McGill

Canada Research Chair (Tier I) in
Sustainable Mineral Resource Development and Optimization under Uncertainty
COSMO – Stochastic Mine Planning Laboratory
Dept. of Mining and Materials Engineering

Canadian Institute of Mining, Metallurgy and Petroleum

CIM – COSMO Lunchtime Seminars, Winter 2011

"Strategic Mine Planning at the Iron Ore Company of Canada"

Rod Williams

Resource Development Manager

IOC - Iron Ore Company of Canada

Rio Tinto

Iron Ore Company of Canada

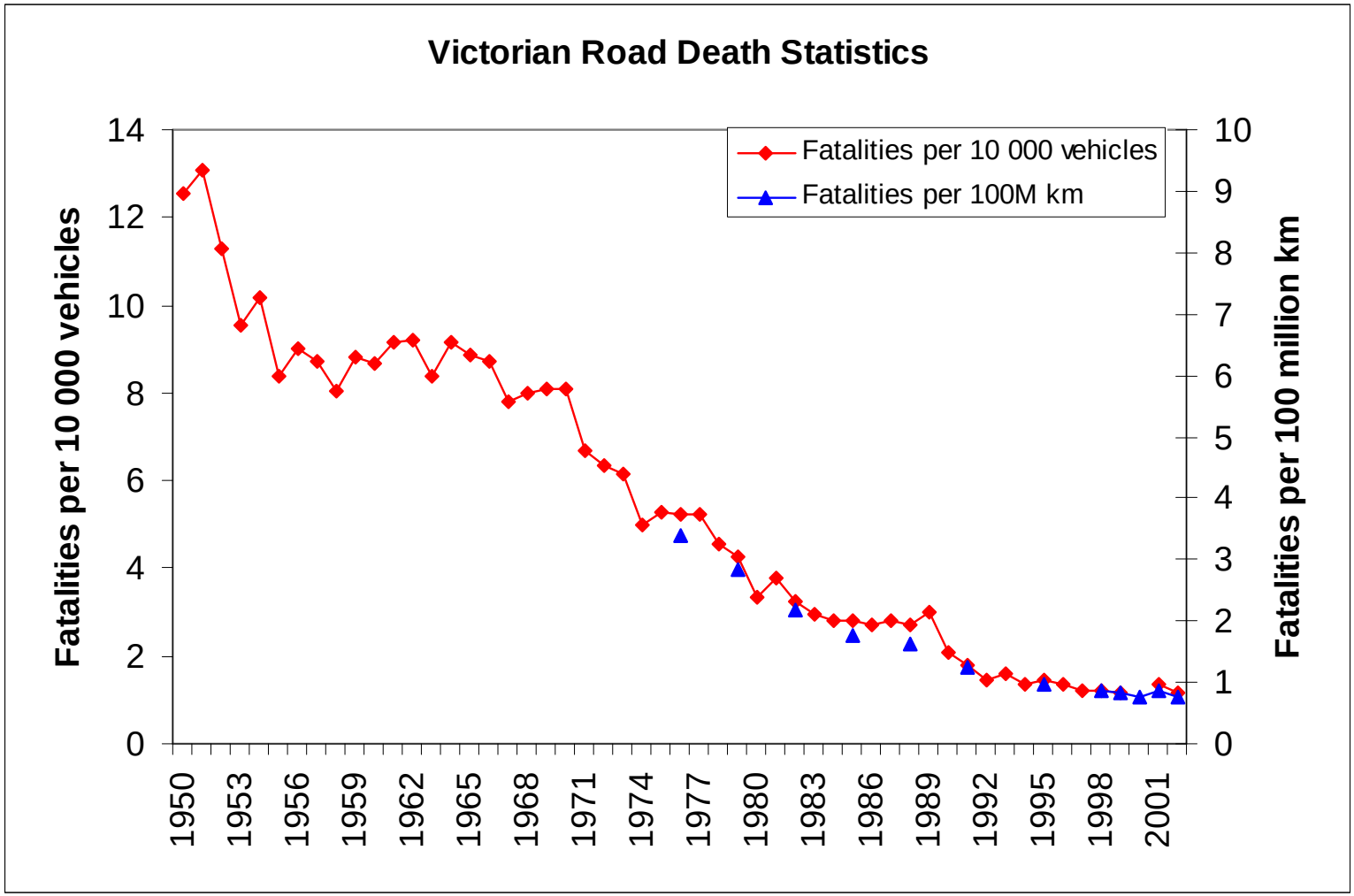
Strategic Mine Planning

CIM-Cosmo Seminar, Montréal, Jan 2010

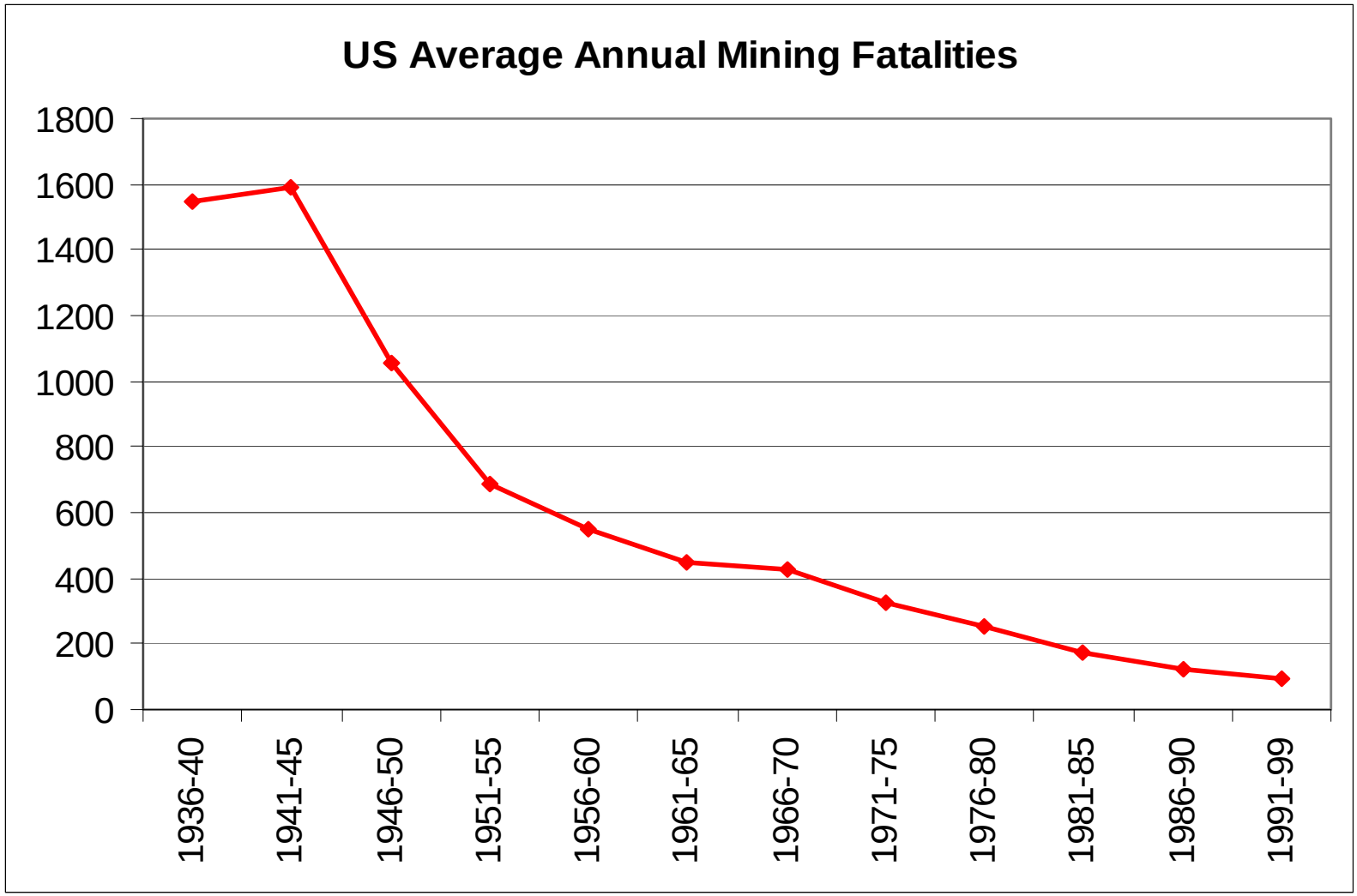
Agenda

- Safety Share
- IOC – Company Profile
- Regional Setting
- Reserves & Resources
- Operations
- Expansion Plans

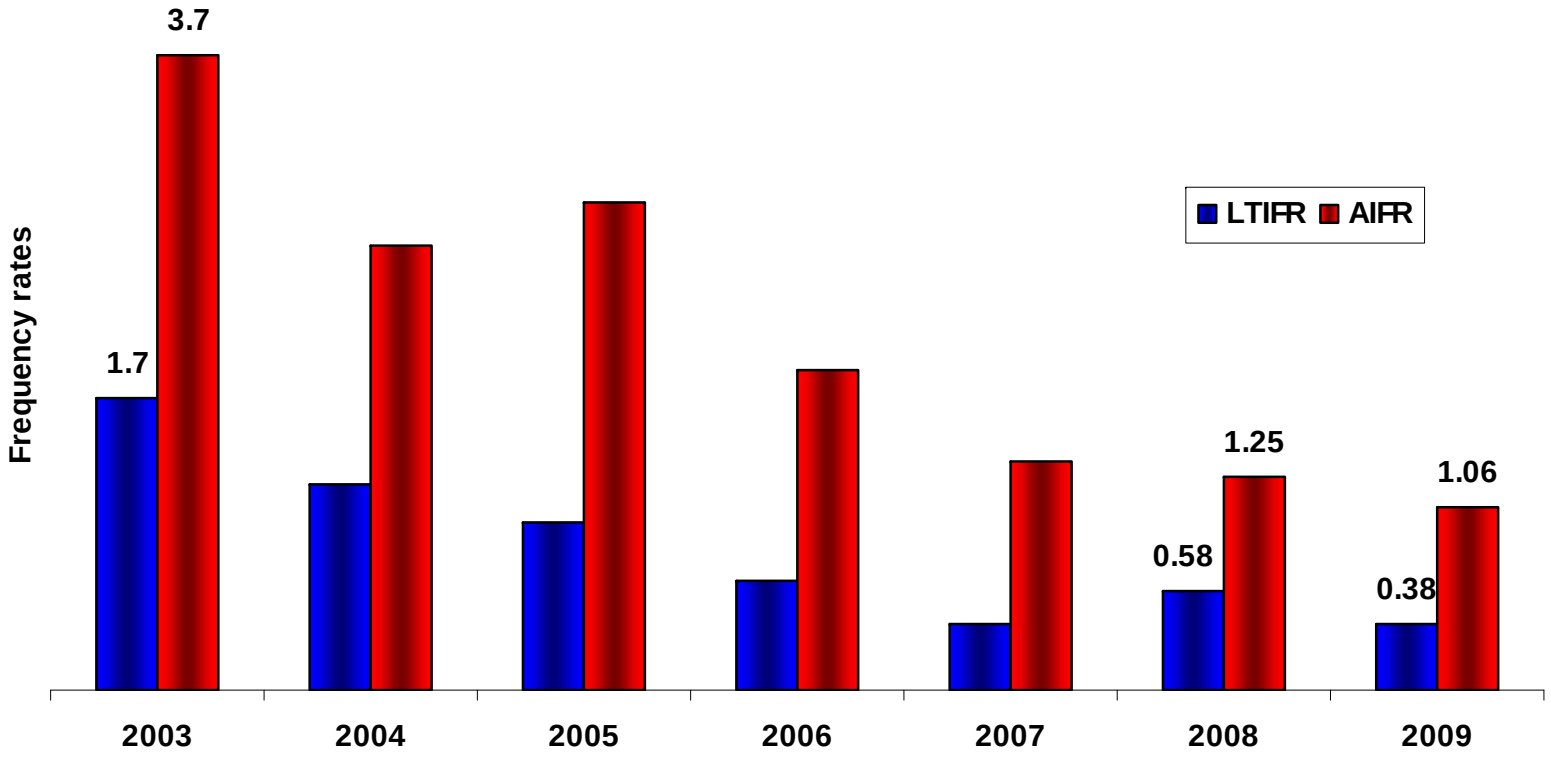
Road Safety Improvement (Australia)



