

Risk Assessments for Fire and Life Safety

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What is a Risk Assessment?

*** Tool used for decision making ***

- Systematic, defensible, measures the likelihood and impact of an event:

RISK = (probability) x (consequence)

Qualitative Risk Analysis

- Useful for simple subjective analysis, or if doing comparative analysis
- Generally won't include quantifiable data; does not give quantifiable results!

Likelihood ↑	Very likely	Medium 2	High 3	Extreme 5
	Likely	Low 1	Medium 2	High 3
	Unlikely	Low 1	Low 1	Medium 2
	What is the chance it will happen?	Minor	Moderate	Major
		Impact →		

Qualitative Risk Analysis

Ideal for “consensus” type analysis

Impact and likelihood are generally very poorly defined, or simply comparative

“Acceptable” risk is subjective and dependent on the analyst

Qualitative Analysis Example

Train derailment with a municipality

Likelihood:

- **“infrequent”**
- Subjectively more likely to occur at high speeds, curved rails, low-quality tracks, at-grade crossings

Consequence:

- Is anyone likely to die or get injured?
- How much damage would be caused?
- **“major”**

Qualitative Analysis Example

- What does “medium” risk mean?
- What additional information is needed?

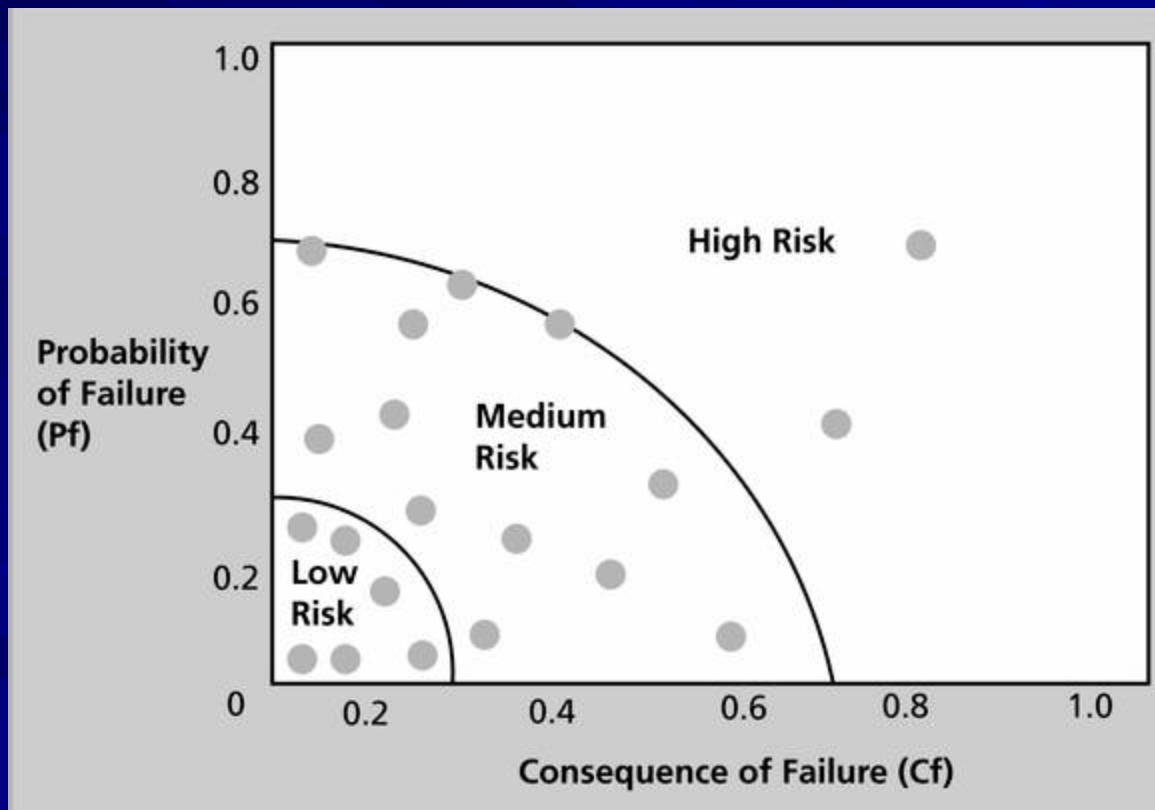
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	Likely	Low 1	Medium 2	High 3
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What is the chance it will happen?		Minor	Moderate	Major

Likelihood ↑

Impact →

Quantitative Analysis

- Applies discrete data to calculate risk



Quantitative Analysis

$$\text{RISK} = (\text{probability}) \times (\text{consequence})$$

Probability is generally simple to quantify (i.e. statistical analysis)

Consequence can be expressed differently:

- Lost Time/Productivity
- \$ Cost
- **Fatality**

Consequence Analysis

What events are being considered?

