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# **Risk-Informed Decision-Making Framework & Risk Management for Land-based Hazardous Materials Spills in British Columbia**

**BC Spill Planning and Response Symposium**

**Plenary Session 3:**

**Effective Planning: Risk Assessments, Spill Contingency Planning, and  
Geographic Response Plans**

**Tuesday March 26, 2013**

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# Objectives and Proposal Summary

- **Research Program Objective:**

*“Develop a risk-informed decision-making framework (RIDMF) and risk management techniques for land based hazardous material spills in BC”*

## Main Design Features

- The RIDMF will be implemented as a Decision Support System (DSS) to assess and manage the risks of hazardous material spills in BC.
- DSS will consist of an integrated modeling toolbox to be used by managers and key personnel responsible for assessing and managing incidents.
- The Toolbox will be based on integrating a dynamic modeling environment depicting the flow of contaminants in the environment and impacts.
- These systems use high-capacity algorithms and allow for rapid development and deployment of 2-D and 3-D virtual reality models and outputs easily.
- They will also facilitate the development of an easy-to-use high-level input/output interface to interact with the modeling environment and to develop/ test several dynamic risk management scenarios and strategies.

# Research Program Trasks

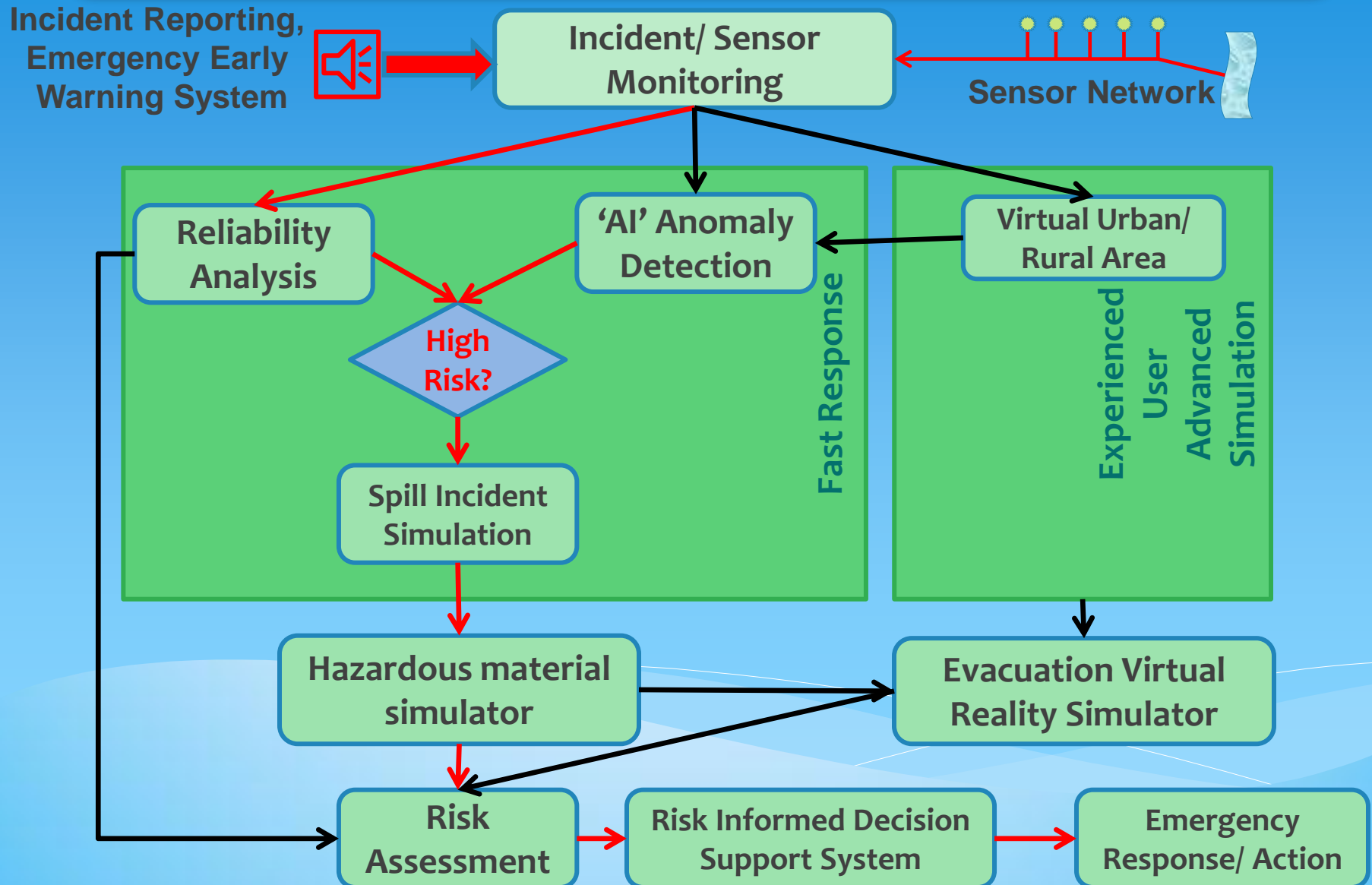
The toolbox is based on a virtual reality approach that will address problems of failure consequence analysis and emergency planning that are not amenable to resolution through existing analysis techniques.

