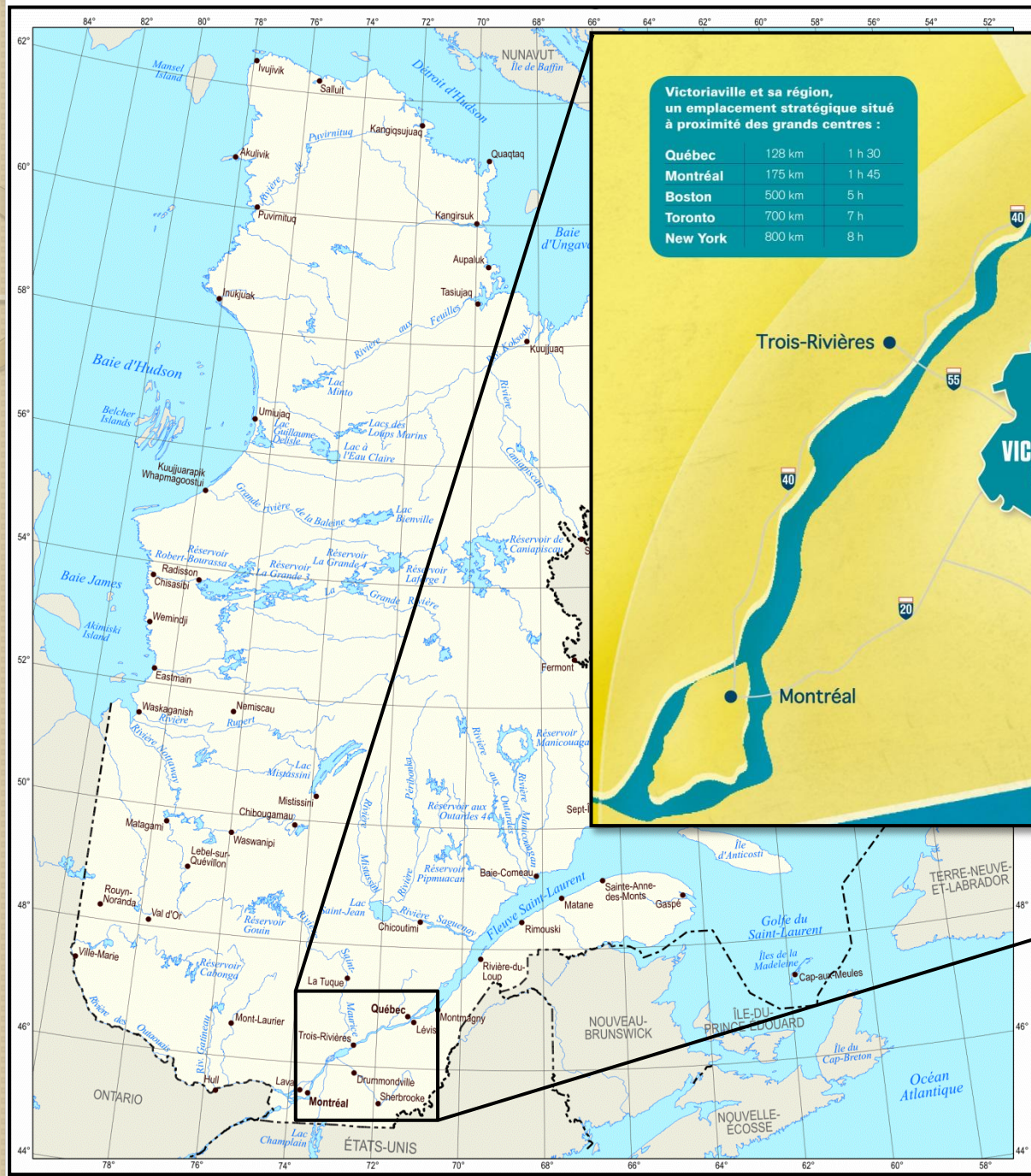




Sediment fingerprinting in Bulstrode River watershed

Watershed overview

Christina Lachance
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AAFC- Soils and Crops Research and Development
Centre

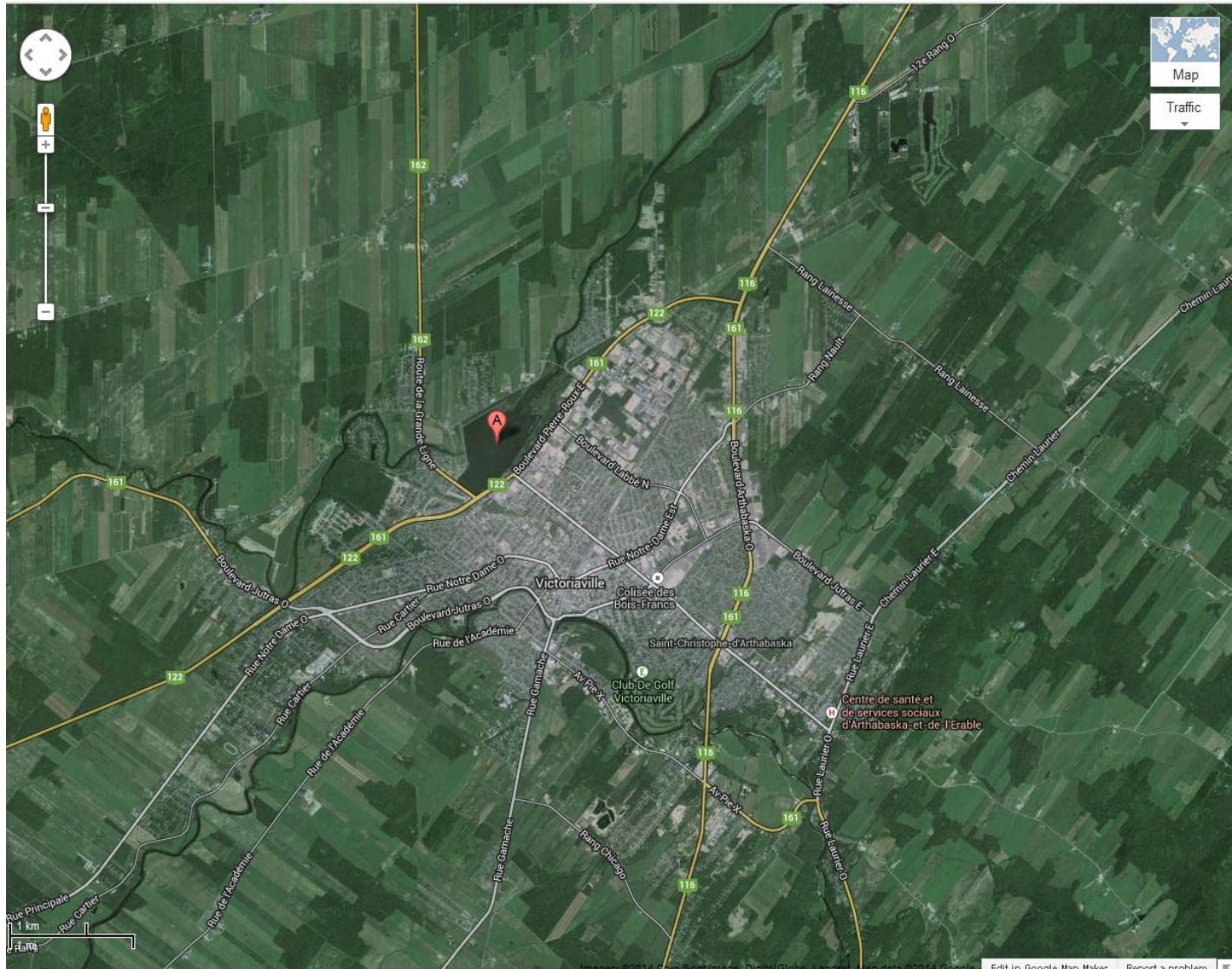


Victoriaville et sa région, un emplacement stratégique situé à proximité des grands centres :

Québec	128 km	1 h 30
Montréal	175 km	1 h 45
Boston	500 km	5 h
Toronto	700 km	7 h
New York	800 km	8 h



Reservoir Beaudet location



Longitude $-71^{\circ}58'21''$ Latitude $46^{\circ}04'20''$

Reservoir Beaudet

- Built in 1977
- Water supply for half of Victoriaville population
- Reservoir area: 94,6 ha

Year	1979	1994	2003
Storage capacity (m ³)	1,70 X 10 ⁶	1,22 X 10 ⁶	1,13 X 10 ⁶
Mean depth (m)	2,45	1,76	-

