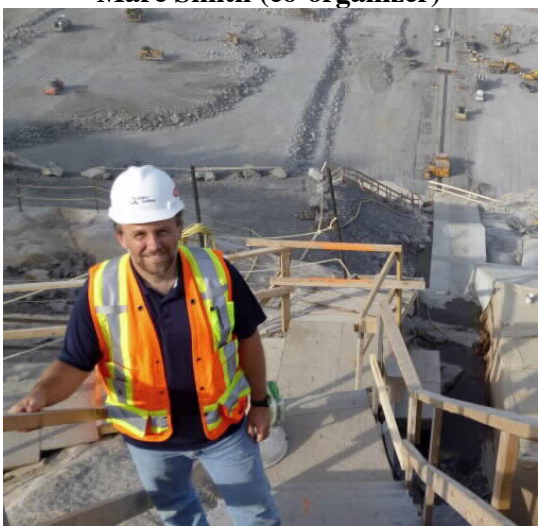
Marc Smith (co-organizer)



Marc Smith, P.E., Ph.D., is a geotechnical engineer with Hydro Québec. He has more than 34 years of experience in the design and construction of embankment dams as well as in their monitoring during the impoundment and operation phases. He has carried out many specialized dam safety analyses in Québec, Latin America, Africa and Asia. He is also an Associate Professor at Laval University as well as part-author of ICOLD Bulletin 164.

Contact erosion detection and rehabilitation: a case study

An embankment dam with a central impervious core was constructed in 1971 perpendicular to another embankment dam constructed in 1915 to create an intermediate reservoir for environmental purposes. The older dam is comprised of random rockfill with an upstream clay core. After impoundment of the intermediate reservoir, total seepage at the junction of both dams was increasing steadily. Contact erosion in the random rockfill was suspected to be the main cause of these observations. Identification of the variable flow patterns was deemed necessary to design optimal remediation works to reduce seepage quantities.

A global survey of the seepage area was completed using an electromagnetic method to detect and map main flow patterns. Based on these global findings, optical televiewer surveys from boreholes were used to assess the rockfill stratigraphy in more detail. Active temperature monitoring using fibre optics as well as passive temperature monitoring using thermistors helped detect a zone of preferential seepage and estimate flow velocities.

The random rockfill was grouted shortly after these investigations. The contact erosion phenomena was stopped thus reducing significantly the seepage quantities.

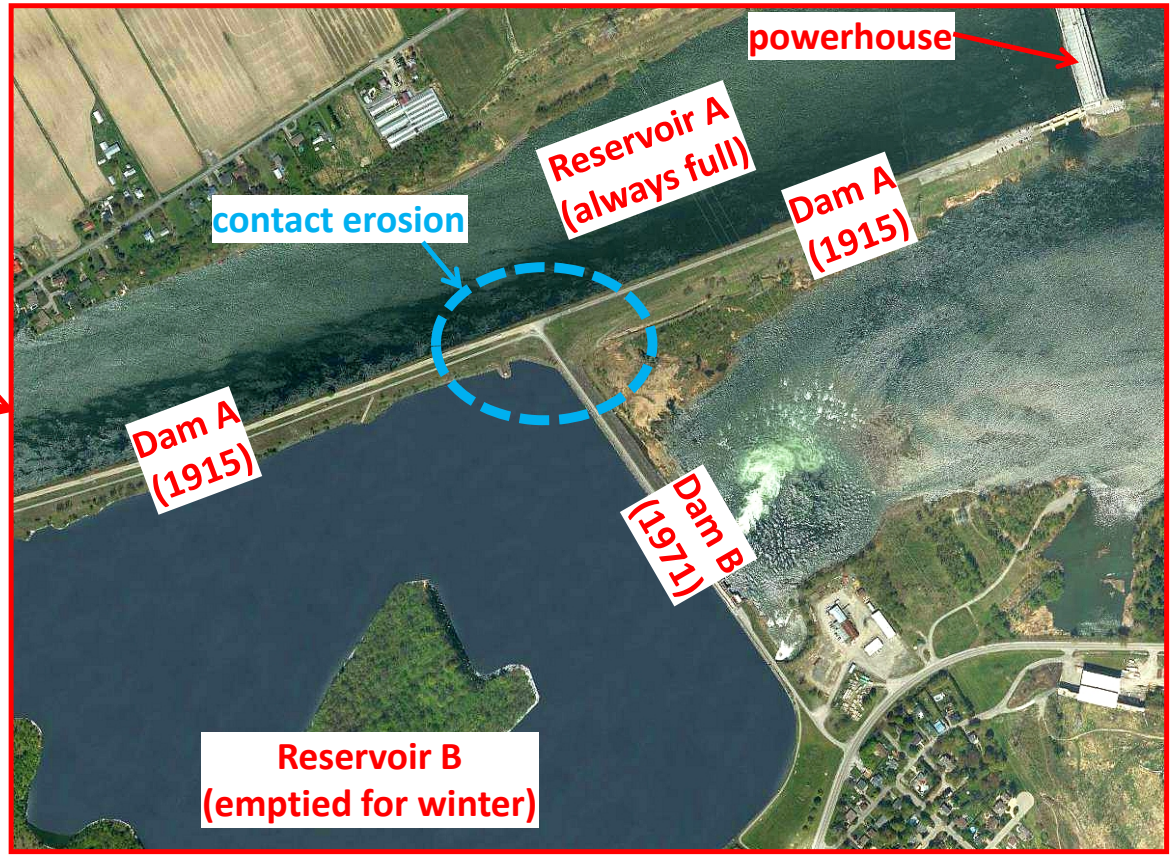
ICOLD BULLETIN 164: INTERNAL EROSION WORKSHOP