- Radiant heat exposure (fireballs, jet fires)
- Overpressure blast (explosions)
- Toxic exposure

What are acceptable limits of exposure?

– What is your risk tolerance?

Consequence Analysis

How does
environment impact
consequence?



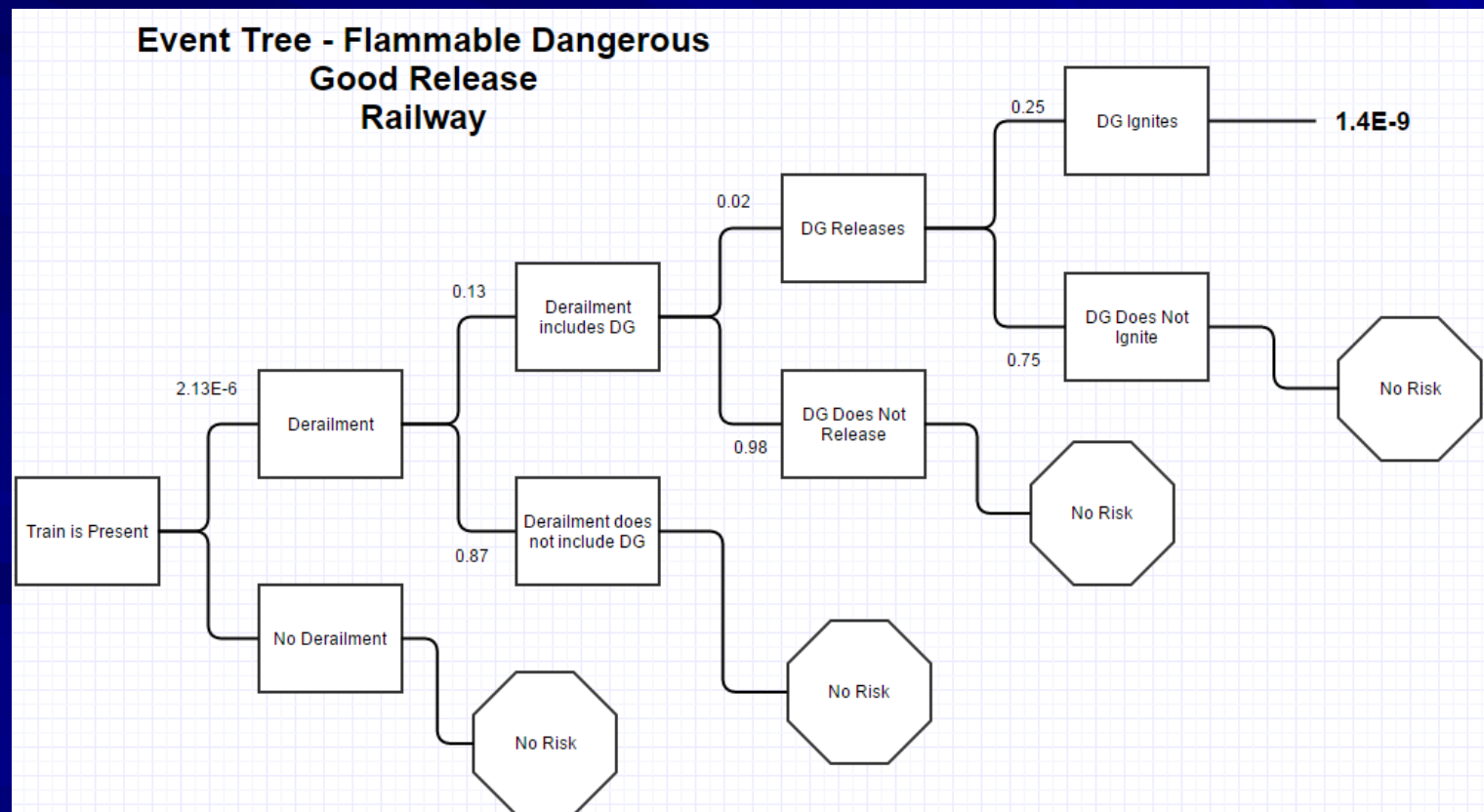
Gainford Derailment – Parkland
County Fire Services

Dispersion Modeling



Probability Analysis

Probability of an outcome is the product of all events leading to that outcome (event tree)



Quantitative Analysis

Quantitative analysis provides a repeatable methodology to evaluate risk of numerous events

Quantifies risk

“Low” vs “once every 1,000 years”

Provides for cumulative risk

RA for Land-Use Planning

Quantitative analysis provides a means to compare risk, and decide whether development is “safe”