Sediment accumulation



Reservoir Beaudet



Date Juin 1965

Échelle ± 1 : 9 500



Mai 1985

± 1 : 15 000



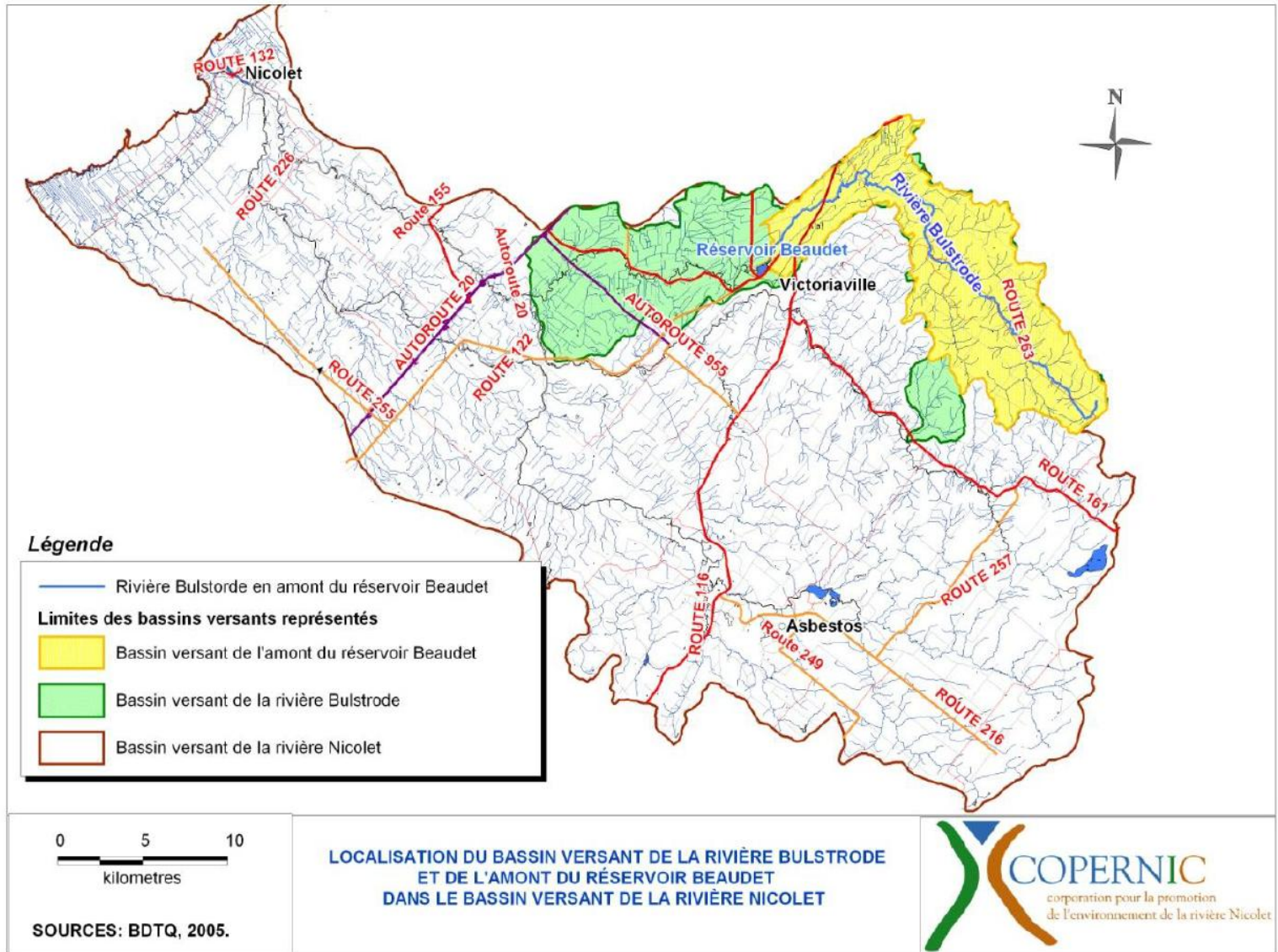
Août 1991

± 1 : 15 000

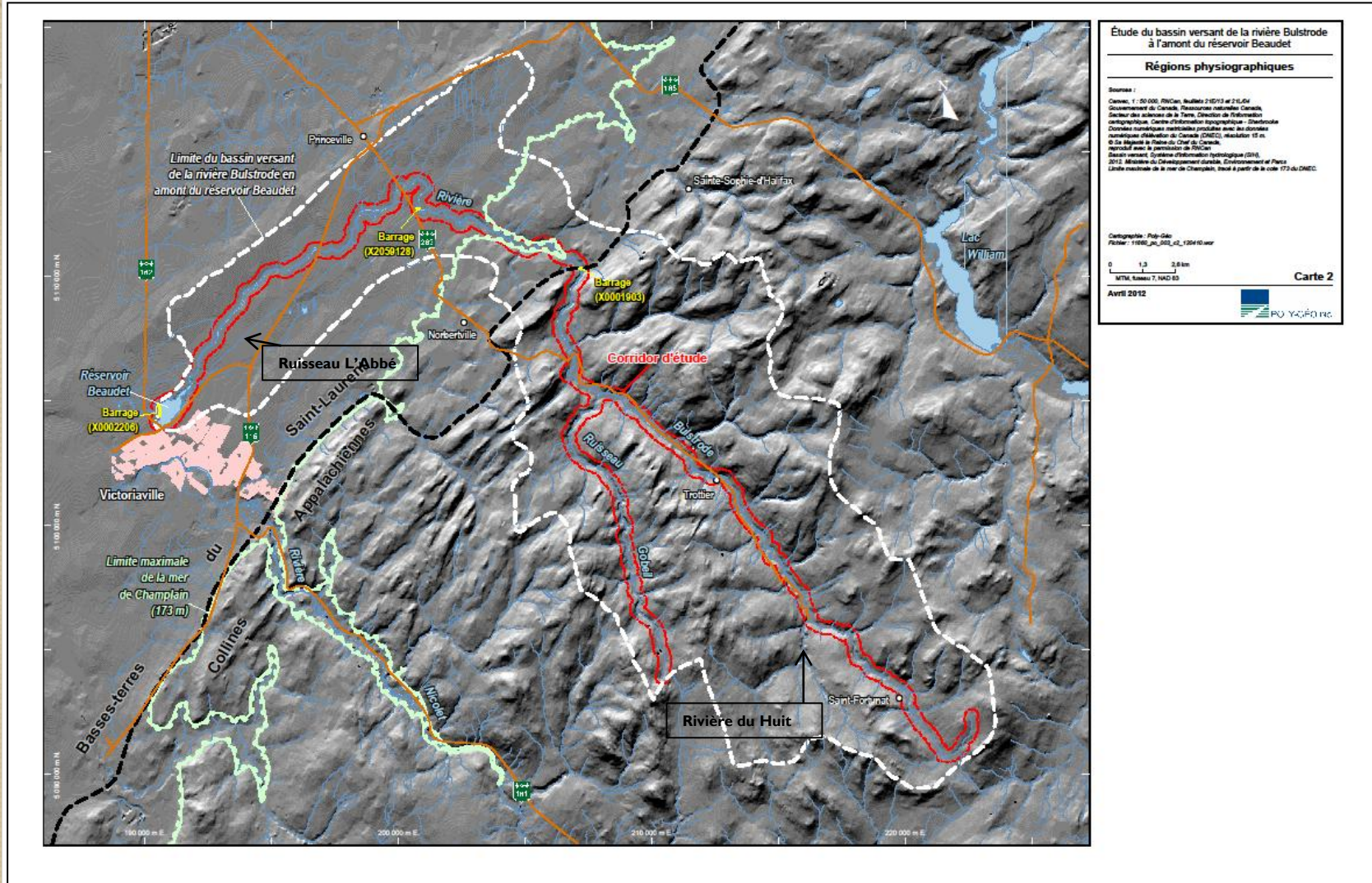
Project objectives:

- Identify the source of the sediments carried toward the reservoir
- Evaluate the contribution of agricultural land to the river sediments