Mines Safety Improvement (US)

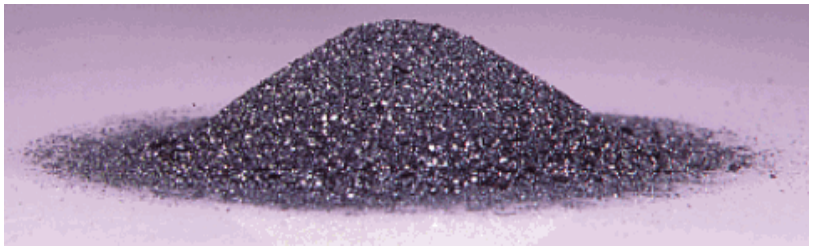


Mine Safety Improvement (IOC)

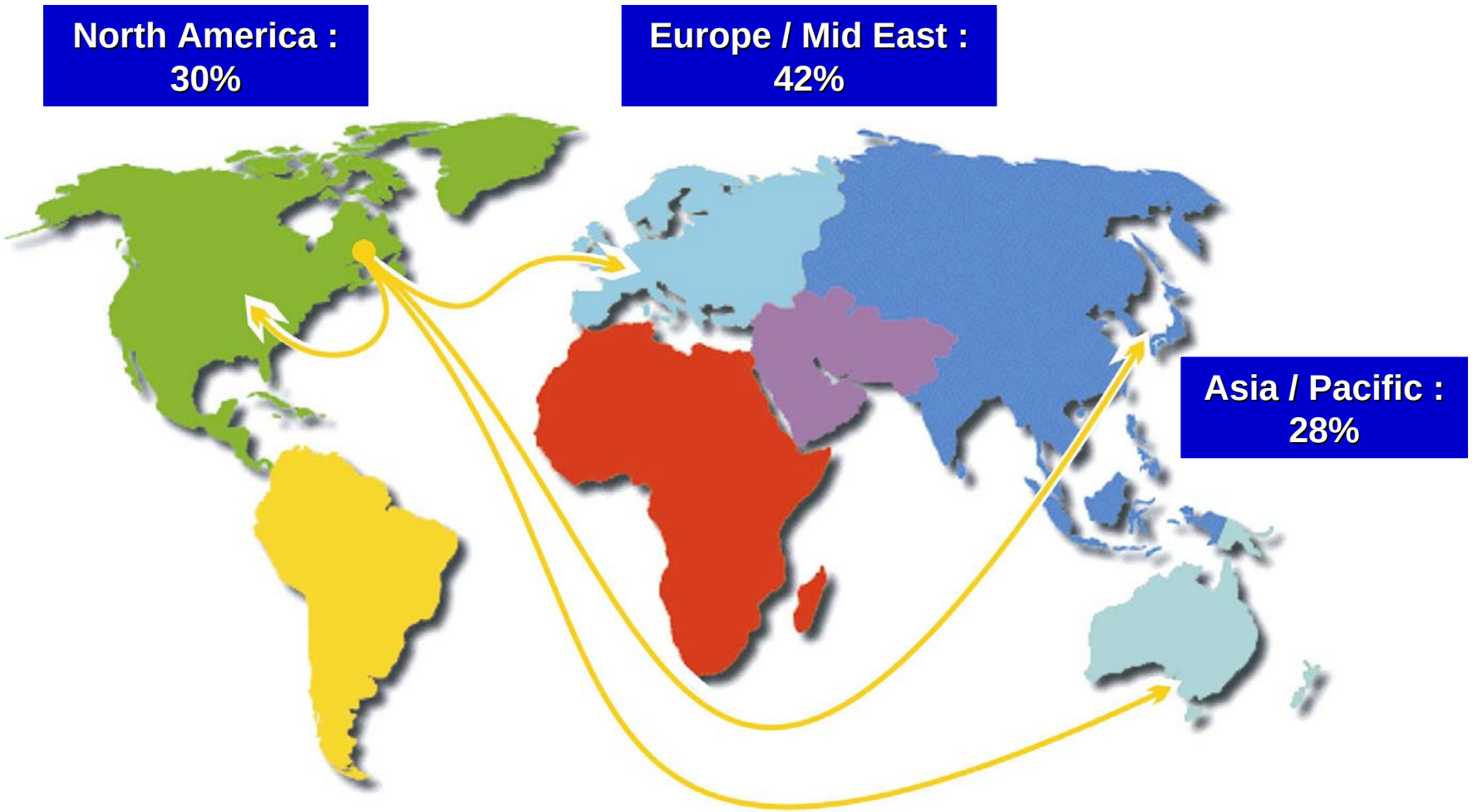


IOC – Production

- Largest Iron Ore Producer in Canada
  - Annual sales
    - 13 Mt/y pellets
    - 4 Mt/y concentrate (sinter feed)