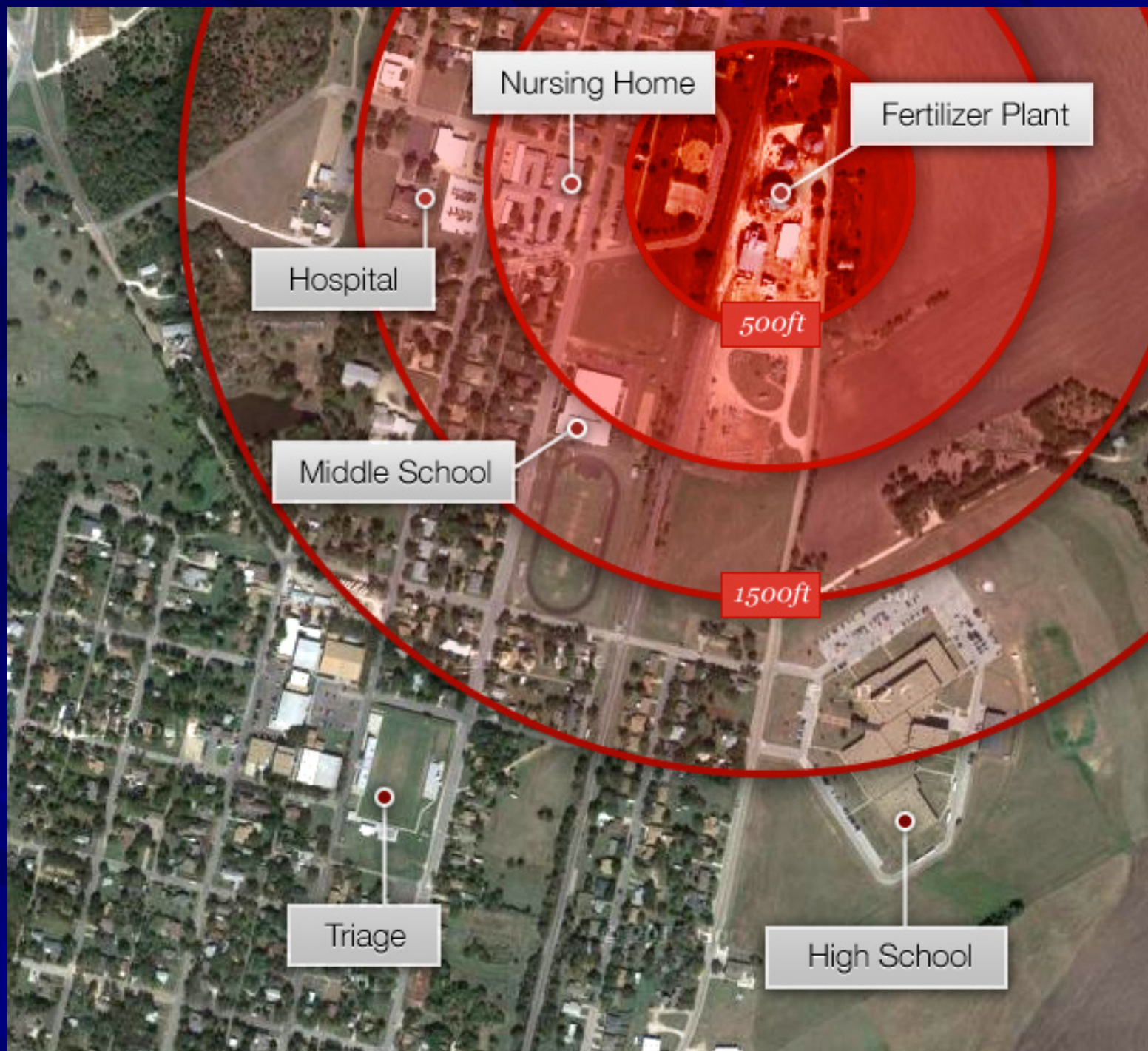
Procedure is repeatable, defensible

Essential for building public policy based on risk

West, Texas 2013

Fertilizer storage facility explosion killed 15,
injured 262





Nursing Home

Fertilizer Plant

Hospital

500ft

Middle School

1500ft

Triage

High School



Lac-Megantic 2013

MM&A crude oil tanker derailment; 47 dead,
over 30 buildings destroyed



AVANT



APRÈS



Etobicoke, 2003

Natural gas line ruptured after it was improperly located/marked and struck by construction backhoe