Contact erosion detection and rehabilitation : a case study

Marc Smith P.E. Ph.D.

ICOLD Annual Meeting, Ottawa, June 14 2019

Context

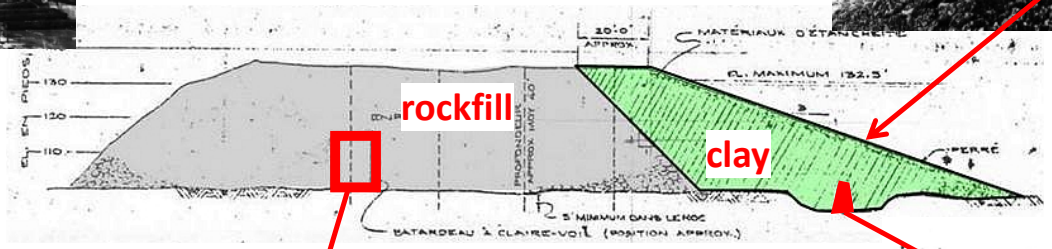


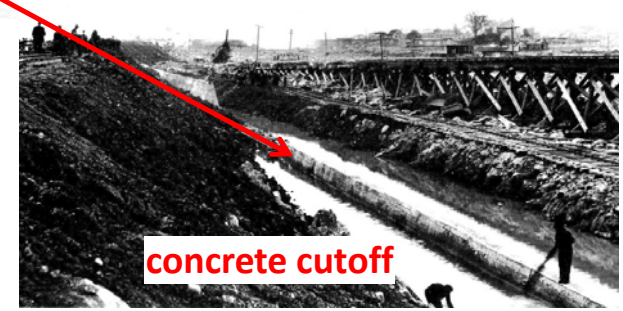
Gradual seepage increase

Seepage detection

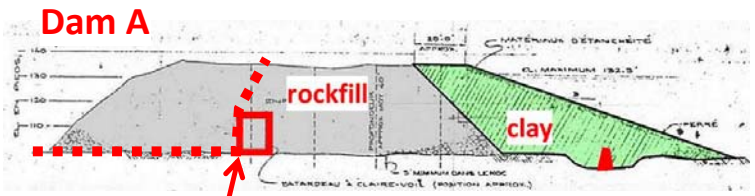
Rehabilitation

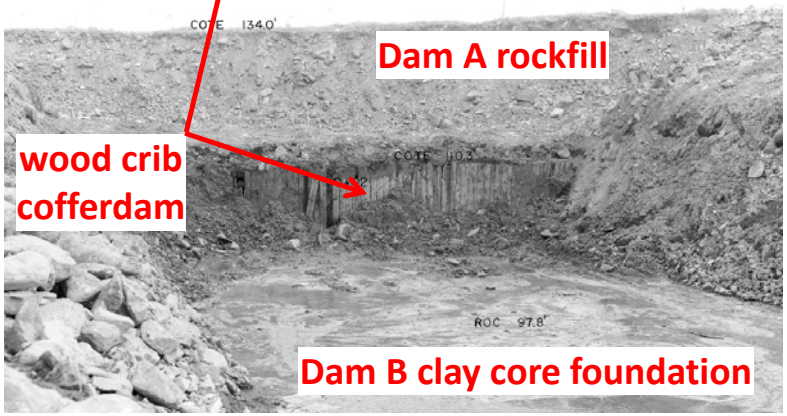
Dam A construction (1915)

