



Canadian National Railway Company



Ground Hazard monitoring and emergency recovery case studies

21st International ÖVG Convention

Optimizing the wheel/rail system – Availability of the Infrastructure

Graz, Austria

September, 2017

Jim McLeod, P.Eng.

CN - Chief Engineer

Structures, Design & Construction

Jim McLeod - Background – Roles & Responsibilities

- Joined CN full time in 1983 – Bridges & Structures, Region and HQ
- 1991 – Bridge Engineer - City of Edmonton
- 1998 – Sr Bridge/Railway Engineer – UMA Engineering
- 2004 – Rejoined CN – Sr Manager B&S, US Region

Currently System Chief Engineer – Structures, Design & Construction

CN Franchise - General Overview

Problem Solving Engineering... in Accelerated Real Time !

Railroad – Natural Hazards

- Rock Fall recovery
- Fountain slide stabilization

Bridge Emergency Recovery – Case studies

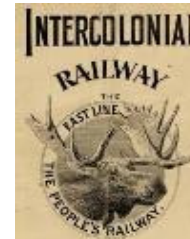
- Lac St Jean
- Wainwright – Fabyan Bridge
- Gogama
- Mayerthorpe

Continues Improvement - Applying future technologies today!



A Long History ...

- CN was a Crown corporation, a historic institution that was put together in 1919 and owned by the Canadian government.
 - Along the way, the organization was a hotel operator, a ship owner, a telegraph and telecommunications company, and even the forerunner to an airline known today as Air Canada.
- Was an amalgamation of five financially troubled railways during the years 1917–23:
 - the Grand Trunk and its subsidiary, the Grand Trunk Pacific;
 - the Intercolonial;
 - the Canadian Northern; and
 - the National Transcontinental.








- Starting the late 1970s and by 1989, CN divested itself of non-rail businesses, including real estate, hotels, and CNCP Telecommunications to refocus only on rail.
- November 17, 1995 – CN launched IPO, the largest in Canadian history at that time.

2015 = 20 year privatization anniversary



Expanding our Reach ...

- Following privatization, CN acquired:

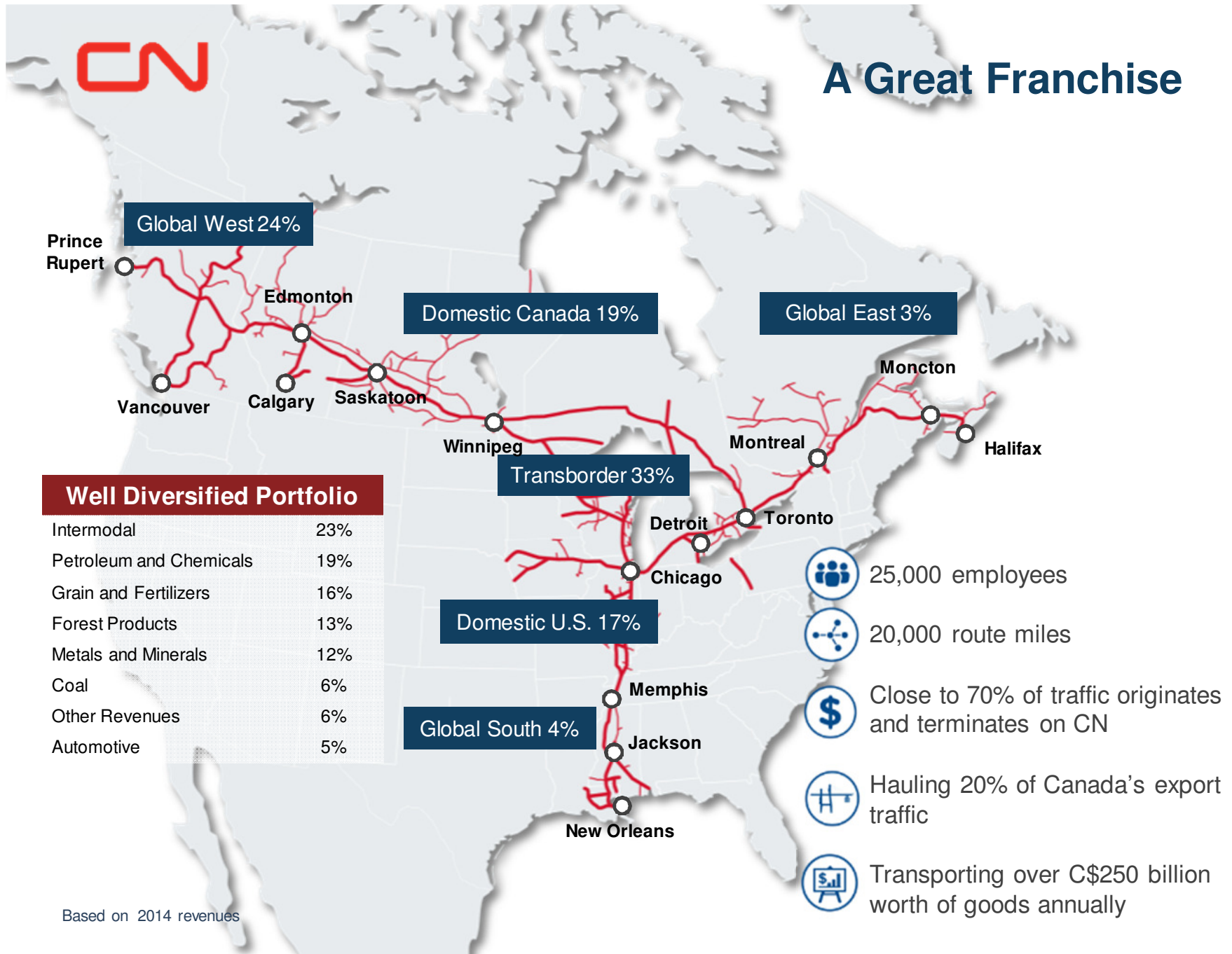
Railroad Purchased	Year
Illinois Central 	1998
Wisconsin Central 	2001
Great Lakes Transportation 	2004
BC Rail 	2004
Elgin, Joliet and Eastern 	2009

- Result made CN the largest rail network in Canada and the only transcontinental rail network in N America.
- Over the past 20 years, we have embraced a mindset of innovation that has kept us on top.
 - Introduced Precision Railroading with a scheduling philosophy that the industry has tried to emulate.
 - Protected Operational focus but also moved to position ourselves as a true Supply Chain Enabler, fostering cooperation among our partners and CN.





