CONSEIL pour la RÉDUCTION
des ACCIDENTS INDUSTRIELS MAJEURS

Industrial Risk Management and Land Use Planning

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President - CRAIM

OUTLINE

- CRAIM Overview
- CRAIM Tools & Expertise
- Land Use Planning (LUP) & Risk Management
- CRAIM Methodology & Proposal
- Key Takeaways

WHO ARE WE?

Non-profit org., created in 1996; as a regional organization for the Montreal area of the MIACC

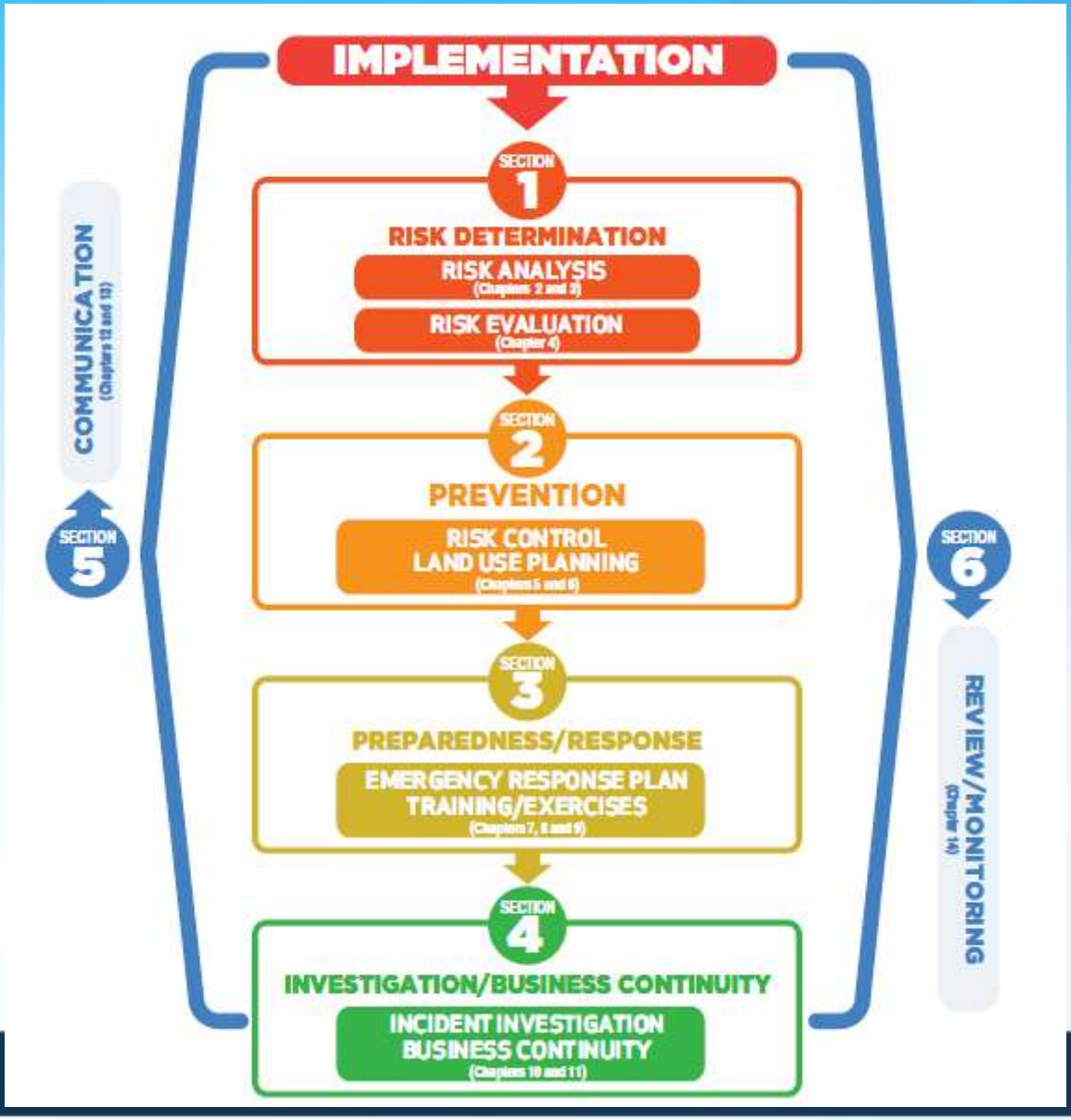
To be the benchmark in hazardous substance risk management, within the scope of sustainable development, by:

- DEVELOPING rigorous tools and methods,
- PROMOTING and supporting a culture of collaboration between all stakeholders,
- FOSTERING a reduction in the risks through the implementation of appropriate prevention, preparedness, response and recovery measures.

