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# Risk Based Land-Use Planning in the Edmonton Area

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**Presented by:**

Doug McCutcheon, P. Eng.

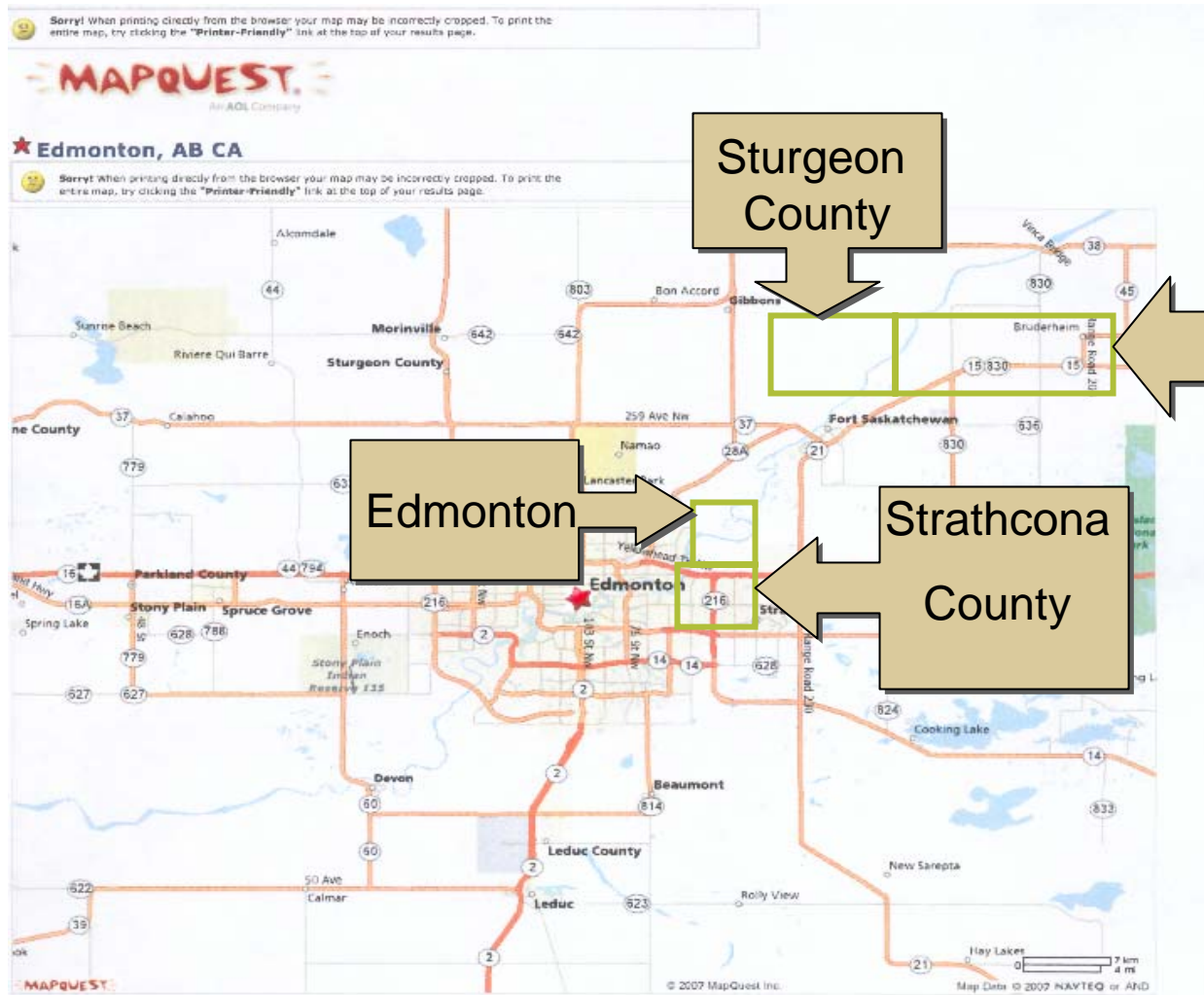
Professor and Director

Engineering Safety and Risk Management Program

Faculty of Engineering

University of Alberta

# the Edmonton Area



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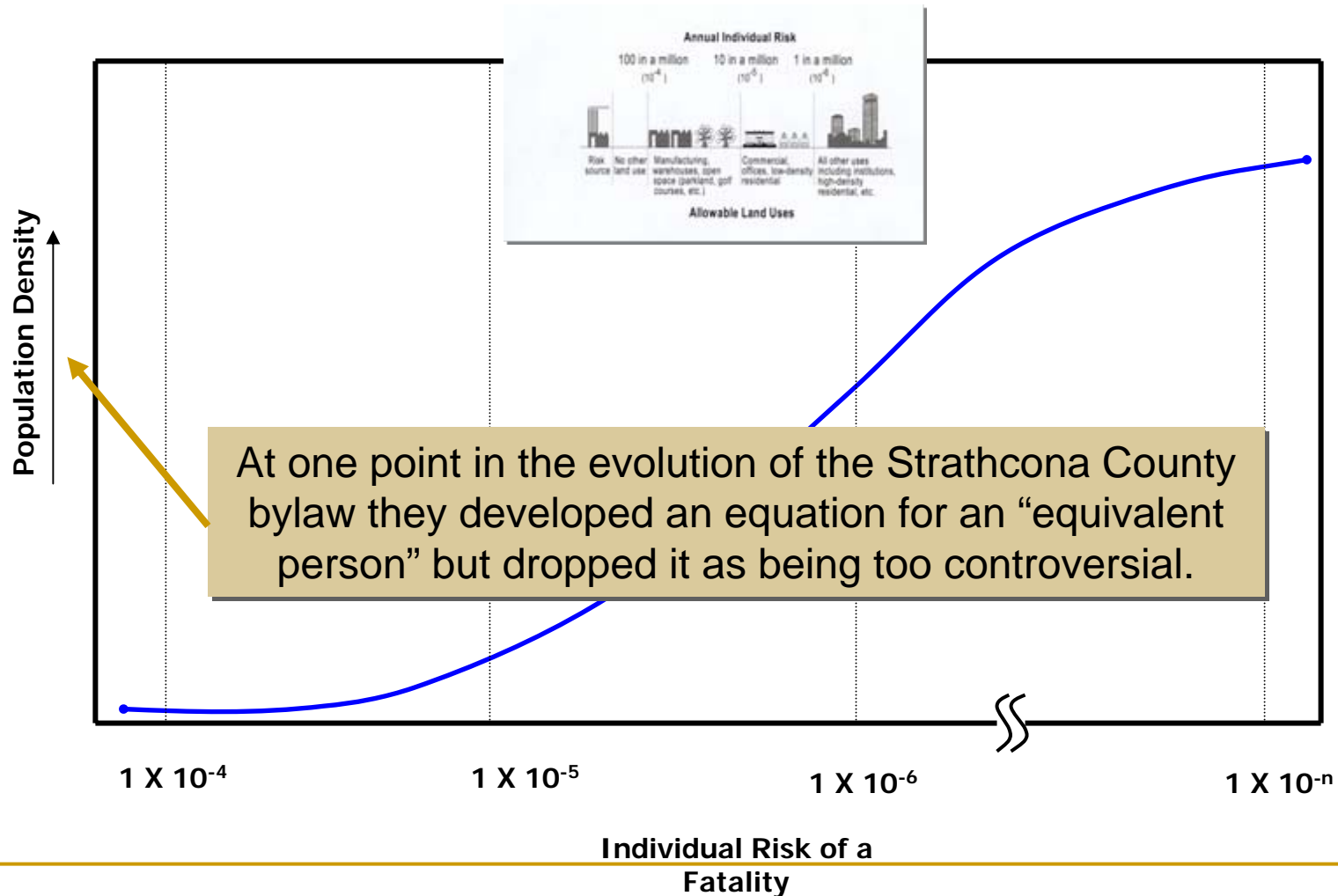
# Spread of the MIACC Criteria

