2022 Community Risk Assessment

Final Report, June 1, 2022 (Revised)

DARKHORSE ANALYTICS

iStrategic Advisors Inc.
Involvement, Ideas and Innovation

Limitations

This Community Risk Assessment is based on data and information available within the context of this project and at the time the community risk assessment was completed.

This Community Risk Assessment focuses on a subset of data from public and Strathcona County sources representing nine risk profiles. This inaugural comprehensive Community Risk Assessment will and should evolve in its detail and supporting data in the years to come.

Table of Contents

Acronyms

The following lists a few key acronyms used in this report:

CFAI	Commission for Fire Accreditation International
CPSE	Center for Public Safety Excellence
CRA	Community Risk Assessment
CRR	Community Risk Assessment
CRRP	Community Risk Reduction Plan
CSA	Canadian Standards Association
EMRB	Edmonton Metropolitan Region Board
EMS	Emergency Medical Services
FESSAM	Fire and Emergency Service Self-Assessment Manual
FUS	Fire Underwriter Survey
HIRA	Hazard Identification Risk Assessment
HRVA	Hazard Risk Vulnerability Assessment
ISO	International Standards Organization
MP	Master Plan
NFPA	National Fire Protection Association
SCES	Strathcona County Emergency Services
SOC	Standards of Cover

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Executive Summary

Overview

Strathcona County Emergency Services (SCES) provides integrated fire, rescue, and emergency medical services (EMS) for Strathcona County (County). SCES also provides 9-1-1 emergency communications, public education, fire prevention and investigation, emergency management, and other specialty rescue services.

SCES is developing a 10 to 12-year Emergency Services Master Plan and Standards of Cover (SOC), to anticipate and navigate the future challenges and opportunities of community growth and associated risk while balancing fiscal and other realities for emergency services. The Community Risk Assessment (CRA), the demand side of services, informs the SOC, the commitment side of services, both of which are companion documents to the Master Plan (MP).

Figure 1: Demand, Commitment, Path Model

The SOC and the CRA are tools to enable SCES to plan for and invest in emergency services and programs that mitigate community risk and ensure public safety.

CRA is defined as a comprehensive evaluation that identifies, prioritizes, and defines the risks that pertain to the overall community (NFPA 1300[1], 2020). This CRA builds on the initial CRA completed in 2012 and establishes the basis for a more comprehensive approach to the CRA.

The community level risk profile is informed by looking at nine distinct risk profiles (see Appendix D) including demographics, building stock/occupancies, hazards, economics, and critical infrastructure systems. Each of these profiles may be represented geographically or spatially.

[1] National Fire Protection Association (NFPA) provides industry leading standards for fire and emergency services. NFPA 1300 is the standard for Community Risk Assessment and Community Risk Reduction.

Community Risk

The County has one of the most unique and complex community level risk profiles in North America with a rapidly growing urban footprint, an expansive rural area, and an extensive heavy industry presence.

Within Sherwood Park, the urban service area (Figure 2), there are large residential areas with a growing number of multi-family dwellings, various elderly facilities, numerous retail areas, industry, a number of commercial corridors, retail locations, and more. There is a significant call volume for emergency services (e.g., fire, EMS) related to the urban service area. There are also a handful of wooded and parkland areas adjacent to residential and commercial structures posing some additional risk.

Figure 2: Urban Service Area

The rural service area (Figure 3) of the County boasts a dense country residential population, particularly to the south and east of Sherwood Park. These residences bring additional wildland interface exposure and contribute to fire and EMS call demand. There are a handful of industrial and agricultural sites throughout the County as well as critical infrastructure (e.g., roads, rail, air).

Figure 3: Rural Service Area

Petrochemical facilities extend from the mid-west fringe of the urban service area to the north rural service area. Associated with these, there are major petroleum and other hazardous materials storage facilities and a number of pipelines that support the petrochemical industry. Finally, hydrogen production and bitumen-by-rail are recent and growing risks that have yet to be fully quantified.

