Complexe de *la Romaine*

ASPHALT CORE DAM
Hydro-Québec Experience

by
Jean-Pierre Tournier

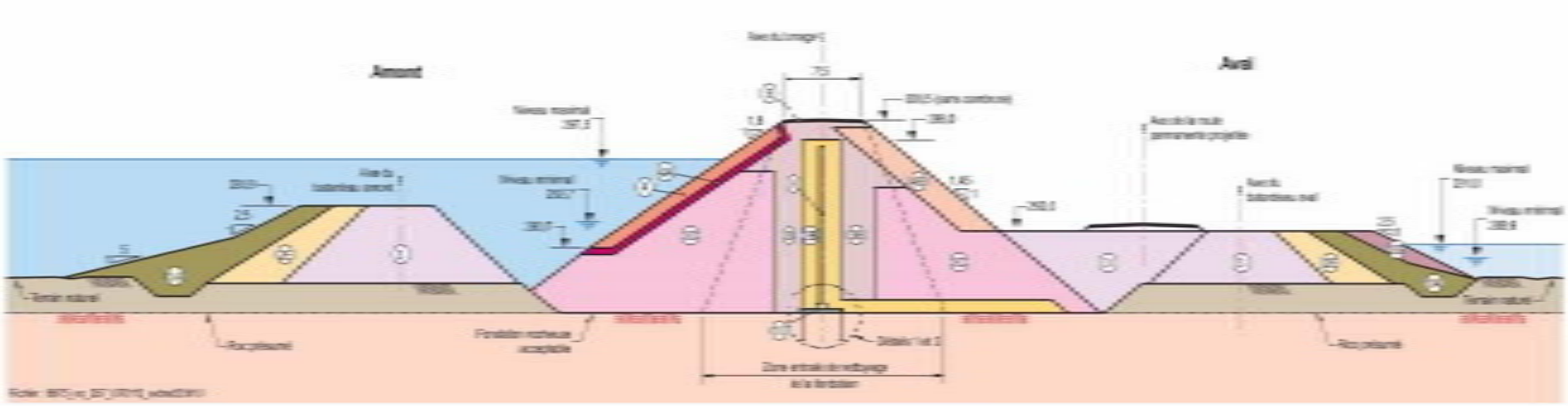
Symposium du Comité Français des Barrages et Réservoirs
Marseille – 31 janvier 2019

Asphalt Core Dam – Hydro-Québec Experience

- **Hydro-Québec has built the first ACRD in North America, in 2008, on the Rupert diversion project in the James Bay area. The intention was to have a better understanding of that technology to apply it on the La Romaine Complex (north shore of the Saint-Lawrence River).**

- **The Nemiscau-1 dam has a height of 16,2 m with a length of 336 m at his crest. The maximum hydraulic head is 7,6 m due to a pond at his downstream toe. The construction started in June, 2008 and was completed by October, 2008.**

Nemiscau 1 Dam – Typical cross section



<u>For the asphalt core</u>:
Thickness : 40 cm
Thickness of the layer after compaction : 22,5 cm
Maximum 3 layers per day

Nemiscau 1 Dam – Trial and test sections

Asphalt Core Dam – Hydro-Québec Experience

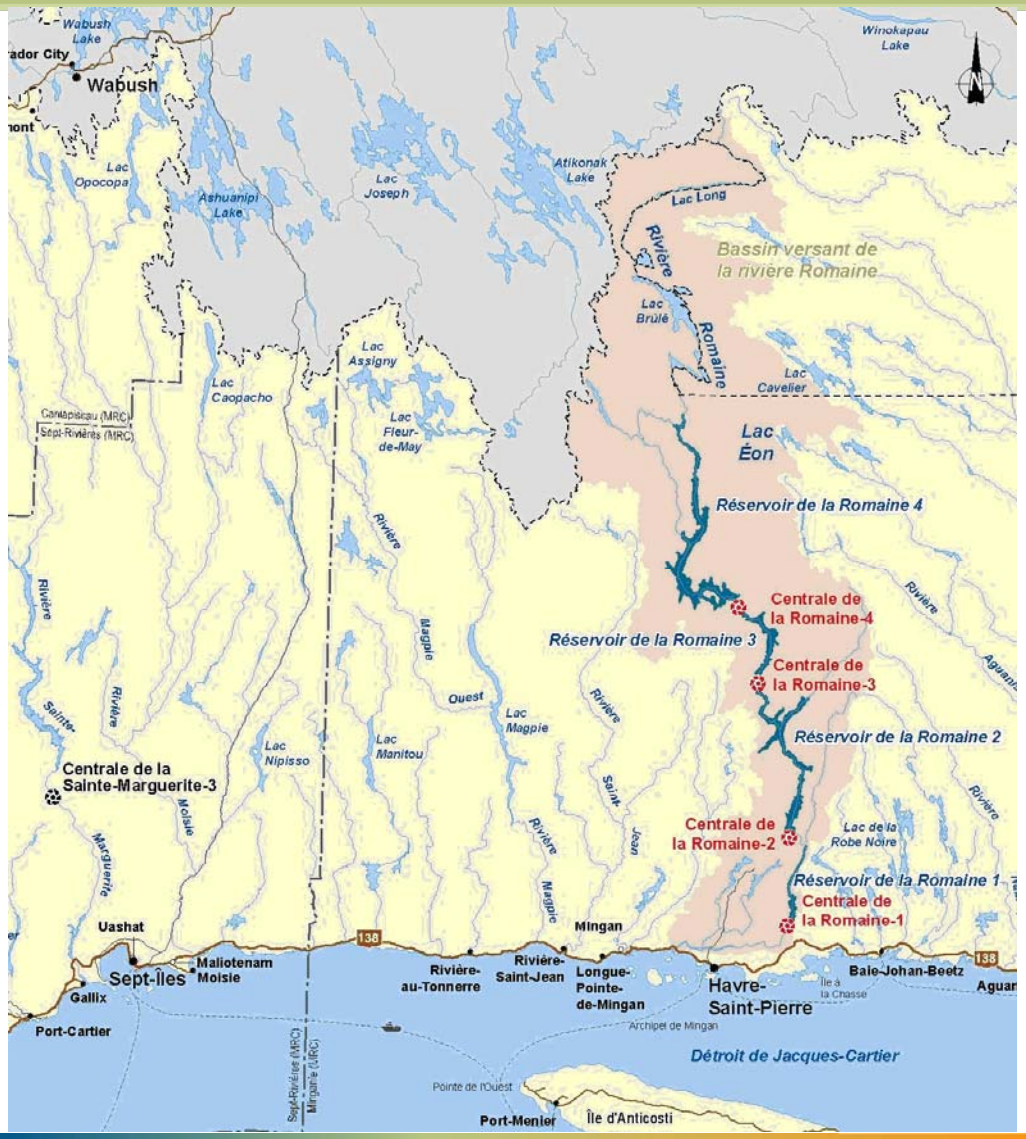
- **Good experience at Nemiscau dam; the contract allowed us to make trial tests and an in depth understanding of that technology.**