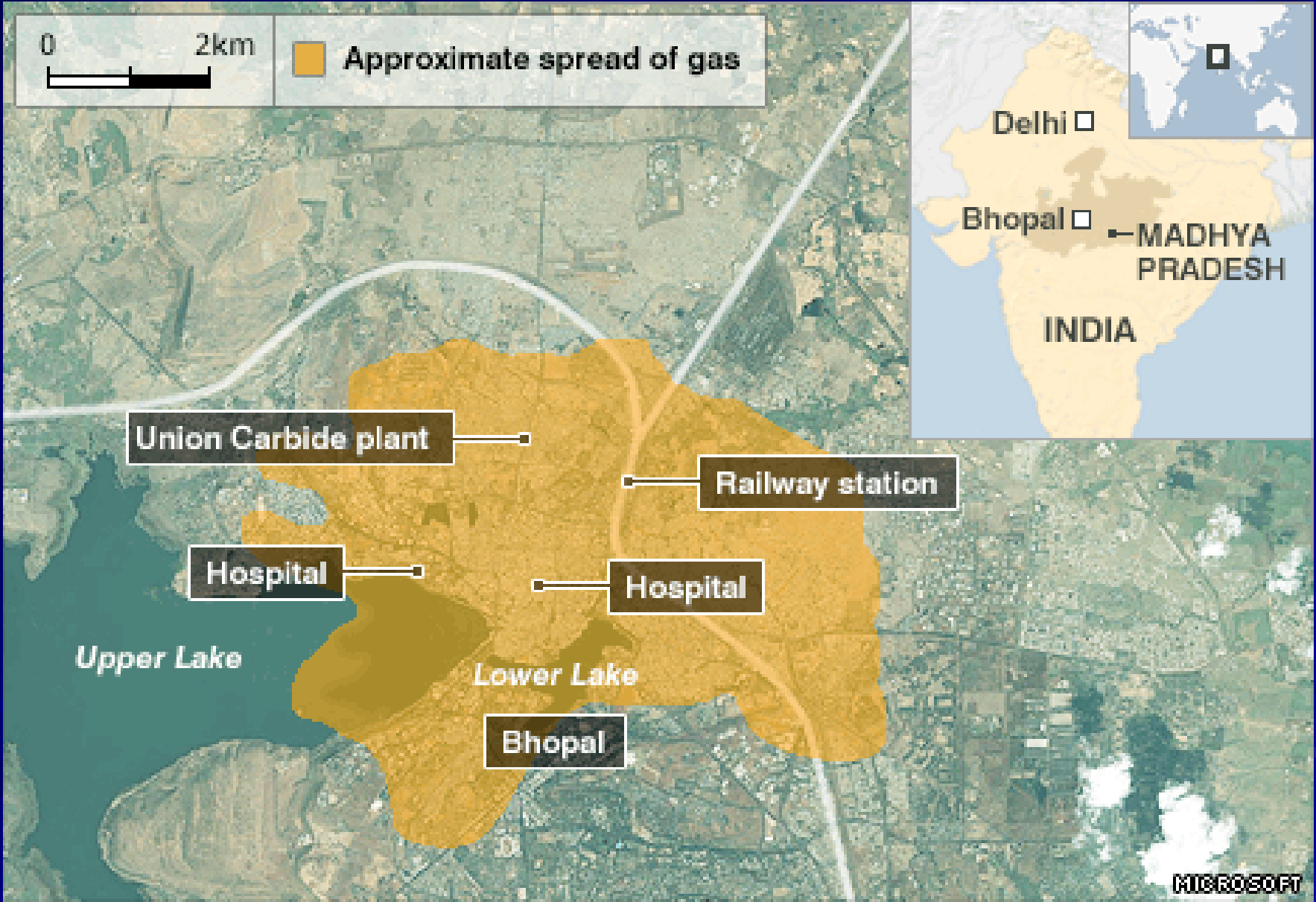
Seven people died, destroyed adjacent 2-storey building