IOC – Markets



IOC – Location

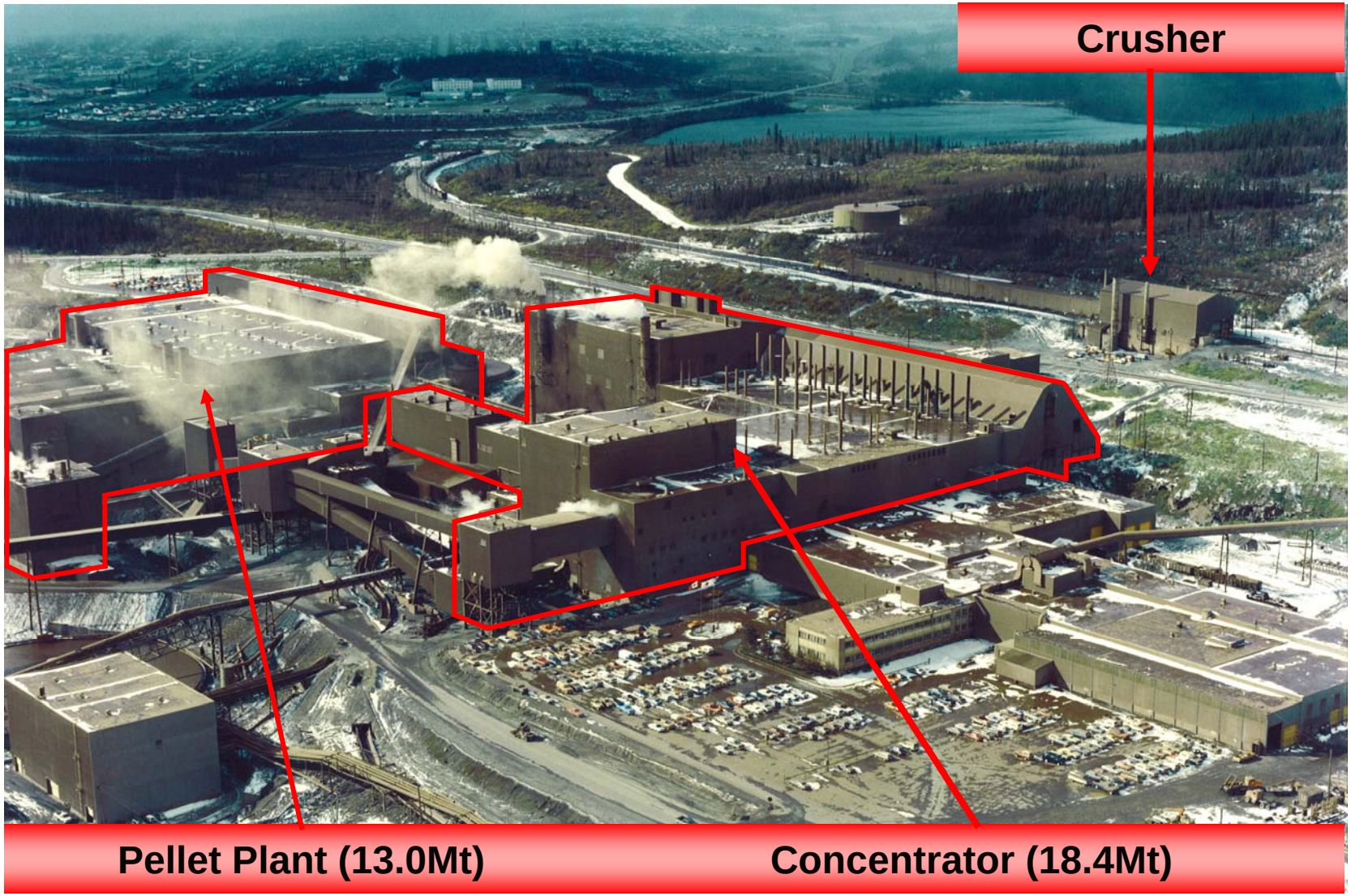
Labrador City and Sept Iles

- **Population 9,000**
- **Sub-Arctic climate**
- **Mine, concentrator and pelletizing plant**

- **Population 25,500**
- **Deep-sea port accessible year-round and one of Canada's largest by volume**

Two operating mines are linked to the concentrator by an automated train

Concentrator and adjacent pellet plant



A 418 km railway connects Labrador City operations to the Quebec coast...

...and IOC's deepwater port at Sept-Iles

IOC – Ownership

- Rio Tinto (58.7%)
- Mitsubishi (26.2%)
- Labrador Iron Ore Royalty Corporation, LIORC (15.1%)