- **After that very good appropriation of the asphalt core technology, Hydro-Québec decided to go ahead with seven (7) asphalt core structures on La Romaine Complex.**

Asphalt Core Dam – Hydro-Québec Experience

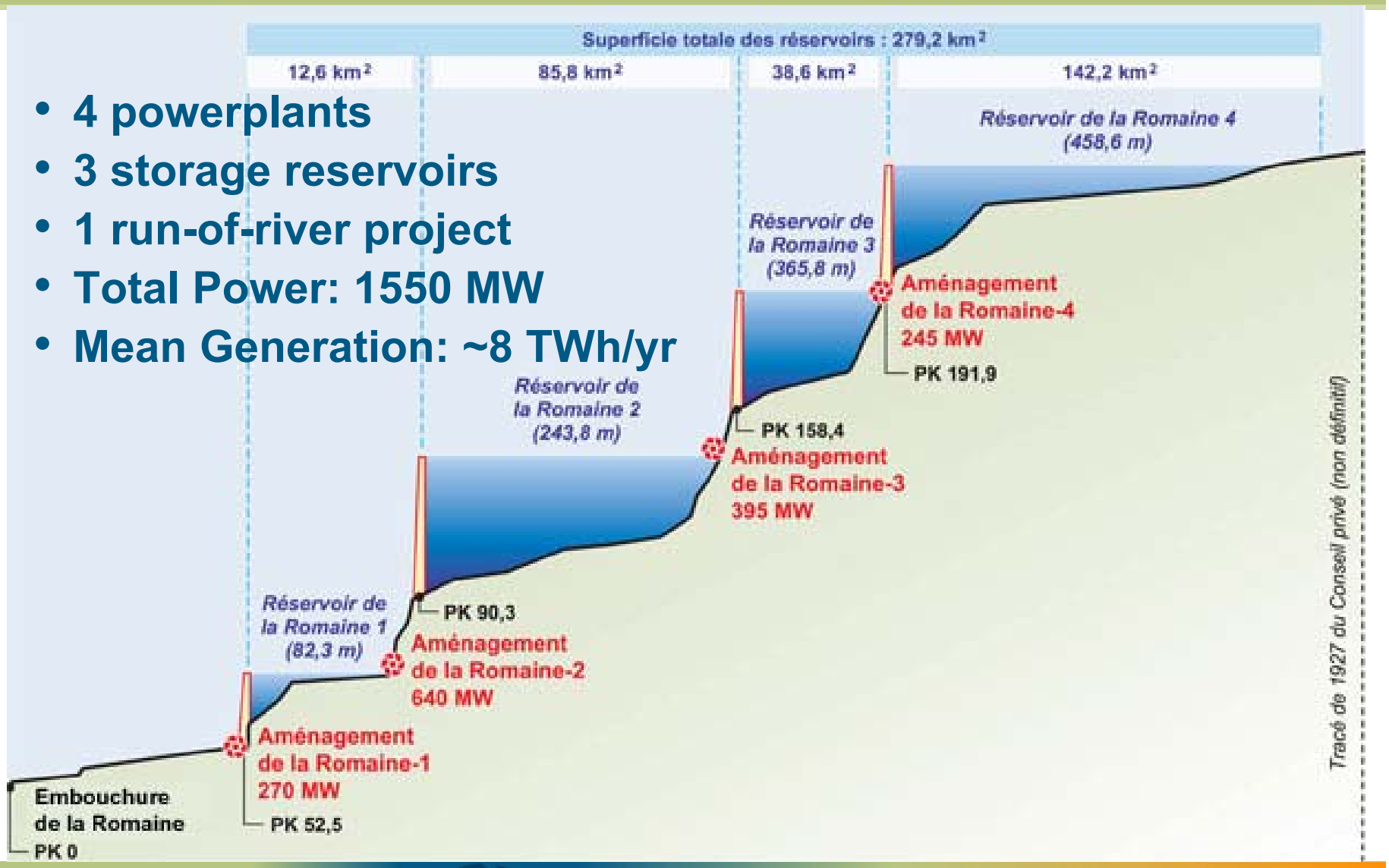
Basin Area of La Romaine River

- **Havre St-Pierre (HSP): 14 470 km²**
- **RO-1: 12 970 km²**
- **RO-2: 12 200 km²**
- **RO-3: 10180 km²**
- **RO-4: 8550 km²**



Complexe de la Romaine Overview

- 4 powerplants
- 3 storage reservoirs
- 1 run-of-river project
- Total Power: 1550 MW
- Mean Generation: ~8 TWh/yr