Bhopal, India 1984

Union Carbide pesticide plant

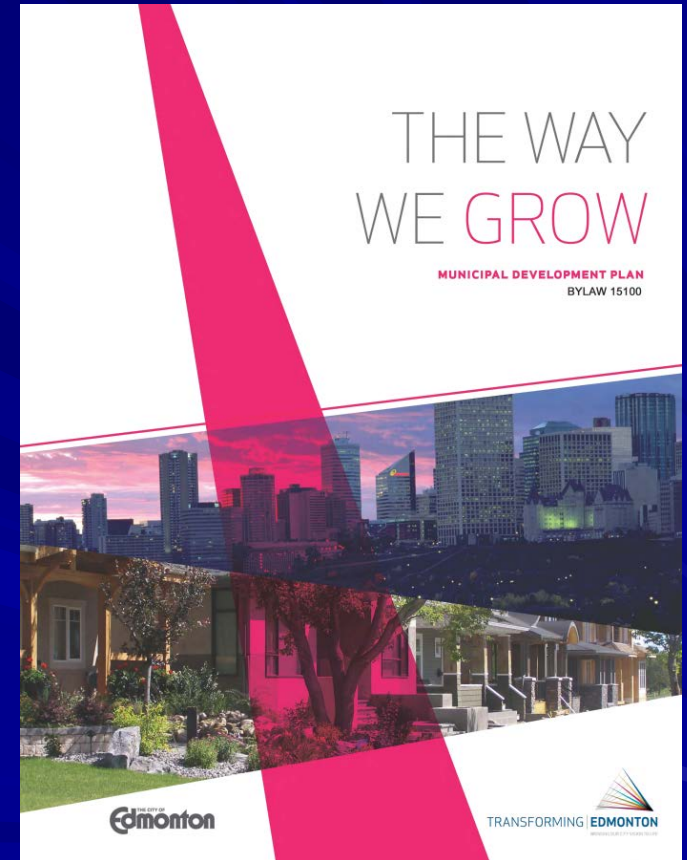
Chemical leak resulted in over 500,000 people being exposed to toxic gas (methyl isocyanate)

Sudden death toll was 2,259 (estimated more than 16,000 fatalities)



Risk Policy - Edmonton

- Municipal Development Plan
 - *Address adequate transition between industry through risk management principles of risk reduction, preparedness, response, and communication*



What is Acceptable Risk?

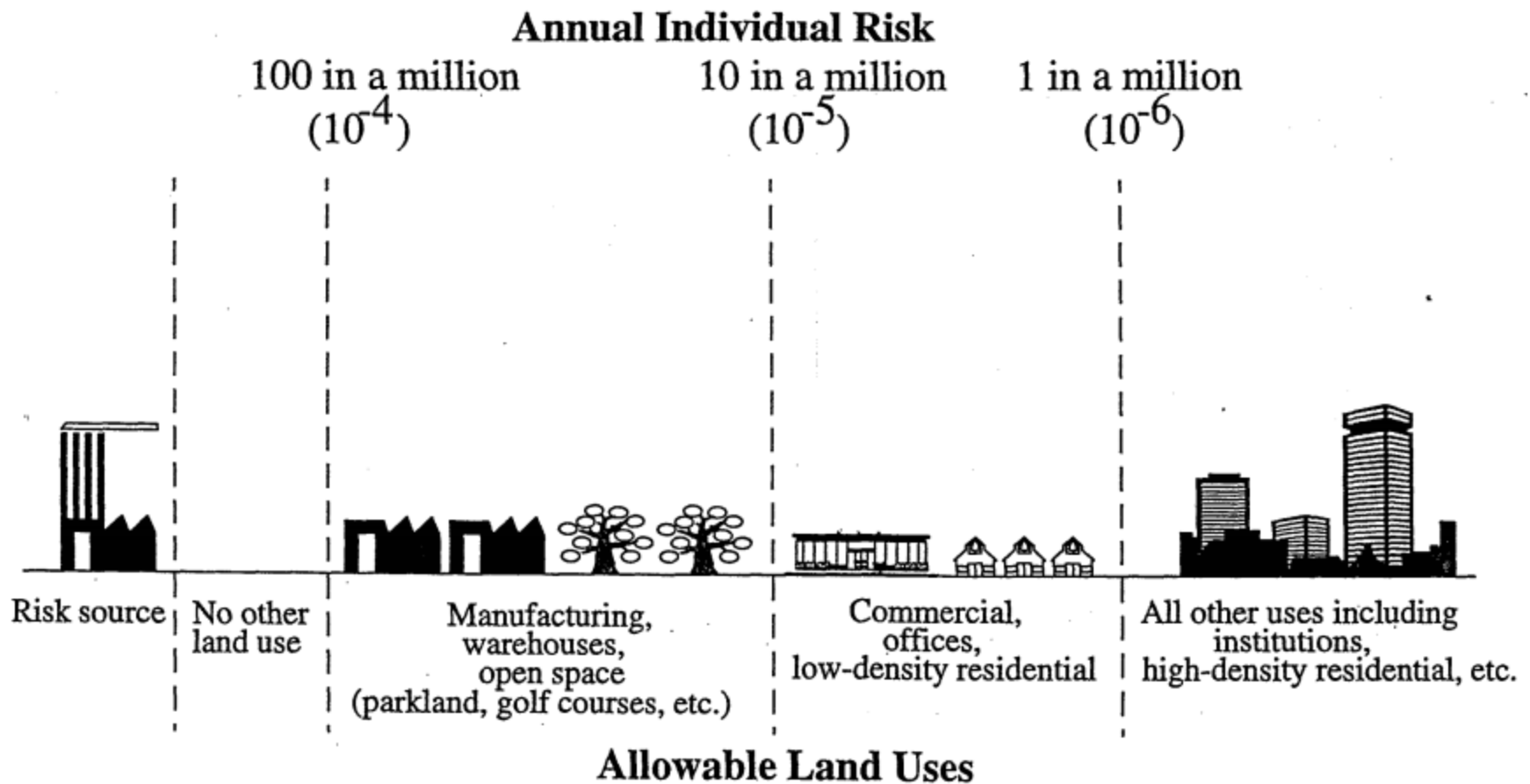
Major Industrial Accidents Council of Canada (1987) – established to reduce the frequency and severity of accidents involving hazardous substances