A Great Franchise



Well Diversified Portfolio

Intermodal	23%
Petroleum and Chemicals	19%
Grain and Fertilizers	16%
Forest Products	13%
Metals and Minerals	12%
Coal	6%
Other Revenues	6%
Automotive	5%

-  25,000 employees
-  20,000 route miles
-  Close to 70% of traffic originates and terminates on CN
-  Hauling 20% of Canada's export traffic
-  Transporting over C\$250 billion worth of goods annually

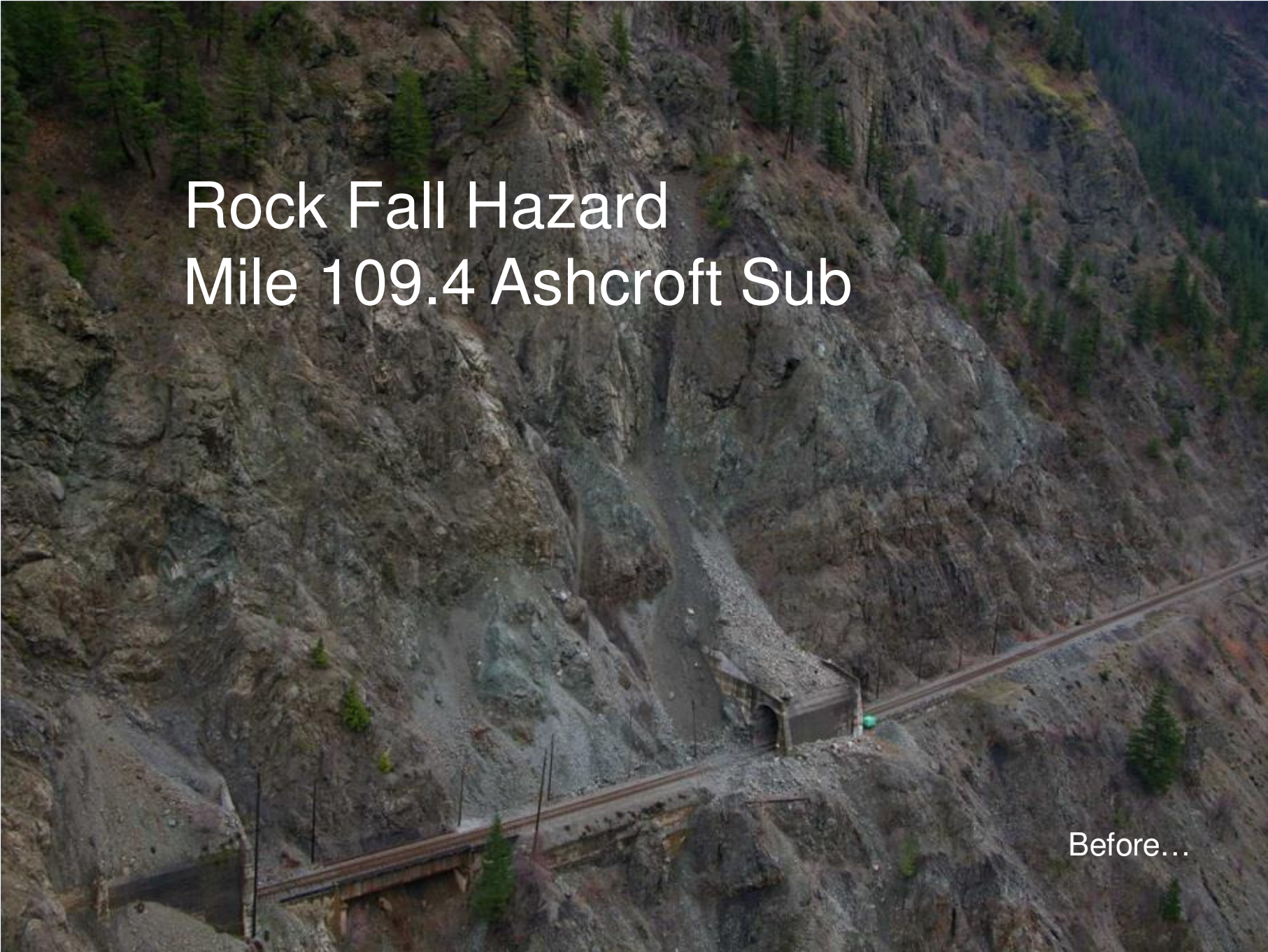
Based on 2014 revenues

Natural Hazards, Unplanned Events...



Well here's your problem right here...

the solution is often not as obvious and can be more challenging to resolve.