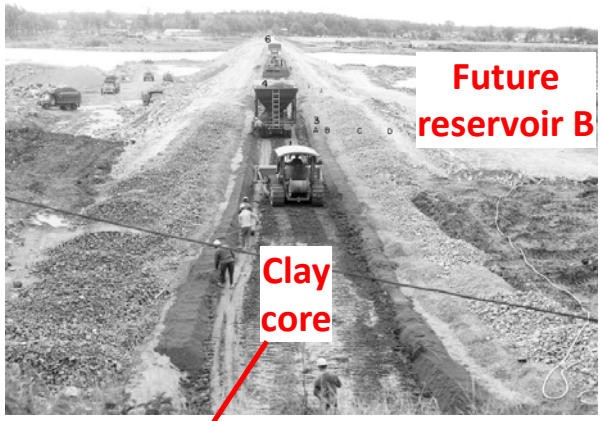


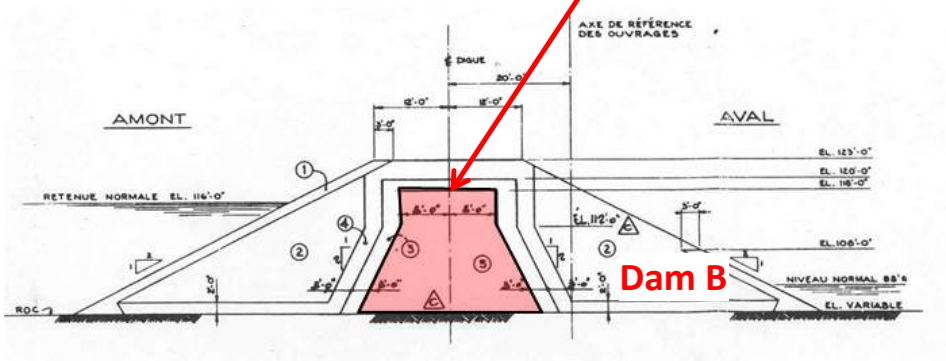


Dam B construction (1971)