RISK MANAGEMENT GUIDE

- First publication – 1996
- Last edition (8th) - 2024
- Aligned with UNEP's APELL Program
- Received the « Mérite québécois de la sécurité civile »
- Referenced in the Technical Guidelines for the Environmental Emergency Regulations

CRAIM RISK MANAGEMENT PROCESS



Aligned with
ISO 31000:18

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OTHER TOOLS

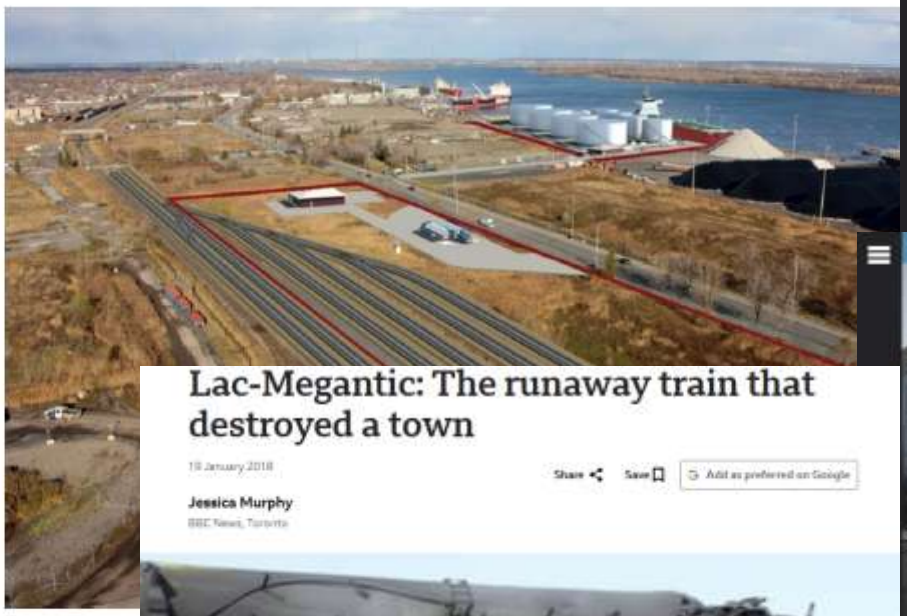

Safety Barriers
The Bow Tie
Vision and Mission of the CRAIM


ALLIANCE FOR THE SAFE MANAGEMENT OF HAZARDOUS SUBSTANCE
A.S.M.H.S.
CRAIM
WORKING DOCUMENT
Recommendations for the safe management of hazardous substances


INFO CRAIM

LUP NEAR TECHNOLOGICAL HAZARDS

Montréal-Est: le projet de terminal de carburant n'est plus le bienve



Vue aérienne du deu
Photo: Gracieuseté,

Lac-Megantic: The runaway train that destroyed a town

19 January 2018

Share Save Add as preferred on Google

Jessica Murphy

BBC News, Toronto

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LUP CHALLENGES

→ Major accidents in the past few years with significant impacts on people and property (e.g., Sunrise Propane, Mégantic, Beirut) have increased the fear of additional accidents occurring near facilities with dangerous substances;

→ Industrial and residential projects (e.g., LNG and oil terminals, pipelines, and new residential developments) are raising concerns, leading to public mobilization;

→ Land availability (brownfield) and densification of municipalities increase the likelihood of encroachment between industrial, commercial, and/or residential areas;

→ These new projects are evaluated on a case-by-case basis, which prolongs and complicate the review and approval process;

INITIATIVES IN LUP& RISK Mgt.