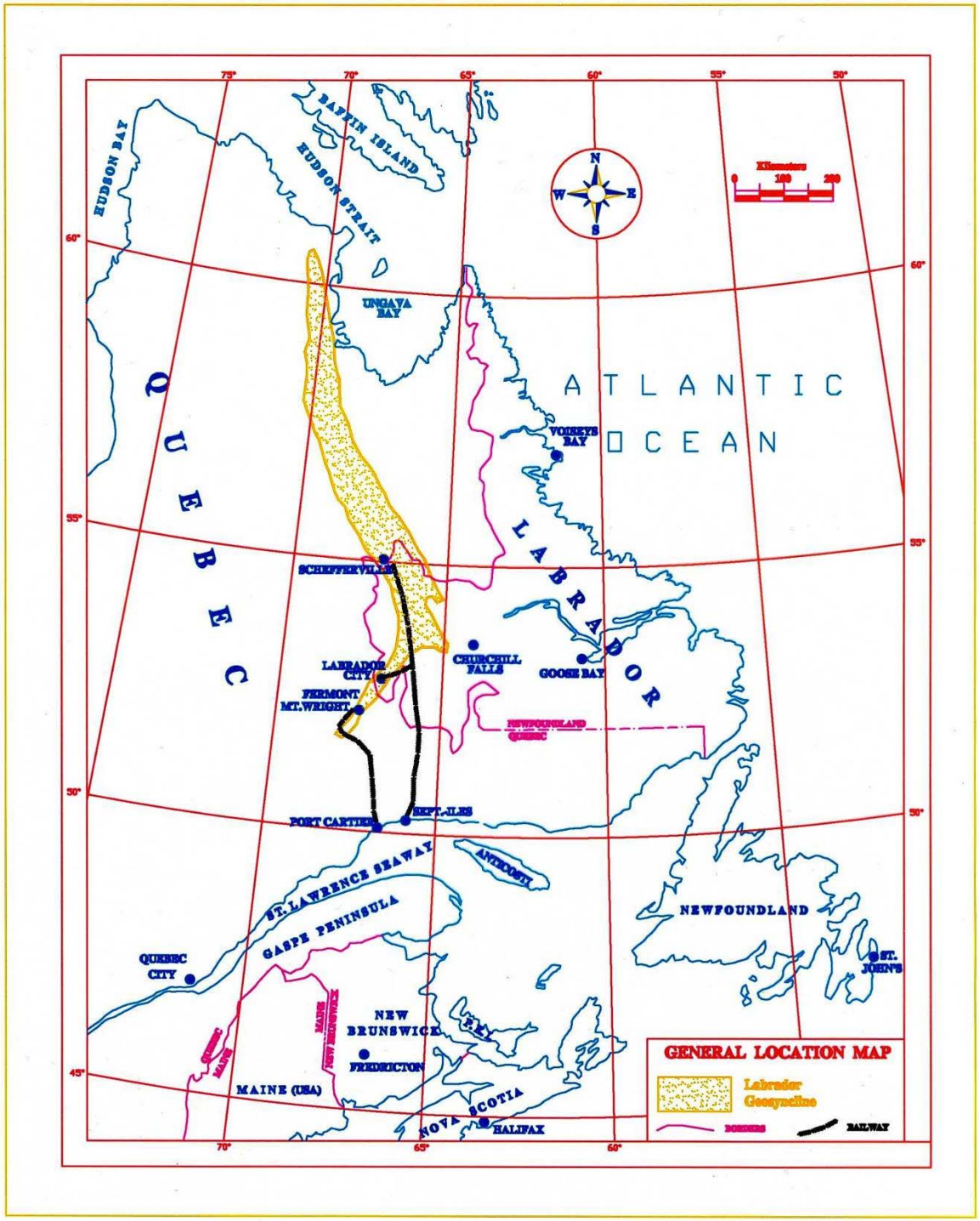
- Operated by Rio Tinto
- Mining leases held by LIORC
  - 7% royalty

IOC – History

- 1954 – Commence operations mining direct shipping ore in Schefferville
- 1962 – Commenced operations in West Labrador (Carol Lake Project)
- 1982 – Schefferville operations closed