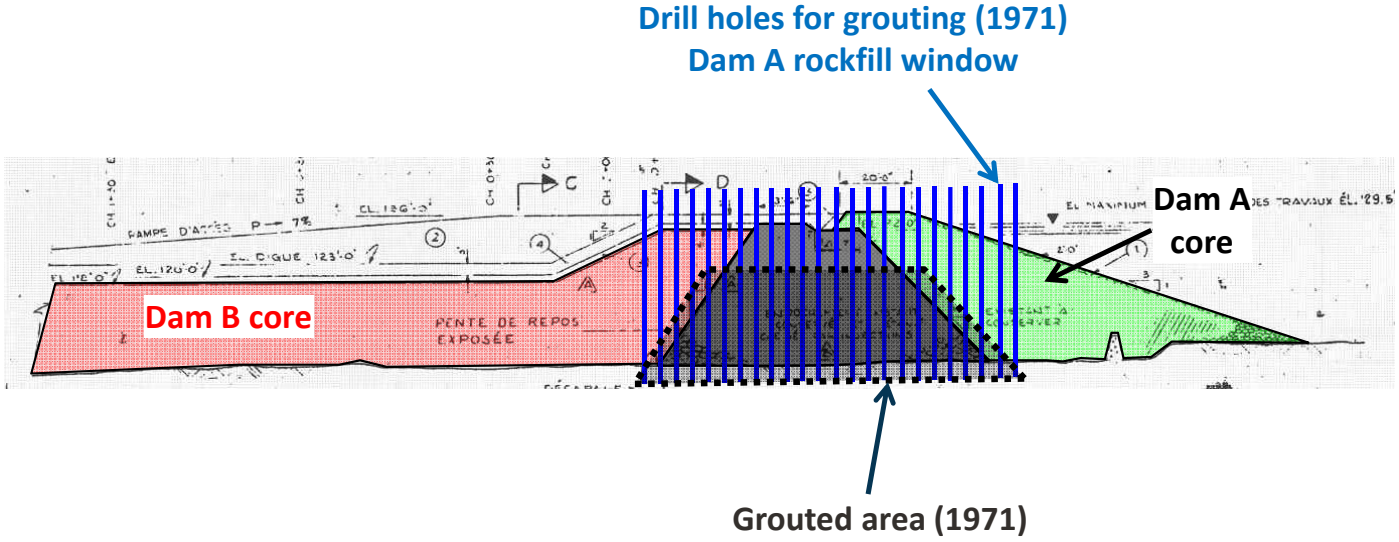




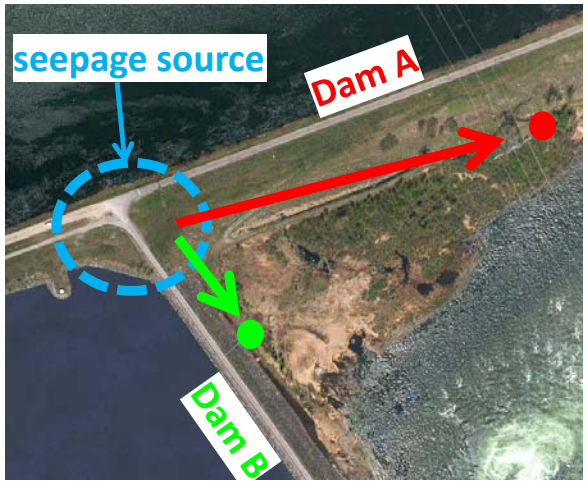


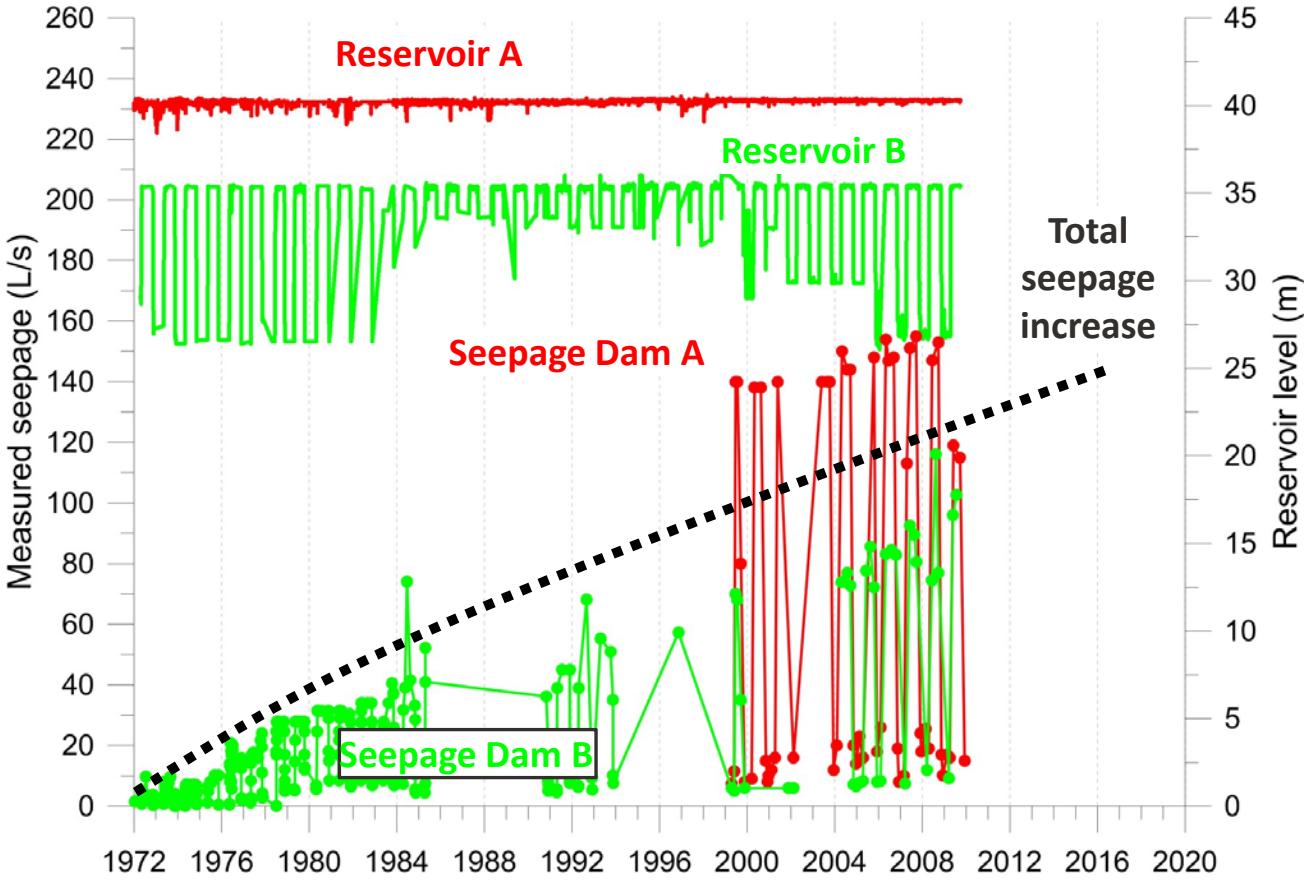


Grouting at the junction of both dams (1971)

