership for the rehabilitation of mining sites
3. Financial securities will be modified so as to make available enough money to cover the rehabilitation costs of all mining sites, mainly accumulated areas with acid mine drainage
4. Quebec will continue its R&D effort to :
 - ◆ minimize rehabilitation costs
 - ◆ improve mineral sustainable development strategy

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A scenic landscape featuring a dirt path that winds through a green field. In the background, there is a dense forest under a clear blue sky. The text "Merci de votre attention !" is overlaid in a large, white, bold, italicized font.

***Merci de votre
attention !***