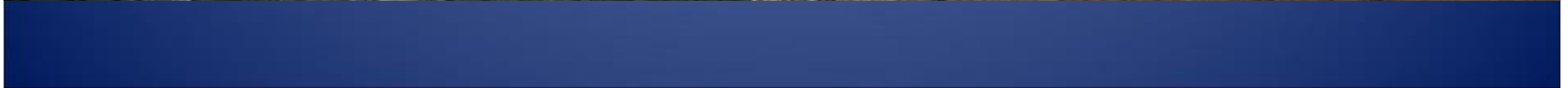
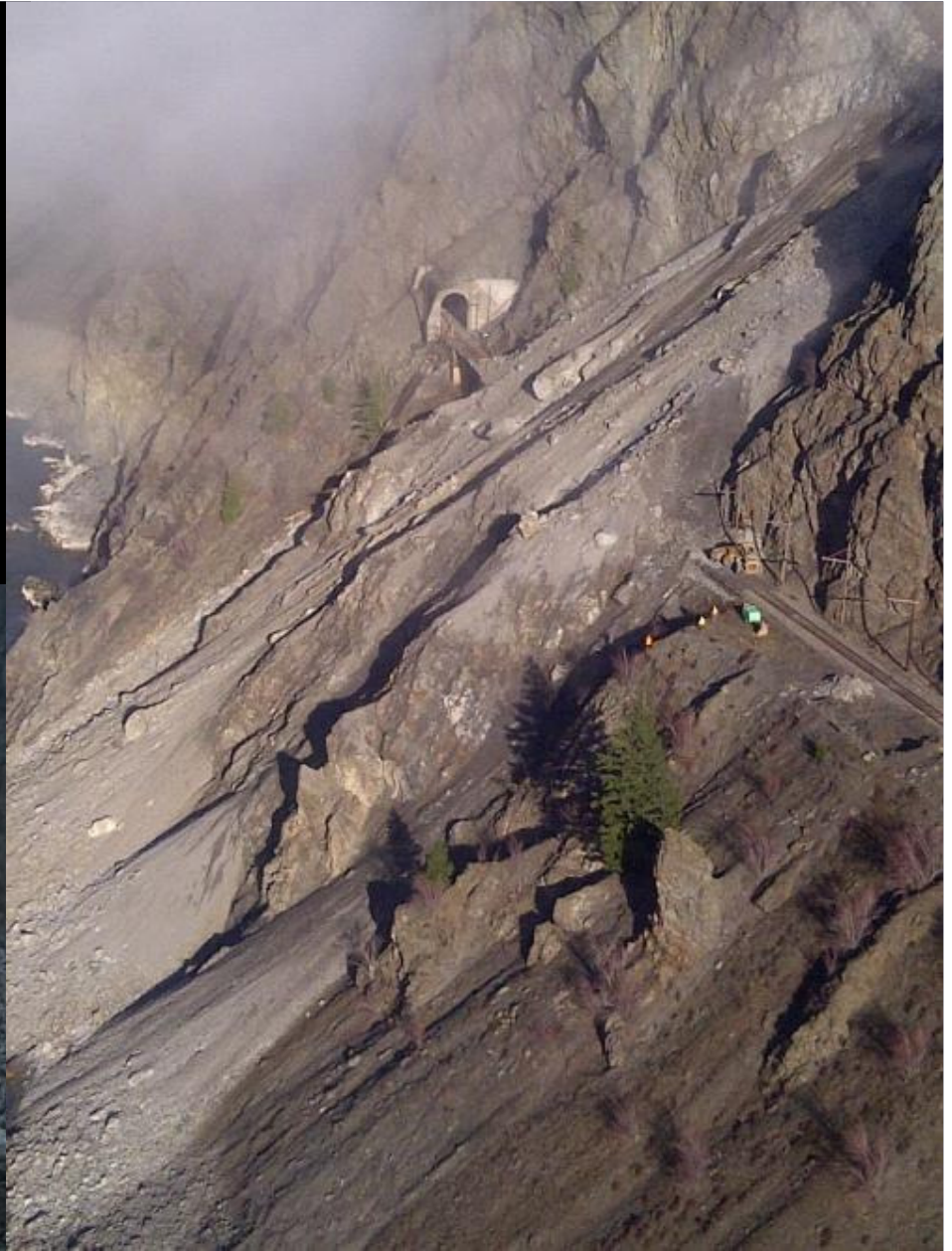


Rock Fall Hazard
Mile 109.4 Ashcroft Sub

Before...