The following (Figure 4) illustrates some of the current key risks in the community based on their relative probability and impact:

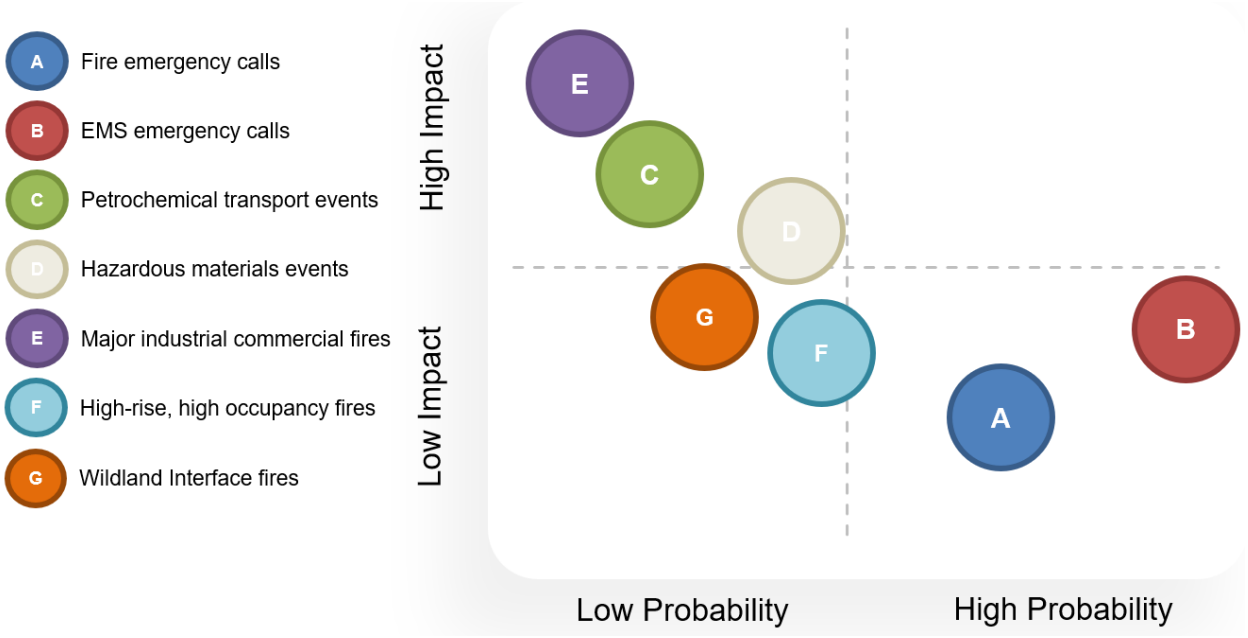


Figure 4: Key Risks

Today's community level risk profile will look different in the future. As growth occurs, housing density, employment areas, and industrial hazards will change (see Figure 5). Strathcona County is a community in transition.

Growth plans for the Cambrian and/or Bremner areas will nearly double the urban footprint within the County and will present new challenges for SCES. Across Sherwood Park there will be many more multi-family and high-rise buildings with associated risks. In short, the development plan transforms the urban service area from a bedroom community to a major urban centre.

The changing nature of risk will require more complex mitigation and response; and the demand for service will double. The industrial risk in the County represents the highest potential impact of risk.