- Strathcona County
  - City of Edmonton
  - Sturgeon County
  - Energy and Utilities Board (emergency planning only)
-

# MIACC Criteria



# Density - versus- Distance from Risk Source (MIACC Criteria)



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# So What Distances to Set in Law?????

- MIACC criteria
  - Emergency response timeliness
  - Industry options
  - Fits with planning scenarios
  - Quality of life issues (nuisance)
-

# Strathcona County

**Chemicals Identified as exceeding the EPA-RMP Threshold Quantities by Strathcona Industrial Association (SIA) Members**  
(Table - 1)

SIA Company	Chemicals Listed as Exceeding the EPA-RMP Threshold quantity	Approximate distance to Baseline Road and Broadmoor Blvd. (meters)	Approximate distance to Baseline Road and Sherwood Drive (meters)
Alberta Envirofuels	ISO - Octane	5,400	6,900
Alcan	No toxic or flammable materials	3,700	5,200
Alta Steel	No toxic or flammable materials	6,200	7,700
AT Plastics	Vinyl Acetate Monomer (VAM) / Ethylene / Propylene	7,500	9,000
Celanese	Chlorine / Formaldehyde / Vinyl Acetate Monomer / Hydrogen / Propylene	5,800	7,300
EPCOR	No toxic or flammable materials	7,900	9,400
IOL	Hydrogen Sulphide / Hydrofluoric acid / Butane / Propane	6,300	7,800
Petro-Canada	Hydrogen Sulphide / Hydrofluoric acid / Butane / Propane	4,000	5,500
Enbridge pipelines	No toxic materials / NGL's	3,700	5,200
Owens Corning	No toxic or Flammable material	3,700	5,200

**Note:** EPA\_RMP (US Environmental Protection Agency - Risk Management Plan) is used as the guideline for reporting offsite impact on communities in the US and is being adopted as an acceptable method for communicating risk in Canada in many communities. Canada does not have a reporting requirement as is the case in the USA.

**Note:** Approximate distance from the centre of the company property

**Note:** At the time of writing this report it was uncertain as to the immediate future of formaldehyde use because of changes at Celanese. However, for this report it is included.

**Note:** Threshold Quantity- the quantity above which it is determined could have an adverse effect on human health and the environment should it be accidentally released. The Act requires EPA to promulgate an initial list of at least 100 substances that, in the event of an accidental release, are known to cause or may reasonably be anticipated to cause death, injury, or serious adverse effects to human health or the environment. Toxic substances were included on the list based on their toxicity, physical state, vapor pressure, production volume, and accident history. Threshold quantities were set for toxic substances based on a ranking method that considers toxicity and volatility of the chemicals. EPA assigned identical thresholds to chemicals with similar ranking scores, ranging from 500 pounds to 20,000 pounds. Similarly, the threshold quantities established today may not always represent a level below which no hazard exists.

Here we were looking at the actual risks of fatalities.

# Strathcona County

**EPA-RMP Toxic Cloud Distances of Threshold Quantities  
(Using the latest ERPG & IDLH numbers.)  
(Table - 2a)**

Com-Pound	Threshold Quantity (lbs)	Molecular Weight	Airborne Quantity over 10 min. (per EPA-RMP)	ERPG 1 (ppm)	Minimum Odour Distance (meters)	ERPG 2 (ppm)	Minimum Hazard Distance (meters)	IDLH (ppm) Old value in ( )	Minimum Hazard Distance (meters)	Estimated Distance from the closest Industrial Source (meters)
NH3 Ammonia	10,000	17.03	1,000	25	4,319	150	1,763	300 (500)	1,246	3,700/ 5,200
Cl2 Chlorine	2,500	70.91	250	1	5,296	3	3,056	10 (30)	1,673	5,400/ 6,900
HF Hydrogen Flouride	1,000	20.01	100	2	4,456	20	1,729	30	1,150	4,000/ 5,500
H2S Hydrogen Sulphide	10,000	34.08	1,000	15	3,491	30	2,787	100 (300)	1,526	4,000/ 5,500
SO2 Sulphur Dioxide	5,000	64.06	500	0.3	14,366	3	4,542	100	787	4,000/ 5,500
Formaldahyde	15,000	30.03	1,500	1	19,916	10	6,298	20 (30)	4,453	3,700/ 5,200
VAM Vinyl Acetate Monomer	15,000	86.09	1,500	5	5,260	75	1,358	ND	--	5,800/ 7,300
HCl Hydrogen Chloride	15,000	36.46	1,500	3	10,434	20	4,041	50 (100)	2,556	3,700/ 5,200

**Note 1:** ND = Not Determined

**Note 2:** HCl is included as it is a typical maintenance chemical used in cleaning processes. It is not a listed chemical for SIA members.

**Note 3:** The distances from the centre of the heavy industrial site where a product is produced to Baseline Road/ Broadmoor Blvd and Sherwood Drive / Baseline Road intersections is approximate.

**Note:** Threshold Quantity- *the quantity above which it is determined could have an adverse effect on human health and the environment should it be accidentally released.* The Act requires EPA to promulgate an initial list of at least 100 substances that, in the event of an accidental release, are known to cause or may reasonably be anticipated to cause death, injury, or serious adverse effects to human health or the environment. Toxic substances were included on the list based on their toxicity, physical state, vapor pressure, production volume, and accident history. Threshold quantities were set for toxic substances based on a ranking method that considers toxicity and volatility of the chemicals. EPA assigned identical thresholds to chemicals with similar ranking scores, ranging from 500 pounds to 20,000 pounds. Similarly, the threshold quantities established today may not always represent a level below which no hazard exists.