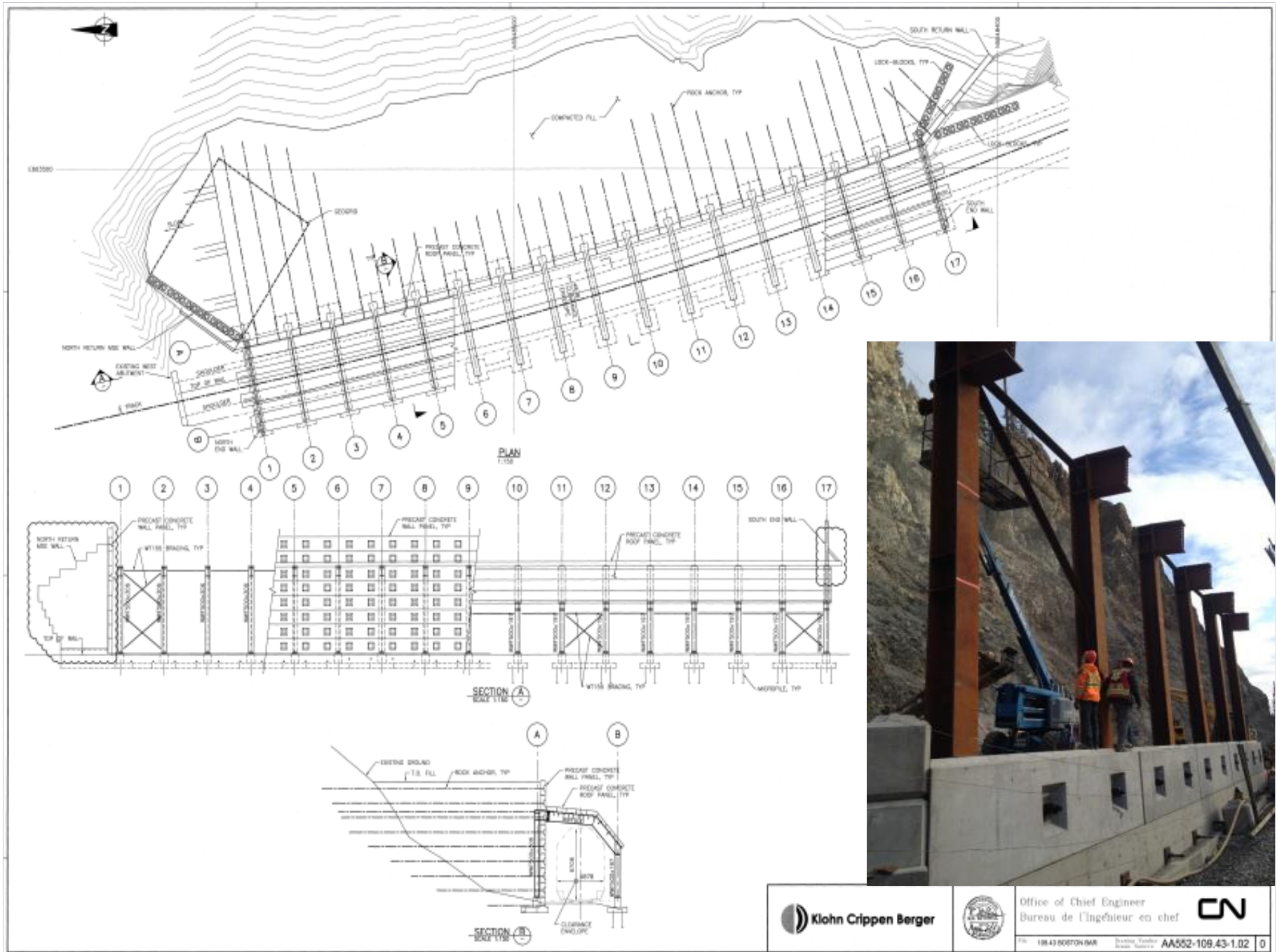


After...