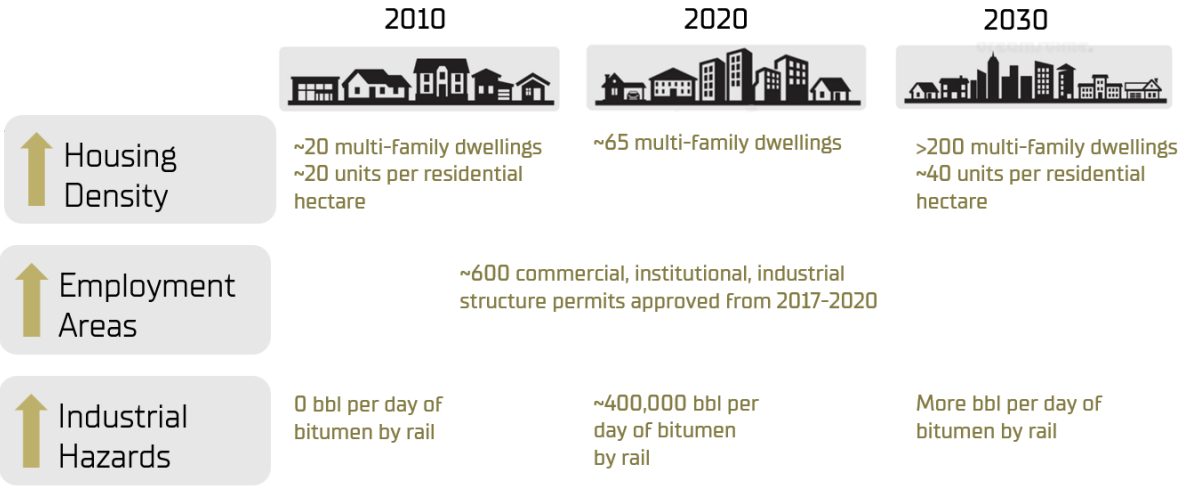


Figure 5: Changing Risk

Changes in risk will impact the demand side for emergency services. SCES and the County must prepare for this future growth and changing risk through enhanced community risk reduction and changes in services and service levels. Areas of risk that will benefit from further community risk reduction efforts and strategies include:

- Building stock risk with high-risk (e.g., hazardous materials) occupancies
- Hazards risk (e.g., medical calls, fire calls) with high call volumes
- Economic risk related to loss and disruption of business, industry, and residential activities
- Critical infrastructure systems risk including pipelines, rail, water, and road systems

What is important to recognize is planning and investments in emergency response should not be the sole community risk reduction strategy. Rather, as demonstrated within SCES today, investments in engineering, education, enforcement, and other economic incentives must all play an integral role in community risk reduction.

Recommendations

Based on this Community Risk Assessment (CRA) 2022, the following recommendations are proposed for consideration by SCES:

1. SCES should use the CRA findings and analysis to inform services and service targets within the Standards of Cover 2022 - the commitment side of risk.

2. Within SCES, Community Risk Reduction (CRR) should be integrated in all or most programs and services, where appropriate. The CRR plan should include identification of goals and accountabilities that support the use of the 5 Es model.

3. SCES should develop a list of community risk stakeholders to optimize access to community risk data, inform future community risk assessment, and support collaboration of a Community Risk Reduction Plan (CRRP).

4. SCES should ensure alignment of CRA terminology, risk analysis scales (i.e., probability and impact), and the CRA use and alignment with other departmental risk instruments (e.g., Industrial Cumulative Risk Assessment). This should result in a single County Risk Register.

5. SCES should ensure an enhanced (e.g., current, metadata, more data sets) collection of community risk data supporting each of the nine risk profiles.

6. SCES should maintain (i.e., update and review) the CRA on a regular basis (e.g., bi, or tri-annually) so as to inform a SOC update which is typically completed every 5 years.

7. SCES should champion a CRRP, the roadmap for community risk reduction, ensuring it is developed, implemented, and maintained on a regular basis.

Conclusion

Community Risk Assessments (CRA) are an integral activity that informs Community Risk Reduction (CRR). The CRR should be documented in a Community Risk Reduction Plan (CRRP).

This CRA is one component that can inform the Standards of Cover and the Master Plan by utilizing the 5 Es of community risk reduction and recognizing the following:

1. There will never be a perfectly safe community. The public accepts a certain level of risk exposure even after all the mitigation efforts are in place. Transparent reporting to stakeholders allows for an informed balancing of risk and investment.

2. Community risk reduction is the responsibility of all stakeholders and citizens, not just a small group within SCES. Front line firefighters, other County departments, and groups throughout the region have both the capability and responsibility to reduce risk.

3. Timely, accurate community risk data and information is foundational to the community. By directing efforts toward the appropriate risks within the County, SCES can have an outsized impact on risk reduction.

4. Prevention is far more cost effective than cure. It is no accident that all but the last “E” deal with the demand side of risk. Community risk reduction is difficult to measure, but intuitively, reducing the number of incidents has far-reaching impacts.

Introduction

Community Profile

Strathcona County, located in Alberta's industrial heartland, is a specialized municipality representing urban and rural areas with significant population and employment areas. The County is a critical voice within the Edmonton Metropolitan Region.

