ONTARIO RIVERS ALLIANCE

- A Registered Not-for-Profit Corporation
- Advocating for
  - Ontario Rivers at Risk
  - Stakeholders, public & First Nations
  - Open, transparent & accountable process
  - Stewardship of Ontario rivers
- Mission:

  To protect, conserve & restore Ontario riverine ecosystems
- Vision:

  Healthy River Ecosystems

www.OntarioRiversAlliance.ca

The Author

- “ Al” (Alan Hepburn) Ph.D., P. Eng.
- Member, ORA Board of Directors
- Retired technical manager from AECL
- Extensive experience in the nuclear industry in the analysis and design of safety-related control and protection systems
- Airline transport pilot

Overview of Presentation

- Determination based on past data for the industry of
  - Causes of failure
  - Incident frequency
  - Release quantity
- Cleanup
  - Effectiveness
  - Impact – environmental and socio-economic
  - Liability/Responsibility
- Possible mitigating strategies
  - Prevention
  - Monitoring, detection, shutdown
  - Improved oversight

Opposing Positions

- Proponent:
  - Portrays a project with zero environmental risk

    "Our target is zero and we think it is achievable"

  - No data or analysis provided to support this assertion
  - Aggressively suppressed bad news in the past

- ORA Concerns:
  - Threats ignored or downplayed
  - Potential Impacts on environment, communities and local economies
  - Cleanup typically prolonged and ineffective
  - TransCanada's (TC) track record
  - Lack of confidence in oversight
  - Application is incomplete

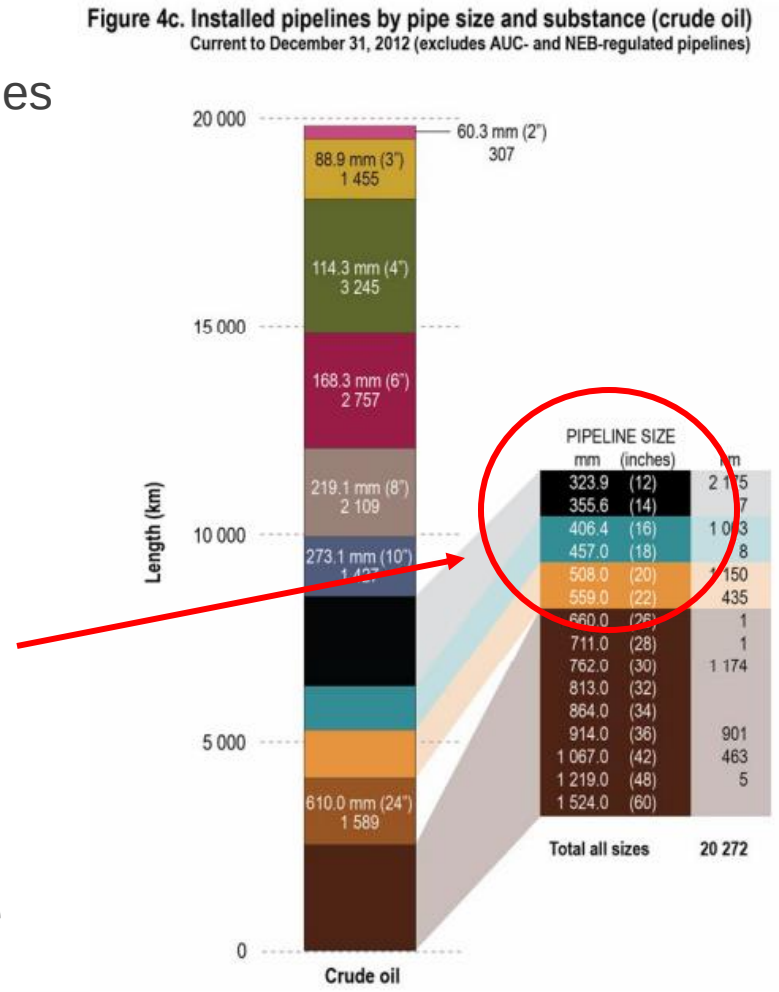
Data Sources

- Informal discussions and correspondence
  - Gary Houston, Vice-President,
    Ontario and Prairies, Energy East Pipeline Project (EE)