- Joint workshops - CRAIM/ASCQ/RECO, 2007;
- Presentation at the Colloque de sécurité civile, 2008;
- International seminar in Montreal, 2009;
- Workshops with the CIRT (Comité interministériel sur les risques technologiques);
- Publication of the Ref. document on LUP, 2013;
- Alliance for the safe mgt of hazardous substances: Recommendations (2014)
- CSA Z663:18 (from the CSA Plus 663 (2004))
- Various municipal legislations and guidelines regarding LUP
  - ✓ Metropolitan Land Use & Dev. Plan (PMAD)
  - ✓ Qc Government LUP guidelines (OGAT)
  - ✓ City of Val d'Or, 2014-24 Bylaw
  - ✓ Construction Code (chapter B-1.1, r. 2) (CSA B149.2)

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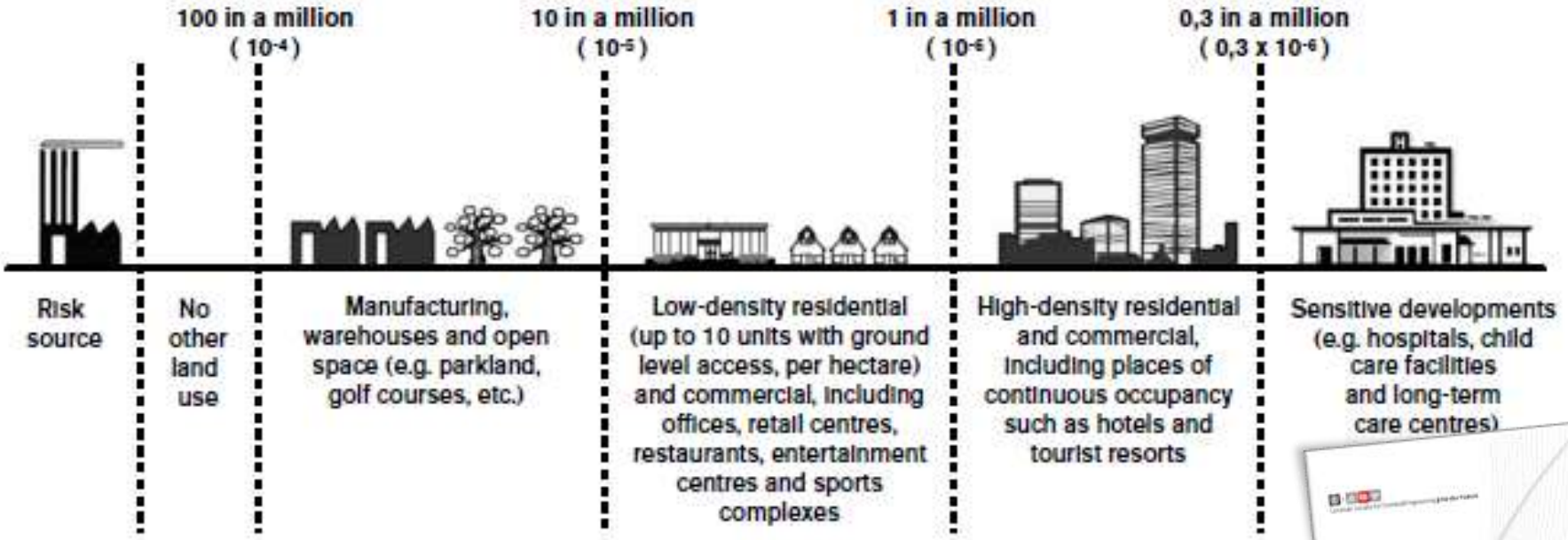
LUP CRITERIA