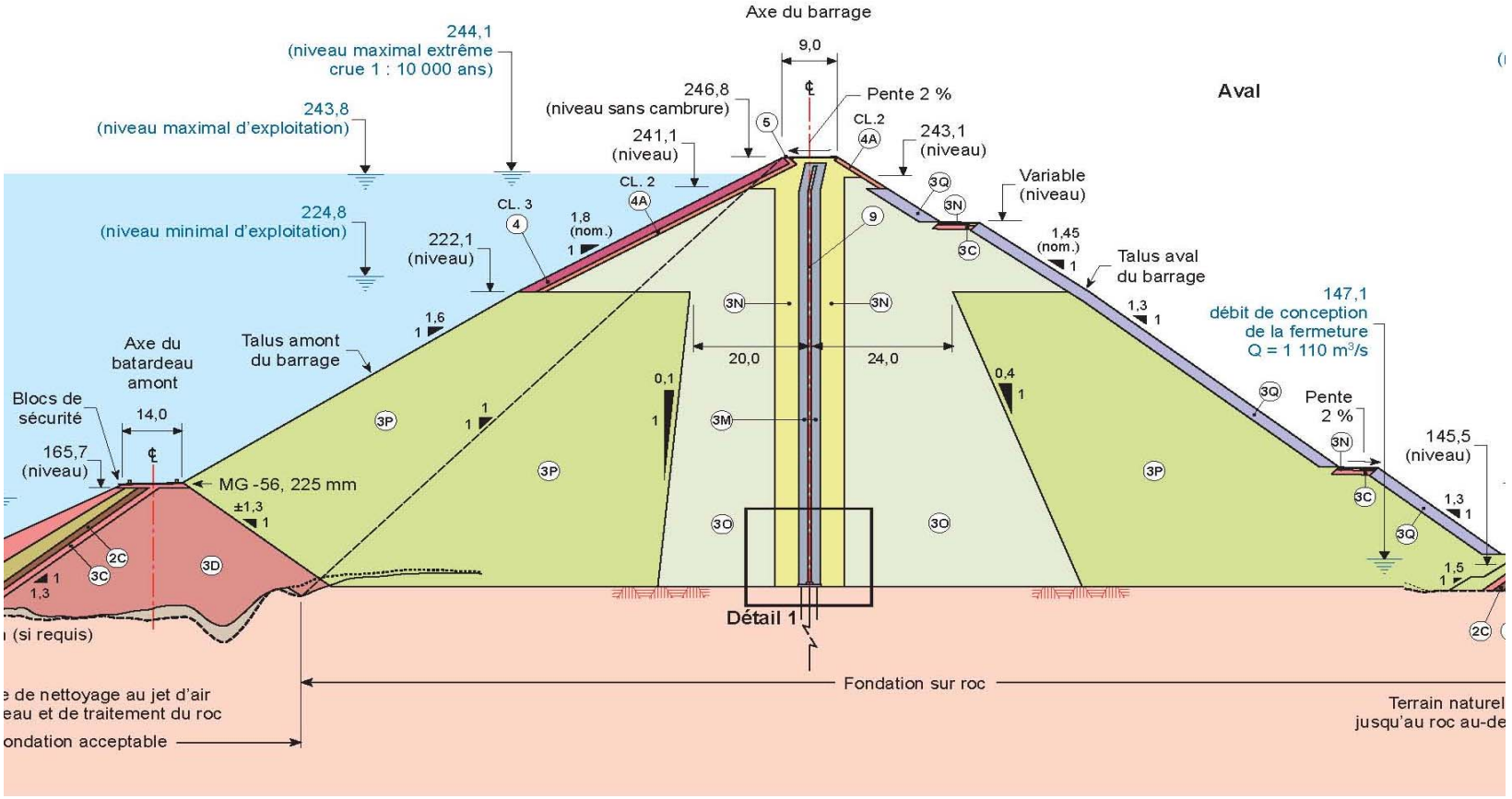


Asphalt Core Dam – Hydro-Québec Experience

Retaining structures of La Romaine 2 facility

Structure	Type	Height (m)	Crest lenght (m)	Asphaltic core volume (m^3)	Fill volume (m^3)
Dyke A 2	**ACRD**	**31**	**144**	**1 040**	**88 300**
Dyke B 2	**ACRD**	**28**	**115**	**790**	**73 400**
Dyke D 2	**ACRD**	**48**	**728**	**6 330**	**666 000**
Dyke E 2	**ACRD**	**39**	**407**	**2 470**	**218 000**
Dyke F 2	**ACRD**	**84**	**423**	**10 700**	**1 947 000**
Main Dam	**ACRD**	**131**	**496**	**18 850**	**4 546 000**
TOTAL				**40 180**	**7 538 700**

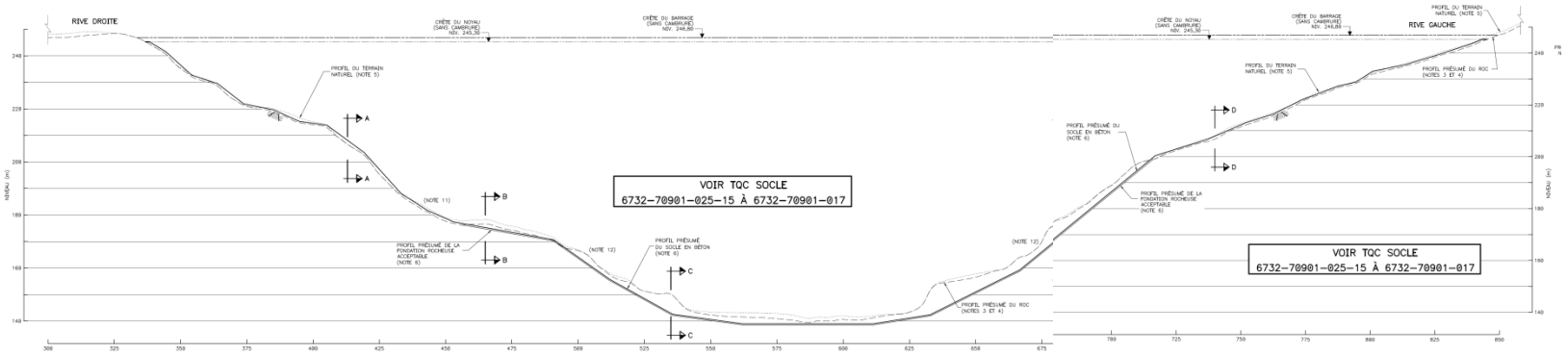
Asphalt Core Dam – Hydro-Québec Experience

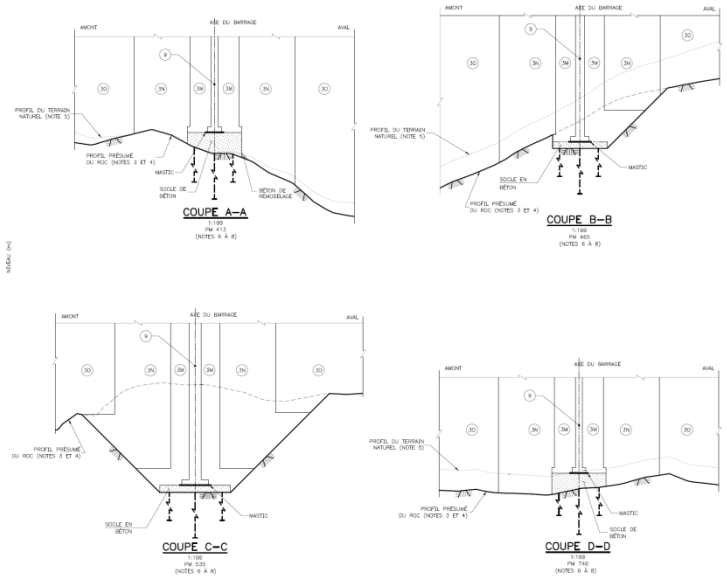


Typical ACRD cross section (Main Dam)

Romaine 2 – Main dam (July 2012)