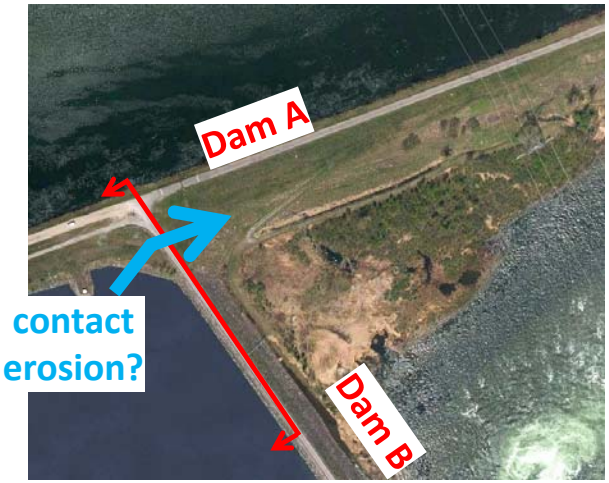


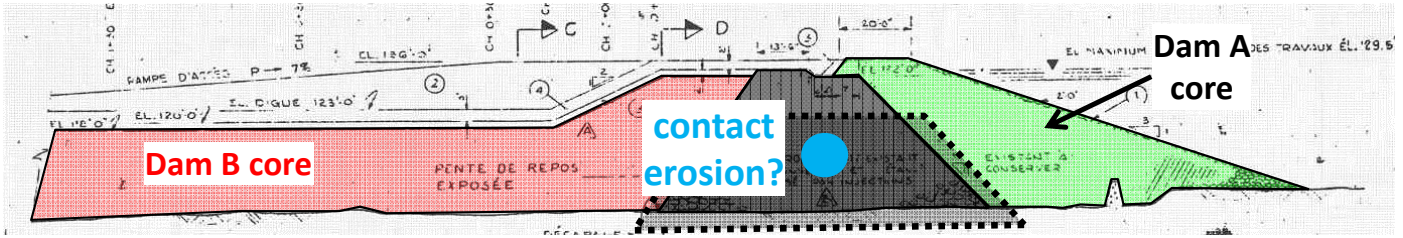
Gradual seepage increase





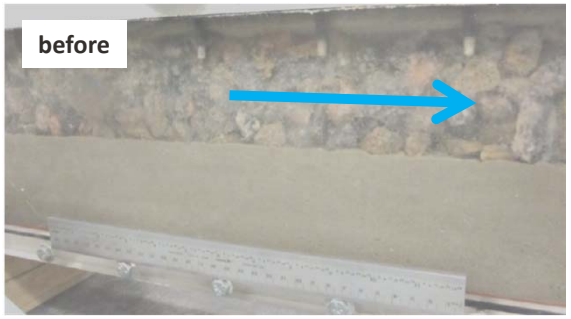
Contact erosion suspected

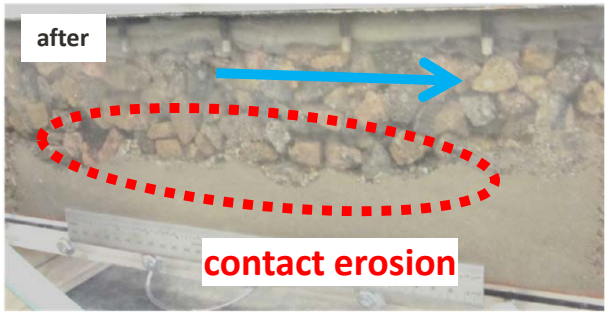




Grouted area (1971)