1. Database covering pipeline spills of all types in Alberta
2. Alberta Energy Regulator Report 2013-B derived from this database:
   “Pipeline Performance in Alberta,1990–2012”
3. TSB Report P09H0074
   “Natural Gas Pipeline Rupture...Near Englehart, Ontario”
4. TSB Report P95H0036
   “Line 100-3, 36-inch Main Line, Line 100-4, 42-inch Main Line
   Rapid City, Manitoba”
5. ERCB Investigation Report
   “Plains Midstream Canada ULC NPS 20 Rainbow Pipeline Failure”
6. OEB Public Consultation, North Bay, Jan 21, 2015
7. Energy East Pipeline Project – Application

Methodology

- Extract data relevant to the EE pipeline
  - Crude oil release from crude oil pipelines
  - Diameter ≥ 16” (“significant in size”, according to Houston)
  - Releases > 100 m^3
  - Eliminate data before 1990
- Adjust for:
  - Length of EE segment in Ontario (~ 2,000 km vs. ~ 5,200 km of large crude oil pipelines in Alberta, per Fig 4c of the Report)
  - Adjust for longer life (50 vs. 22 years)
  - Allow for existing material
  - Greater diameter of converted pipeline



Relevant Data

Incident #	Ø "	Release m^3	Date	Operator	Nature of Failure
20110906	20	4,500	4/29/2011	Plains Midstream	Girth weld failure – previously repaired pipe
19930314	24	2,581	2/4/1993	Rainbow	SCC and corrosion
19931263	24	2,232	7/18/1993	Rainbow	SCC and corrosion
20062487	24	1,200	10/10/2006	Rainbow	SCC and fatigue
20030528	24	350	3/2/2003	Cold Lake	Joint failure
20021635	36	270	7/6/2002	Syncrude	Pipe failure
19910420	16	250	3/10/1991	Federated	Pipe failure
19992067	24	150	9/10/1999	Rainbow	Damage by others