Asphalt Core Dam – Hydro-Québec Experience



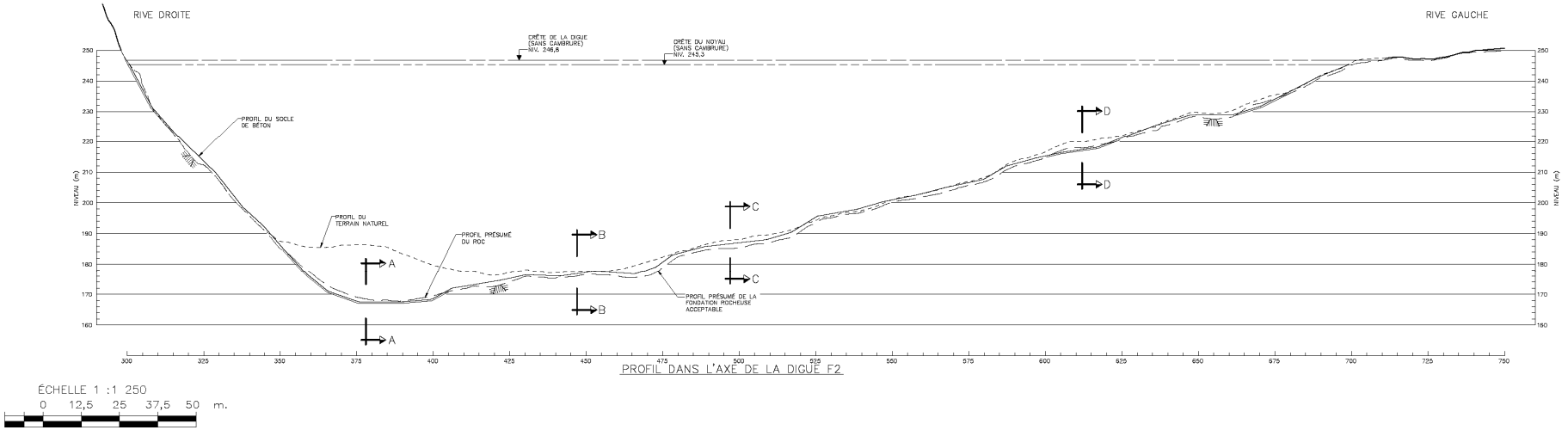


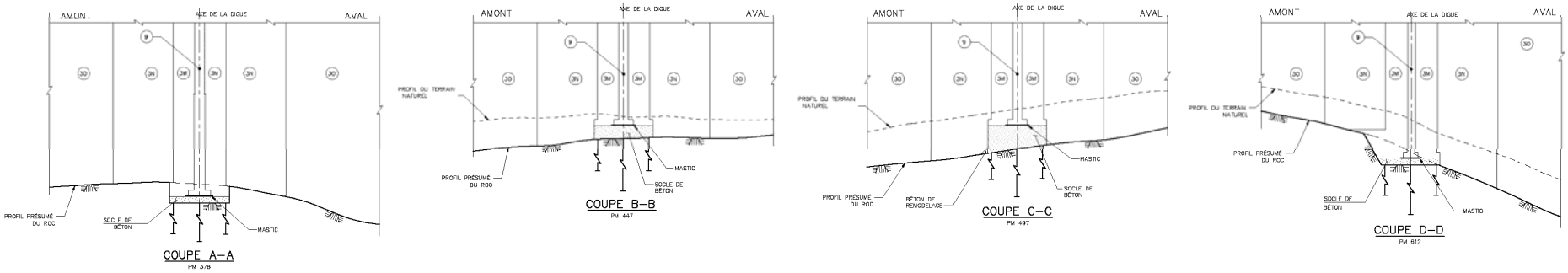
Longitudinal section and concrete sill details (Main Dam)

Romaine 2 – Main dam (November 2014)

Romaine 2 – Dike F2 (May 2013)

Dike F2 - Longitudinal section and sill details





Romaine 2 - Dike F2 (November 2014)

Thickness of the asphalt core

- **Main Dam: from 80 cm to 50 cm**
- **Dike F2: from 70 cm to 50 cm**
- **Dikes A2, B2, D2 and E2: 50 cm**

Layers of the asphalt core

- **Thickness after compaction: 22,5 cm**
- **Maximum of 3 layers per day**

Construction period for the asphalt core

- **11 months (2013 and 2014) with 2 general contractors and 4 core paving machines**

- **Impoundment started on May 10th, 2014 and the maximum level of the reservoir was reached November 7th, 2014.**

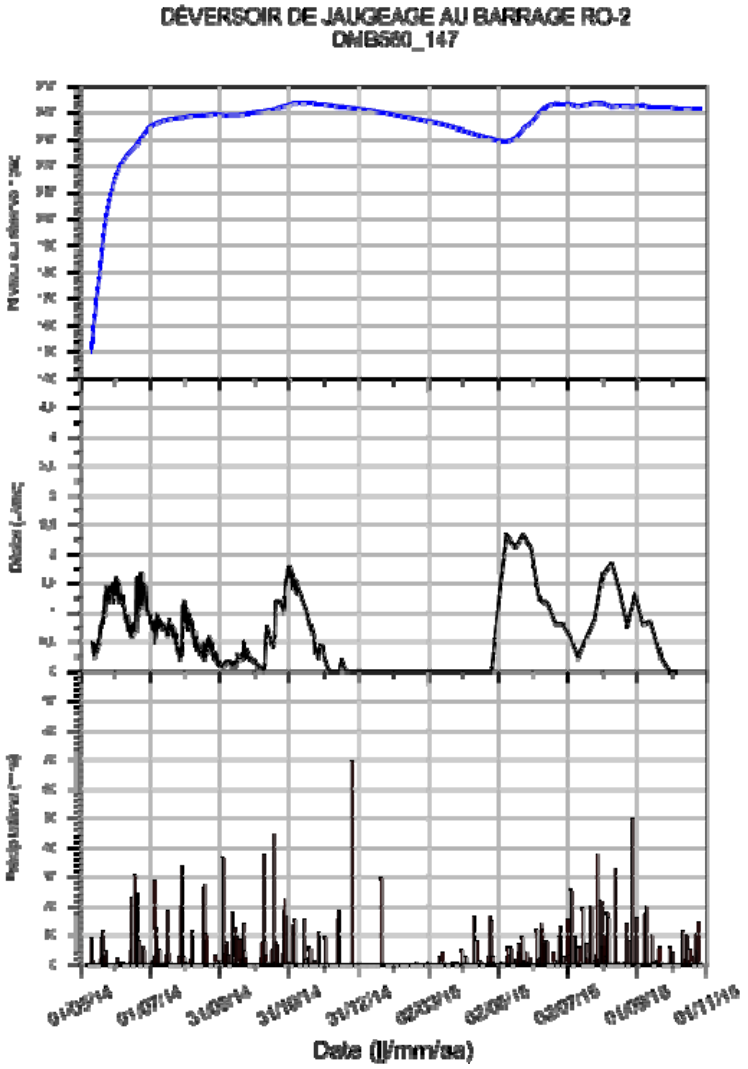
- **One year after impoundment (November 2015):**
  - **The seepage through all the structures is very low and varies from 0 l/s to 2 l/s.**
  - **For the dam the maximum settlement reached at the crest is 220 mm upstream and 40 mm downstream.**