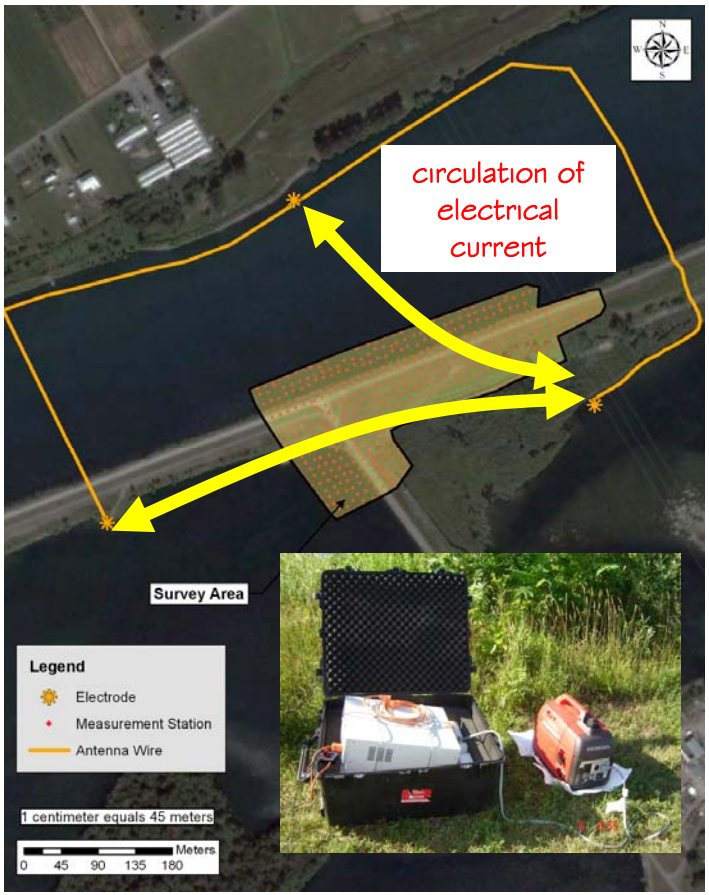
Erosion of finer particles in rockfill window and/or of grouting material ?



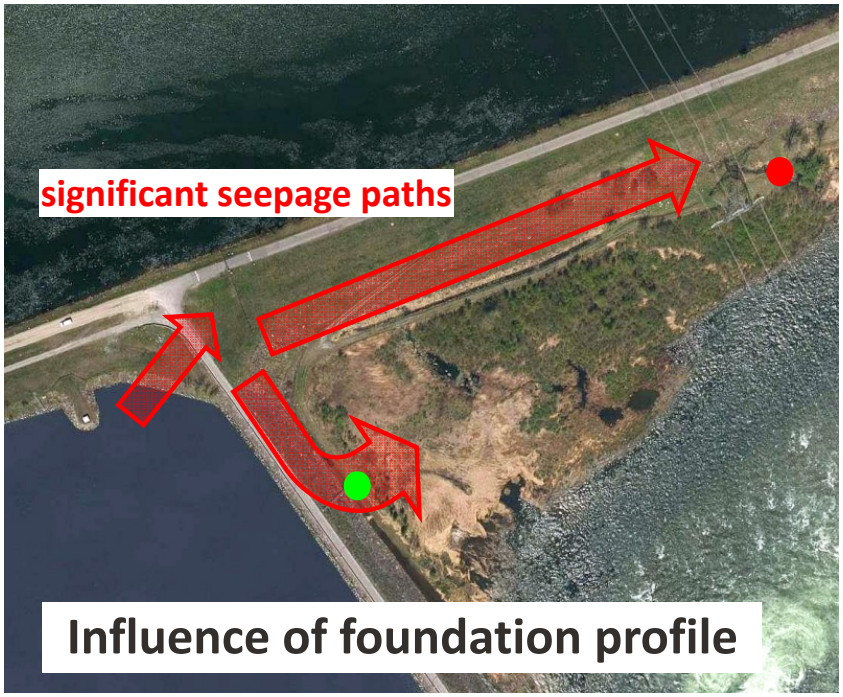


from Laval University

Seepage detection : electromagnetic survey

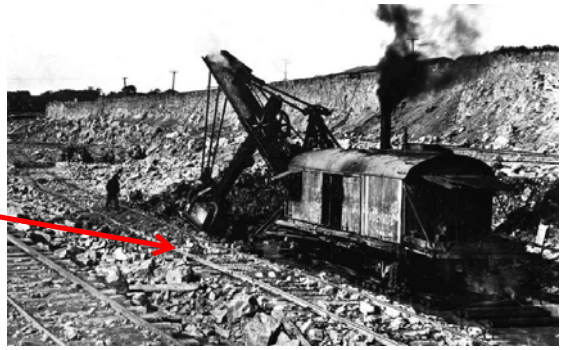


Seepage detection : electromagnetic survey

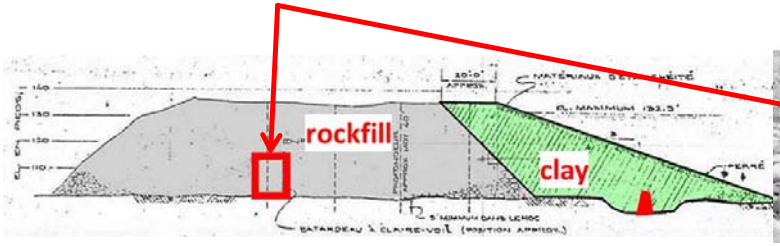


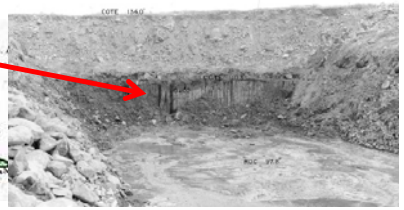
« Perfectly straight » seepage paths

Buried metal debris ?