## Key tasks include:

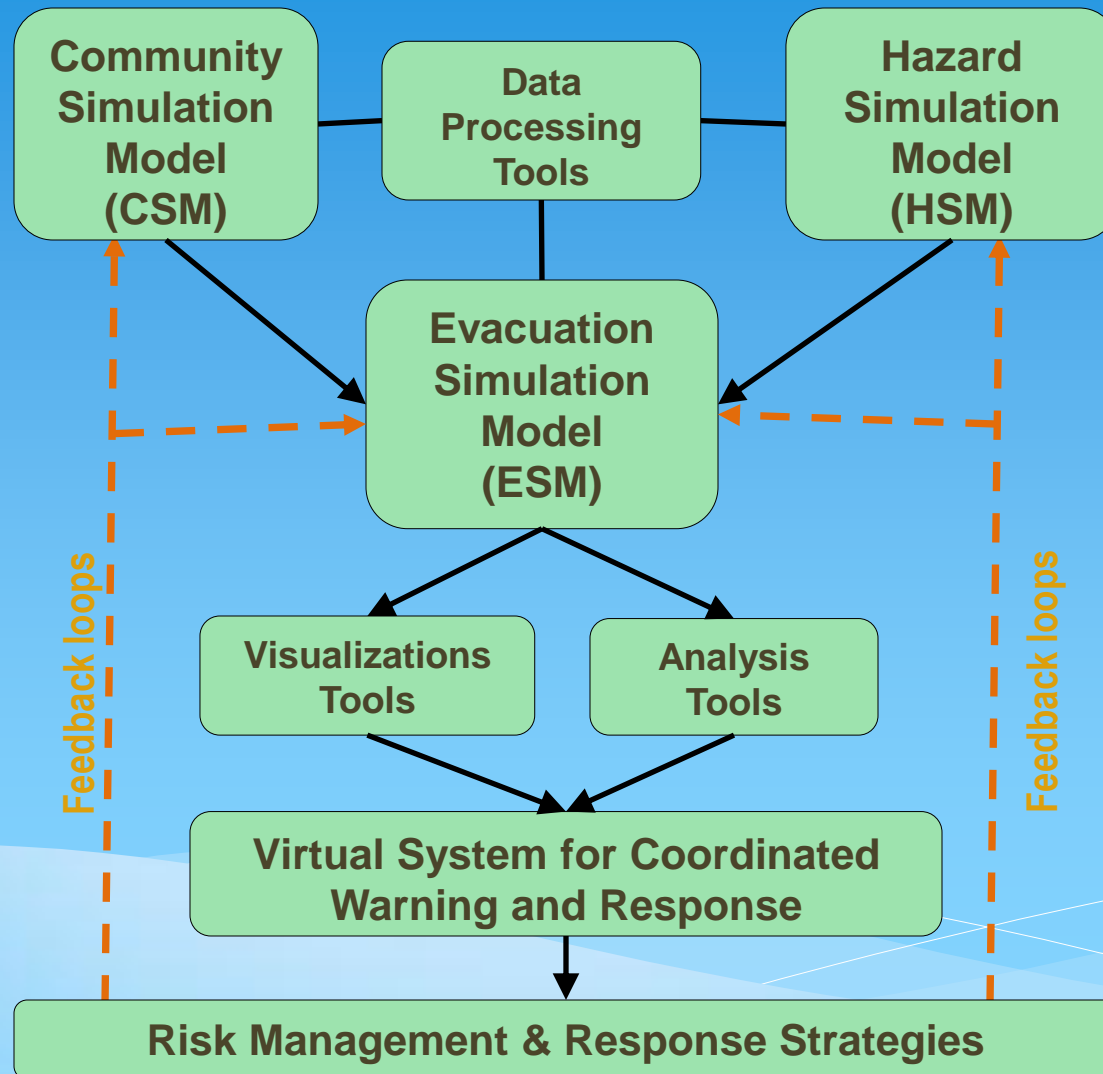
1. Identify risky transportation corridors, high risk areas & collect data.
2. Calculate accident risks & develop regional risk maps for BC.
3. Develop the Risk-Informed Decision-Making Framework and the Toolbox.
4. In cooperation with local agencies, prepare case studies and design/ test/ evaluate spill mitigation strategies.
5. Evaluate the findings and recommendation for future research and development and to maintain the toolbox.