Seepage at RO-2 Dam

Reservoir water level (m)

Seepage flow measured at weir (L/sec)

Rainfall (mm)

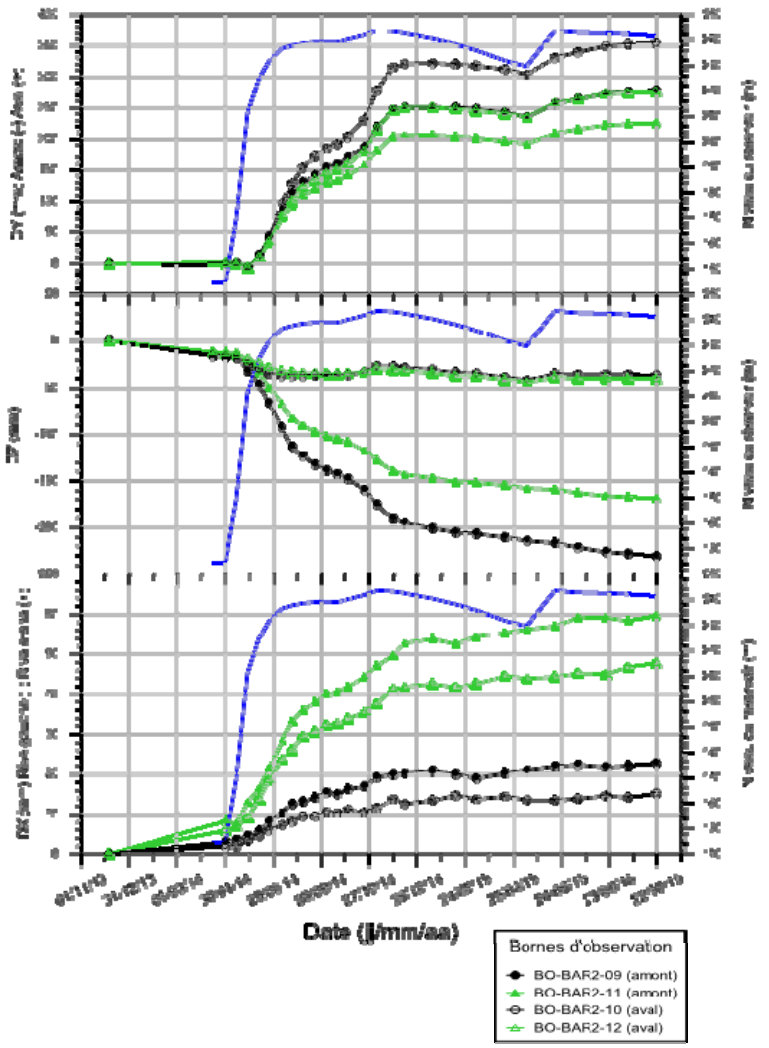


Displacements at RO-2 Dam Crest

Upstream/Downstream (mm)

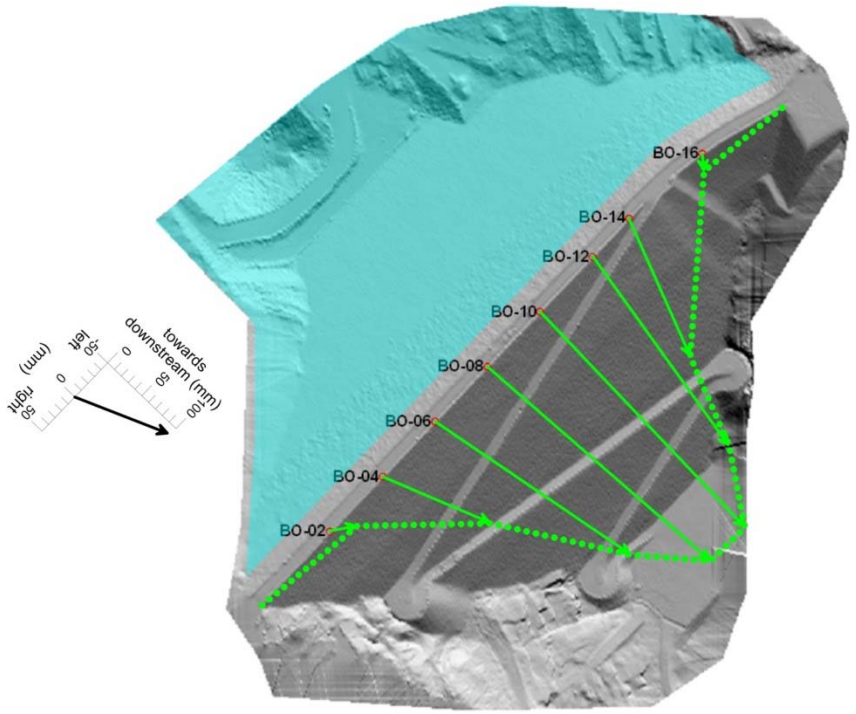
Settlements (mm)

Longitudinal (mm)