# Strathcona County

**EPA-RMP Toxic Cloud Distances of Threshold Quantities for Flammable Vapours  
(Using the latest ERPG & IDLH numbers.)  
(Table - 2c)**

Com-Pound	Threshold Quantity (lbs)	Molecular Weight	Airborne Quantity over 10 min. (per EPA-RMP)	ERPG 1 (ppm)	Minimum Odour Distance (meters)	ERPG 2 (ppm)	Minimum Hazard Distance (meters)	Estimated Distance from Industrial Source (meters)
C2H4 Ethylene	10,000	28	1,000	400	687	3,000*	307	7,500
CH4 Methane	10,000	16	1,000	15,000	181	25,000*	141	3,700
C3H8 Propane	10,000	44	1,000	2,100 (LEL)	293	2,100*	293	4,000
C3H6 Propylene	10,000	42	1,000	--	--	--	--	5,800
C4H10 Butane	10,000	56	1,000	2,400	198	2,400*	198	4,000

**Note 1:** LEL = Lower Explosive Limit,

**Note 2:** \* = TEEL value ( A "temporary Emergency Exposure Limit" if an ERPG is not available)

**Note:** Threshold Quantity- *the quantity above which it is determined could have an adverse effect on human health and the environment should it be accidentally released.* The Act requires EPA to promulgate an initial list of at least 100 substances that, in the event of an accidental release, are known to cause or may reasonably be anticipated to cause death, injury, or serious adverse effects to human health or the environment. Toxic substances were included on the list based on their toxicity, physical state, vapor pressure, production volume, and accident history. Threshold quantities were set for toxic substances based on a ranking method that considers toxicity and volatility of the chemicals. EPA assigned identical thresholds to chemicals with similar ranking scores, ranging from 500 pounds to 20,000 pounds. Similarly, the threshold quantities established today may not always represent a level below which no hazard exists.

Again here we were looking at the actual risks of fatalities.

# Strathcona County

Nuisance Reports (Strathcona Industrial Association)  
(1995 – 2000)  
(Table - 3)

Nuisance Concern	Number of Complaints	Percentages	Distance Range (distance from heavy industrial zone)
Odour	74	66	90% within 3 km
Noise	14	12	70% within 3 km
Sight	6	5	
Alarms	8	7	
Explosions	6	5	
Flare	2	2	
Other	4	3	
<b>Total</b>	<b>114</b>	<b>100</b>	
Spring	26	23	Not applicable
Summer	16	14	"
Fall	31	27	"
Winter	41	36	"
<b>Total</b>	<b>114</b>	<b>100</b>	"

Here we were looking at the criteria for “quality of life”.

# Strathcona County

**Nuisance Reports (Alberta Energy and Utilities Board)**  
**(1996 - 1999)**  
*(Strathcona County)*  
*(Table 4)*

<b>Nuisance Concern</b>	<b>Number of Complaints (approx.)</b>	<b>Percentages</b>
Odour	1380	41
Noise	330	10
Flare/smoke	445	13
Public Health & Safety	415	12
Lease management	490	14
Spills	325	10
<b>Total</b>	<b>3385</b>	<b>100</b>

# Strathcona County

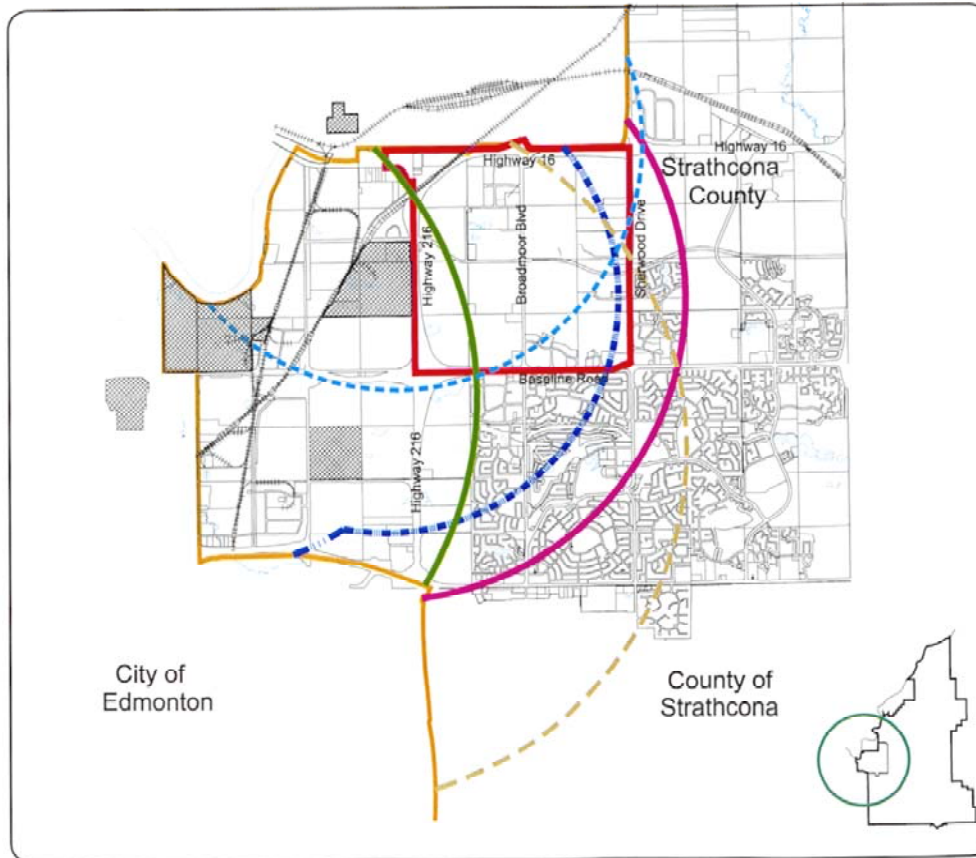
## Nuisance Reports (County of Strathcona) (2000 – 2001 to date) (Table 5)

There were approximately 250 reported incidents through the 9-1-1 system over a 5-year period. These reported concerns are broken down as 82% odour, 8% noise and 5% light/flares and 25% other. These do not include calls received by other agencies (e.g. RCMP).