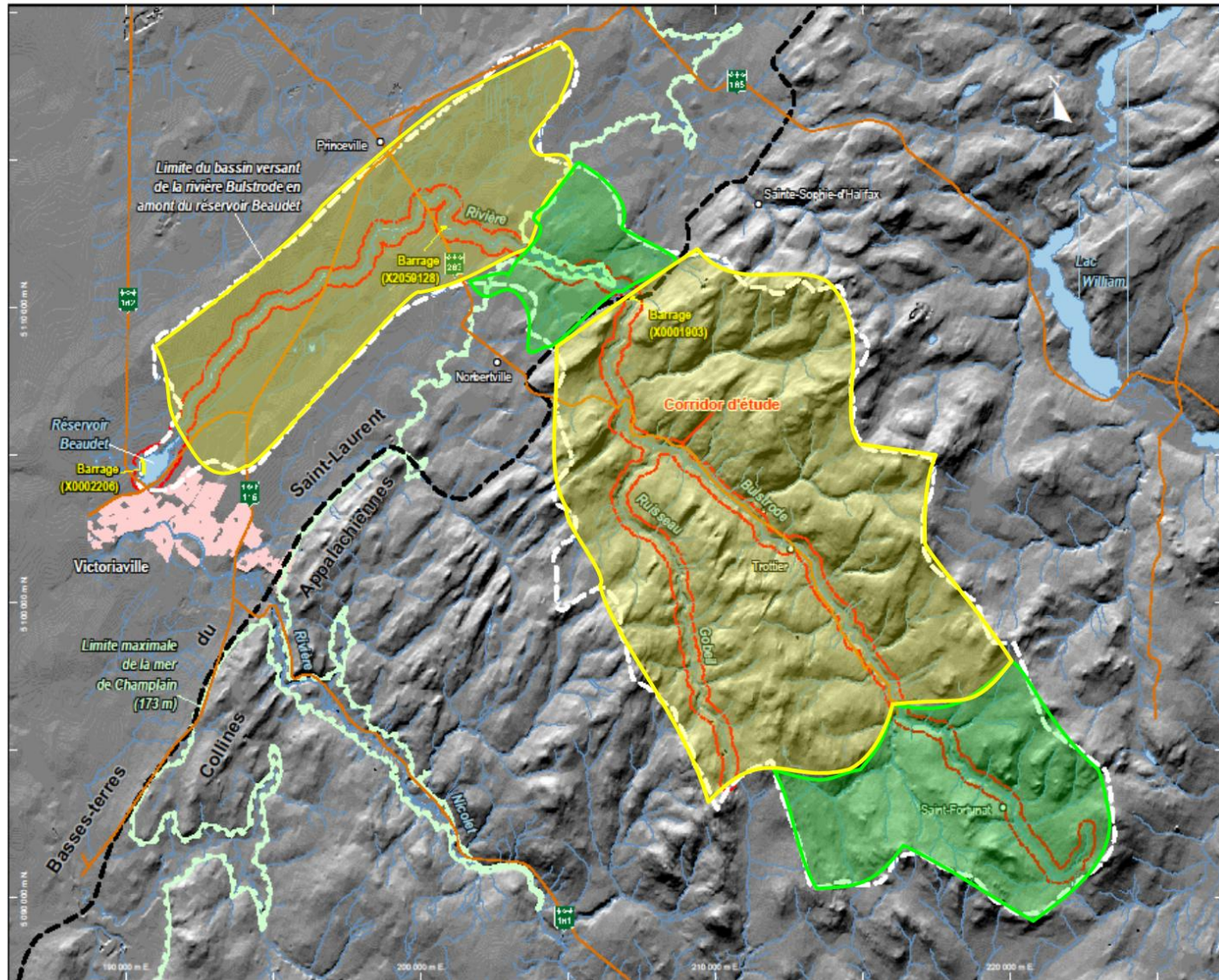
Bulstrode river Watershed



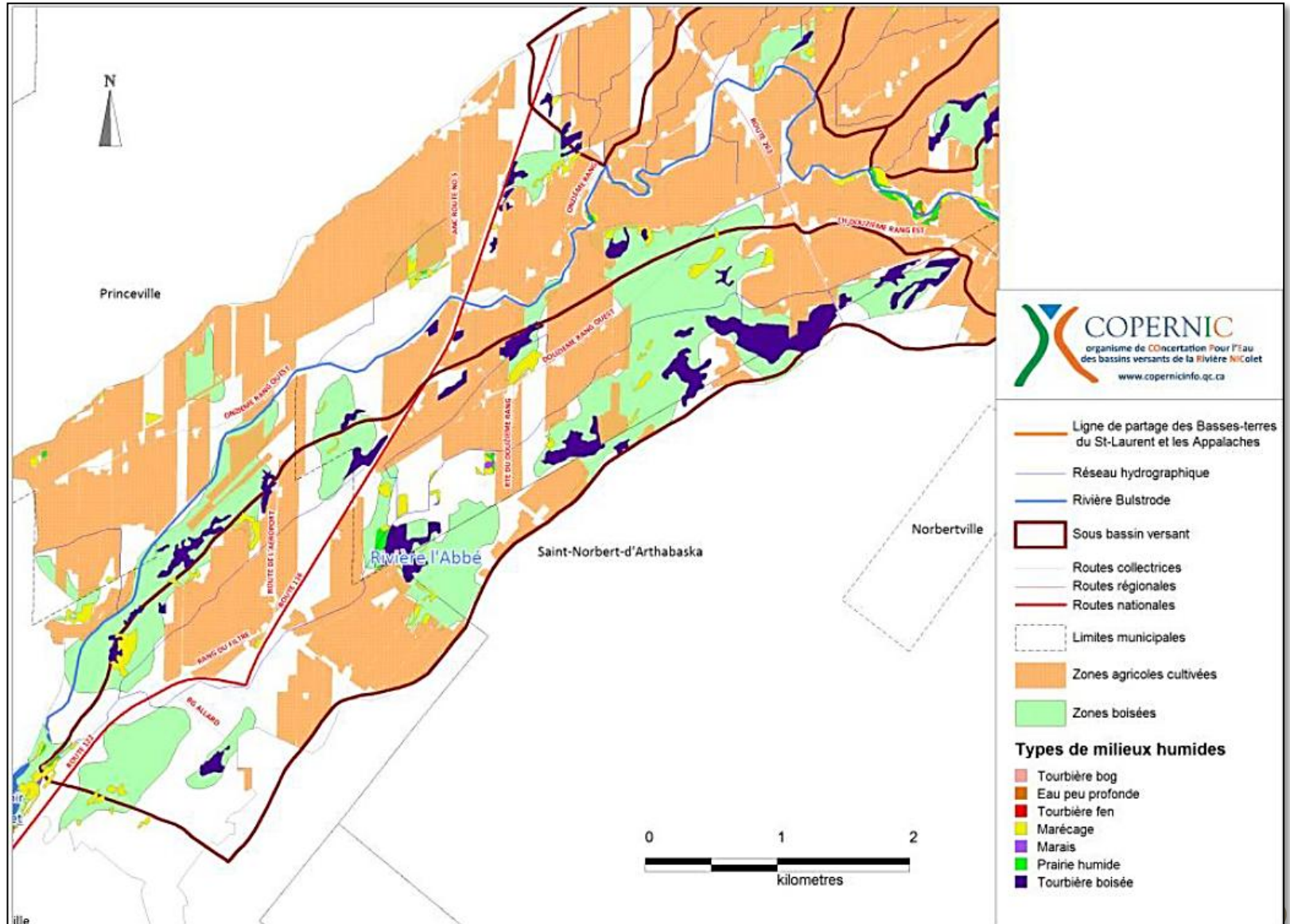
Reservoir Beaudet watershed



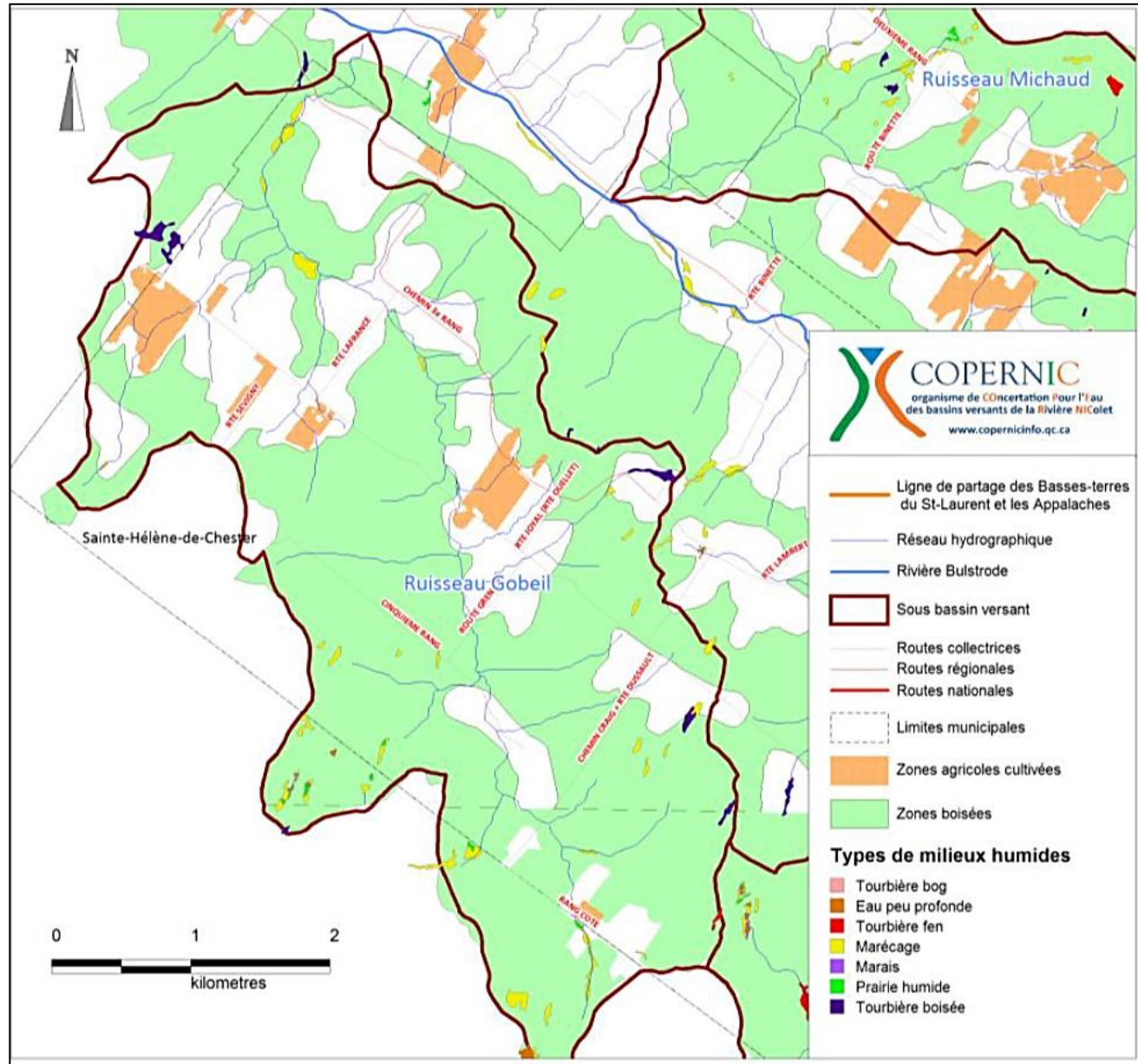
Physiographic units



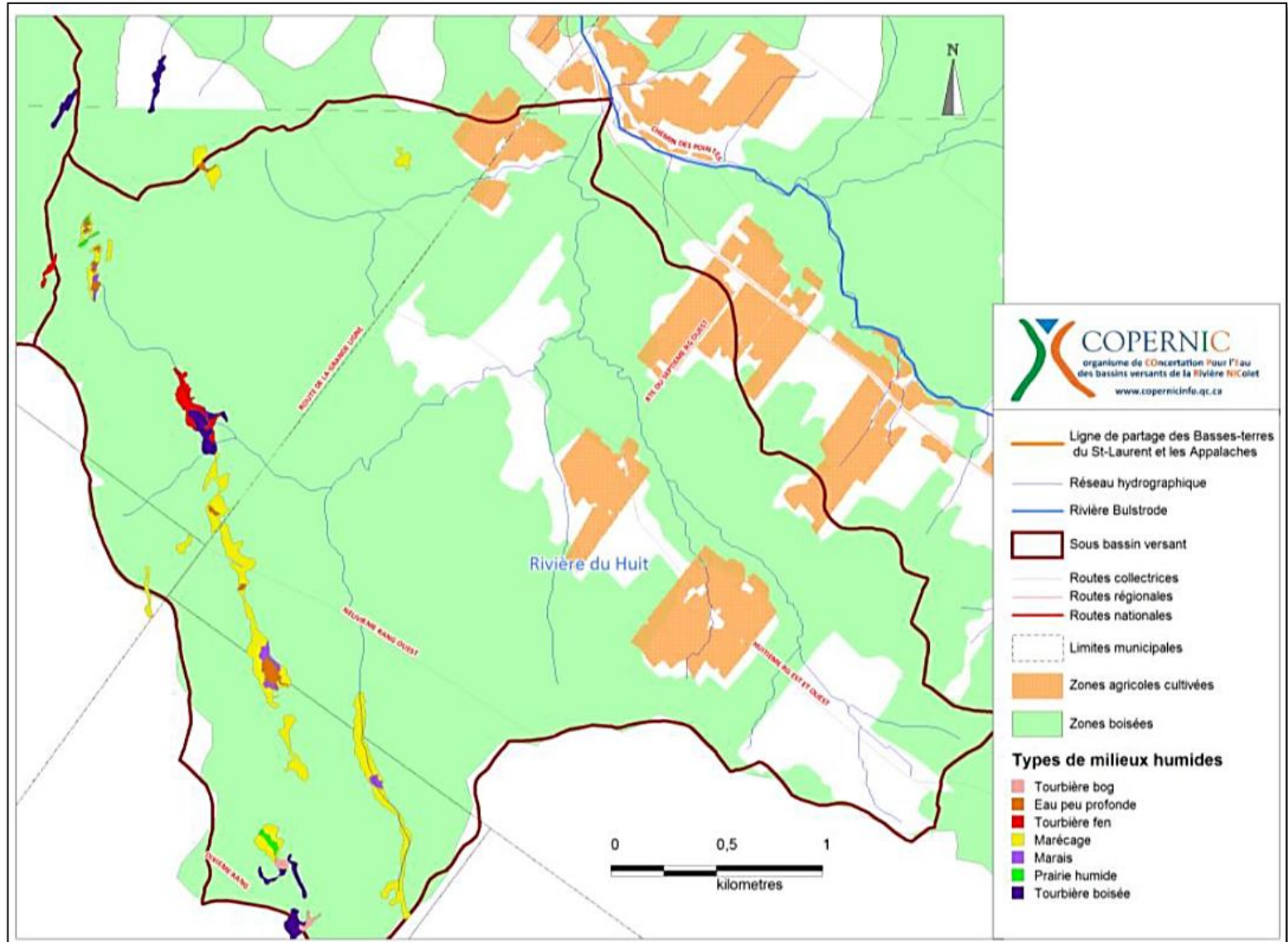