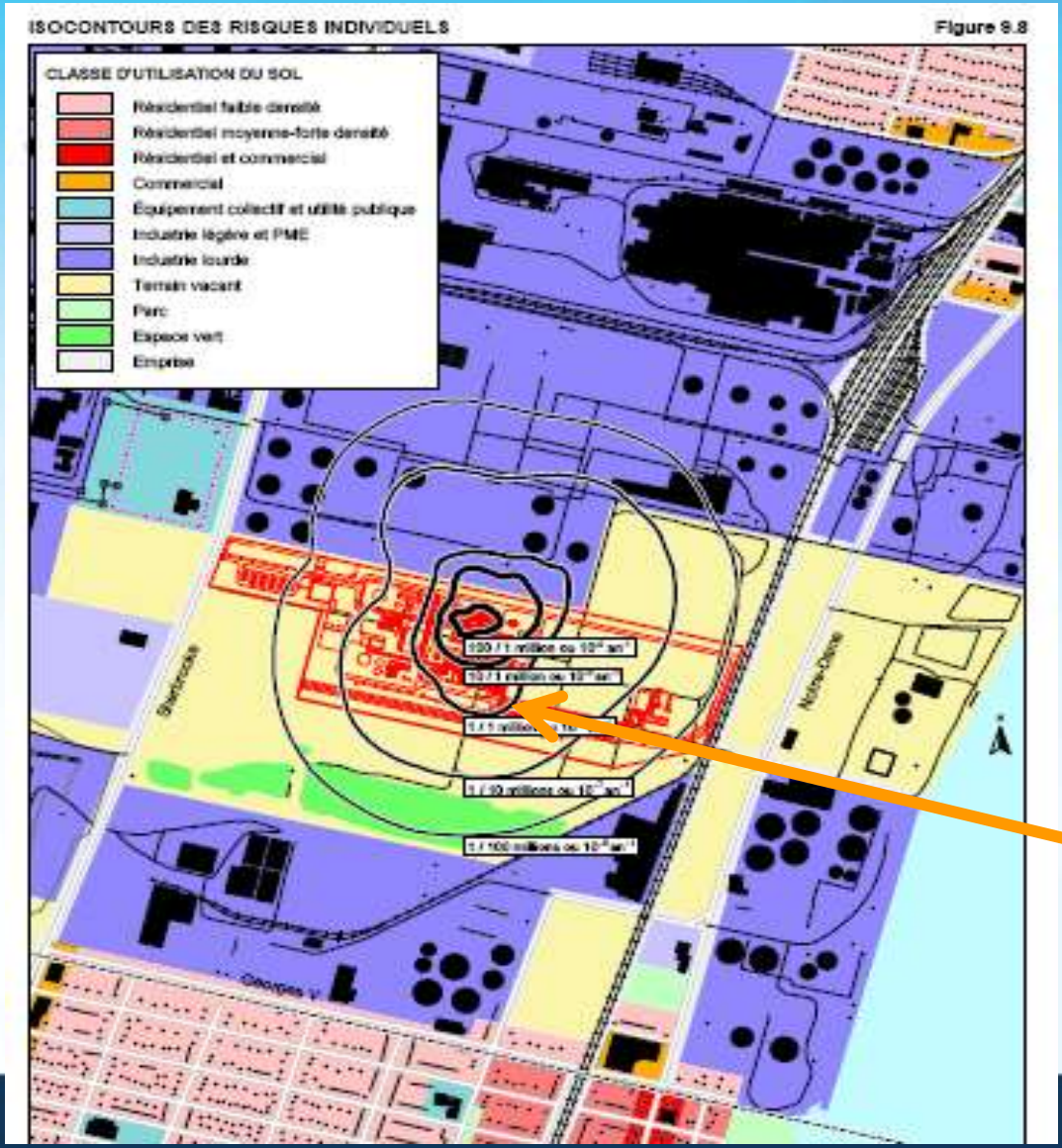
MIACC criteria for acceptable levels of risks as a function of land use [6]