This research program will involve several faculty members, researchers, graduate and undergraduate students at UBC.

# Structure of the Land-based Spill Emergency Response and Management System



# Land Based Hazardous Material Spills Preparedness & Response Modeling Framework

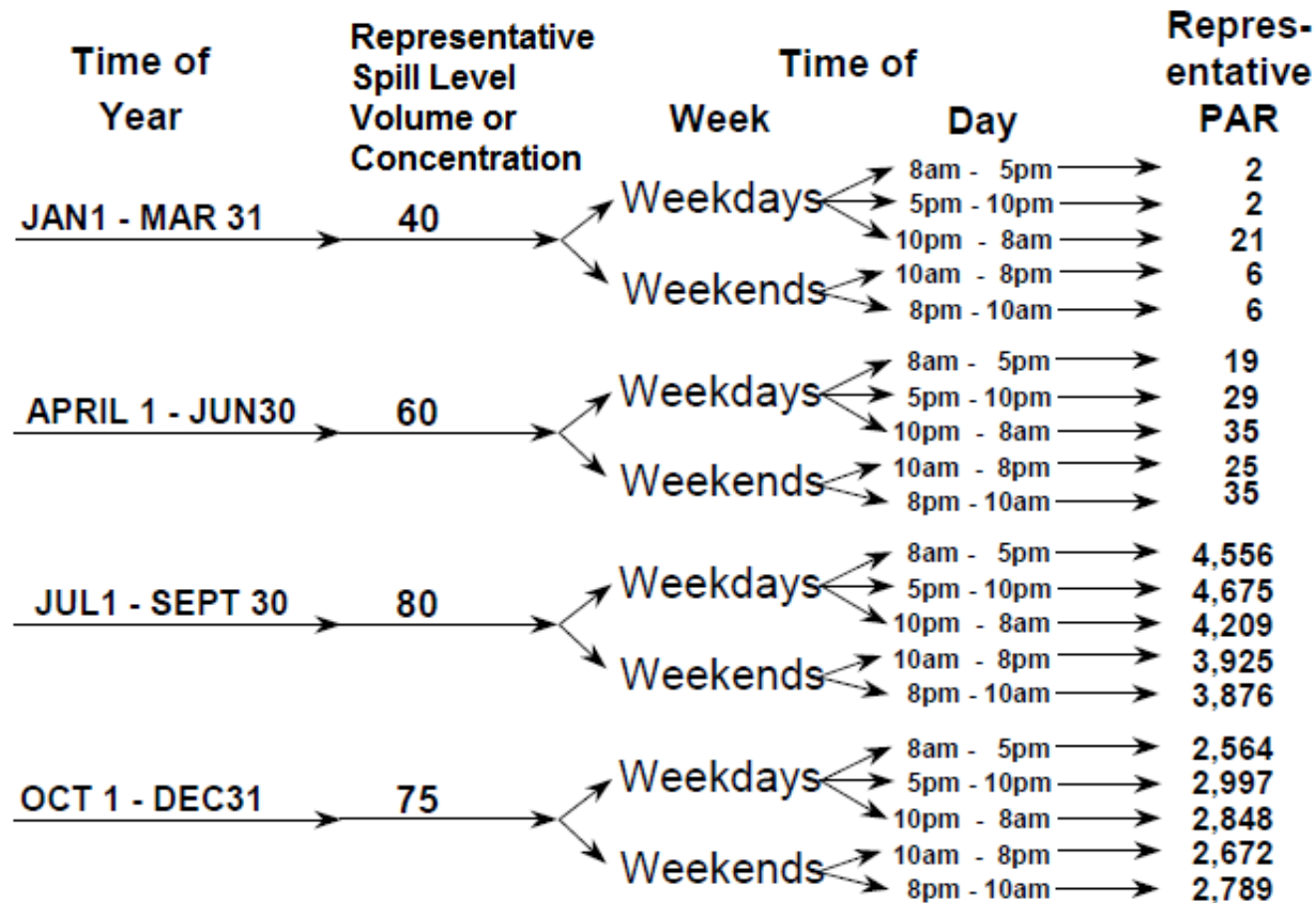


(adapted from Assaf, 2012)