L'Abbé river sub-watershed



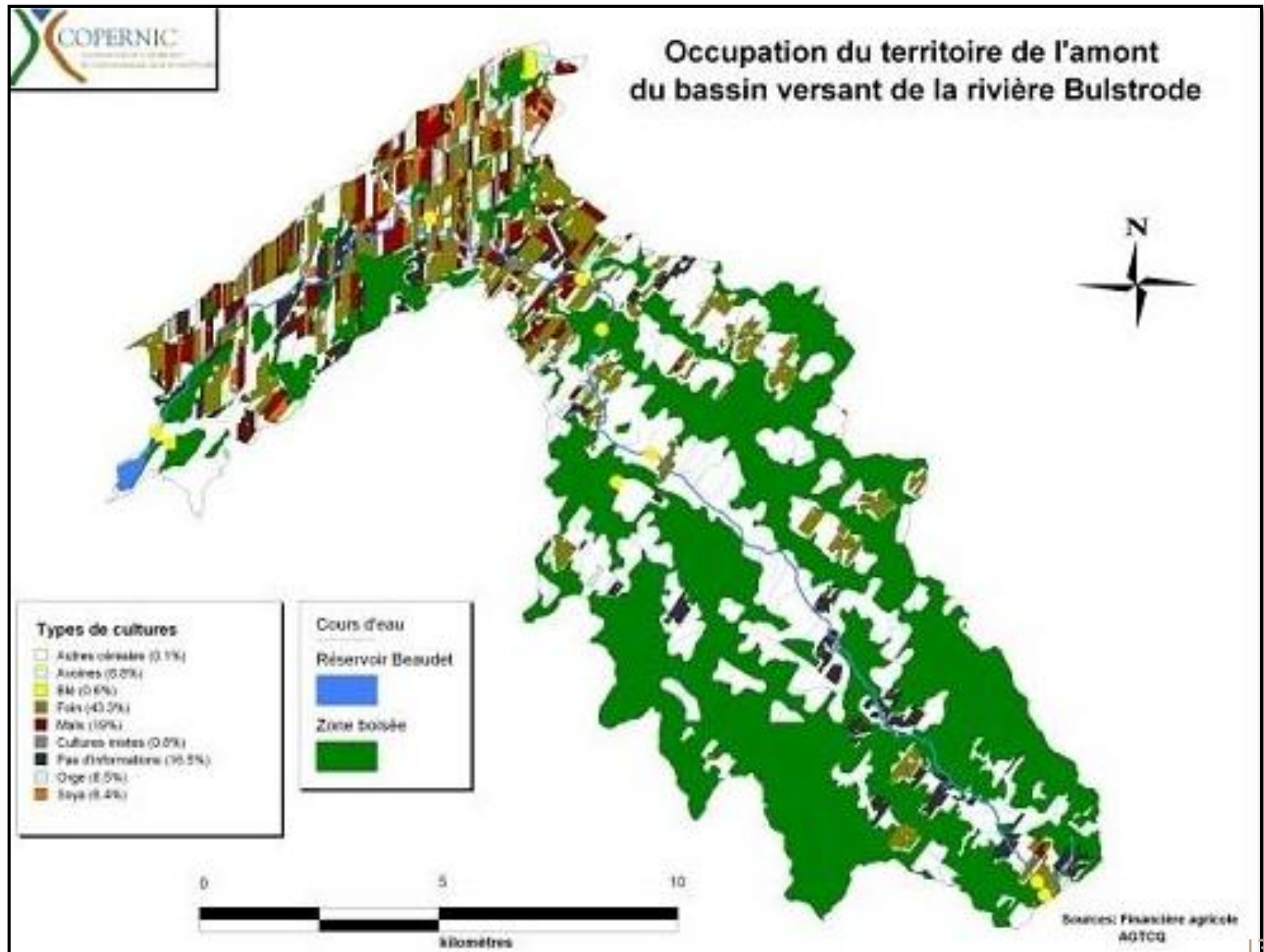
Gobeil river subwatershed



Huit (8) river subwatershed

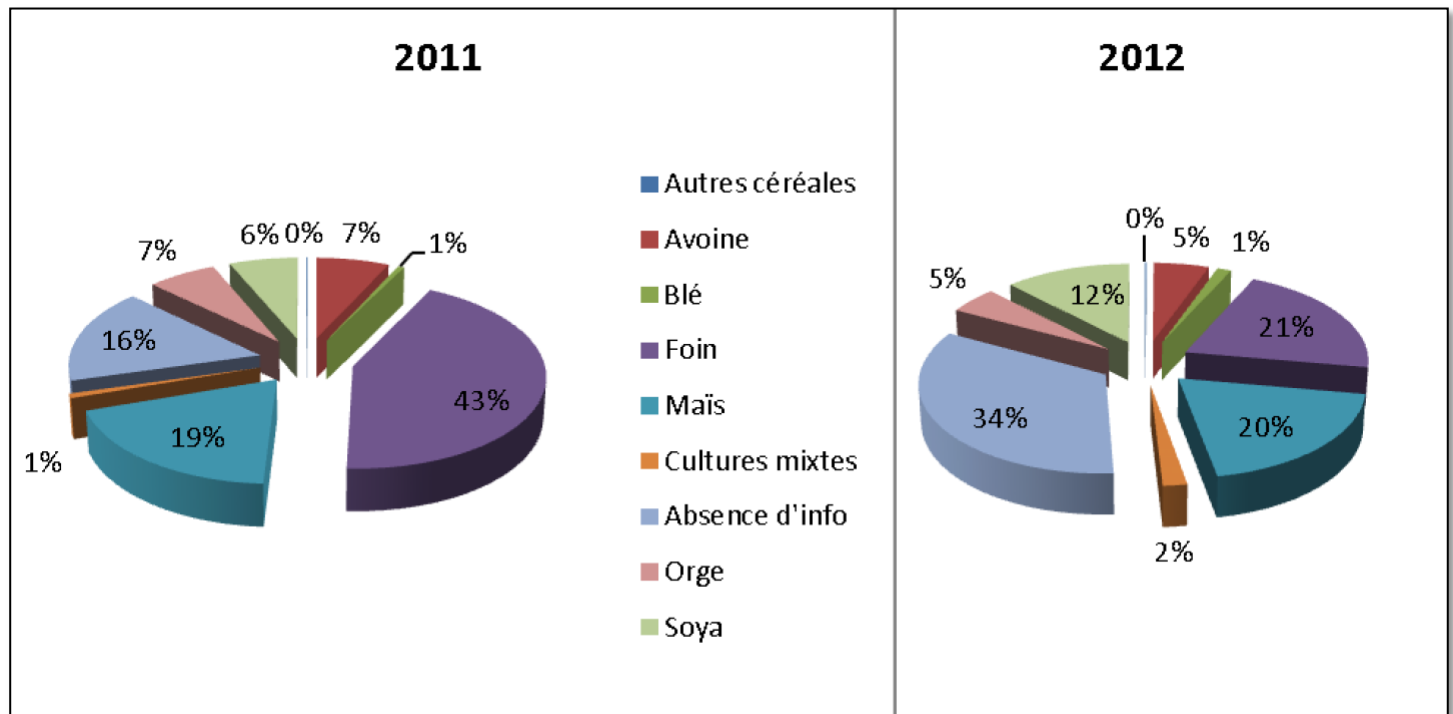


Land use



Land use

- Forest: 49%