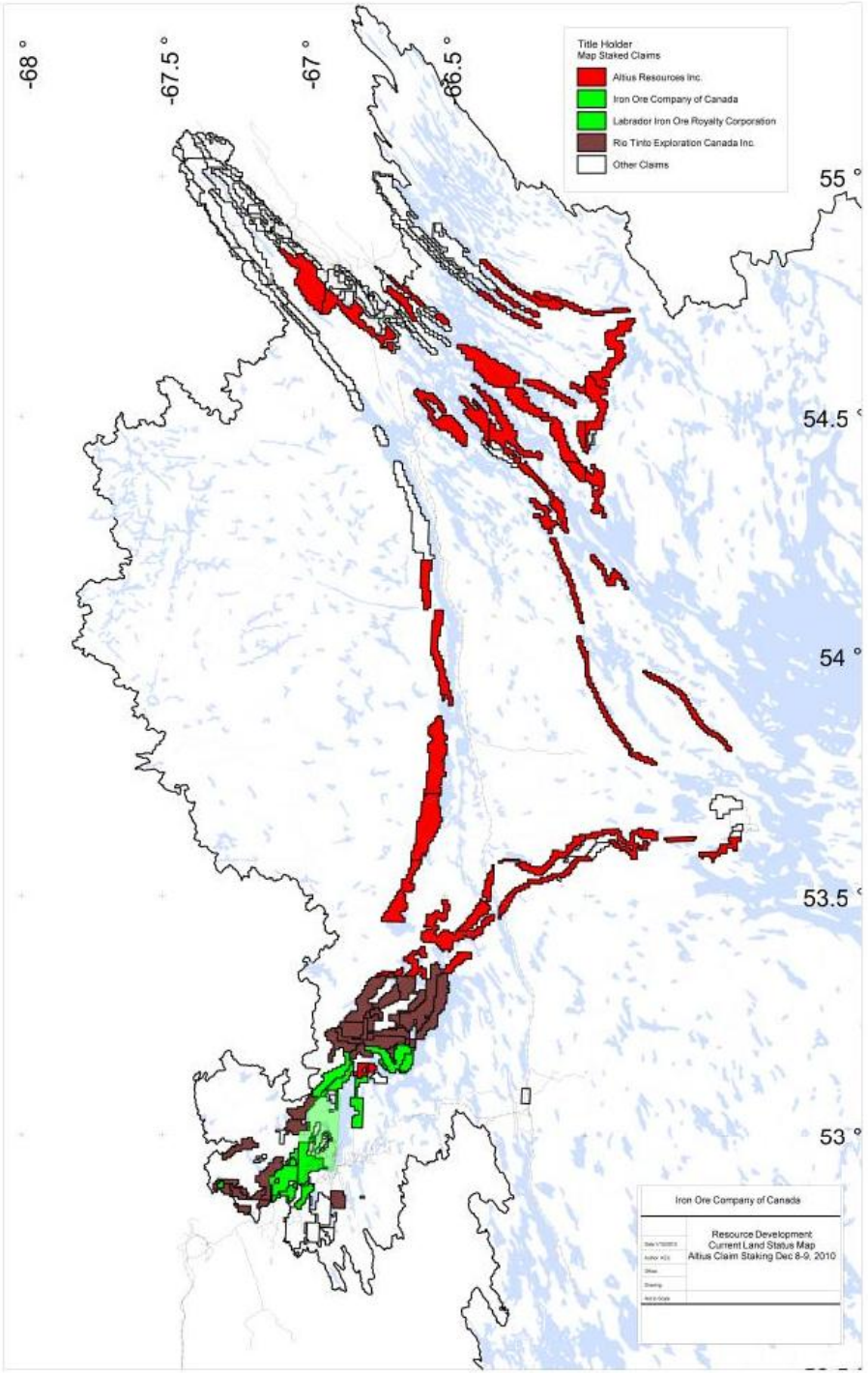
RioTinto

Regional Setting

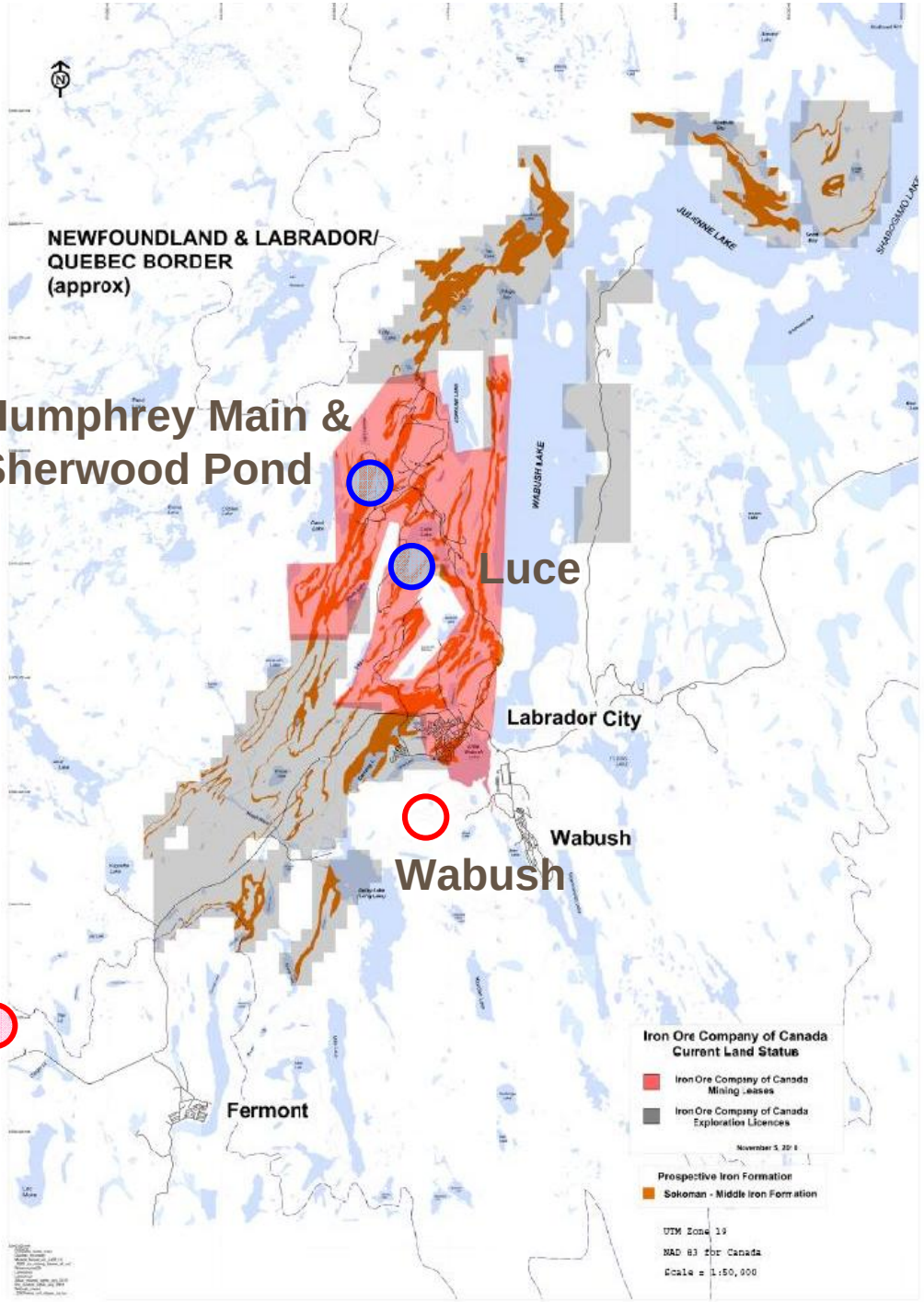


RioTinto

West Labrador



Tenements and Mineralisation

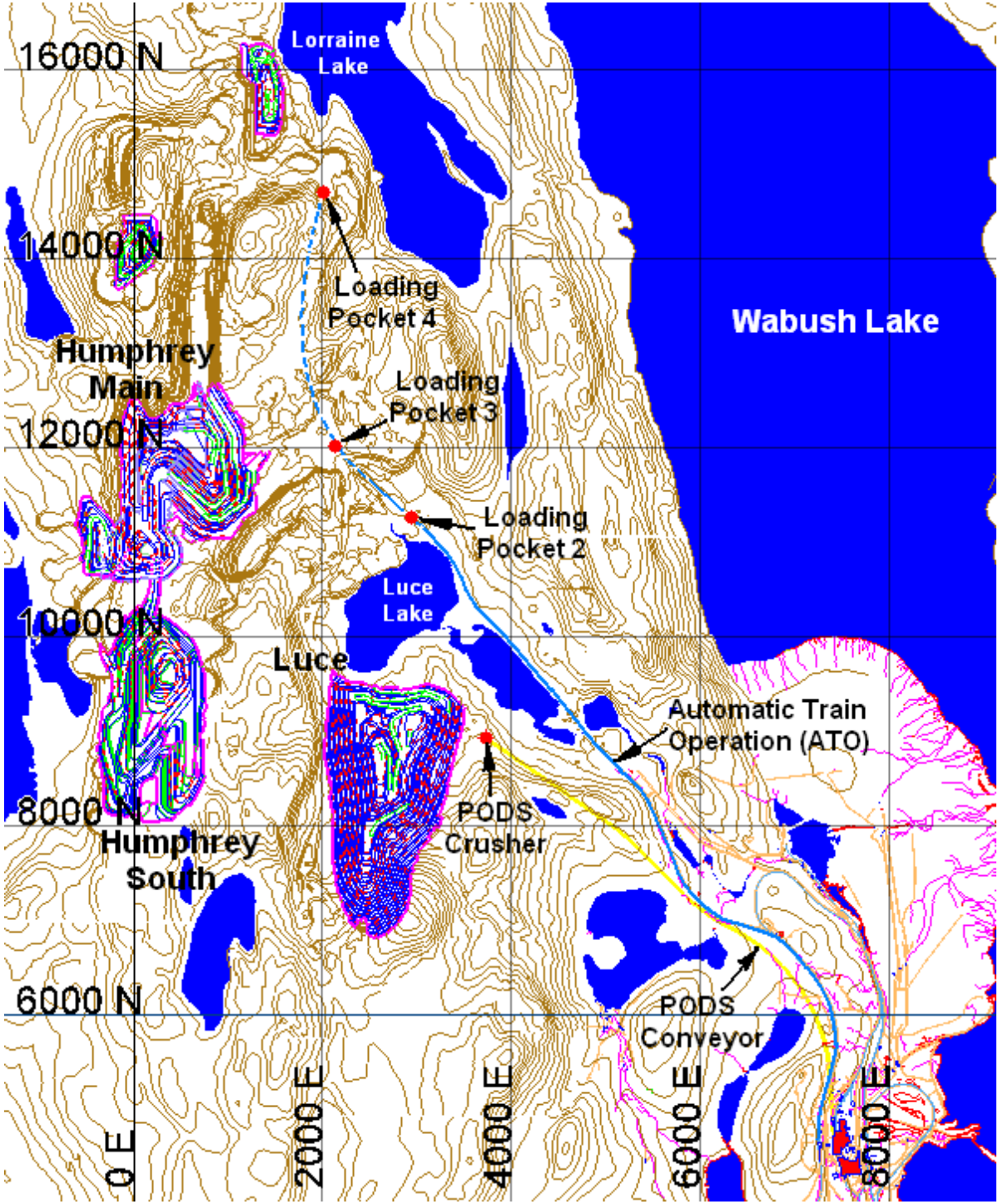


Labrador Trough Operations

- **IOC** (Carol Lake)
  - 13 Mt/y pellets
  - 4 Mt/y concentrate
- **Cliff Natural Resources** (Wabush Mines)
  - 5.5 Mt/y pellets
- **Consolidated Thompson** (Lac Bloom)
  - 8 Mt/y concentrate
  - FS underway for 16 Mt/y production
- **ArcelorMittal** (Mont Wright)
  - 9 Mt/y pellets
  - 5 Mt/y concentrate

RioTinto

End 2009 Reserve Pits



Reserves & Resources (End 2009)

		Ore		Product	
		Mt	**%Fe**	**Mt**	**%Fe**
Ore Reserves	Proved	1,028	38.0	440	65.0
	Probable	341	37.5	144	65.0
	Total	**1,369**	**37.9**	**585**	**65.0**
Mineral Resources	Measured	275	39.4	123	65.0
	Indicated	842	38.0	370	65.0
	Inferred	1,424	37.6	580	65.0
	Total	**2,540**	**37.9**	**1,073**	**65.0**

Notes:

1. Ore reserves and mineral resources authorised for publication by Tim Leriche (IOC Competent Person)
2. Ore reserves and mineral resources detailed in the Rio Tinto 2009 annual report.
3. Reserves are additional to resources.

Mining - flowsheet

Drill & Blast

8 rotary drills

Loading & Hauling

- 4 x rope shovels
- 2 x loaders
- 30 x haul trucks

Load Pockets (x3)