## Nuisance Reports (Alberta Environment - 2000) Electoral Constituency of Sherwood Park (Table 6)

Nuisance Concern	Number of Complaints (approx.)	Percentages
Odour	45	69
Dust	1	1.5
Visible emissions	2	3
Land use	8	12
Surface water	4	6
Waste issues	2	3
Pesticide usage	2	3
Miscellaneous	1	1.5
<b>Total</b>	<b>65</b>	<b>100</b>

# Strathcona County



## Heavy Industrial and Residential Separation and Transition Uses Study

Map 7: Toxic Chemical Cloud Impact  
for odours

### Legend

- Chlorine - 5.3 km Boundary
- Chlorine - 5.3 Km Boundary
- Hydrogen Fluoride - 4.5 km boundary from
- Hydrogen Sulphide - 3.5 km Boundary from
- Sulphur Oxide - 14.3 km boundary from
- Municipal Boundaries
- Study Boundary

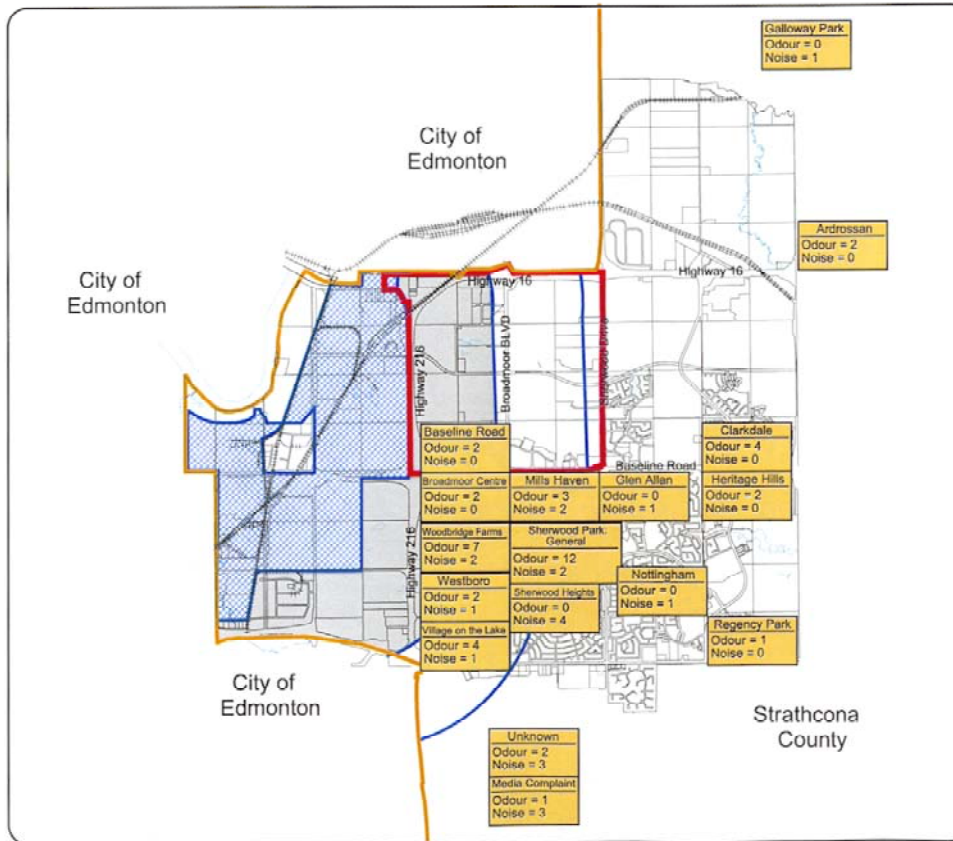


Jan 2002

City of Edmonton  
Planning Department

JEREMY A. DYER-SAITT  
& ASSOCIATES LTD.

# Strathcona County



## Heavy Industrial and Residential Separation and Transition Uses Study

Map 5 - Nuisance Complaints

(Strathcona Industrial Association Data for 1990 - 2001)

### Legend

- Strathcona County Heavy Industrial District
- 1.5 km Separation Distance from Strathcona County Heavy Industrial District
- 3.0 km Separation Distance from Strathcona County Heavy Industrial District
- Municipal Boundaries
- Study Boundary



Jan 2002

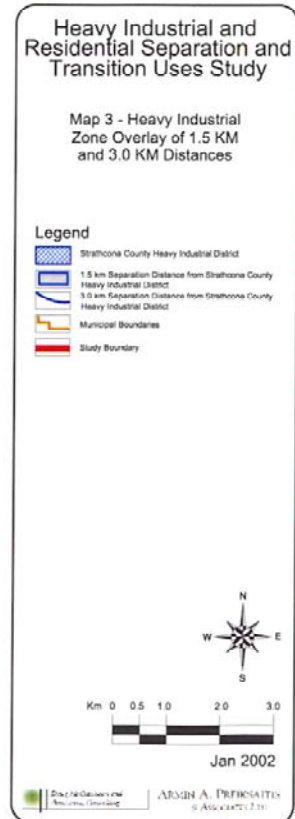
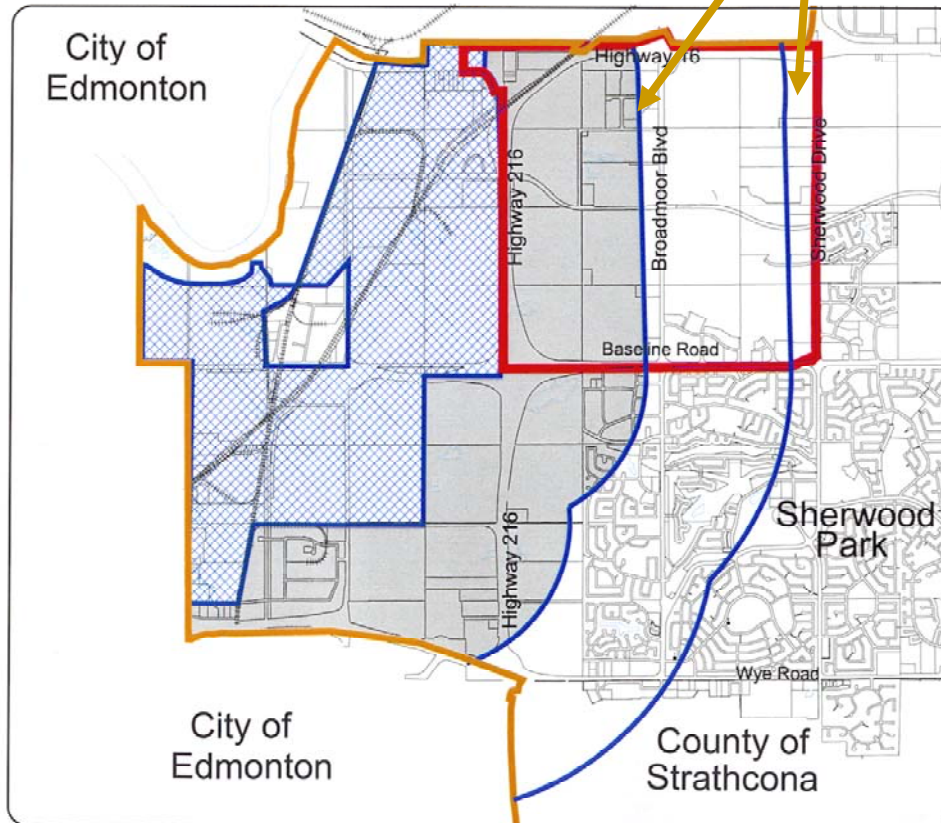
Diagrams & Graphics  
Solutions Limited