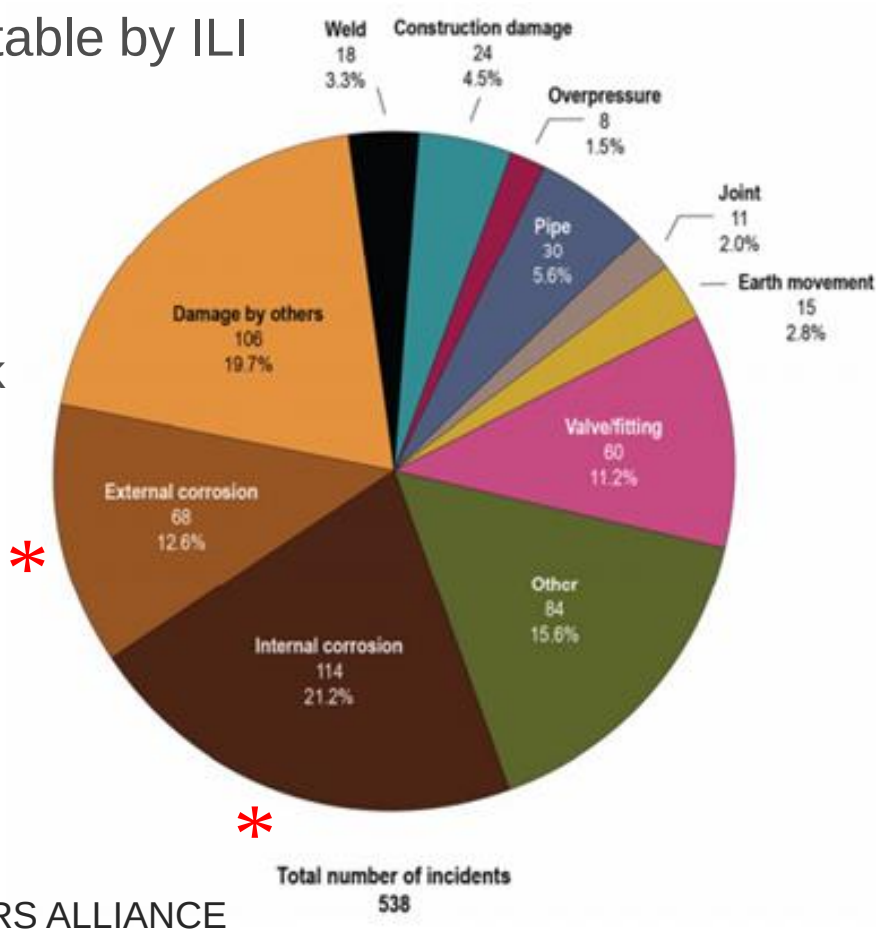
- A 42” line is pushing the envelope

Expected Release Incidents

- Over 22 years, with current technology:
  - Expect 8 releases per 5,200 km of pipeline
- Equivalent figure for the EE segment in Ontario over 50 years:
  - Expect (8 x 2200/5200 x 50/22) 7 releases
- What effect will new technologies have on leak detection?
  - TC would use “smart pigs” (ILI)
    - In-pipe sensor identifies corroded locations and pipe deformation
    - Scans every few years
    - Purports to identify defects before they become leaks
    - ILI technology has been around since the 80’s, as has cathodic protection
    - Recent advances improve SCC detection
  - Not all leaks are due to defects detectable by this technology
- Defect detection will not be anything like 100% effective

Causes of Failure

- Only 33% of all releases are potentially detectable (* below)
  - That's 2.6 of our predicted 7
- Many mechanical failures not detectable by ILI
  - Latent fatigue failures undetectable
  - Minimal defence against unauthorized digging (e.g. event # 7 in the Table)
  - No defence against malicious attack
- Assume recent ILI advances detect half of that 33% (1.3)
- That leaves 5.7 leaks over a 50 year period



*

*

Effects of Aging

- Database does not contain information on age of the pipe
- Pipe to be converted has already been in the ground for 20 to 40 years, excluding a short new section east of Cornwall
  - At least 5% is polystyrene wrapped, which is known to be prone to SCC
- Metal fatigue
  - Assessed cause of incident #20062487
- Condition of existing repairs
  - Assessed cause of incident #20110906

Other Hazards Not Addressed

Malicious Attack

- Given the capabilities of modern GPS, it would be very easy to stage simultaneous attacks on several sites across North America
  - Have not adjusted my figures for this, but the threat is real

Seismic Analysis

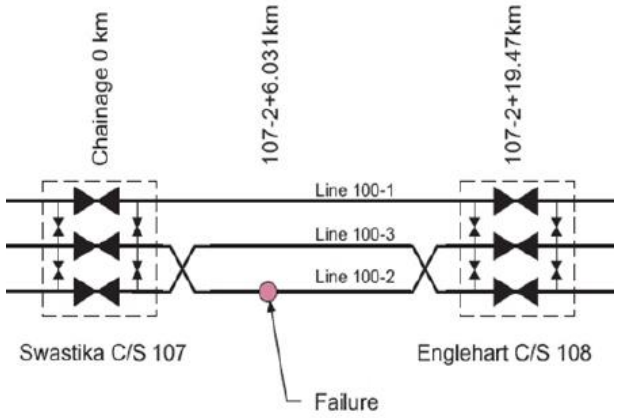
- Ottawa and St. Lawrence River valleys are in known earthquake zone

Adjacent Pipelines

- Proximity to aging gas line presents an additional hazard
  - 2 or 3 lines running side by side
  - Will now look at the track record of the existing pipeline to be converted

Track Record of the Line in Question

- Adjacent 100-2 line ruptured near Englehart, Ontario in 2009
- Resulting explosion "uncovered" the 100-3 line, which was visually inspected and returned to service



- Application does not consider the co-location hazard

Co-Location Hazard

- Line 100-4 ruptured near Rapid City, Manitoba, in 1995
- Explosion and fire ruptured the 100-3 line an hour later
- Explosion took out communications and SCADA gear for all 6 lines at this site
  - Neither the local operator nor the ROC could effect the desired shutdown
  - ROC eventually succeeded in shutting down using the station 110 km further up the line in Saskatchewan
  - Inferno continued for 2 hours
- Design was assessed as not being fail safe
  - How effective was the imposed corrective action?
  - No sign that it affected the design near Engelhart, 14 years later

Predicted Incident Frequency

- I have made no allowance made for:
  - Malicious attacks
  - Adjacent lines/co-located equipment
  - “Pushing the envelope”
- Adjacent lines/equipment is a significant problem
  - No standards or industry guidelines governing lateral separation
  - Retroactive application of such a standard could be a showstopper
- For aging pipe etc., have assumed a 20% increase to 6.8
- Conclusion:

The Ontario section of the EE Pipeline will experience approximately 7 release incidents of 100 m^3 or greater over a 50 year period

...and these other hazards should be looked at

Predicted Release Volume

- Database average volume for the 8 releases listed: 1,441 m^3
- Average diameter of the pipelines: 24”
- EE pipeline: 42” diameter – 3 times greater area
- Average predicted spill volume: 4,300m^3
- According to Mr. Houston:

“One could calculate a volume of about 250 m^3 per incident”

“Our leak detection system has a specification of detecting 1.5% of the flow rate within 2 hours”

- A 1.5% leak of a 42” pipe would release 220 m3 over 2 hours
- Why the difference?
- A leak must not only be detected – it must be stopped

Why Are The Leaks So Large?

- ERCB Investigation Report:
  - The 4,500 m^3 spill on Plains Midstream pipeline in 2011 took 8½ hours to make the decision to shut it down
- Clearly, it was a much bigger release rate than 1.5% of full flow
  - A 20” pipe releasing 1.5% for 8½ hours would only account for 360 m^3
  - To release 4,500 m^3 in this period, they must have had a 33% break
  - Yet, even for a large 33% break, it took 8½ hours to reach the shutdown decision
- Concluded:

“the Plains’ alarm response protocol...”
exhibited a
“potential bias towards inaction”