109.4 Ashcroft Subdivision – Rock Fall event December 11, 2014



Pre – December 11, 2014



Post – December 11, 2014



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Fountain Slide

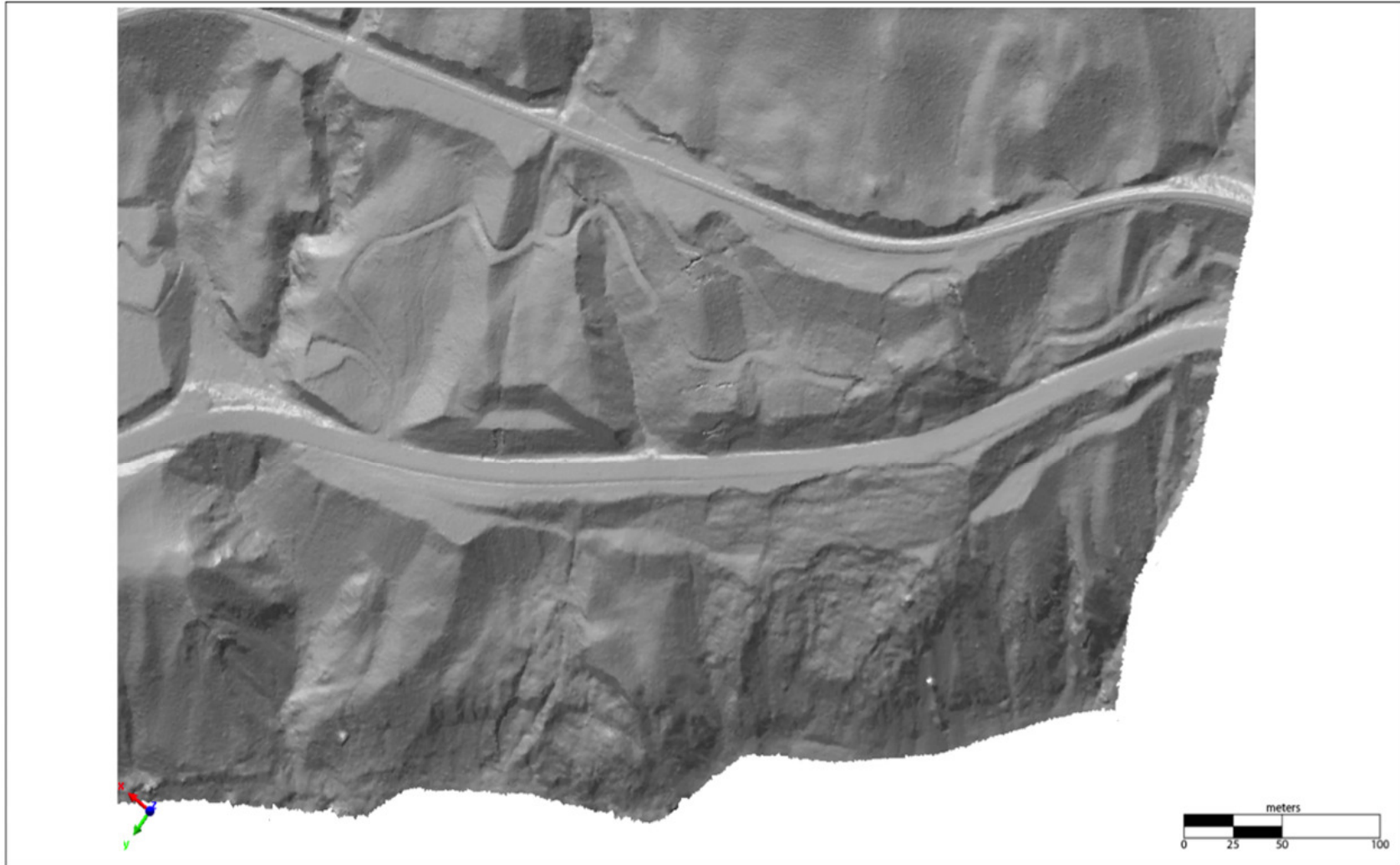
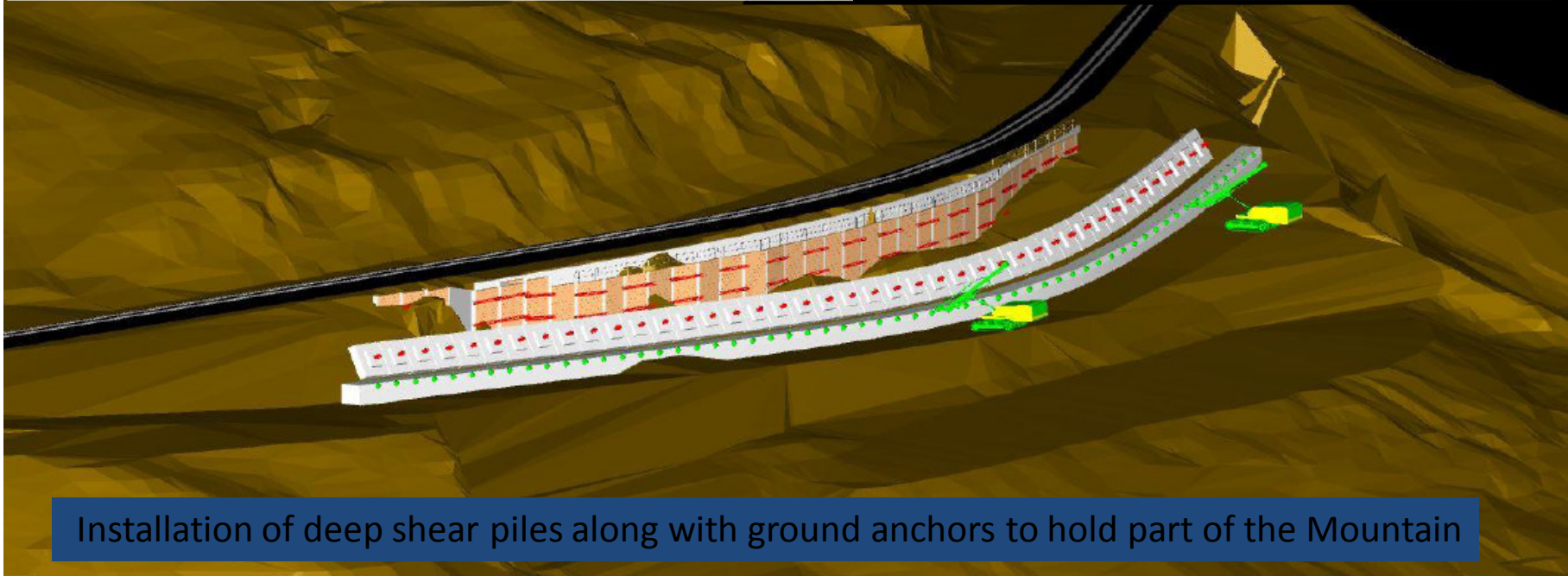
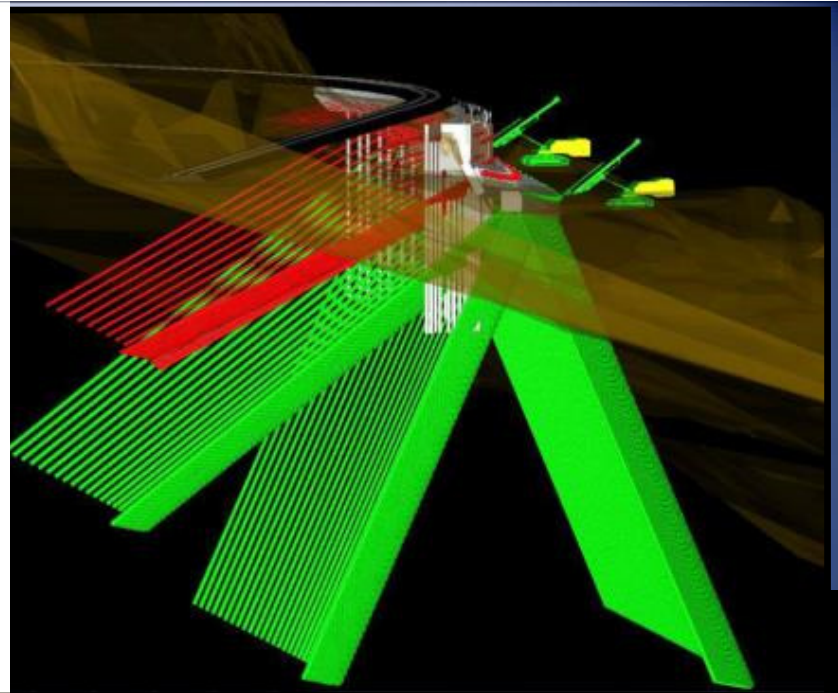
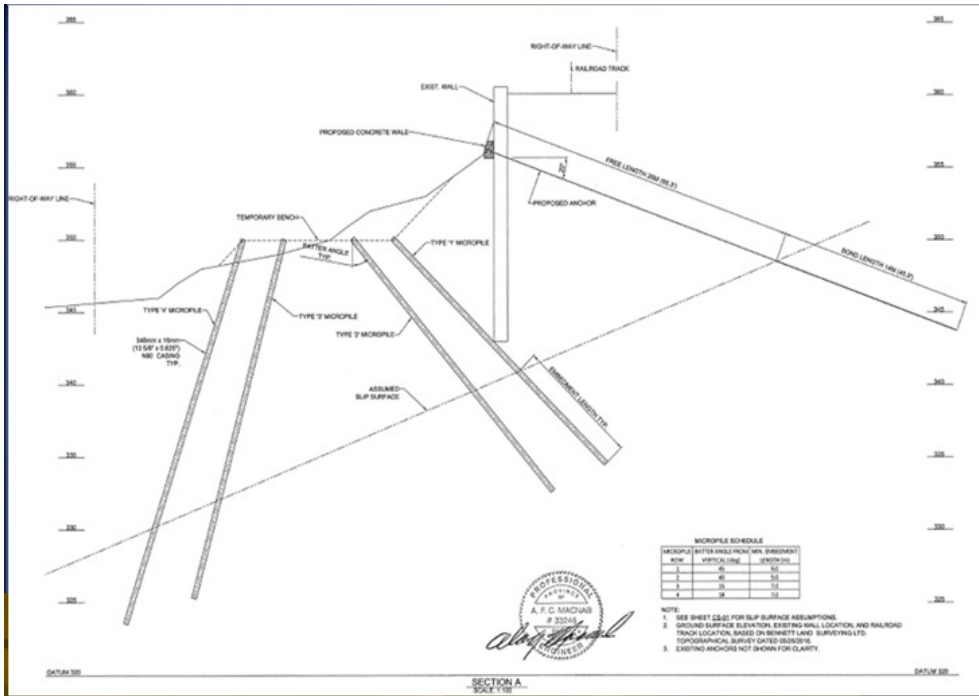