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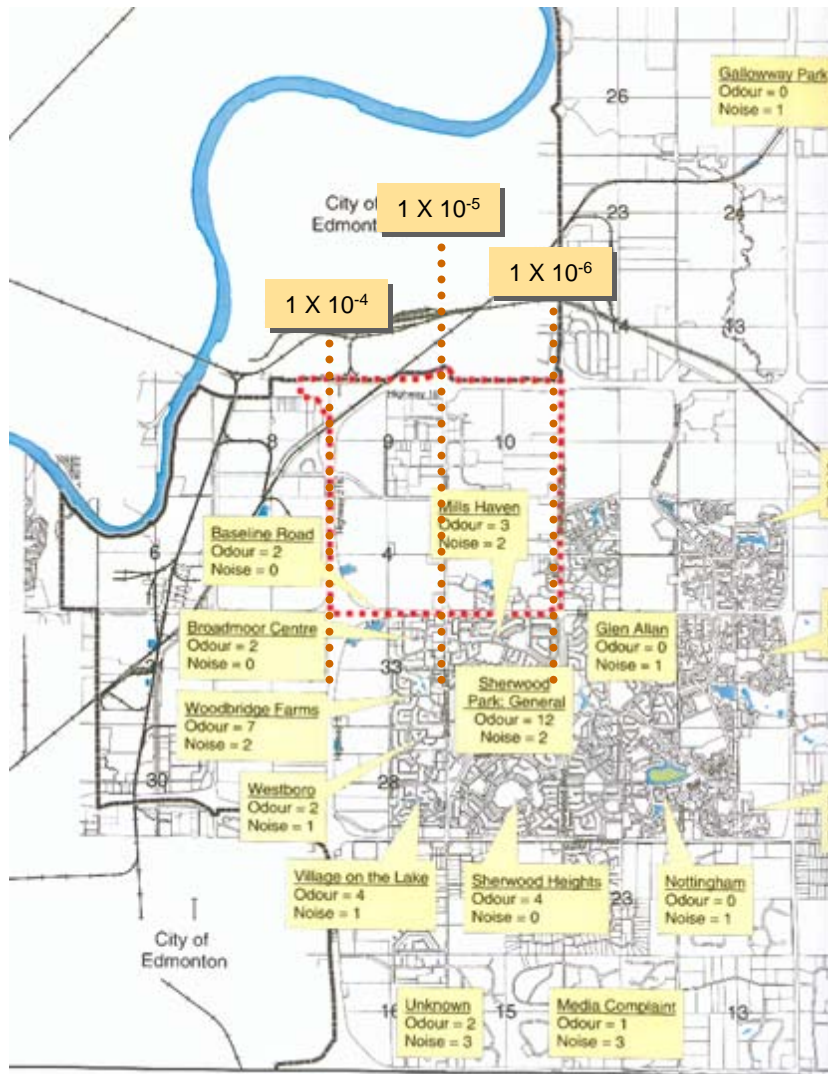
# Strathcona County

Strathcona chose main streets in order to be simple.

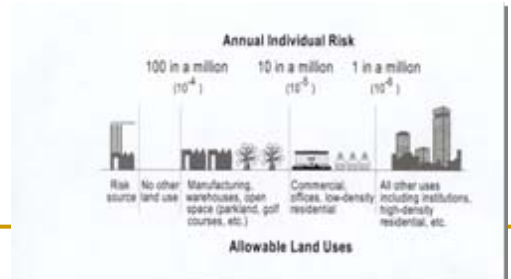
They also chose 1.5 and 3.0 Km rather than 1.6 and 3.2 Km as this allowed for the same development to be on each side of the road, (quality of life).



# Strathcona County



And again here we were looking at the criteria for “quality of life”.





# Strathcona County

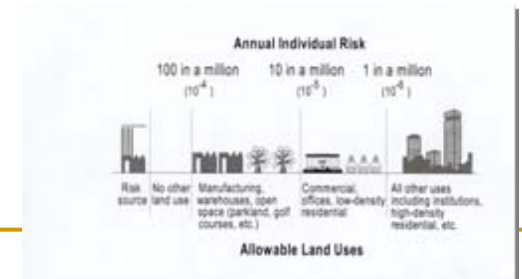
## Examples of Uses Allowed between 0 - 1.5 Km

### Prohibited Uses:

- All residential uses
- Schools
- Night clubs
- Hotels
- Health services
- Indoor recreational
- Religious assembly
- Spectator sports

### Discretionary uses:

- Major amusement arcades
- Motels
- Gas stations
- Library and exhibits



# Strathcona County

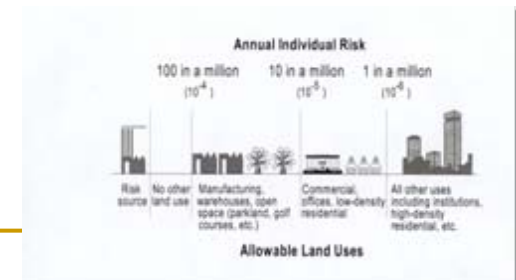
## Examples of Uses Allowed between 1.5 - 3.0 Km

### Prohibited Uses:

- All residential uses
- Schools
- Night clubs
- Hotels
- Indoor recreational
- Hospitals

### Discretionary uses:

- Major care centres
- Private & public education activities
- Major health services but not hospitals
- Religious assembly
- Spectator sports