# Potential Virtual World Data Objects

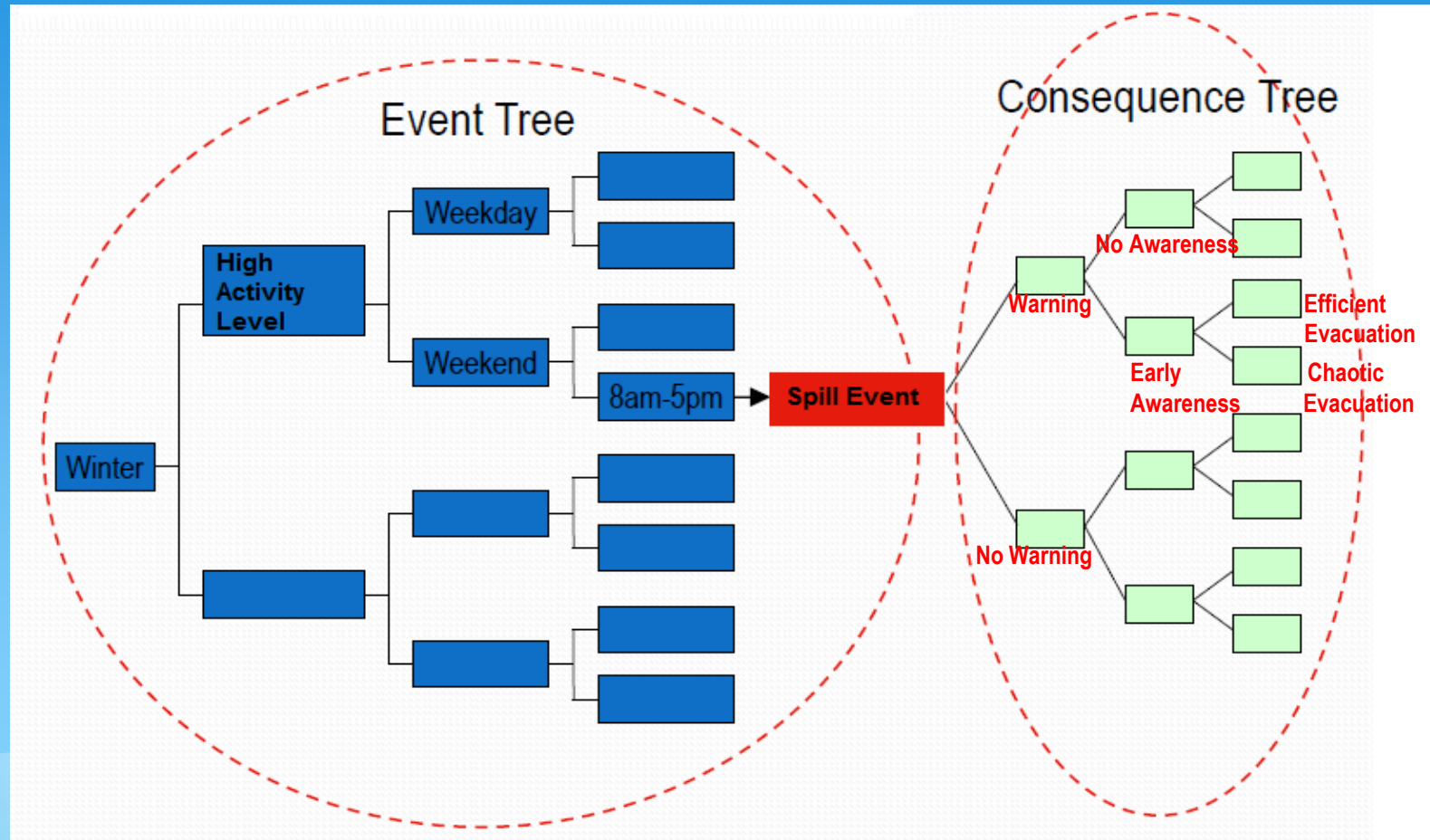
| Key Objects                      | Example Properties  |
|----------------------------------|---|
| Digital Elevation Model (DEM)    | location (x,y,z)  |
| Time of day, day of month        | Monday April 1, 2013  |
| Spill plume/ wave                | Movement or static  |
| Population At Risk -Unit (PARU)  | States  |
| Population At Risk -Group (PARG) | Age (old, mature adults, school students)   |
| Building & Outdoor Place         | Locations (x,y,z), type (residential, school, office, industrial, hospital, residential). Can act as containers or safe havens? |
| Vehicles in incident area        | States: static, moving, direction (fed from monitoring systems)   |
| Road & Trail Network             | States: busy (fed from monitoring systems)  |
| Safe Haven & Warning Centre      | Locations (x,y,z), capacity   |