Figure 2: Cropped section of airborne LiDAR data near the Fountain Slide zone (data from 2006)

BGC ENGINEERING INC.



Installation of deep shear piles along with ground anchors to hold part of the Mountain

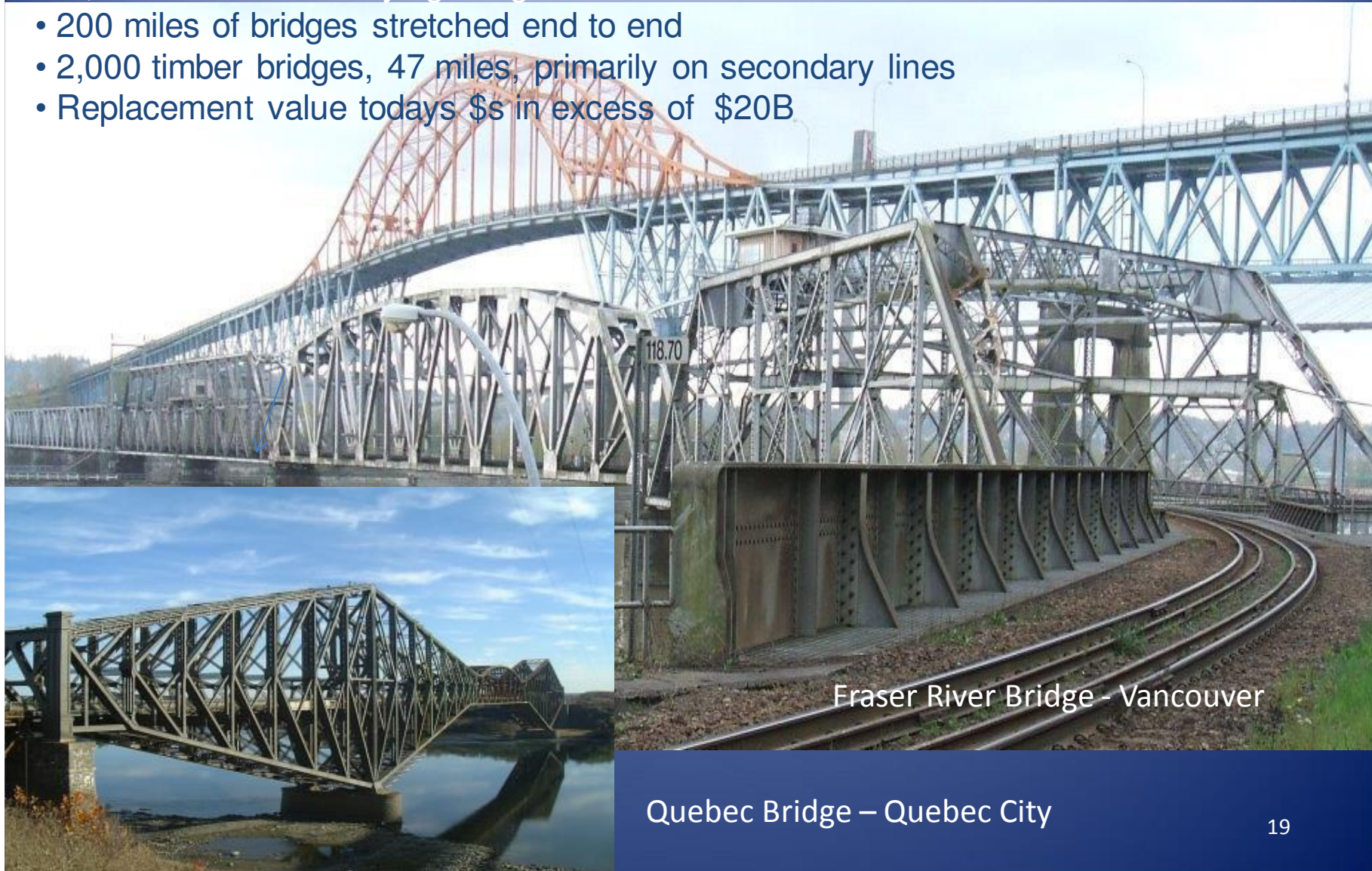
Fountain Slide – Retaining wall and slope stabilization