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# Strathcona County

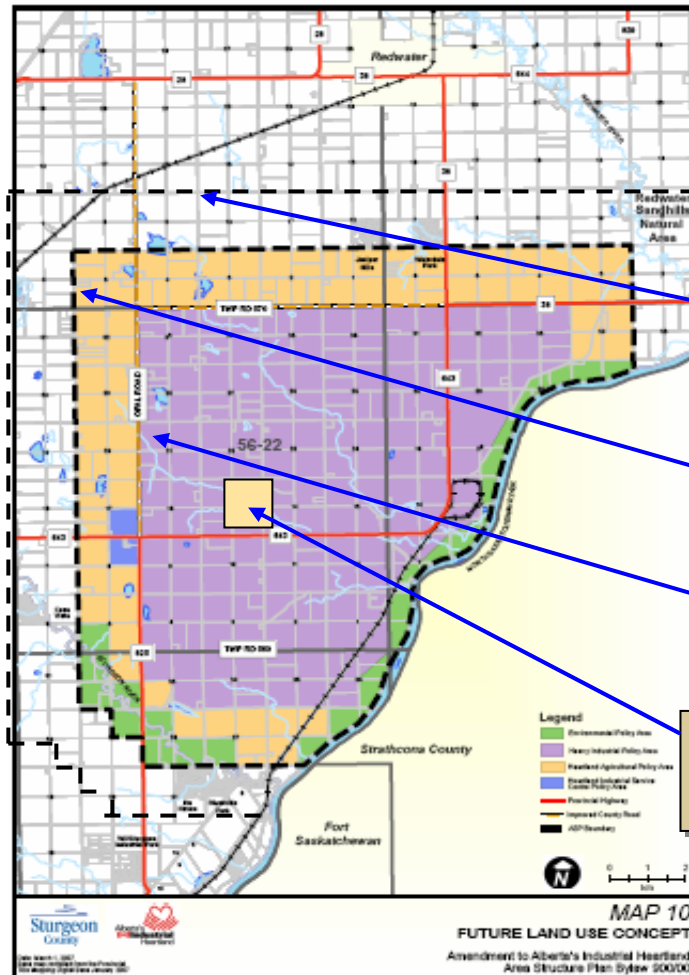
## INCORPORATED INTO STRATHCONA'S PLANNING DOCUMENTS INCLUDE THE FOLLOWING:

- **TRANSITION ZONE** - KEEP THE 3.0 "TRANSITION ZONE" RECOGNIZING THAT THIS DISTANCE REPRESENTS THE ACCEPTABLE RISK CRITERIA AS PUT FORWARD THROUGH MIACC.
  - **EMERGENCY PREPAREDNESS** - REVIEW THE "STRATHCONA COUNTY EMERGENCY PREPAREDNESS PLAN" FOR SPECIAL RESPONSE PLANS THAT MAY NEED TO BE IN PLACE FOR THE EXISTING RESIDENCES AND BUSINESSES WITHIN THE 0-3.0 KM TRANSITION ZONE. THESE SPECIAL NEEDS SHOULD BE INCORPORATED WITHIN THE COUNTY PLAN AND KEPT CURRENT.
  - **RECIPROCAL RISK ASSESSMENT FOR NEW PROJECTS** – REQUIRE NEW INDUSTRIAL AND DEVELOPMENT PROJECTS, INCLUDING EXPANSIONS, TO PROVIDE DESIGNS THAT WILL HAVE A CALCULATED RISK EQUAL TO OR HAVE A LOWER RISK THAN THE  $1 \times 10^{-6}$  RISK CRITERIA AT THE 3.0 KM DISTANCE.
  - **RISK ASSESSMENT FOR EXISTING INDUSTRY** – REQUIRE EXISTING INDUSTRY TO CONDUCT RISK ASSESSMENTS AND TO IMPLEMENT MEASURES TO REDUCE THE RISK TO THE ACCEPTABLE LEVEL OF  $1 \times 10^{-6}$  RISK CRITERIA AT THE 3.0 KM DISTANCE. STRATHCONA ACCOMPLISHES THIS THROUGH A REVIEW OF LICENSING WHEN RENEWED BY THE AEUB.
  - **BUFFER ZONES** - REQUIRE "BUFFER ZONES" ON INDUSTRIAL PROPERTIES WHERE NECESSARY.
  - **SCREENING PROCESS** – DEVELOP AND ADOPT A SCREENING PROCESS TO EVALUATE THE RISK IMPACT OF THE PROPOSED DEVELOPMENT.
-

# Strathcona County

- **INTERMUNICIPAL CO-OPERATION** – APPROACH THE CITY OF EDMONTON TO ADDRESS THE IMPACT EACH JURISDICTION HAS ON THE OTHER'S HEAVY INDUSTRIAL AREAS TO ENSURE PROPER SEPARATION DISTANCES AND RISK REDUCTION MEASURES ARE INCLUDED IN PLANNING ACTIVITIES.
- **AMENDMENTS** – PURSUE A NUMBER OF AMENDMENTS TO THE COUNTY'S PLANNING DOCUMENTS (MDP AND LAND USE BYLAW), INCLUDING THE INTRODUCTION OF A RISK MANAGEMENT APPROACH FOR ESTABLISHING ACCEPTABLE LEVELS OF RISK TOWARDS MORE PERFORMANCE-BASED ZONING;
- **TRANSITION ZONE** – MAINTAIN LIGHT/MEDIUM INDUSTRIAL AREA AND BUSINESS COMMERCIAL INDUSTRIAL AREA WITHIN THE 3.0 KM TRANSITION ZONE.
  - Maintain the existing 3.0-kilometer separation distance. This separation is necessary to provide an acceptable level of public protection by ensuring an acceptable level of risk according to the MIACC Guidelines. Permitted and discretionary land uses within this 3.0 km transition zone need to be restricted given health and safety considerations. Within the 0 to 1.5 km distance, the land uses that have the following characteristics should be prohibited or at least restricted:
    - All Residential uses (except accessory dwellings to farming and industrial operations);
    - Large indoor/outdoor assemblies of people (e.g. spectator arenas, stadiums);
    - Uses, which cater to small children or the elderly (e.g. day care, senior citizens homes);
    - Uses, which cater to temporarily or permanently confined disabled people due to illness (e.g. hospitals, extended care facilities)
    - Uses, which house public emergency response organizations (e.g. fire, ambulance, police, etc.);
    - Structures or buildings, which present difficulties in the event of evacuations (e.g. hotels, high-rise office buildings); and
    - Uses, which create the potential for large numbers of people to remain on site for long periods of time (e.g. schools, recreation facilities, shopping centres, camping, outdoor amusements).