Automatic Train Operation

- 7 train lines
- 20 cars/train

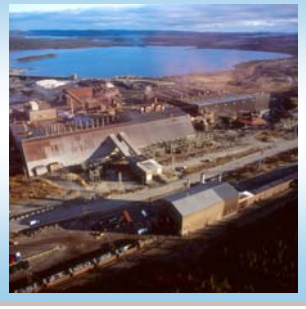
Waste Dumps

Processing – flowsheet

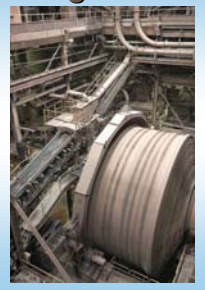
Loading Pockets

ATO

Crushers



Grinding – AG Mills



Spiral Plant

CFS

Tails

Mag Plant

Tails

Hem Plant

Product Dependent

Regrinds

Filtering and Balling

Induration

Chips

Flotation

Pellet Stockpile

Capacity Constraints

- Ore Delivery
- Grinding
- Spiral Circuit
- Magnetite Circuit

Current Expansion Plans

Phased Expansion of Concentrator (de-bottlenecking)

- Phase 1 (in construction)
  - Parallel Ore Delivery System
  - Fourth Autogenous Grinding Mill
- Phase 2 (awaiting approval to restart)
  - Additional Magnetite Circuit Ball Mill
- Phase 3 (PFS)
  - Additional Spiral Lines

Future Expansions

- Capacity limits
  - Mine
    - Equipment
    - Operating areas
  - Concentrator
  - Rail
  - Port

Future Expansions

- Expansion options
  - Additional pits
    - Extensions of current pits
    - Adjacent to current operations
    - Satellite deposits
  - Additional concentrators
    - Modular expansion to current plant
    - Satellite plants
  - Rail expansions
    - Sidings
    - Duplication
  - Port
    - Additional car dumpers
    - Additional ship loaders
    - Additional stockyards