# Time Domain Concept



(Adapted from Assaf / Hartford)

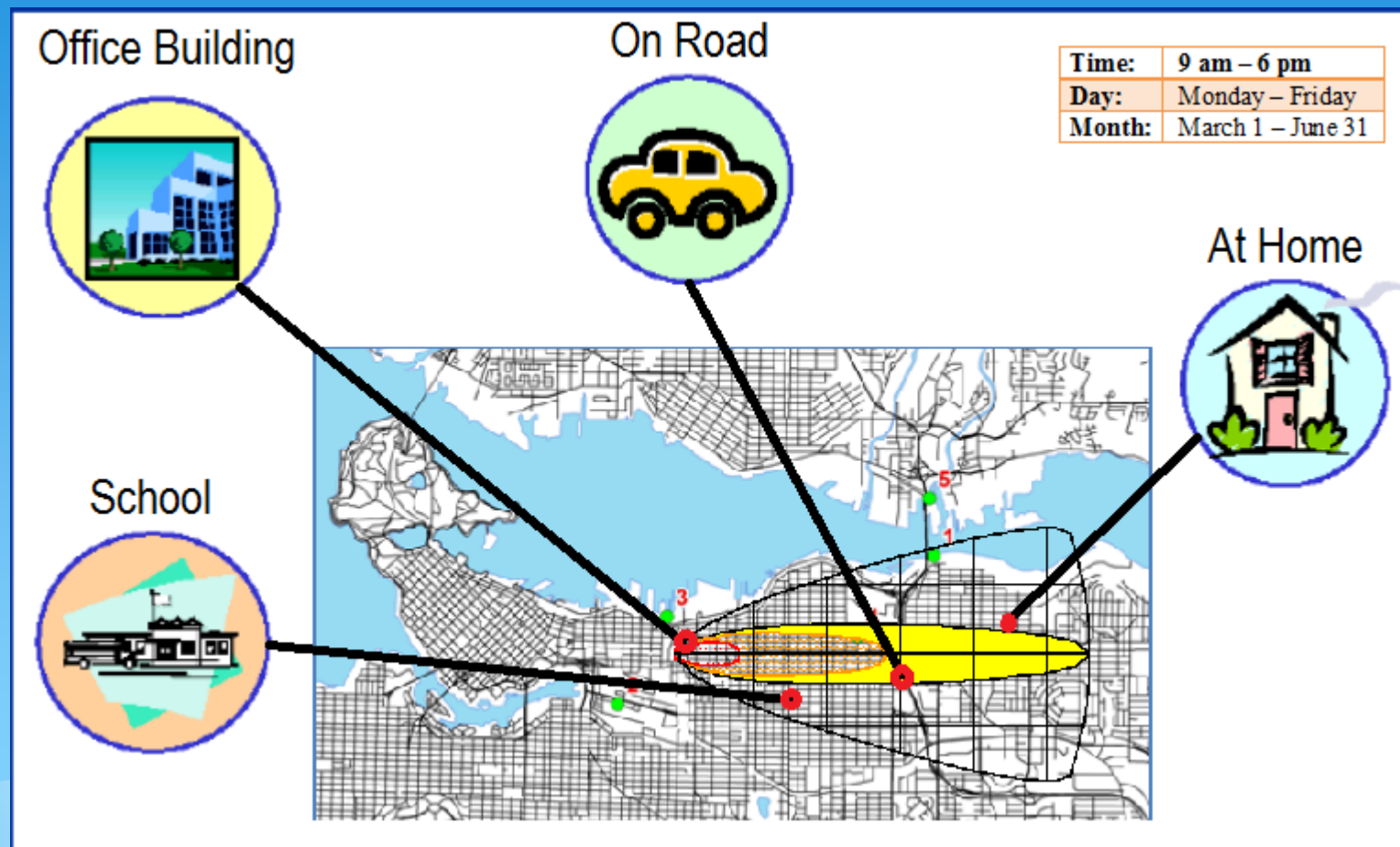
# Time and Event Considerations



(Adapted from Assaf / Hartford)