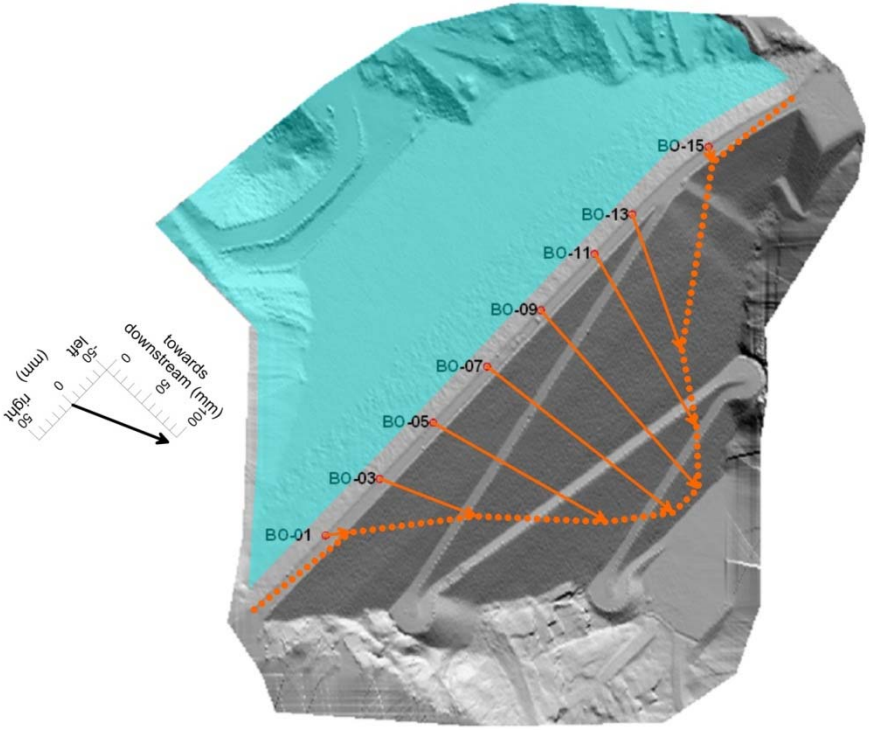


Horizontal displacements during impoundment (topographic monuments at the crest of the dam)

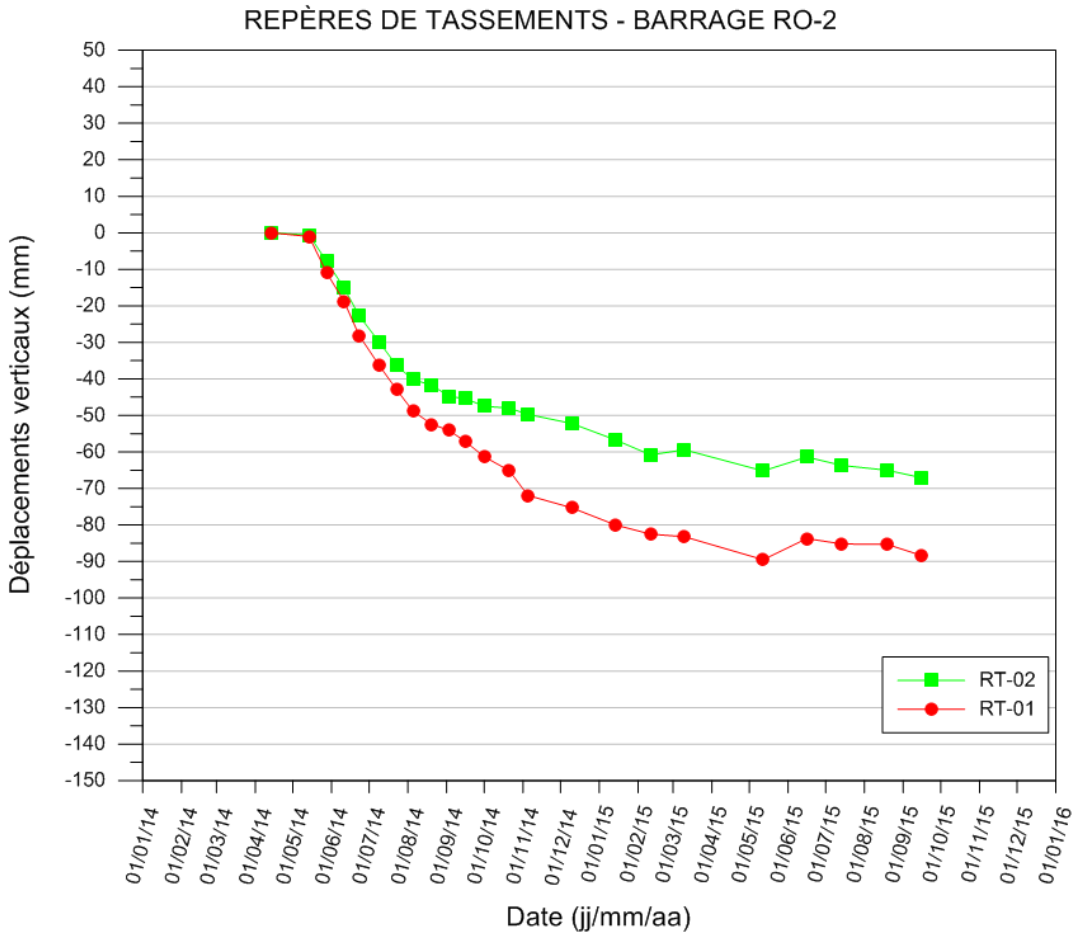
Downstream (320 mm max)



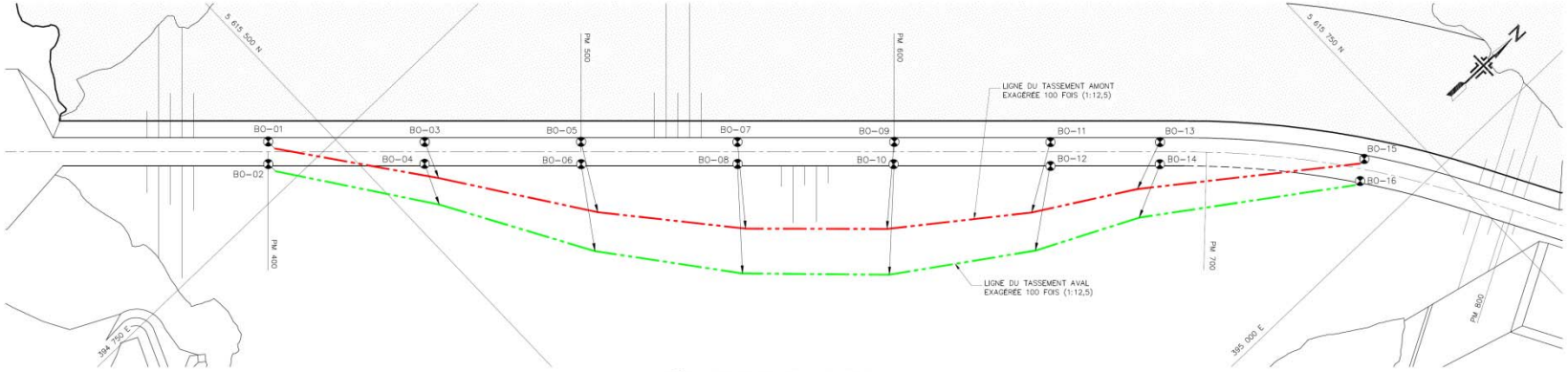
Upstream (250 mm max)