Expansions Evaluation Methodology

- Quantify Cost of Expanded Capacity
  - Multiple options
  - Cost vs capacity curves
    - Capital
    - Operating
- Schedule Multiple Expansions Scenarios
  - Evaluate return on capital
  - Assess expansion risk
  - Select « optimum » expansion
- Extract synergies from plant and orebody characteristics
  - Grinding energy of ore
  - Iron recovery (flow sheet designed for robust recovery)

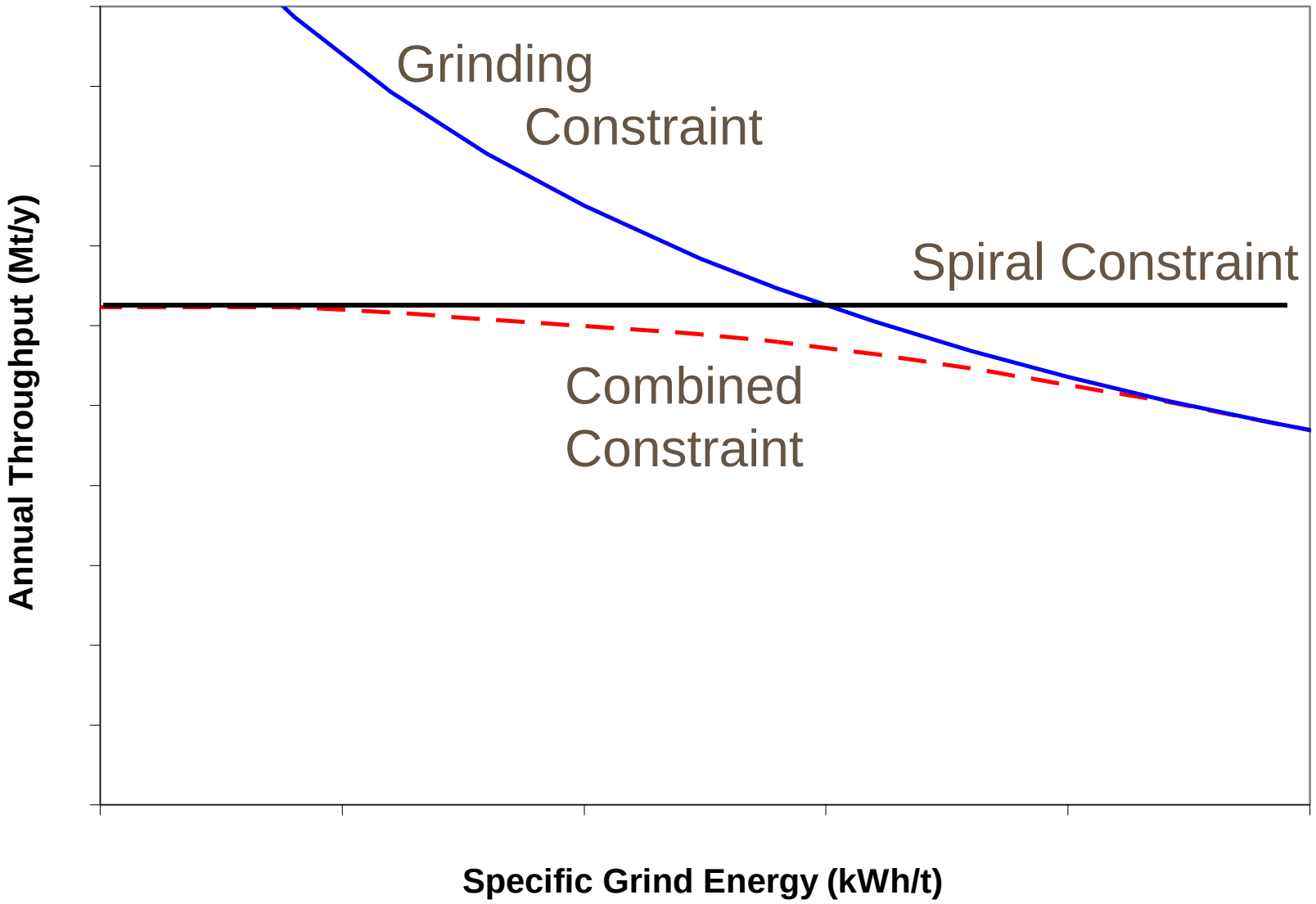
Schedule Optimisation

- Evaluate Pit Development Sequence Options
  - Strip ratio balancing
  - Ore quality blending
  - Infrastructure planning
    - Clustered development
    - Pit-infrastructure interaction
  - Environmental issues
    - Closure
    - Fish habitate compensation
    - Tailings disposal
  - Community

Strategic Mine Planning is Multi-disciplinary

- Driven by constraints
  - Marketing
  - Geological
  - Environmental
  - Community
  - Processing
  - Delivery
  - Infrastructure
- Value Extracted from Synergies
  - Marketing (blending)
  - Processing (blending)
  - Optimisation of value chain
  - Risk assessment/parameter sensitivity

Warning – Constraints Interact!



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CIM – COSMO Lunchtime Seminars, Winter 2011

UPCOMING

January 26th
12:15, Adams, Rm 105

A Case Study on the Impact of Hedging against Foreign Exchange Energy Price Risk

Dr. Margaret Armstrong, Professor at Mines-Paris Tech, Paris

February 23rd

Directions and Challenges of a Prosperous Industry

Dr. Gordon Pealing , CEO, Mining Association of Canada, Ottawa

March 9th

Real Options to Value Mineral Assets based on their Engineering

Dr. Edmundo Tulcanaza, Principal Consultant, Vice Presidency of Development & Sustainability, CODELCO-Chile, Santiago

March 30th

Application of a Particle Swarm Algorithm to the Capacitated Open Pit Mining Problem

Dr. Jacques A. Ferland, Université de Montréal, Département d'informatique de recherche opérationnelle, Montreal

April 13th

Real Time Modeling on Mine Operations Data - Opportunities and, Challenges

Dr. Rajive Ganguli, Professor of Mining Engineering, University of Alaska, Fairbanks, Alaska