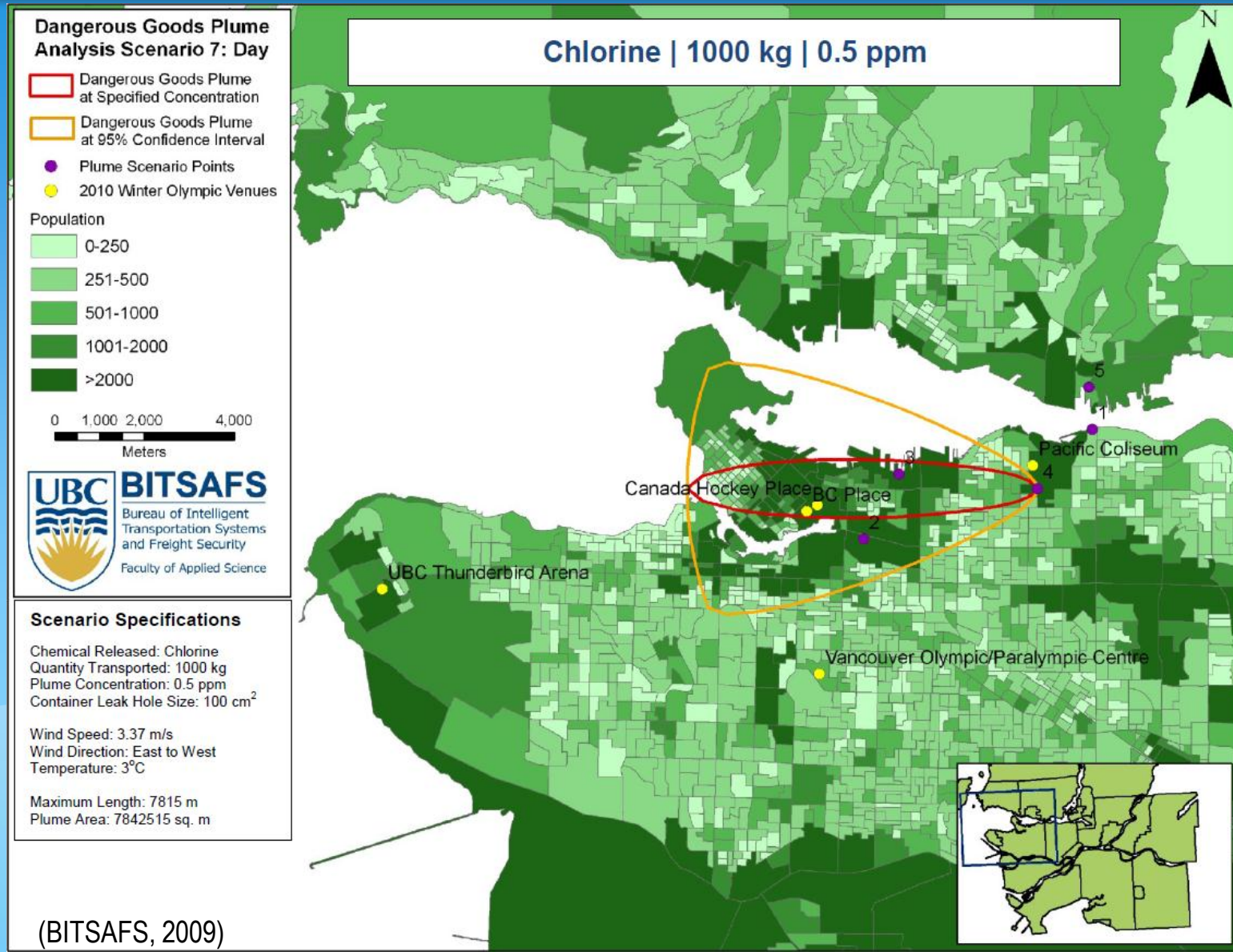


## Examples of Toxic Threat Zone Plume Analysis, Population at Risk and Infrastructure