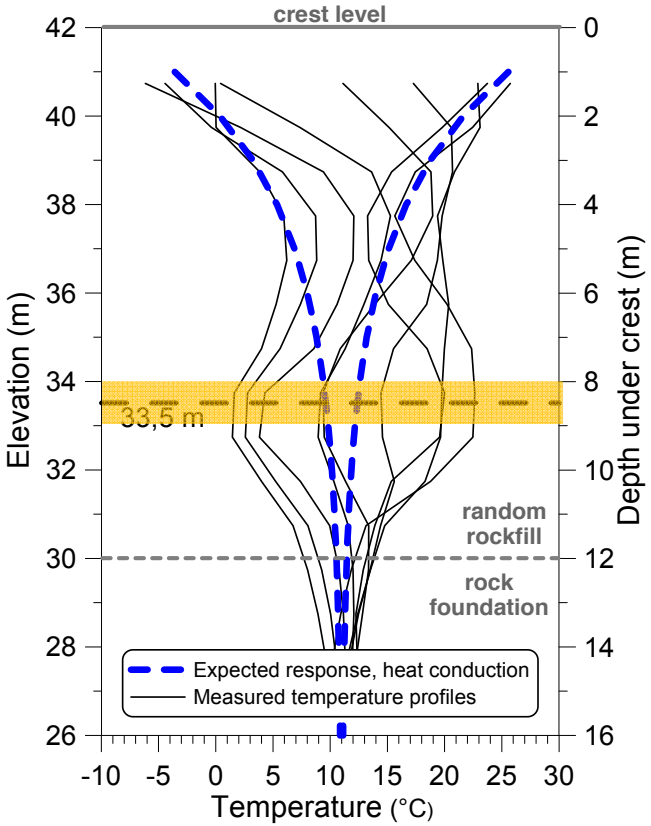


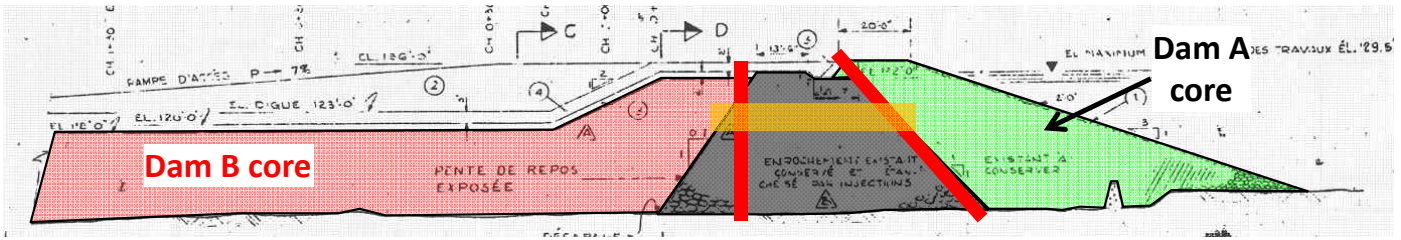
Influence of Dam A cofferdam





Seepage detection : passive thermometry





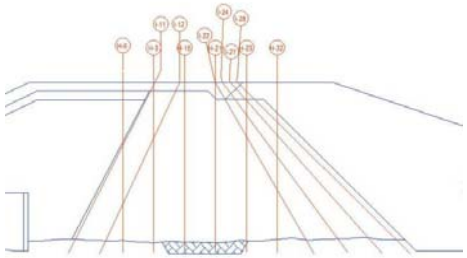
absence of grout material

Detection of seepage by thermometry confirmed by boreholes and optical televiewer images