Annual Individual Risk



Allowable Land Uses

QRA – INDIVIDUAL RISK CONTOURS



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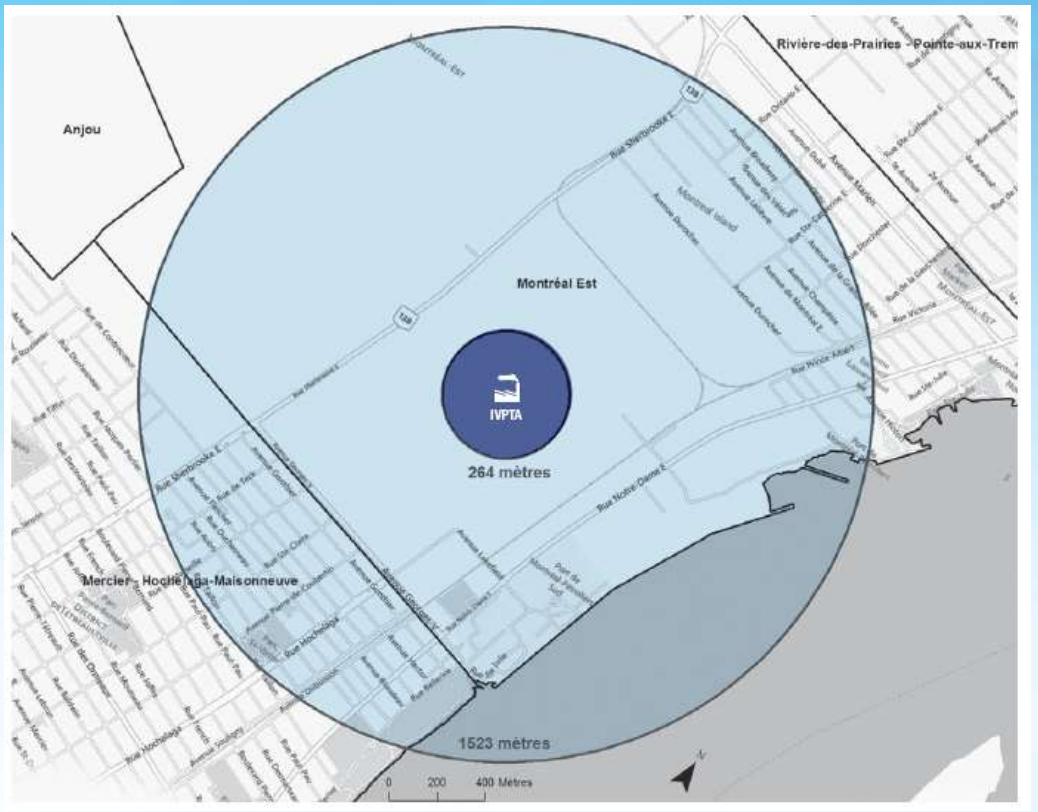
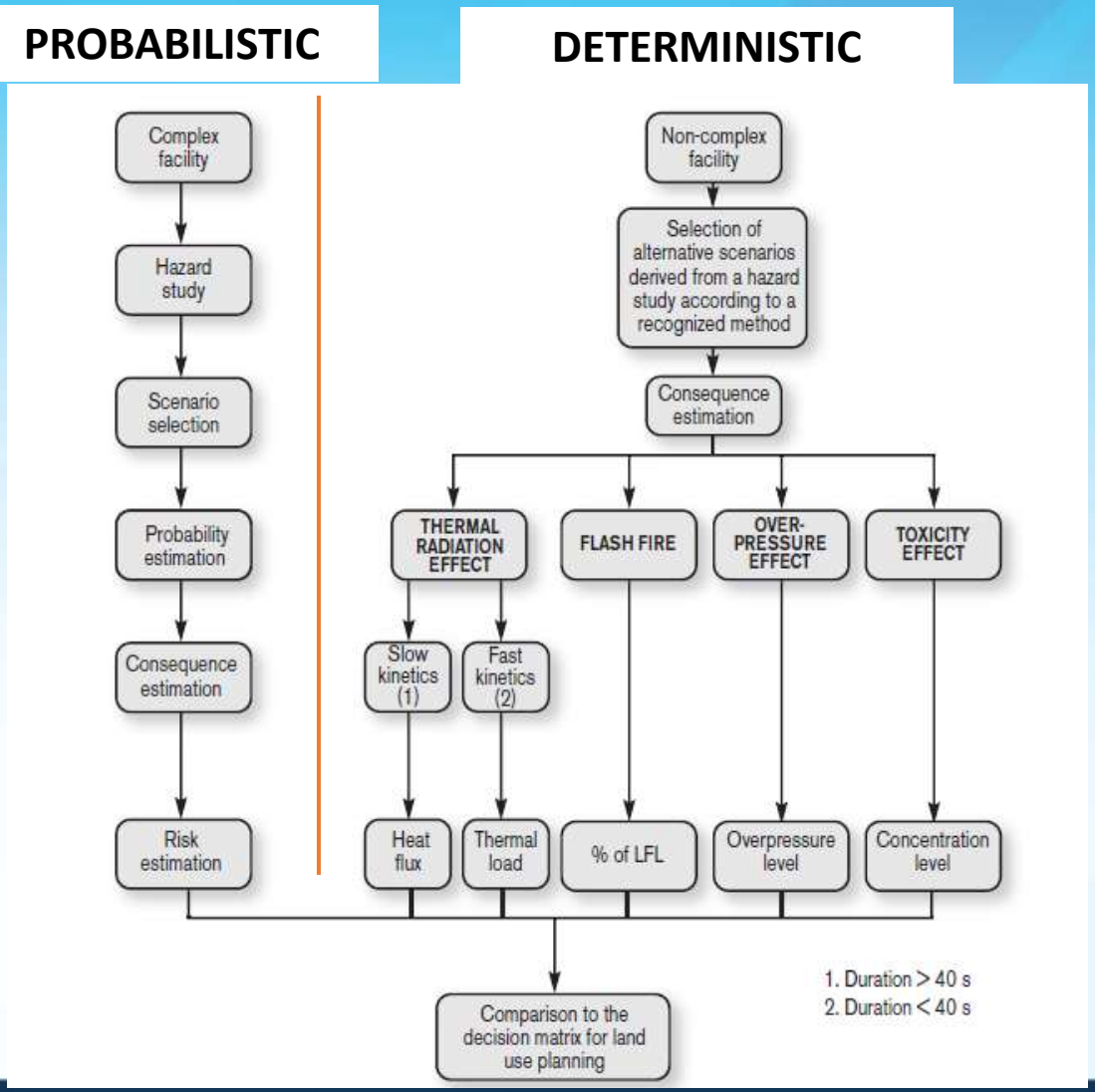
EMERGENCY PLANNING ZONES