Variations in Time and Space



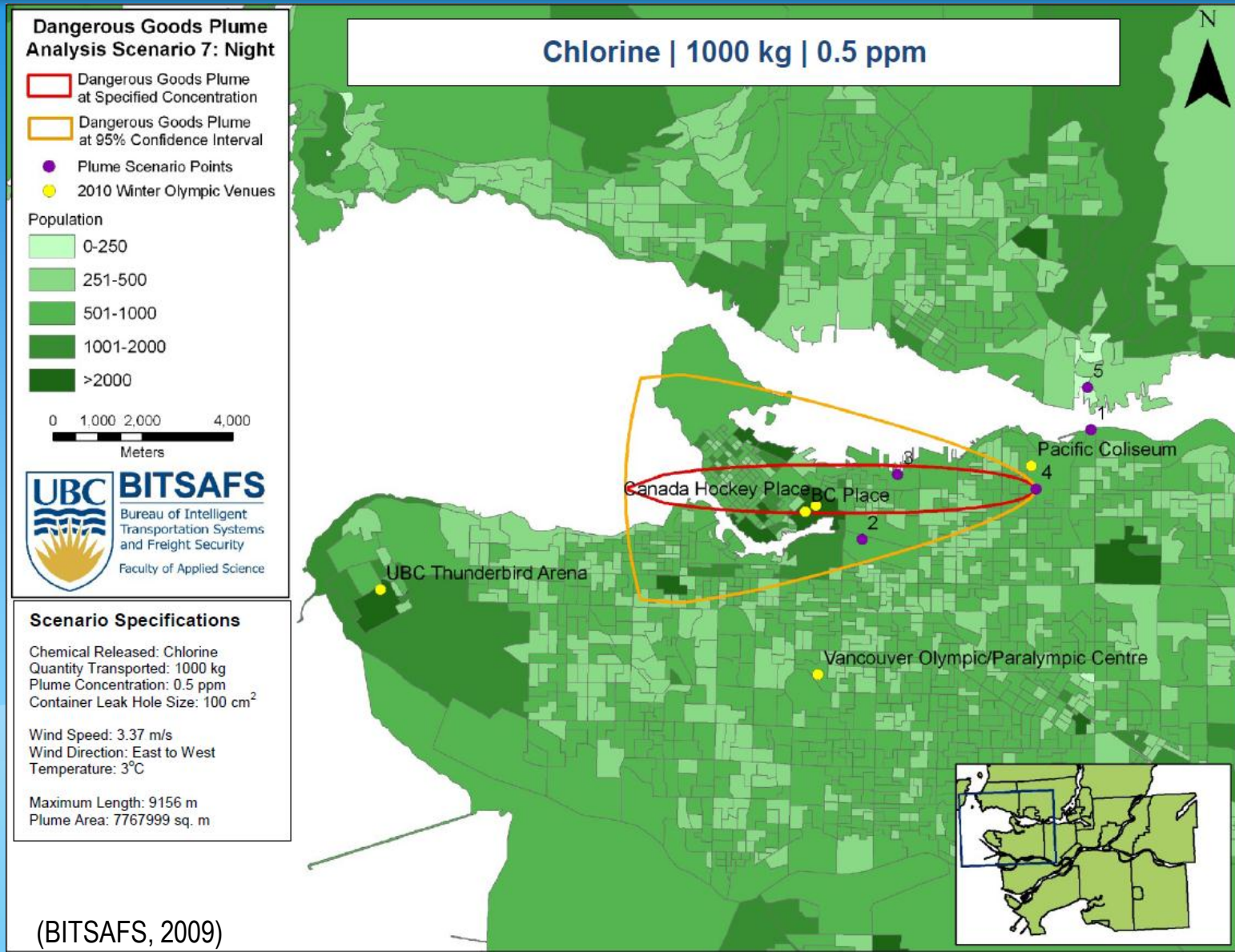
(Adapted from Assaf / Hartford; EPA; ALOHA)