The urban population resides in Sherwood Park, while the rural population resides in a large rural area that includes eight hamlets (Antler Lake, Ardrossan, Collingwood Cove, Half Moon Lake, Hastings Lake, Josephburg, North Cooking Lake, and South Cooking Lake). Strathcona County is a diverse community with a population of 103,187 in 2021[2], the 4th highest in the province.

The vast majority of the population (>70%) resides in Sherwood Park. The population has increased 3.56% in total for the years 2015-2020. The community encompasses 1,262 square kilometres (or 125, 536 hectares) and is situated within a UNESCO biosphere called the Beaver Hills/Cooking Lake Moraine. The Moraine is the traditional territory of First Nations people. There are more than 87,000 hectares of land utilized for agriculture purposes.

The following is the 2022 community profile as per Alberta Municipal Affairs:

Attribute	Fact
Specialized municipality	Largest in Alberta
Service areas	Sherwood Park and eight hamlets in rural area
Total area	125,536 ha. or 1,262 sq. km.
Length of all maintained roads	1,733 km.
Length of all urban roads	~400 km.
Length of all rural roads	~1,300 km.
Length of all water mains	~816 km.
Equalized assessment (residential)	~17.6 billion
Equalized assessment (rural)	-
Equalized assessment (total)	$~33.9 billion
Tax Revenue Industrial and Linear	44%
Tax Revenue Residential	34%
Tax Revenue Commercial	22%
Population (total) - 2019	98,381
Population (Sherwood Park) - 2019	71,332 (73%)
Population (Hamlets and Rural) - 2019	27,049 (27%)

Table 1: Alberta Municipal Affairs 2020 Community Profile

[2] Alberta Municipal Affairs Regional Dashboard

The Strathcona County May 2019 Community Profile describes the County as having "a rich cultural and economic history, with strong agricultural roots, a robust petrochemical sector, and high quality natural and recreational amenities and is situated within a world-renowned natural biosphere."

SCES and Community Risk

Strathcona County Emergency Services (SCES) provides integrated fire, rescue, and emergency medical (EMS) services for Strathcona County (County). SCES also provides 9-1-1 emergency communications, public education, fire prevention and investigation, emergency management, and other specialty rescue services.

SCES is developing a 10 to 12-year Emergency Services Master Plan and Standards of Cover (SOC) to anticipate and navigate the future challenges and opportunities of community growth and associated risk while balancing fiscal and other realities for emergency services.

The County is a key member of the Edmonton Metropolitan Region Board (EMRB) and as such risk in the County is as equally important to all municipalities in the region, as is other risks across the region to the County (see Appendix A).

Risk assessments are not new to SCES and the County. Numerous community level risk assessments have been completed over the years (see Appendix B), each contributing to a body of data and information, albeit many areas of risk do not have data that can be spatially presented. These past County risk assessments contribute to an overall understanding of risk in the County.

This CRA will utilize an approach to spatially represent available risk data as a basis for future risk identification, analysis, and treatment.

Definitions

For the purposes of this Community Risk Assessment (CRA), we will leverage definitions from the National Fire Protection Association (NFPA) 1300 standard.

- Community risk pertains to the community, including the aggregate potential of loss or damage to critical infrastructure, individual properties, or stakeholders that could have a significant detrimental impact on the overall community.
- CRA is defined as a comprehensive evaluation that identifies, prioritizes, and defines the risks that pertain to the overall community.
- Hazard (includes threat) is a condition, situation, or behaviour that presents the potential for harm or damage to people, property, environment and can also include harm or damage to economic interests or community reputation.
- Risk is a measure of the probability (also known as likelihood or frequency) and impact (also known as consequence or severity) of adverse effects that result from manifestation of risk. Ideally, vulnerability to risk should be mitigated.

Purpose and Scope

The CRA is a component of the SOC and is an overall evaluation of risk in the community. Further, a CRA informs Community Risk Reduction (CRR) and a Community Risk Reduction Plan (CRRP).

The CRA allows an emergency services organization, and its community, to make evidence-based decisions, including investments, about the types and levels of emergency services they will provide based on identified community risks and needs for community safety.

This CRA will primarily focus on those aspects which directly impact SCES services, programs, and activities. However, the CRA model and approach used for this assessment can and should provide a foundation for broader use and application across other County departments.