Effect	Guideline
Inhalation (Toxic)	AEGL-2 (1hr)
Heat Radiation	5 kW/m^2
Overpressure	1 psi
Flammable Vapor	LFL/LEL

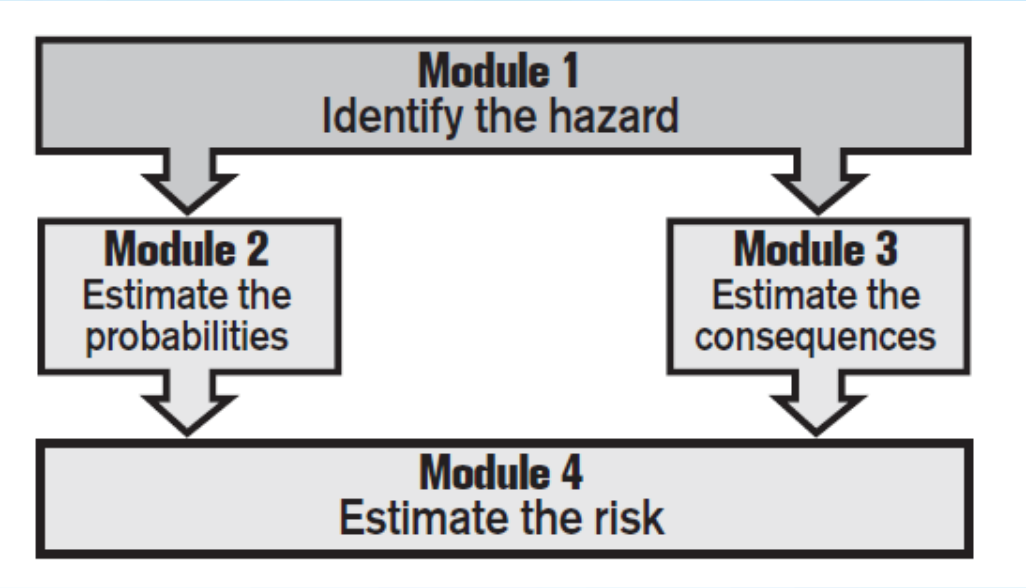


PROPOSED METHODOLOGY



PROBABILISTIC METHOD

- The probabilistic method in LUP is based on a Quantitative Risk Analysis (QRA), used to evaluate the risks using numerical values of the probability of an accident occurring and the severity of its consequences;
- **Output**: Individual or Social Risk



DETERMINISTIC METHOD

- The deterministic approach is based on estimating the **consequences** of **alternative accident scenarios**, without explicitly quantifying the probability of these accidents (taken into account partially);
- This approach determines land use zones mostly on the consequences rather than the probability;
- The generally used reference values for effect thresholds typically results in more conservative exclusion zones than probabilistic methods;

DETERMINISTIC METHOD (2)

- For *non-complex* facilities;
- CRAIM proposes the use of predetermined alternative scenarios to estimate the consequences and to compare the results with the decision matrix;
- This approach is referred to as « semi quantitative ». It is often more conservative, but it has the advantage of not requiring complex analysis.