# Examples of Toxic Threat Zone Plume Analysis: 2010 Olympics Analysis

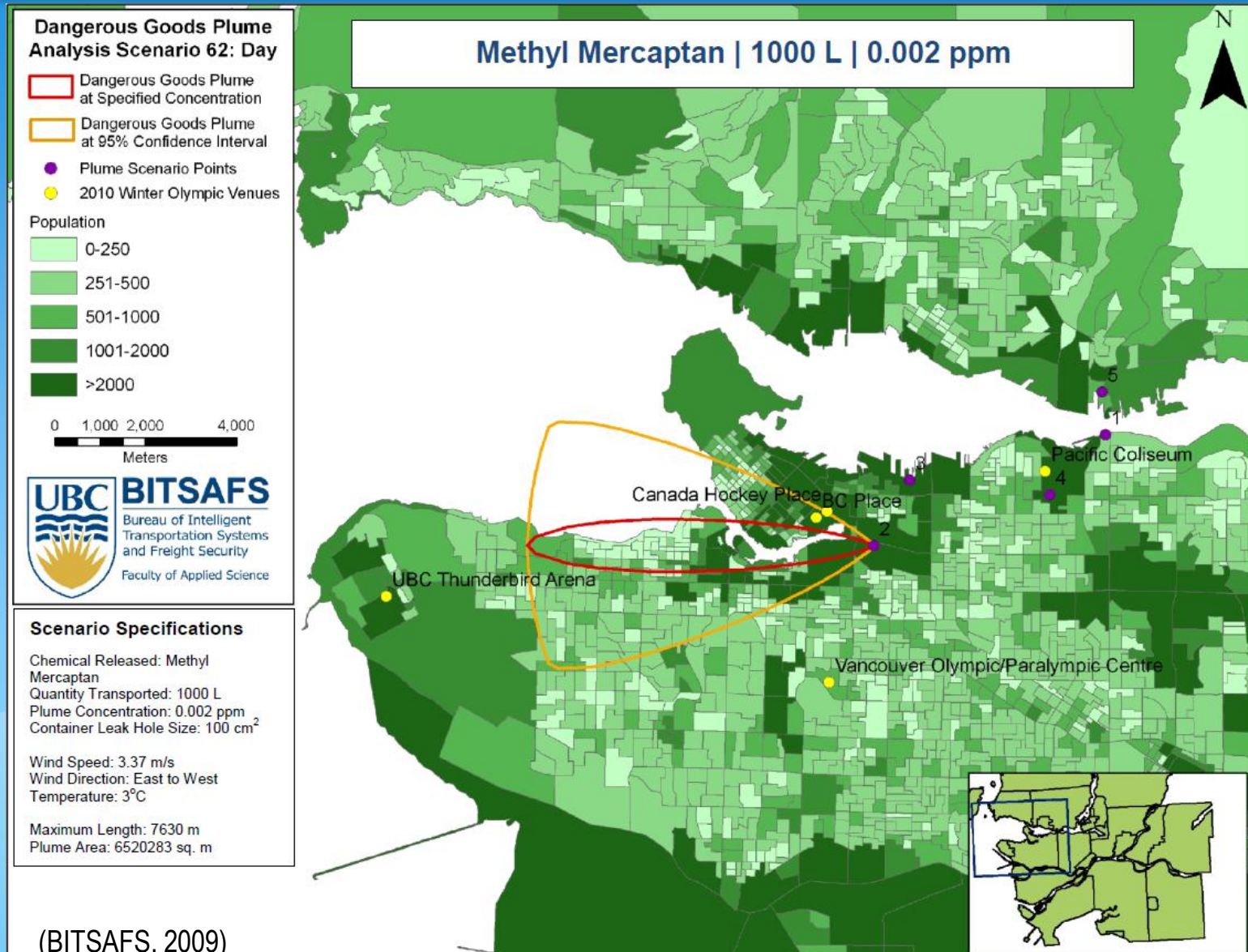




# Examples of Toxic Threat Zone Plume Analysis: 2010 Olympics Analysis



# Examples of Toxic Threat Zone Plume Analysis: 2010 Olympics Analysis



# Research Team and Budget

Several faculty members, researchers and graduate and undergraduate students will be involved in this research program.

**Dr. Ziad Shawwash**, Professor at the Dept. of Civil Engineering, UBC

**Dr. Loretta Li**, Professor at the Dept. of Civil Engineering , UBC

**Dr. Tarek Sayed**, Professor at the Dept. of Civil Engineering, UBC

**Dr. Hamed Assaf**, Professor of water resources, Civil Engineering Department, American University of Sharjah. Previously a Senior Risk Analysis and Water Resources Engineer with BC Hydro and will be a co-investigator in this research project.

Several Graduate Students:

- 2 PhD
- 4 MASc
- 5 part-time undergraduate students
- Several Computer programmers will also be recruited through the Coop-student program at UBC.

The research program is expected to be completed in 4 years

The program is estimated to cost about **one million dollars**, 40% in industrial contributions and 60% from NSERC and other research funding agencies and parties.



# Summary & Conclusions

- Research program will develop a state-of-the-art risk management toolbox for land based hazardous material spills in BC.
- The toolbox will enable disaster management entities to more effectively Coordinate-Communicate-Cooperate and manage land-based spill incidents.
- The toolbox can also be used by the oil, gas and chemical industry and transportation companies to assess and manage their risks
- It can also be used by insurance companies to develop risk maps to assess insurance risks
- The research program will train highly qualified professionals in this important area at one of the best universities in the world: UBC.
- We are seeking research grants from industry, government agencies and any interested party. Research grants will be leveraged by grants from NSERC and other research funding agencies/ parties to develop the toolbox at UBC.
- Methods and techniques will be publically available and Intellectual Property (IP) for the toolbox will be jointly held by UBC, researchers and funding parties.
- **For more information please** contact [Shawwash@mail.ubc.ca](mailto:Shawwash@mail.ubc.ca) Cell: 604-649-2390