Assumptions and Principles

This assessment includes the following assumptions:

- Risk is a normal and expected characteristic of any community.
- Risk should be transparent and effectively communicated to facilitate informed decision-making
- Risk can and should be managed in a balanced and appropriate manner, subject to the risk appetite for the community.
- Risk management is a shared responsibility across a community.

This community risk assessment considers the following industry leading principles for risk management:

- All-hazards approach:
    - an all-hazards approach is a comprehensive emergency management framework that takes a full scope of emergencies, major incidents, or disasters into account when planning for response and recovery capacities and capabilities. In simple terms this means a community plans for the consequences of events regardless of the source of the hazard or threat.
- Whole-of-community approach:
    - a whole-of-community approach is community focused, involving all aspects of the community from local government to industry to citizens. This means a full-spectrum of risk-reduction strategies and tools are brought to the forefront of planning and readiness for hazards and threats.
- Continuous Improvement approach:
    - The community risk assessment approach is not a one-time action. Rather, community risk assessments are an ongoing set of actions for data collection, analysis, decision-making, intervention, and improvement. These actions should support CRR strategies within a CRRP.

Methodology Overview

The primary standard used for this community risk assessment is NFPA 1300 Standard on Community Risk Assessment and Community Risk Reduction Development. Further, NFPA 1300 provides guidance for conducting a CRA, creating CRR strategies, and implementing a CRRP including continuous improvement of that plan.

The essence of any risk methodology includes three steps:

- Risk Identification
- Risk Analysis or Prioritization
- Risk Treatment

Details on the methodology for this report are found in Appendix C.

Additionally, there are numerous all-hazard risk assessment criteria identified within Centre of Public Safety Excellence (CPSE) "Community Risk Assessment: Standards of Cover" and the "Fire and Emergency Service Self-Assessment Manual (FESSAM)" documents.

One key performance indicator from CPSE is the need for a "documented and adopted methodology for identifying, assessing, categorizing, and classifying risks throughout the community or area of responsibility."

Risk Identification and Analysis

Risk identification helps find, recognize, and describe risk through various risk profiles. Risk analysis or prioritization helps comprehend the probability and impacts of the risk.

NFPA 1300 utilizes nine risk profiles to identify and describe community risk. Each of these risk profiles are listed below, then defined[3] and/or analyzed in Appendix D:

1. Geographic
2. **Demographic**
3. **Building Stock**
4. **Hazards**
5. **Economic**
6. Critical Infrastructure Systems
7. Public Safety Response Agencies
8. Community Services Organizations
9. Past Loss and Event History

Geographic and critical infrastructure systems risk will be incorporated into views of demographic, building stock, hazards, and economic risk profiles as composite impacts of risk. Past Loss and Event History will be represented in the composite probability of risk. Public Safety Response Agencies and

[3] Ontario Fire and Prevention Act, Community Risk Assessments.

Community Services Organizations have not been analyzed for specific risk and are presented as a placeholder for future risk identification, analysis, and treatment.

Risk Treatment

Risk treatment is how risk is avoided, transferred, mitigated, or accepted within a community.

Supporting NFPA 1300 is a framework for risk treatment including risk mitigation. This framework (adapted from the CFAI[4] Vision 20/20 risk assessment) is the Five Es (known as the "5 Es") as illustrated following:

Figure 6: The 5 Es of Community Risk Reduction

- Education:
  - is the set of activities that teach the public and other stakeholders about the various community risks and changes (e.g., behaviour, safety) to reduce risk. It includes the training and guidance given to these groups to improve their safety when an incident has occurred.
- Enforcement:
  - is the act of inspecting structures for compliance with fire standards and codes and requiring occupants to make appropriate adjustments to ensure occupancies are within standards and code.
- Engineering:

[4] CFAI - Centre for Fire Accreditation International

- deals with the codes and regulations that govern infrastructure, building standards, and integrated fire suppression/prevention (e.g., sprinkler systems, alarms, firestopping/fireproofing).

- Economic incentives:
  - are one of the ways enforcements can be actioned. Organizations and businesses can be rewarded with reduced fees for exemplary behaviour and those that can be disincentivized are charged. This may be done through tickets, fees, and the revocation of licenses for failed inspections or frequent false alarms.