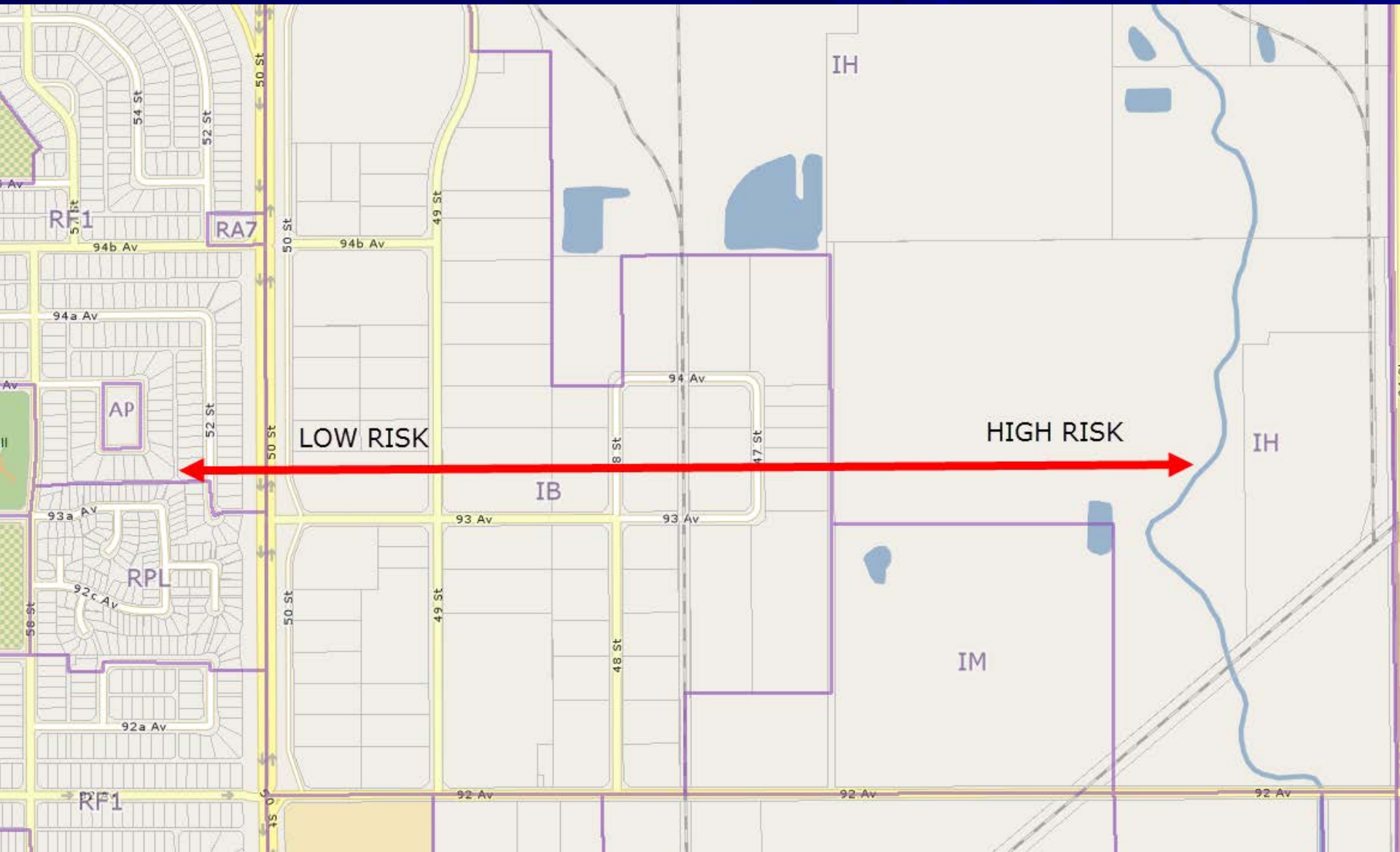
Major contribution included a national consensus on “Acceptable Risk”