# Sturgeon County



The cumulative risk level will not exceed  $1 \times 10^{-6}$  of a fatality at this boundary

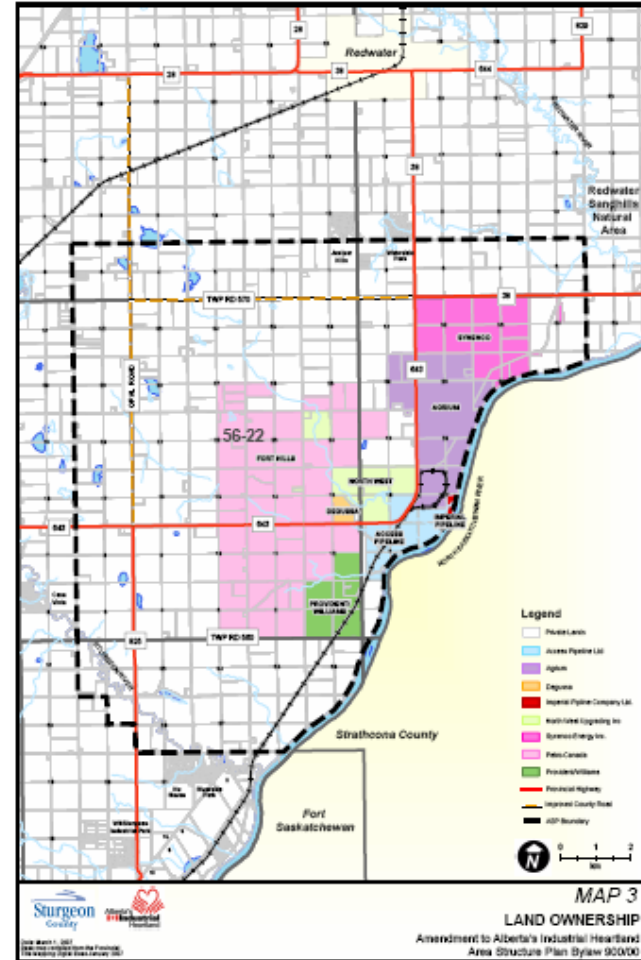
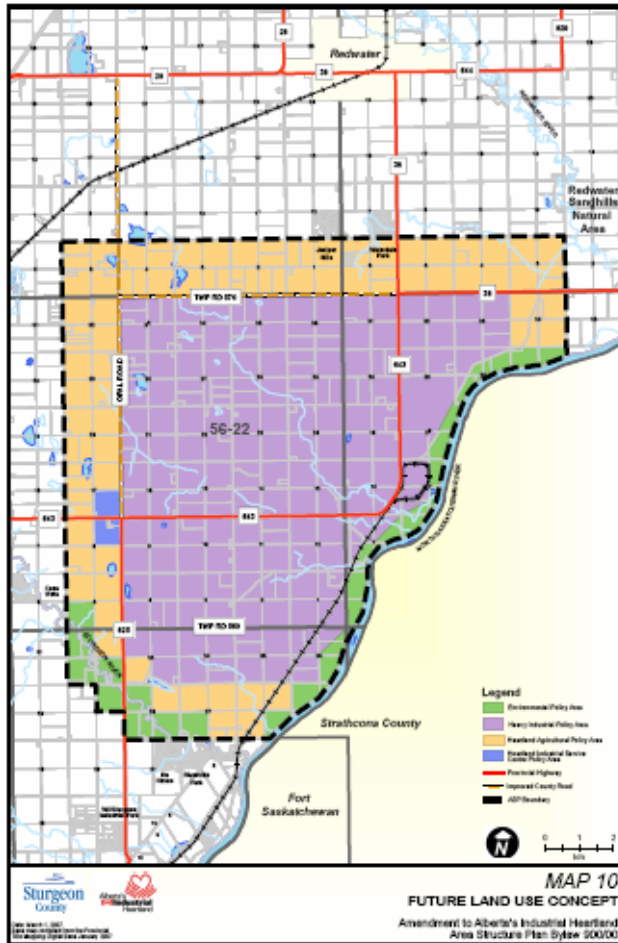
The cumulative risk level will not exceed  $1 \times 10^{-5}$  of a fatality at this boundary

The cumulative risk level will not exceed  $1 \times 10^{-4}$  of a fatality at this boundary

Company "X" will need to ensure any risk does not exceed  $1 \times 10^{-4}$  of a fatality beyond its property line.



# Sturgeon County



# Sturgeon County

## Examples of Uses Allowed between 0 - 1.6 Km

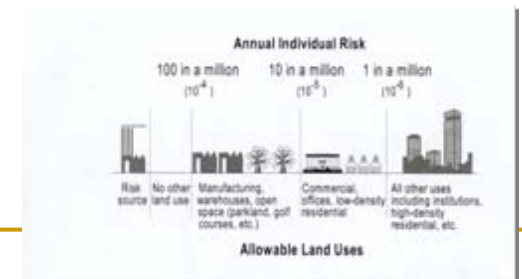
(Similar to Strathcona County)

### Prohibited Uses:

- All residential uses
- Schools
- Night clubs
- Hotels
- Health services
- Indoor recreational
- Religious assembly
- Spectator sports

### Discretionary uses:

- Major amusement arcades
- Motels
- Gas stations
- Library and exhibits



# City of Edmonton

## **DRAFT – EDMONTON'S RISK MANAGEMENT APPROACH: DRAFT REQUIREMENTS**

The City of Edmonton has adopted a risk management approach to development proposals where an industrial land use involving hazardous goods or materials, is proposed near residential areas or near other particularly susceptible uses. Such uses include hospitals, seniors' residences, activities with large gatherings of people or facilities which would be difficult to evacuate in the event of an industrial accident. The risk management approach also applies to those situations where new residential development or development of other susceptible uses is proposed near to an existing source of risk or a potential source of risk that would be permitted through zoning. Typical examples include heavy industry, rail lines, pipelines, etc.

As part of the development approval process, proponents will be asked to submit a risk assessment. The purpose of the risk assessment is to demonstrate to City Council that a development involving potentially hazardous substances or activities will be situated at a satisfactory distance from residential and other susceptible uses, such that the risk to the adjacent population would be within acceptable limits.

### **Information requirements**

The intent of a risk assessment report is to answer the questions: "What can go wrong?" "How likely is it?" and "What are the consequences?" The following items should be included.

- Identify the source of risk – A description of the land use, facility, activities and operations.
- Identify and investigate the potential hazards – hazardous substances, quantities, their use, transportation, storage, transfer points.
- Investigate the likelihood of an incident occurring – frequency analysis may be based on a historical review of the operation of the facility, other typical examples and/or research on industrial or transportation accidents.
- Analyze the consequences of an incident. Analysis could include: the type of failure, uncontrolled release, exposure to hazardous materials, routes of exposure to risk, characterization of harm, the number of people affected, expected property damage, impact on environment, mitigating factors, duration of event.
- Discussion of information limitations, where appropriate
- Assessment of risk and comparison of risk to that of other activities
- Proposed risk mitigation measures. These might include buffers, building design, site layout, operating procedures, evacuation routes, etc.
- Emergency planning and response provisions

Some variation of these requirements may be appropriate, depending on the particular application. Risk assessments for pipelines, rail lines and potential industrial uses allowed by zoning may differ from this outline because of limitations on available information. Proposals for residential development near areas zoned for heavy industry or shown as a heavy industrial area in 'Plan Edmonton' will deal with a range of possible risks based on potential uses. An examination of existing uses and their possible expansion would be a starting point.