LUP PROPOSAL BY THE CRAIM

For other facilities (probabilistic approach) (see note 1)	For non-complex, common facilities (deterministic approach) (see note 2)						Land uses			
Individual risk of death per year	Corresponding qualitative risk level	Reference values for effect thresholds (see note 4)					Manufacturing, warehouses, open space (e.g. parkland, golf courses, etc.)	Low-density residential (up to 10 units with ground level access, per hectare) and commercial, including offices, retail centres, restaurants, entertainment centres and sports complexes	High-density residential and commercial, including places of continuous occupancy such as hotels and tourist resorts	Sensitive uses (e.g. hospitals, child care facilities, long-term care centres, etc.)
		Toxicity (C : concentration) (based on 60 minutes of exposure) (see note 3)	**Over-pressure** (p: pressure expressed in psi)	**Thermal load (TL)** for scenarios with phenomena lasting 40 seconds or less (TL: thermal load expressed in $(kW/m^2)^{4/3}s$)	**Heat flux** for scenarios that cannot cause phenomena with fast kinetics (Φ : heat flux expressed in kW/m^2 - based on 40 seconds of exposure)	**Flashfire** (C : concentration)				
≥ 1/10 000 per year	Catastrophic	AEGL-3 < C	8,7 < p	1800 < TL Apply the probabilistic approach	12,5 < Φ	LFL < C	Prohibited	Prohibited	Prohibited	Prohibited
Between 1/10,000 and 1/100,000 per year	Critical	Apply the probabilistic approach	2 < p ≤ 8,7		8 < Φ ≤ 12,5	Apply the probabilistic approach (see note 5)	Permitted with protective measures	Prohibited	Prohibited	Prohibited
Between 1/100,000 and 1/1,000,000 per year	Severe		1 < p ≤ 2	1 000 < TL ≤ 1 800	5 < Φ ≤ 8		Permitted	Permitted with protective measures	Permitted with protective measures	
Between 1/1,000,000 and 0.3/1,000,000 per year	Moderate	AEGL-2 < C ≤ AEGL-3	0,3 < p ≤ 1	500 < TL ≤ 1 000	3 < Φ ≤ 5	50% LFL < C ≤ 100% LFL	Permitted	Permitted	Permitted with protective measures	
≤ 0,3/1 000 000 per year	Low	C ≤ AEGL-2	p ≤ 0,3	TL ≤ 500	Φ ≤ 3	C ≤ 50% LFL	Permitted	Permitted	Permitted	

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ASSESSMENT vs ACCEPTABILITY

Risk Assessment

A systematic process of **identifying hazards**, analyzing consequences and probabilities and evaluating the level of risk associated with potential accident scenarios.

Risk Acceptability

A decision-making process that determines whether the assessed level of risk is **tolerable** for a given community or land use context, based on established criteria, societal values and stakeholder consultation.

ASSESSMENT vs ACCEPTABILITY (2)

Key Differences

- **Nature:** Assessment is a technical and analytical exercise; Acceptability is a judgment-based decision;
- **Question answered:** Assessment asks « What is the risk? »; Acceptability asks “Is this risk tolerable?”;
- **Inputs:** Assessment relies on scientific data and modelling; Acceptability incorporates societal values, regulations, and stakeholder perspectives;
- **Outcome:** Assessment produces a risk level or profile; Acceptability produces a go/no-go decision for land use or activity.

REQUIREMENTS TO FOSTER ROBUSTNESS IN LUP

- **Consistency**: results for similar situations are substantially the same;
- **Proportionality**: planning constraints are proportional to the assessed level of risk;
- **Transparency**: the decision-making process is clear.

CONCLUSION & KEY MESSAGES

- Complexity in land use and risk management;
- Need for structured and consistent approaches;
- CRAIM provides practical and recognized solutions;
- A key partner for municipalities and industry;
- CRAIM contributes to safer and more resilient communities.

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