- Crop under the insurance program: 22% of the area

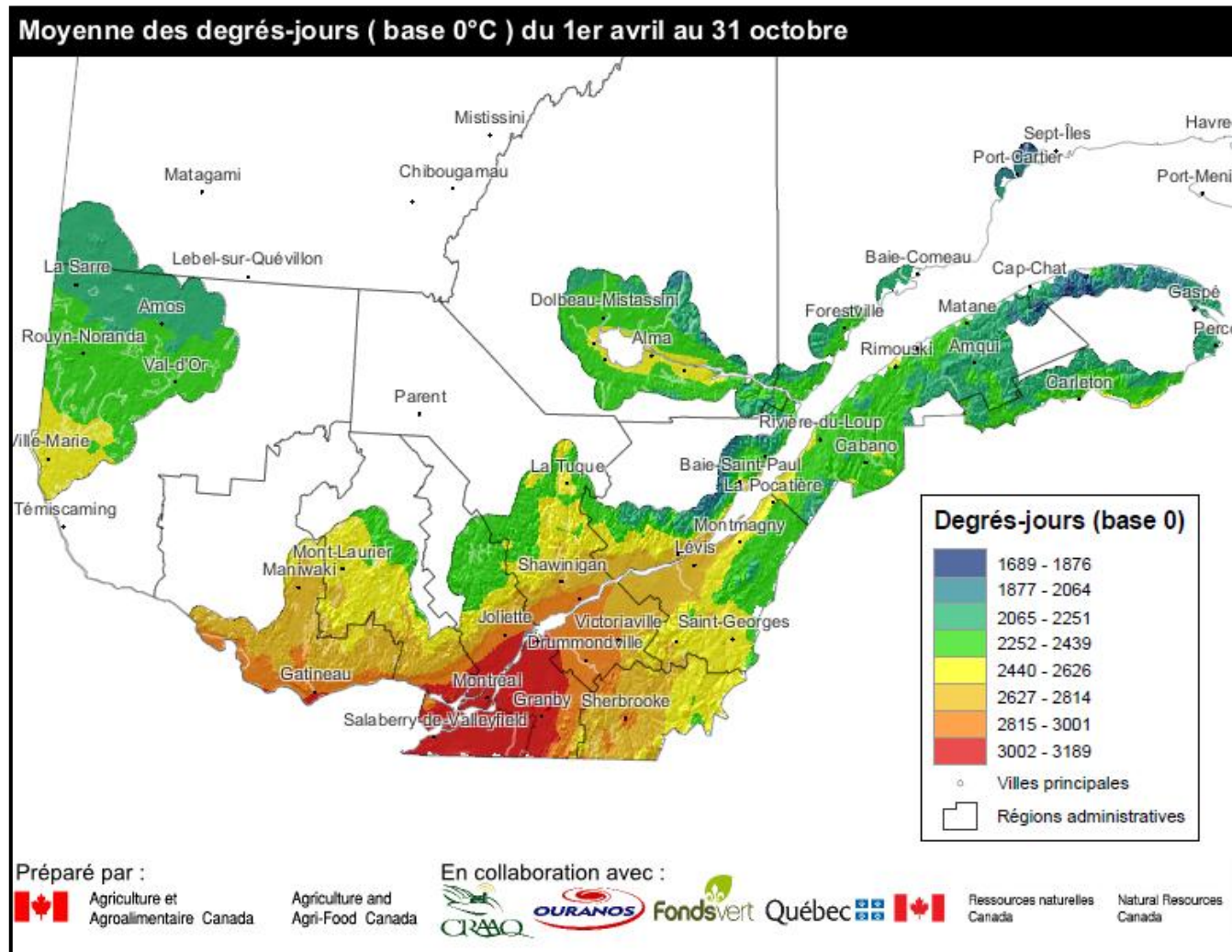


Climate

- Annual mean T: 5°C
- Maximal mean T: 25°C
- Minimal mean T: -16°C
- Annual mean rainfall: 886,8 mm
- Annual mean snowfall: 272 mm