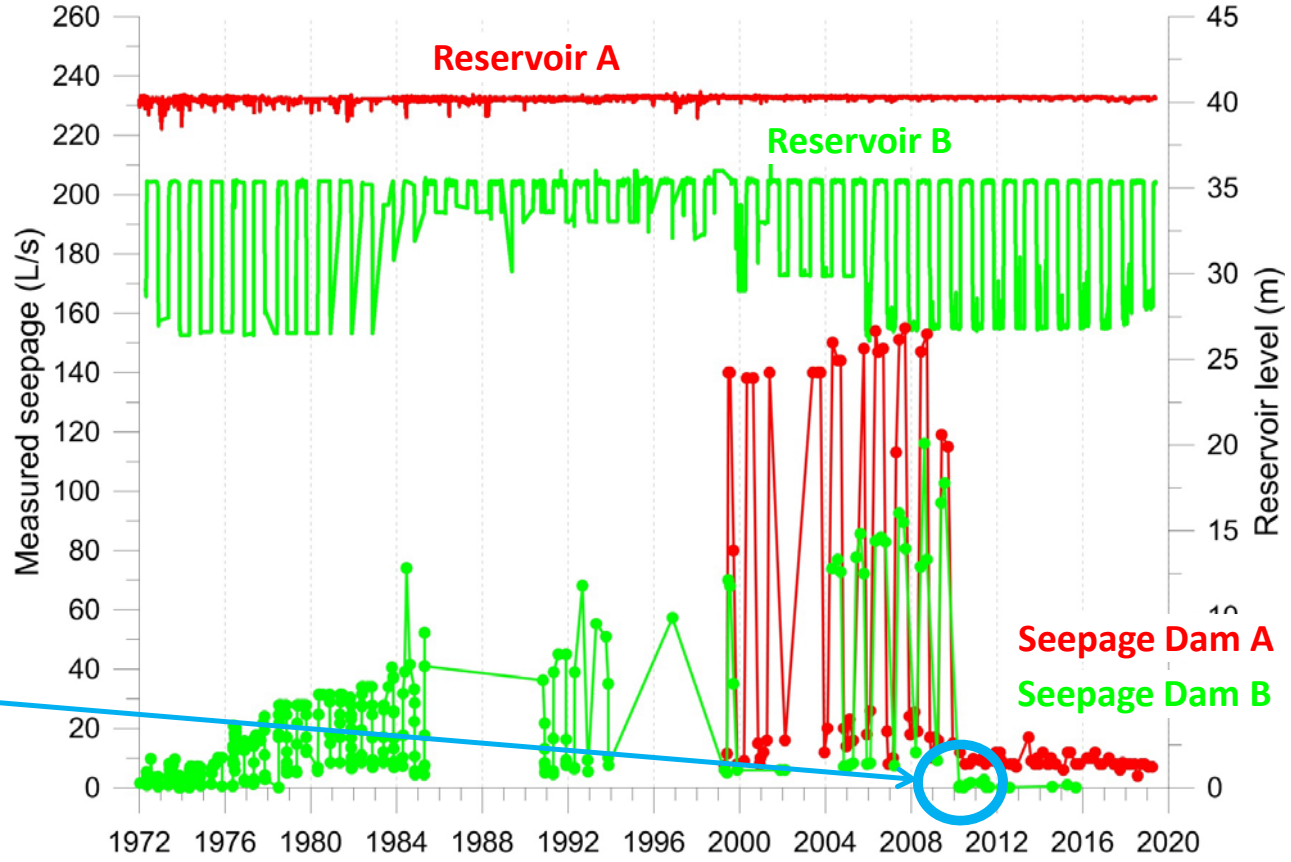
Rehabilitation (2009-2010)

Monitoring results, global survey (electromagnetic) as well as local surveys (televiewer and thermometry) confirmed the presence and extent of contact erosion : 2nd grouting of rockfill window at the junction of both dams

from Lauzon et al. 2011



Effects of rehabilitation

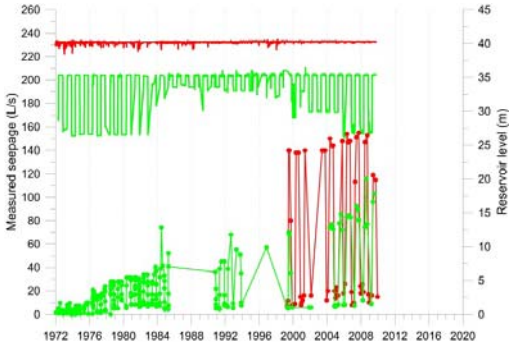


Rehabilitation

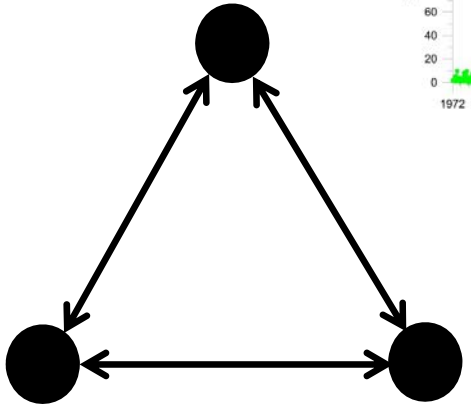
Conclusions

Importance of :

Monitoring results



Historical data



Local + global surveys