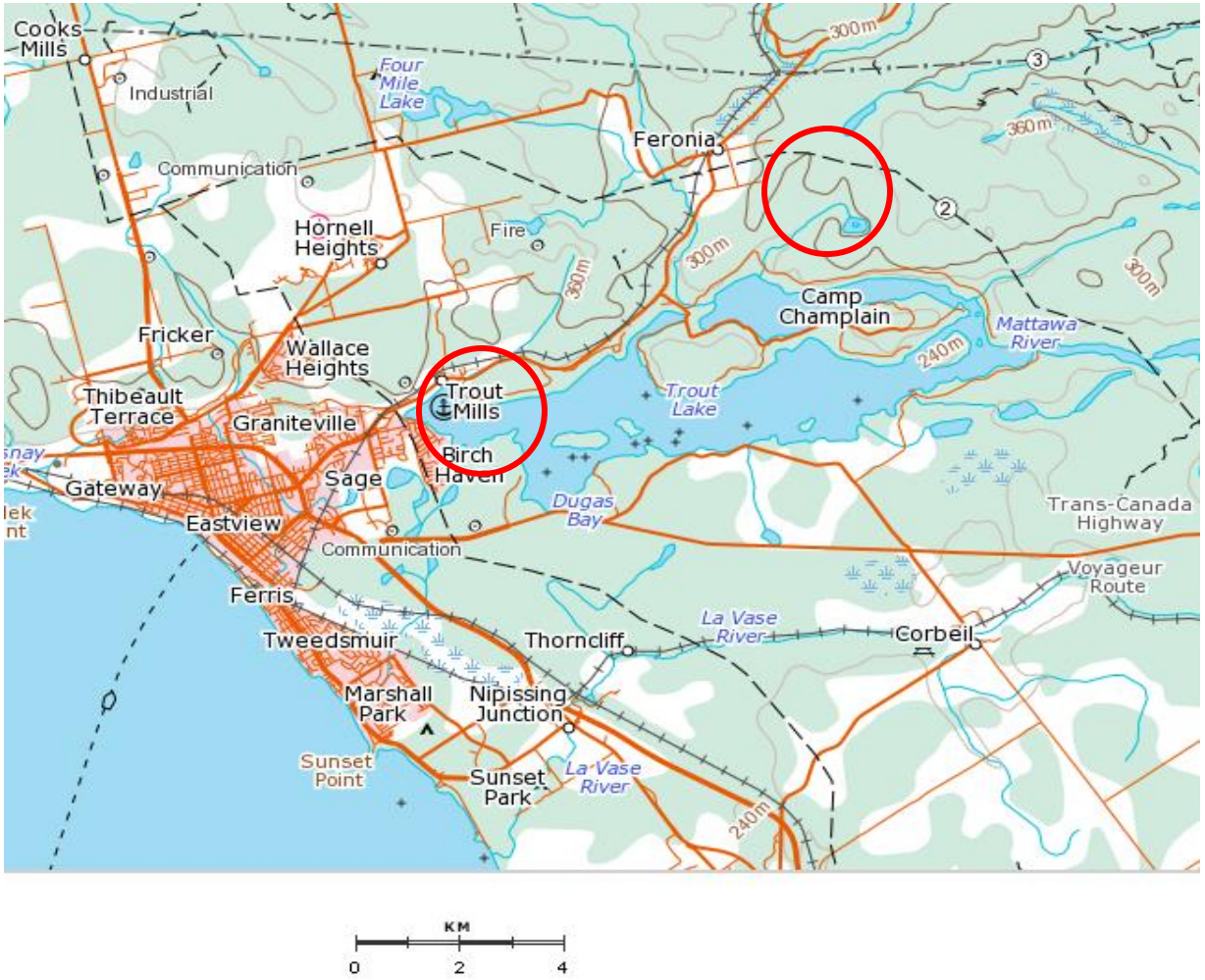
Spill Cleanup

- Pipeline route frequently crosses or lies adjacent to major rivers or their tributaries, lakes, wetlands, aquifers, etc.
- Cleanup can take years or never
  - Remote locations, ice covered rivers
- Average recovery for the 8 large spills in the database was 27%
- Remainder could wind up in rivers and aquifers to
  - Contaminate drinking water sources
  - Adversely affect entire ecosystems for the indefinite future
- Released dilbit tends to separate into diluent and crude
  - Lighter dilbit evaporates, and can threaten early cleanup responders
  - Heavier crude settles and is difficult to remove from the beds of watercourses and aquifers

Example of Area at Risk

Trout Lake, North Bay ON

- *"The City of North Bay obtains its municipal water supply from Trout Lake, a high quality surface water source"*



Mitigation Measures

- Leak Prevention:
  - Improved containment (double walled pipe or laid in a concrete trough)
    - Double walled pipe has been used in the Arctic and in the North Sea
    - Why has it not proved more effective?
  - Shut off valves before and after all water crossings
  - New standards to increase lateral separation of gas and crude pipelines and control/pumping equipment
  - 5% older technology pipe is replaced with epoxy coated pipe
  - Fail-safe design
- Monitoring/Detection/Shutdown:
  - Improved detection technology is just a small part of the answer
  - Design/Operator training emphasize importance of prompt shutdown
    - Training “Biased towards action”, and/or
    - Automate shutdown, make design fail safe
- Confirmation of corrective actions:
  - Independent assessment of compliance with recommendations and policy

And Now...the Bad News

- The frequency and volume of releases are a major concern, but
- So far we have only looked at releases for the oil line in isolation
  - Pieced together from the best old material already in the ground
  - Built within 10 metres of a gas line which has a track record of reliably exploding every few years
  - Aging gas line(s) can only worsen their track record
- Some of these explosions will take out the oil line
  - That wouldn't be a 1.5% release – it would be a major rupture
- What are the impacts of a combined oil and gas fire?
- Is this really a good idea?
- There are no standards for adequate lateral separation
- A safe separation for oil and gas lines must first be determined
  - Only then can the viability of the project be re-assessed
- Implications on the existing network should also be thought through

Conclusion

- Proponent underestimates both the frequency and size of releases
  - ORA estimates about 1 major release every 7 years from the converted line
  - Does not include adjustments for many obvious hazards
- Examine alarm response timeline to predict a realistic release volume
  - Manual intervention will always tend towards procrastination, given the economic impact of shutting down the line
- Examine the implications of co-located lines/equipment
- Only regulatory pressure will ensure adequate mitigation measures
- Need independent third party monitoring to ensure committed procedures and corrective actions are followed
- Proponent liability for all releases, and responsibility for cleanup and decommissioning must be secured up-front

Really?

www.OntarioRiversAlliance.ca

Yet Another Unassessed Hazard

- As a flight instructor, guess where I tell my students to land if they have an engine failure departing to the south?

North Bay Airport

- This one is an airline terminal!

Another Failure

- Marten River, ON
  - 26 Sept. 2009
  - 2 weeks after Englehart
- Line 100-1 failed due to:
  - Manufacturing defect
  - Degradation of protective coating
  - High cathodic protection current
  - Pressure reversal when repaired line at Englehart was being returned to service
- No fire
- Lines 100-2 and 100-3 unscathed