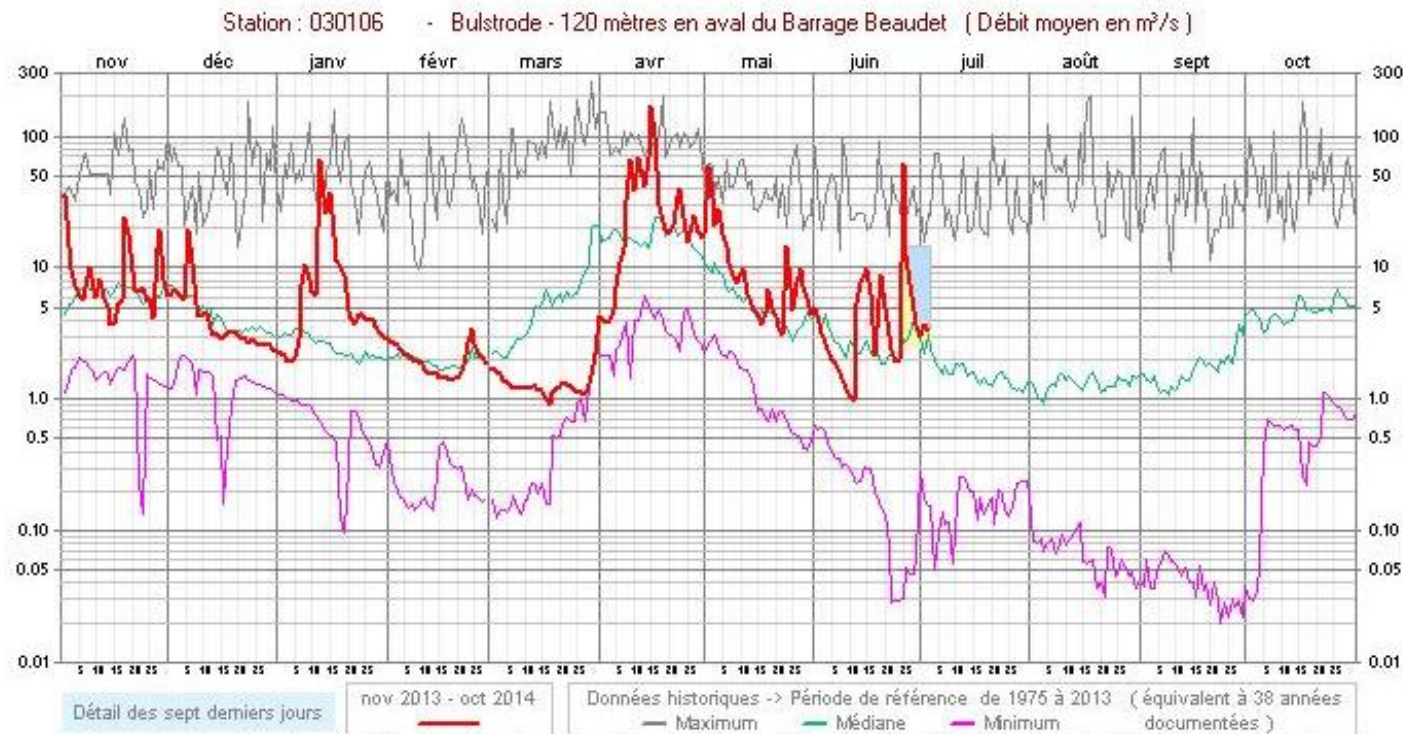
Climate

- Length of growing season: 200 days
- Growing degree days: 2627-2814

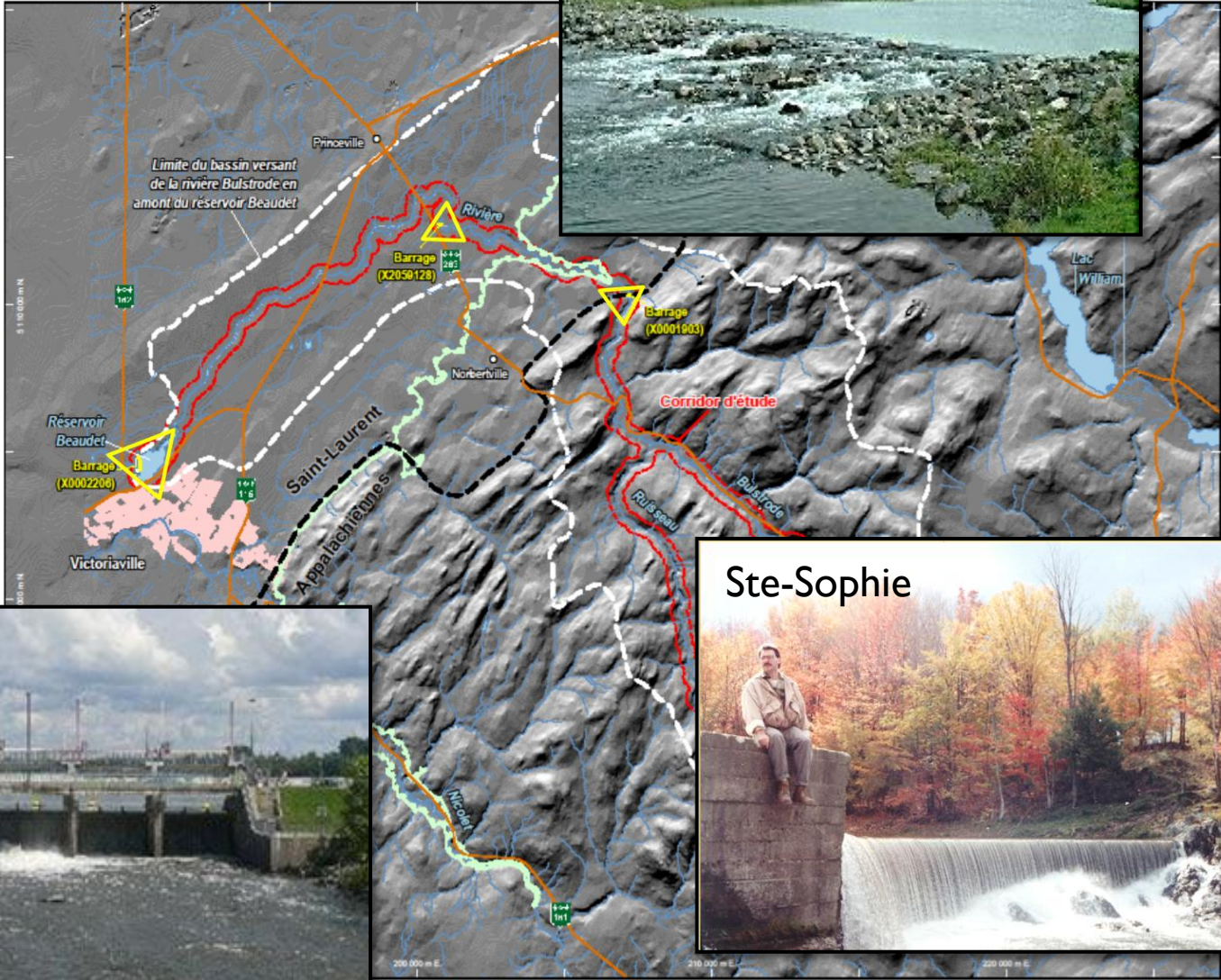


Hydrology

- Mean flowrate (flood) : 65 m³/s
- Mean flowrate (low-water) : 1 m³/s
- Mean daily flowrate : 8.3 m³/s



Dams



Location of dams



Stream channel characteristics

In the lowlands:

- Very weak slope: 0.5%
- Downstream Ste Sophie dam: sand and bedrock riverbed
- At reservoir entrance: sand and silt riverbed

Stream channel characteristics

Appalachian piedmont

- River slope: 1-6%
- Hills: 400-550 m altitude
- Hills cut by Bulstrode and Gobeil glaciated valleys
- Covered with thin till, thicker in valleys
- River Bed: bedrock, sand & gravel
- Banks: silt, sand & gravel