Referenced by COE in Zoning Bylaw 14.6

MIACC Acceptable Risk

Figure 2: MIACC Guidelines for Acceptable Levels of Risk





LOW RISK

HIGH RISK



RF1

RA7

94b Av

94a Av

52 St

50 St

94b Av

49 St

94 Av

8 St

17 St

93a Av

52 St

50 St

93 Av

49 St

93 Av

48 St

56 St

92c Av

50 St

49 St

48 St

93 Av

48 St

92a Av

50 St

49 St

48 St

93 Av

48 St

RF1

50 St

49 St

48 St

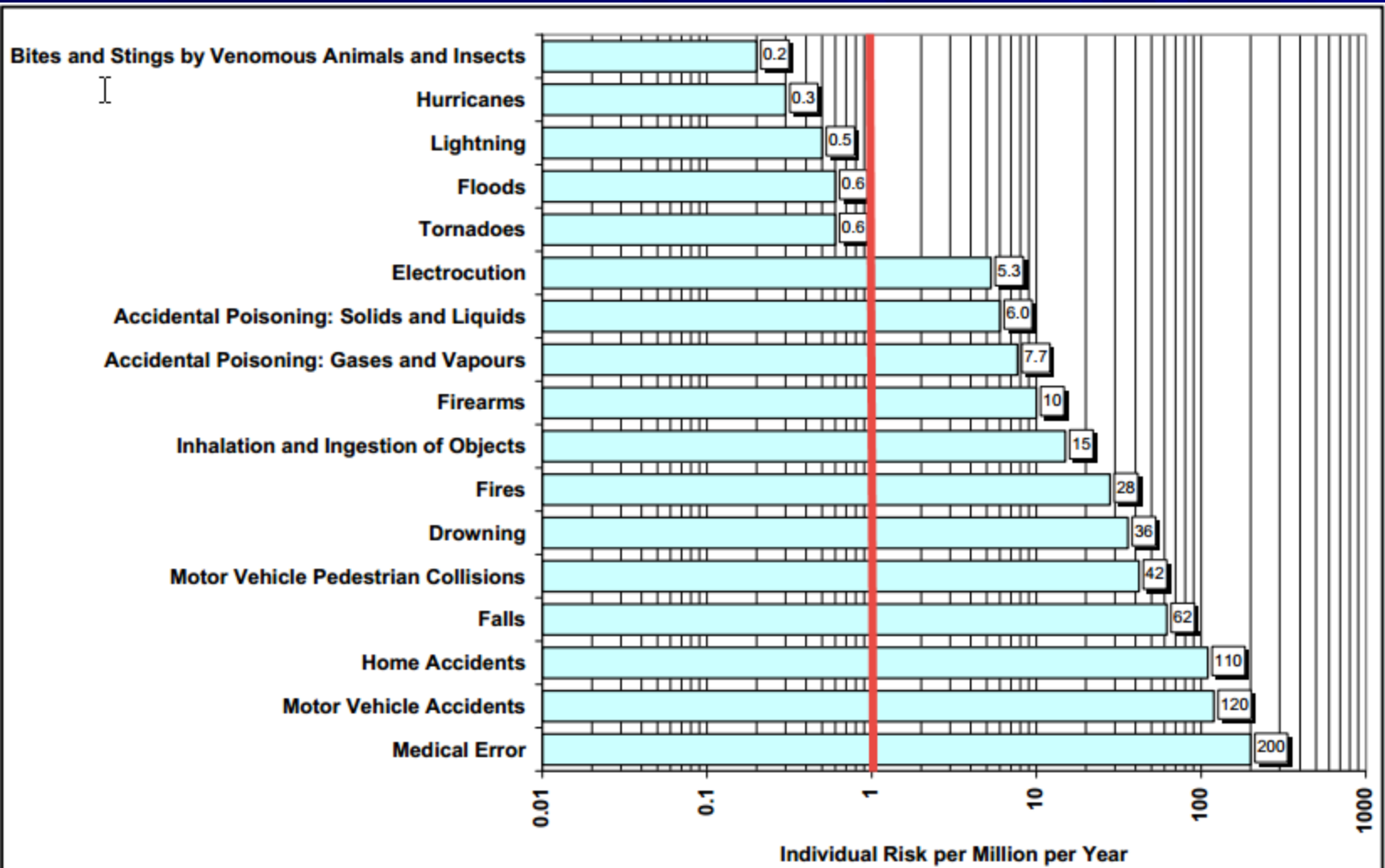
93 Av

48 St

92 Av

92 Av

Comparative Individual Risk



Complexities with RA

Simplified analysis gives simplified results

- Conservative assumptions lead to greater risk
- Detailed statistical data may not be available

Societal Risk

- Individual risk does not account for population density or sheltering characteristics of development

Complexities with RA

How is existing risk reasonably mitigated?