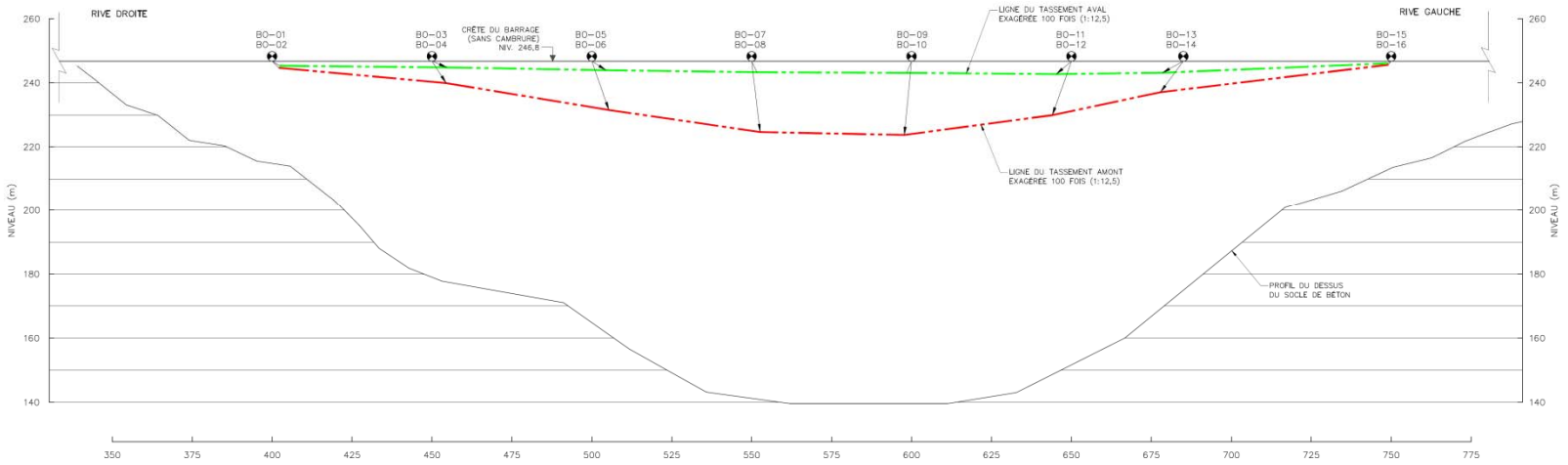
Settlements at RO-2 Dam Core Crest



Horizontal and vertical displacements at RO-2 Dam



DÉPLACEMENTS TRANSVERSAUX
VUE EN PLAN
ÉCHELLE : 1:1250



DÉPLACEMENTS VERTICAUX
PROFIL EN LONG
ÉCHELLE : 1:1250

Romaine 2 – Intake, Dikes D2, E2 and F2 (November 2014)

Survey monument (November 2015)

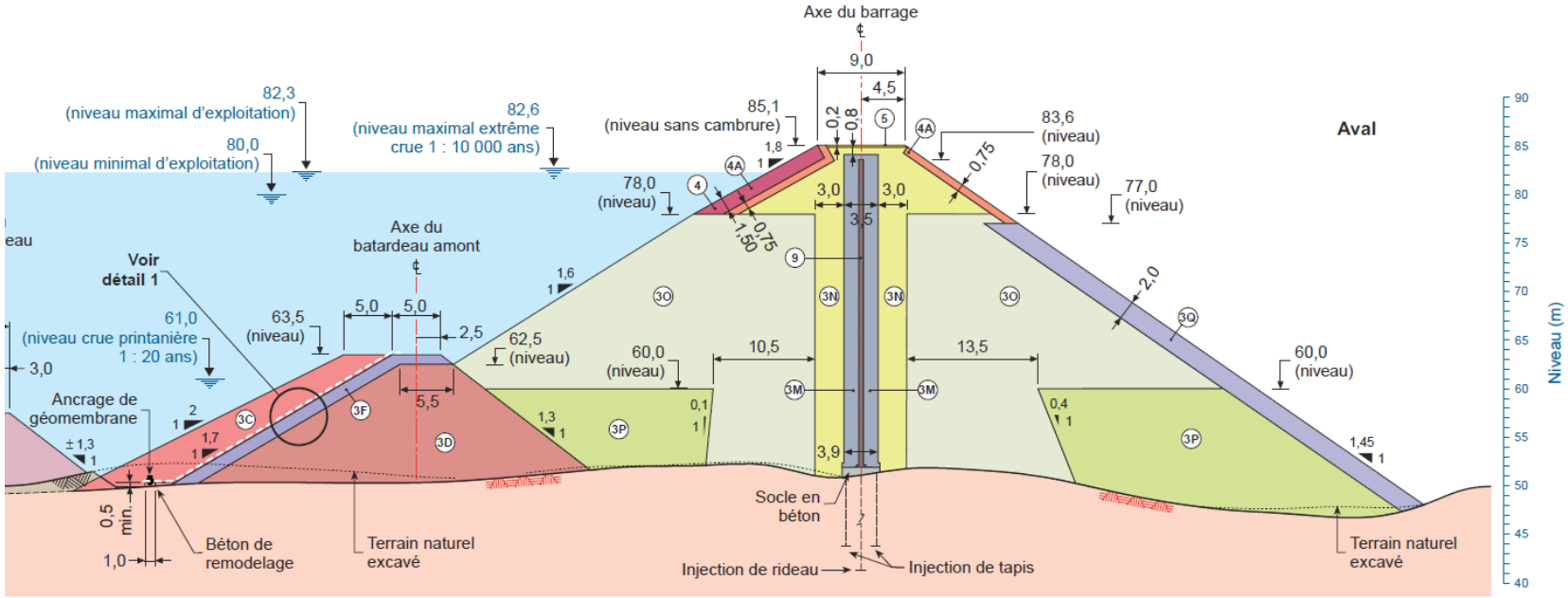
	Survey monument (SM) - Crest				Buried SM in core
	ΔY max (mm) (Upstream/Downstream)		ΔZ max (mm) Settlements		ΔZ max (mm) settlements
	Upstream side	Downstream side	Upstream side	Downstream side	
Dam	250	320	-220	-40	-90
Dyke A2	2	2	-1	-1	--
Dyke B2	1	2	-0,5	-1	--
Dyke D2	9	8	-1	-0,5	--
Dyke E2	4	3	-2	-1	--
Dyke F2	40	40	-36	-6	-13