Fountain Slide - Now renamed - Retaining Wall Mi 167.7 Lillooet Subdivision

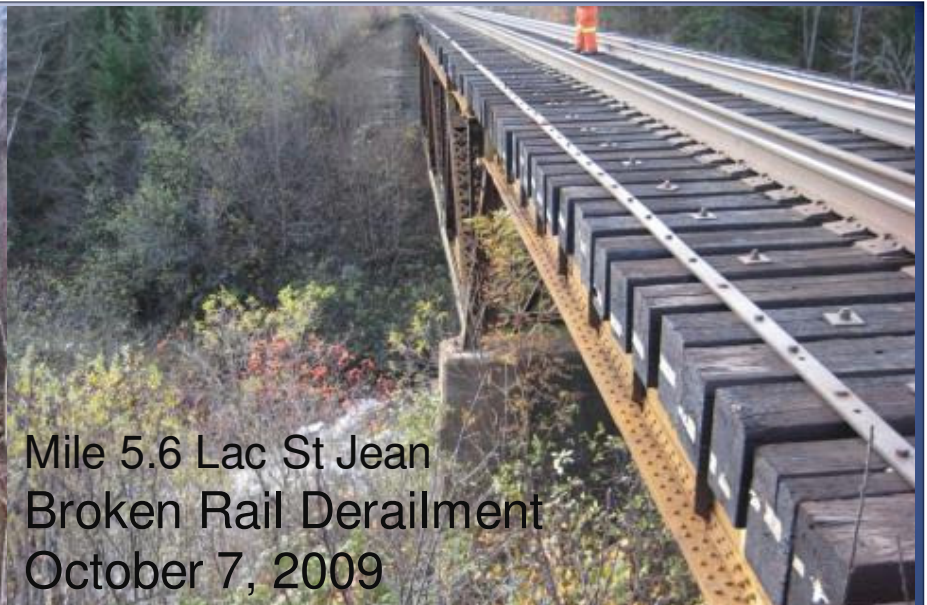
CN Bridge Plant by the numbers

- 7, 151 active rail carrying bridges
- 200 miles of bridges stretched end to end
- 2,000 timber bridges, 47 miles, primarily on secondary lines
- Replacement value today's \$ in excess of \$20B