- Barriers, berms, obstructions
- Evacuation plans, limits of exposure
- Refuge areas, building construction
- Changes in process

What is the impact of subjective mitigation?

- Education
- Communication

Municipal RA in Practice

Bercha Report 2010 studied three areas within COE, using a quantitative, cumulative risk analysis

Provides insight on “acceptable” land use as well as areas to concentrate prevention/mitigation

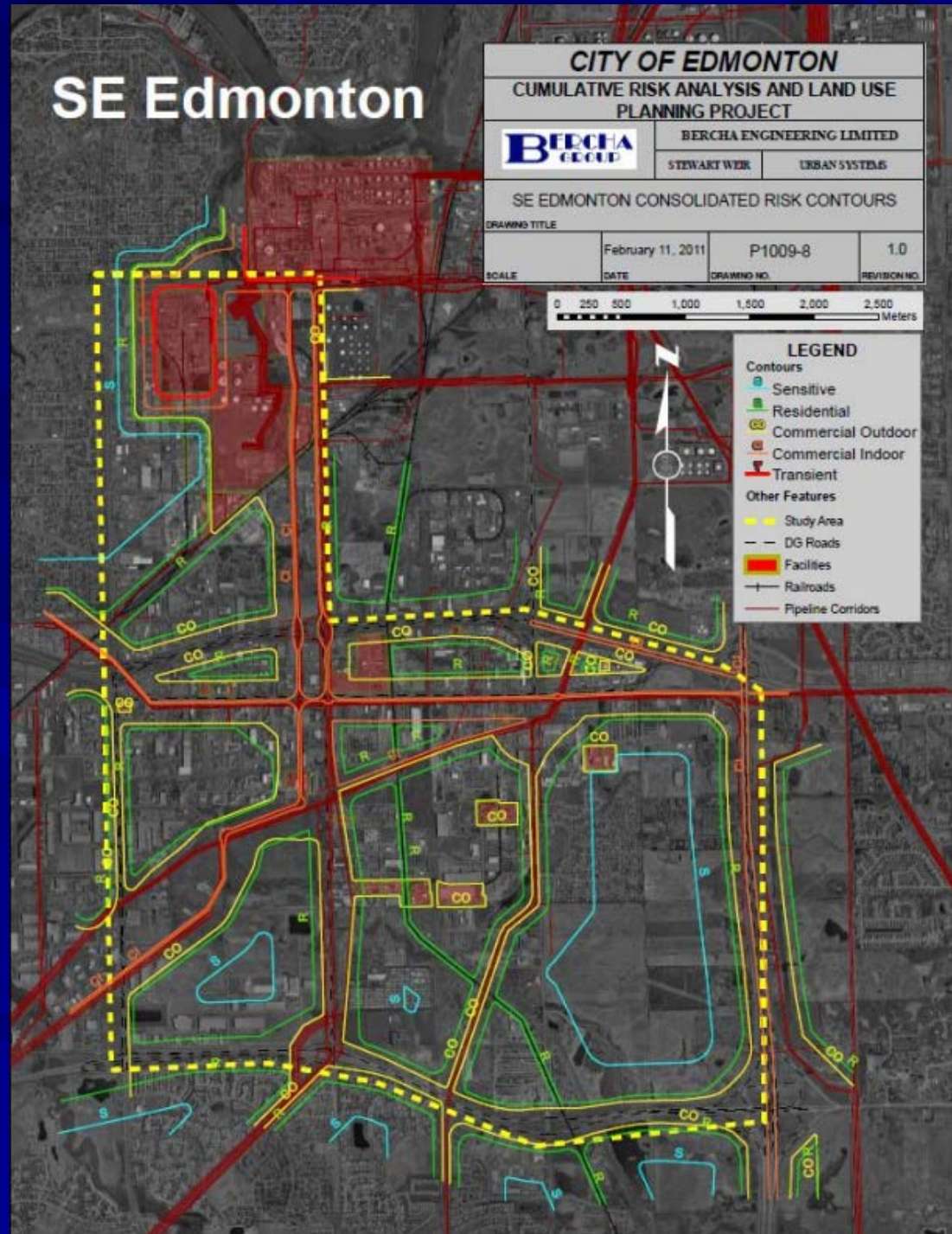
Bercha Report

Fatality Scenarios:

- Explosions (overpressure waves)
- Fireballs (radiant heat exposure)
- Toxic gas clouds

Risk Sources:

- Industrial Sites
- DG Routes
- Railways
- Pipelines





Questions?