Asphalt Core Dam – Hydro-Québec Experience

Retaining ACRD structure of La Romaine 1 facility

Structure	Type	Height (m)	Crest lenght (m)	Asphaltic core volume (m^3)	Fill volume (m^3)
Main Dam	**ACRD**	**41**	**850**	**5 600**	**608 000**

Typical cross section of the dam



Thickness of the asphalt core : 50 cm

Layers of the asphalt core

- **Thickness after compaction: 22,5 cm**
- **Maximum of 3 layers per day**

Construction period for the asphalt core

- **6 months (2014) with 1 general contractors and 2 core paving machines**

Romaine 1 Dam (October and November 2014)

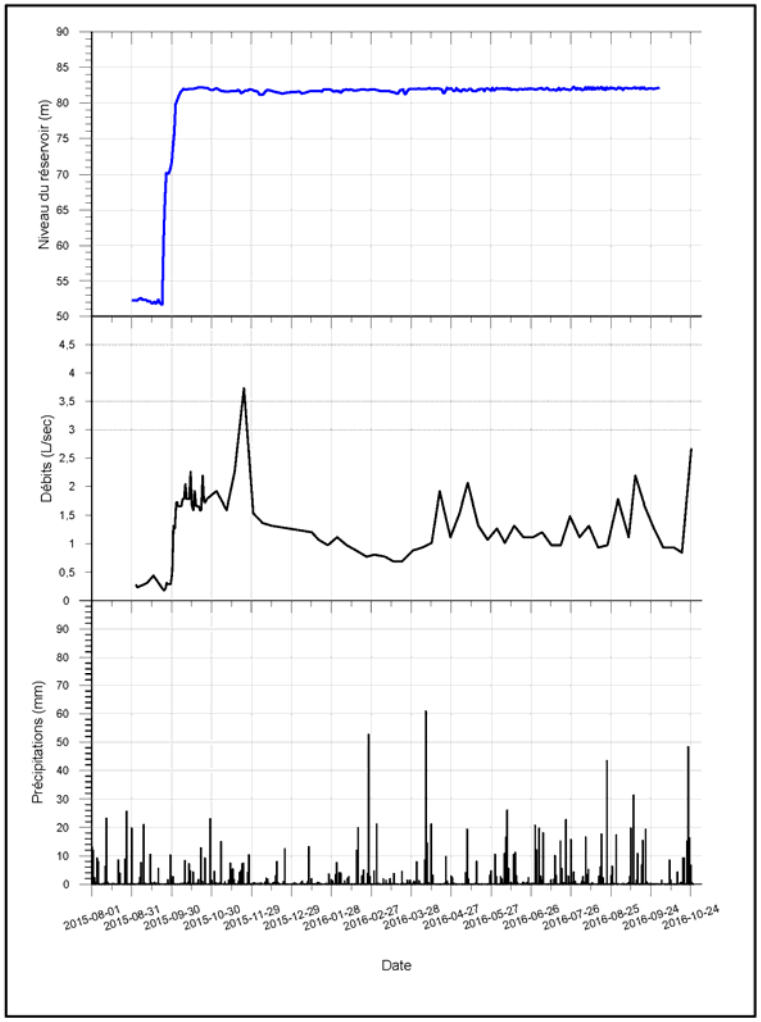
- **Beginning of Reservoir Impoundment : September 22, 2015;**
- **Full Supply Level was reached on October 20, 2015;**
- **Reservoir First Filling Lasted 28 Days.**
- **Instrumentation data indicates very small displacements (maximum of 5 mm settlement) and negligible seepage flow during winter conditions.**

Seepage at RO-1 Dam

Reservoir water level (m)

Seepage flow measured at weir (L/sec)

Rainfall (mm)

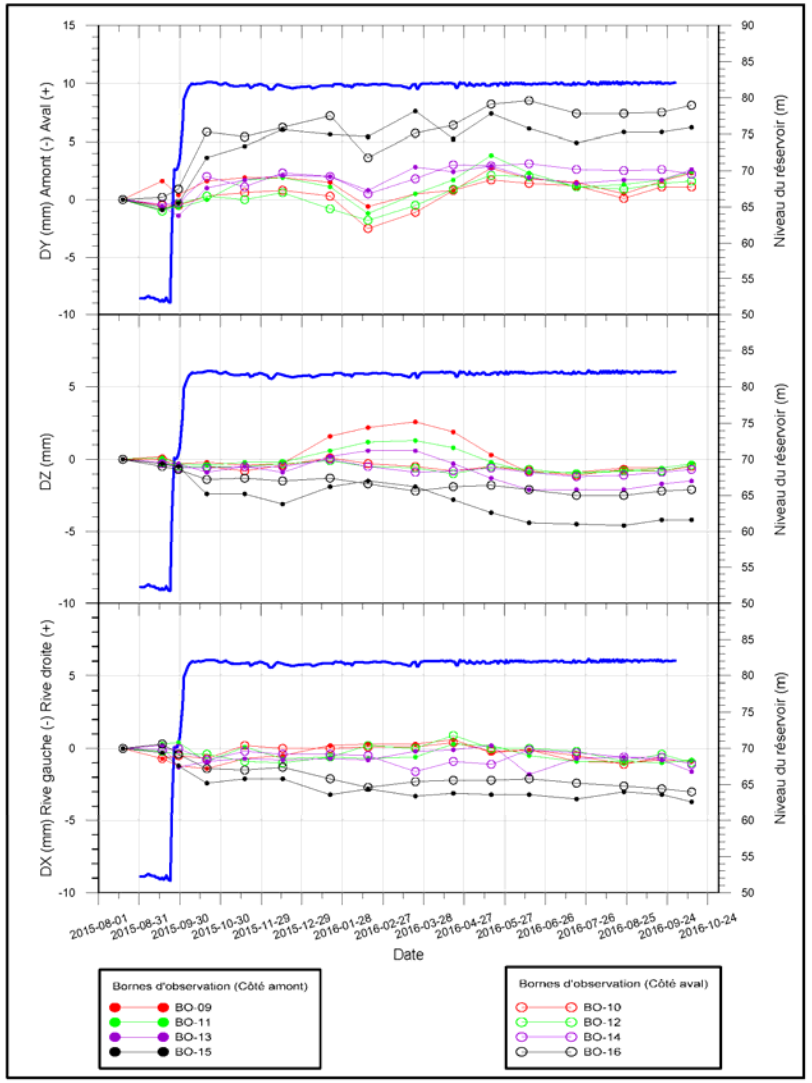


Displacements at RO-1 Dam

Upstream/Downstream (mm)

Settlements (mm)

Longitudinal (mm)



Complexe de *la Romaine*

Thank you

Hydro Québec Équipement