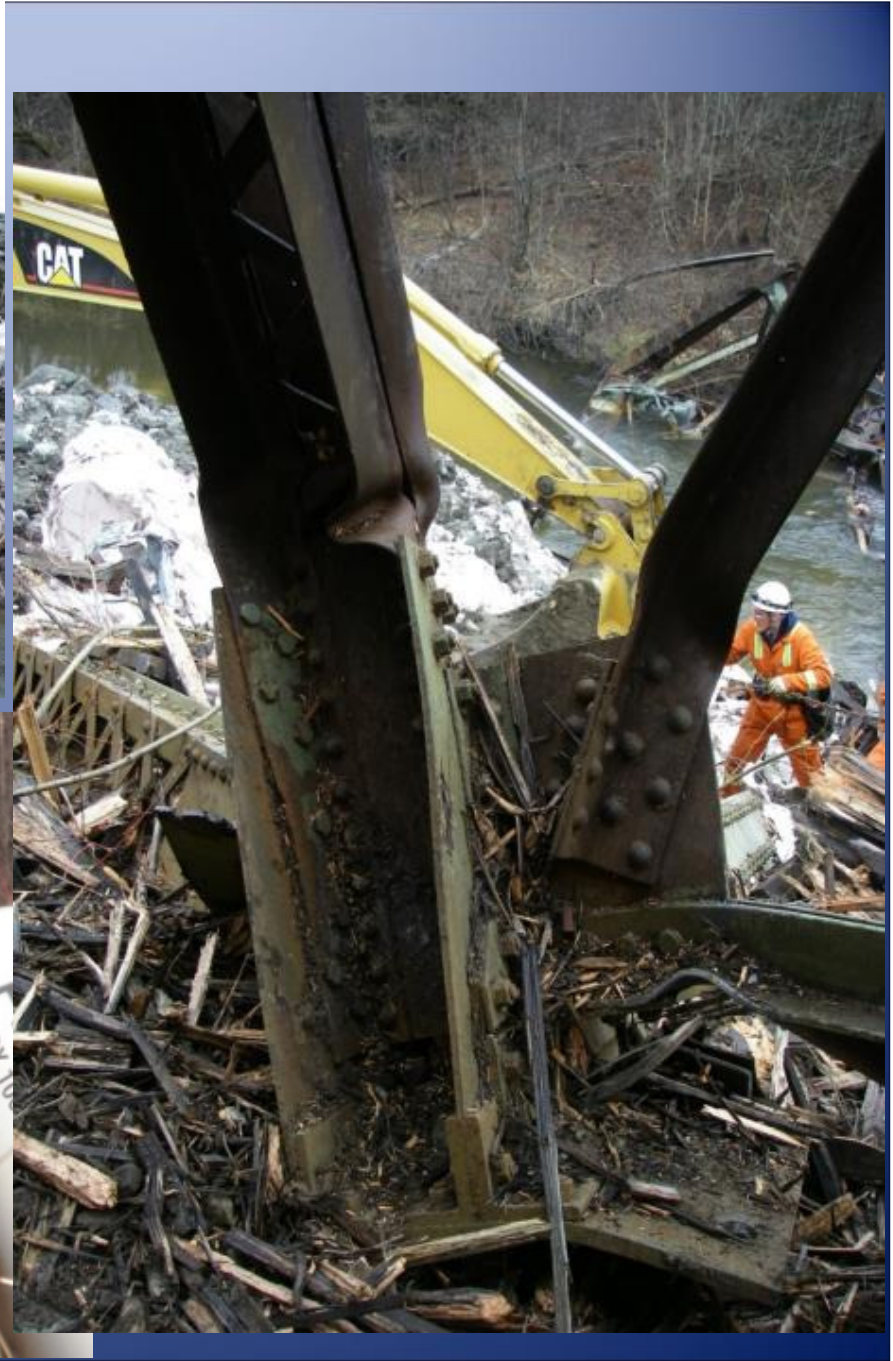
Fraser River Bridge - Vancouver

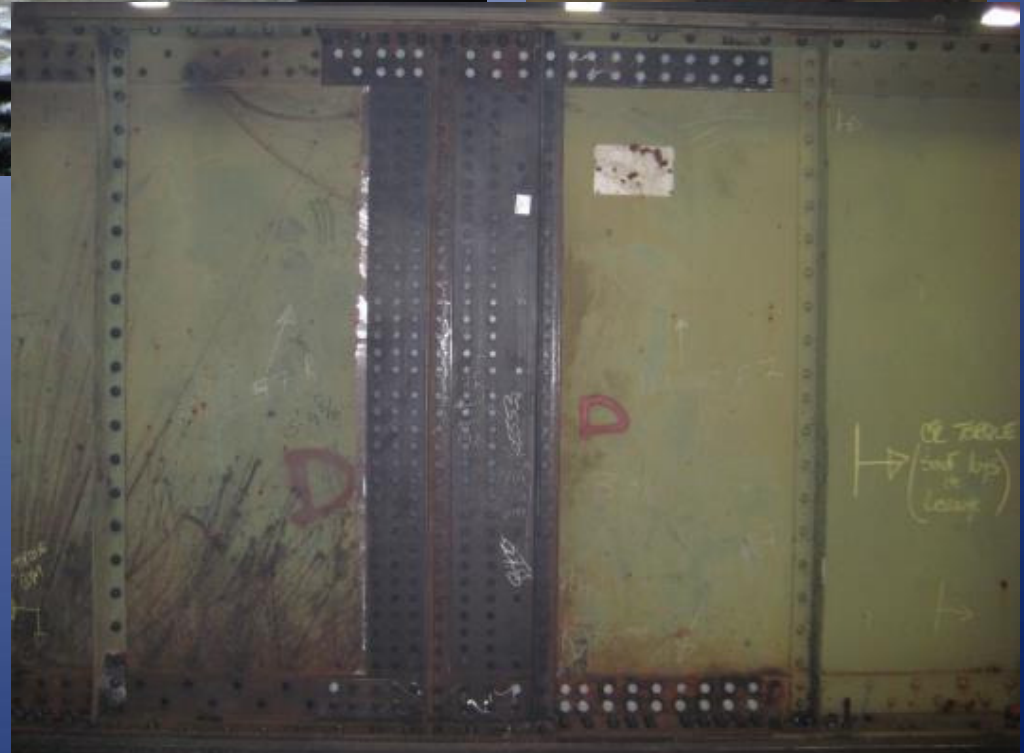
Quebec Bridge – Quebec City



Mile 5.6 Lac St Jean
Broken Rail Derailment
October 7, 2009









Crane Assembly for span installation



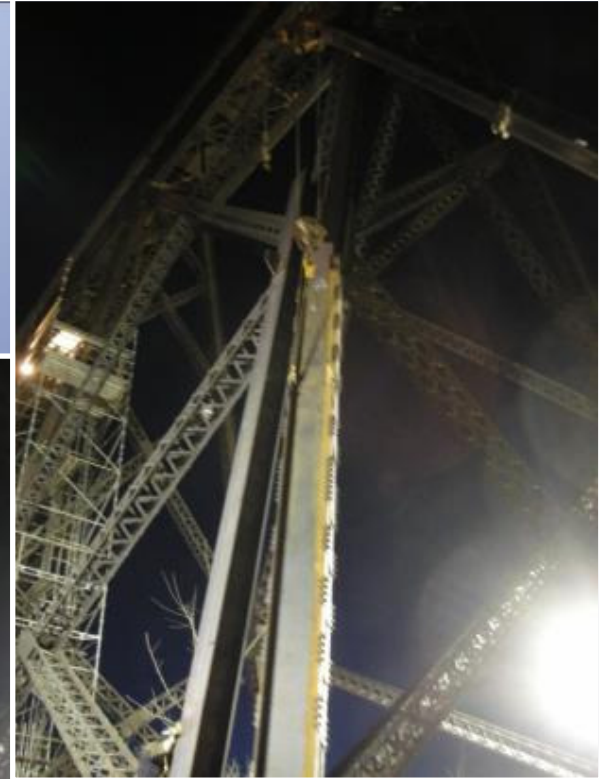


Fabyan Bridge – Wainwright Alberta

January 21, 2012







Emergency Steel
Repairs, critical tower
legs.
Return to service
January 26, 2012





Gogama, Ontario
March 7, 2015
Crude oil fire