Geology

Sedimentary and metamorphic bedrock

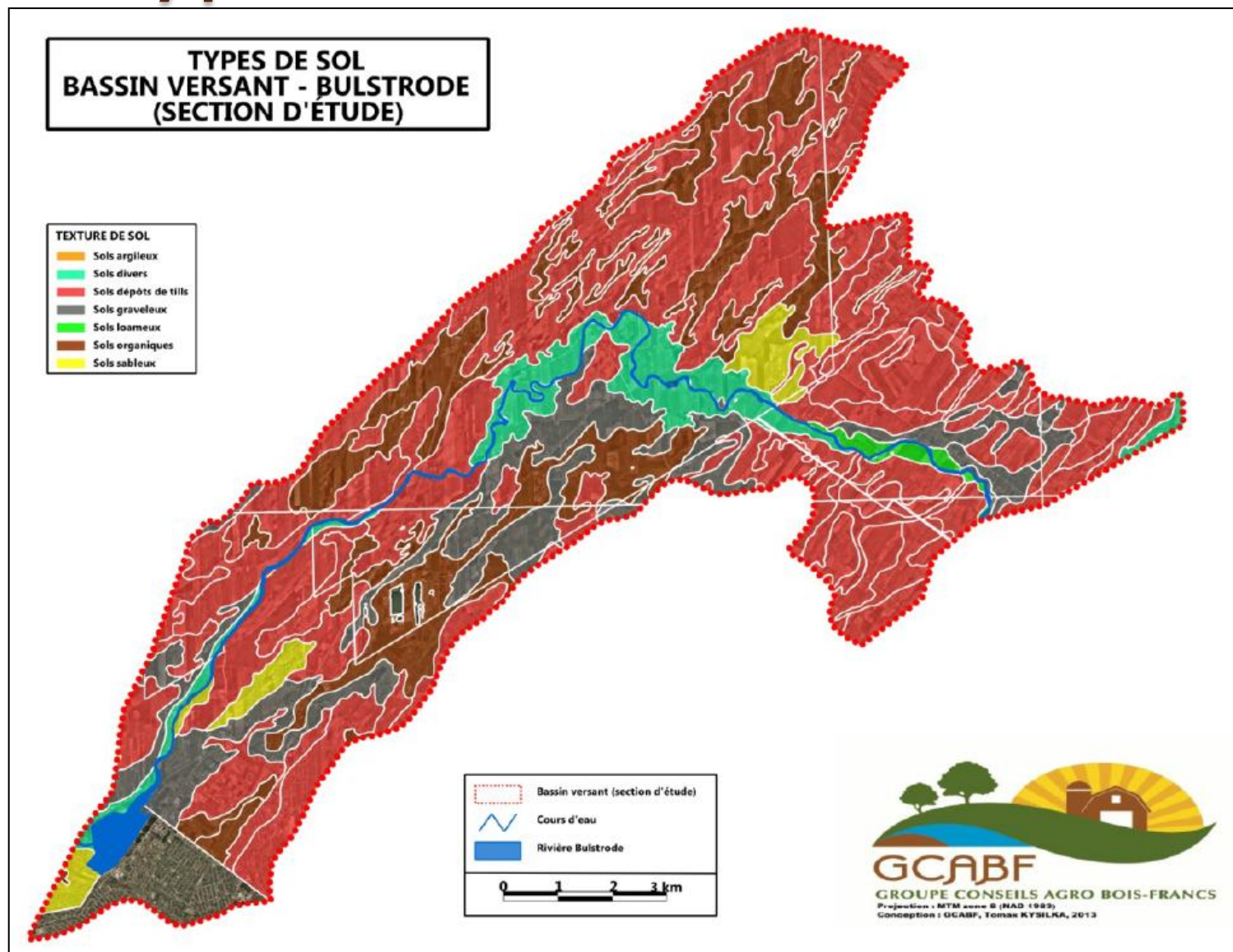
Downstream

- St Lawrence Lowlands
- Clay deposits (Champlain sea)
- Limestone and slates

Upstream

- Appalachian piedmont
- Altitude of 400-550 m
- Shales, slates, sandstones, conglomerates and dolomite rocks

Soil types



Ecozone

- Mixedwood Plains Ecozone
- Ecoregion: St Lawrence Lowlands
- Temperate deciduous forest
- Sugar maple, yellow birch, eastern white pine
- Abundant precipitations

Ecology

- Fish released in the river since 1964
- 449 wetlands in Reservoir watershed: 8.6 km² area (2.6%)
- Canada and snow geese stop by the reservoir



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- Nature Conservancy, <http://www.natureconservancy.ca/en/what-we-do/conservation-explorer/st-lawrence-lowland/>
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Centre d'expertise hydrique, <https://www.cehq.gouv.qc.ca/barrages/ListeBarrages.asp?region=Centre-du-Québec&Num=17&Tri=No&contenance1=on&contenance2=on&contenance3=on>, Quebec Government

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Énergie et Ressources naturelles Québec, http://www.mern.gouv.qc.ca/scripts/isapi_srun.dll/territoire/portrait/portrait-quebec.jsp

Panoramio, <http://www.panoramio.com/photo/102750189>



Sediment fingerprinting in Bulstrode River watershed

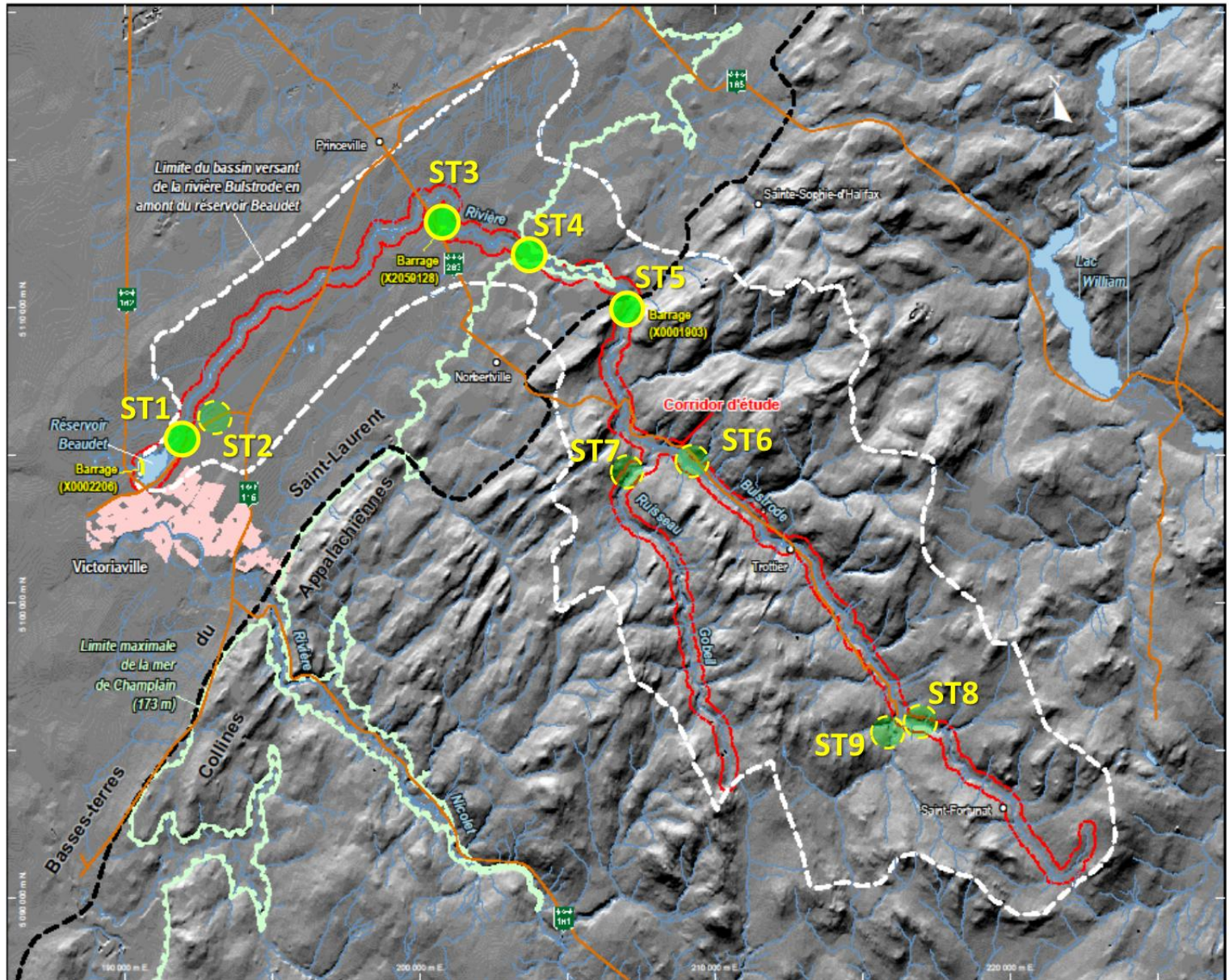
Sediment fingerprinting study overview

Christina Lachance
Water management student trainee
AAFC - Soils and Crops Research and Development Centre

2013

- Work done by Catherine Domingue, former student trainee
- Litterature review
 - ✓ Fingerprinting studies
 - ✓ Color techniques
 - ✓ Geochemical techniques
 - ✓ Isotopes techniques
 - ✓ Summary done for the team
- Investigation for sediment traps sites
- 1st suspended sediment sampling campaign – Fall 2013 (August 26th to October 30th)