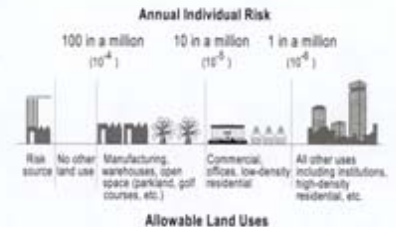
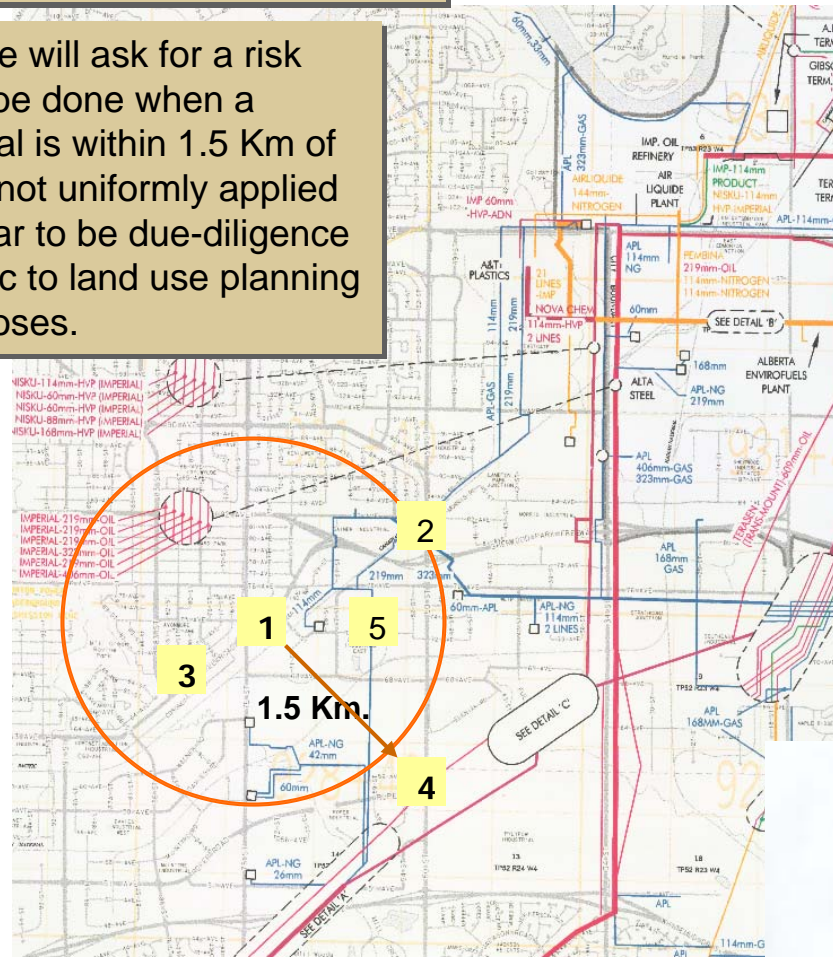
**Note the City of Edmonton references MIACC and the fact they meet MIACC criteria.**



# City of Edmonton

## Application of MIACC criteria

The City's guideline will ask for a risk assessment to be done when a development proposal is within 1.5 Km of heavy industry. It is not uniformly applied and the results appear to be due-diligence related and not specific to land use planning purposes.



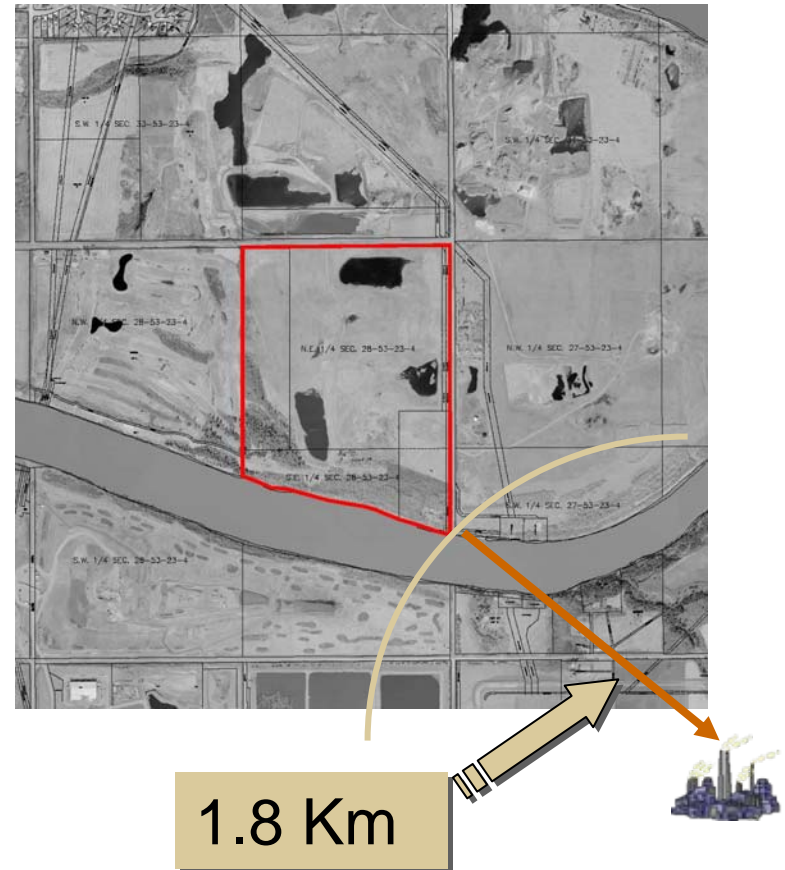
# City of Edmonton

A camp for underprivileged children almost run year round. At most 1,000 people there at one time.

One approach used for a risk assessment for the City was to determine the maximum amount of hazardous chemicals could be located in a heavy industry zone to the south. The table below shows some of the quantities.

Not a lot.

Hazard Distance to the IDLH Concentration	H <sub>2</sub> S Kg	SO <sub>2</sub> Kg	Cl <sub>2</sub> Kg
1 Km	979	1,748	203
2 Km	3,915	6,991	811
3 Km	8,808	15,729	1,825
Resulting Probability (high end) = $4.15 \times 10^{-5}$			



# City of Edmonton

A camp for underprivileged children almost run year round. At most 1,000 people there at one time.

- The City was willing to accept this but in doing so they have limited the amount and type of “heavy industry” that can be located in the area.
- It may be just as well as the encroachment of medium and light industry as well as commercial and residential is already happening in the area surrounding the heavy industrial zoned area.



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# Alberta Energy and Utilities Board

- Reference to MIACC criteria for setting Emergency Planning Zones (EPZ's)
- Reference to Z 731-03 for emergency planning (ERP's)
- Reference to Sheltering in Place

Note the MIACC content in what is taking place here.

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Any Questions?