SST site choices



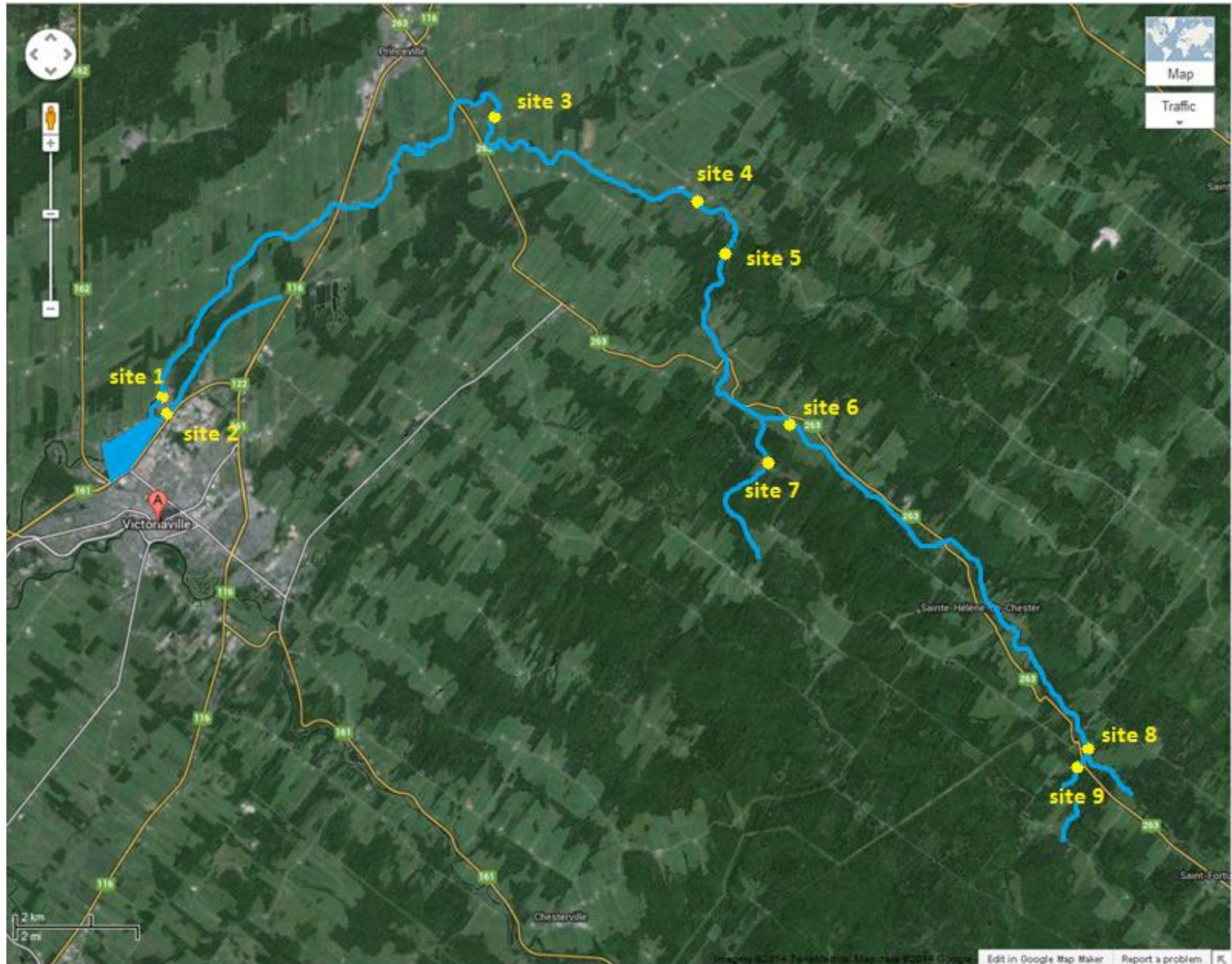
SST site choices

- 4 primary sites (ST1, ST3, ST4 & ST5)
 - ✓ Lowland region
 - ✓ Where agriculture is most intensive
 - ✓ At the location of dams and physiographic boundaries
 - ✓ To determine the relative contributions from land surface and the river channel

SST site choices

- 5 secondary sites
 - ✓ ST2 in the lowland region: L'Abbé subwatershed
 - ✓ ST6 & ST8: upland region of the Bulstrode river
 - ✓ ST7 & ST9: on tributaries
- Final choice: all 9 sites for more detailed study

Final choice for SST sites



SST Sites

Site 1



Site 3



Site 2

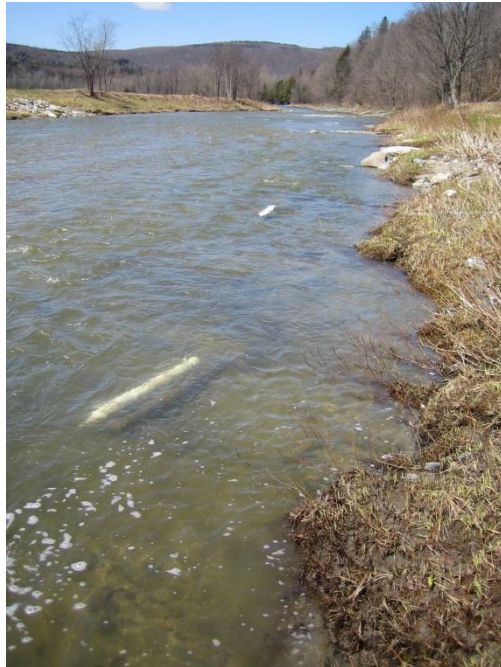
Site 4



Site 5

SST Sites

Site 6



Site 7



Site 8



Site 9

SST set up

- H beam to hold traps with anchors
- Quick links to hold traps to H beam
- Steel chains to attach H beam to trees



SST set up



- Traps always installed in pairs
- Some traps installed on the same H beam
- Others are on separate H Beam
- Weekly maintenance

SST set up

	For 9 sites (18 traps)
H beams	822\$
Ring anchors	75\$
Steel Chain	758\$
Quick links	92\$
Sediment traps	9225\$
Total	10 972 \$

Bedload samples – Fall 2013

- Taken at SST removal
- Sites 1, 2, 3, 7 & 9
- Other sites not sampled because of coarse bedload material
- Used a soil scoop
- 1 bedload site sampled

Analysis

Fall samples:

- Cs analysis done on all samples with gamma spectrometry
- Colour analysis done on bedload samples (raw data) with diffuse reflectance spectrometry

To do:

- Particle size and shape
- Geochemical analysis
- Colour analysis on SST samples

Preliminary results – Fall 2013 samples

Sample ID	Counter	Cs -137 Activity (Bq/kg)	Error 1SD
Site1 SST1	CAT	6,37	0,43
Site1 SST2	CAT	4,19	0,97
Site2 SST1	CAT	0,00	
Site2 SST2	CAT	0,00	
Site3 SST1	CAT	2,71	0,39
Site3 SST2	CAT	3,03	0,37
Site4 SST1 1/2	GEM2	5,11	0,54
Site4 SST1 2/2	GEM2	2,49	0,65
Site4 SST2 1/2	GEM2	5,75	0,68
Site4 SST2 2/2	GEM2	3,04	0,53
Site6 SST1 1/2	GEM2	5,30	0,71
Site6 SST1 2/2	GEM2	3,06	0,47
Site6 SST2	GEM2	3,90	0,57

Sample ID	Counter	Cs -137 Activity (Bq/kg)	Error 1SD
Site7 SST1	CAT	8,14	0,99
Site7 SST2	CAT	10,23	0,84
Site8 SST1 1/2	GEM2	2,63	0,37
Site8 SST1 2/2	GEM2	1,92	0,45
Site8 SST2	GEM2	2,52	0,40
Site9 SST1 1/2	CAT	4,87	0,37
Site9 SST1 2/2	CAT	1,94	0,18
Site9 SST2	CAT	5,60	0,47
Site1 BL1	GEM2	0,90	0,31
Site2 BL1	CAT	0,78	0,18
Site3 BL1	CAT	0,00	
Site7 BL1	CAT	0,00	
Site9 BL1	CAT	0,00	

Other data collected

- Rainfall and flowrate data
- Total P, total N and TSS analysed weekly at outlet
- City analyses water quality at their pumping station

Spring-summer 2014

- 2nd suspended sediment sampling campaign
 - ✓ At the same 9 sites
 - ✓ April 9th to June 9th
- Bedload sampling at SST removal
 - ✓ At all 9 sites
 - ✓ 5 sub samples / sample
 - ✓ Upstream from traps location
- Literature review for source sampling
- Draft of source sampling procedure

What's next

- Source sampling in July-August
- 3rd suspended sediment sampling campaign – Fall 2014
- Sample analysis
- Identification of reference sites

- Official beginning of master project – January 2015

List of issues

- Transect planning and sampling
- Bank sampling
- Standard procedures for source sampling