- Emergency response:
  - deals with the planning and execution of emergency interventions after an incident has occurred. It includes station location, deployment, staffing, operational standards, and execution.

The 5 Es framework is intended as the primary "solutions toolbox" for SCES and the County to transform community risk reduction in the future. This whole of community, data-driven process will ensure the changes needed across the County for CRR can occur including its influence on reinvention of the SCES culture and services.

What is important to recognize is planning and investments in emergency response should not be the sole community risk reduction strategy. Rather, as demonstrated within SCES today, investments in engineering, education, enforcement, and other economic incentives must all play an integral role in community risk reduction.

As an example, the growth in the County is visible in urban developments (Cambrian/Bremner, multifamily, high-rise buildings) and heavy industrial areas (highest risk) thus, some investment or resource allocation should be toward engineering, education, and enforcement to contribute to community risk reduction for this growth.

Risk Profiles

The following risk profiles illustrate the impact of various risks for urban and rural service areas.

Demographic

Four aspects of demographic impact of risk were analyzed using data acquired from the Edmonton Metropolitan Region Board (EMRB):

- Overall Population Density - the total number of people residing within a geography
- Over 65 Population Density - the total number of seniors residing within a geography
- Under 20 Population Density - the total number of youths and children residing within a geography
- Employment Population Density - the total number of people employed in a particular geography. We use this as a proxy for daytime population.

The data was combined into a single demographic profile for risk impact by weighting each component equally into a hex. The demographic impact of risk within Sherwood Park is concentrated in the denser urban area, with pockets of higher density on the western and northern edge of Sherwood Park including daytime populations related to industry and commercial activities.

The darker color hexes represent higher demographic risk.

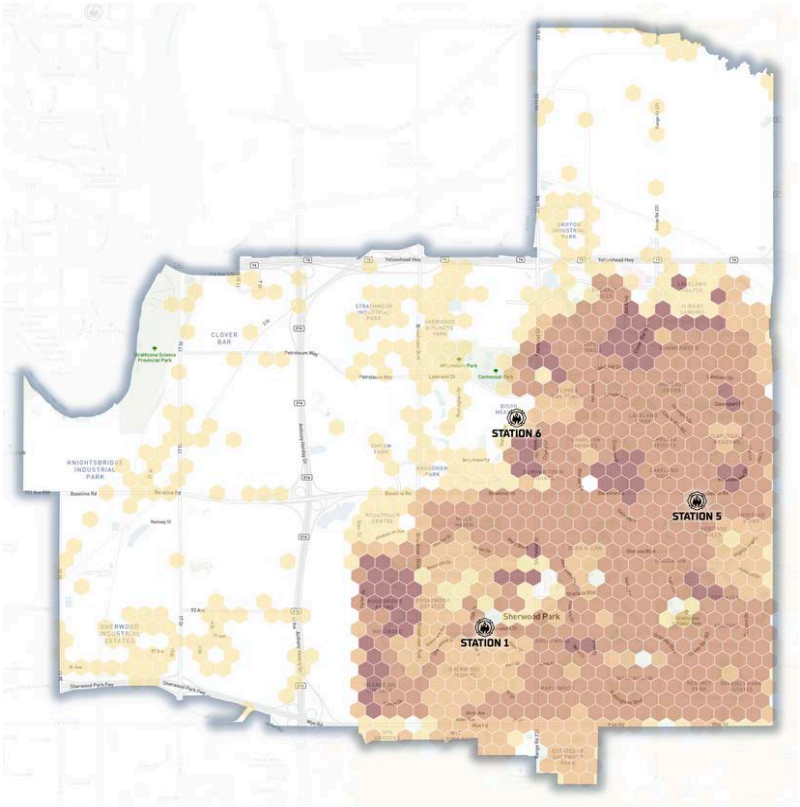


Figure 7: Demographic Impact of Risk (Urban Service Area)

The rural service area has significant country residential developments - particularly in the southern half of the County and in the immediate vicinity of Sherwood Park. There is an area of higher demographic impact in the extreme northern portion of the County based on an assumed day-time population (e.g., the Scotford facility and supporting businesses).

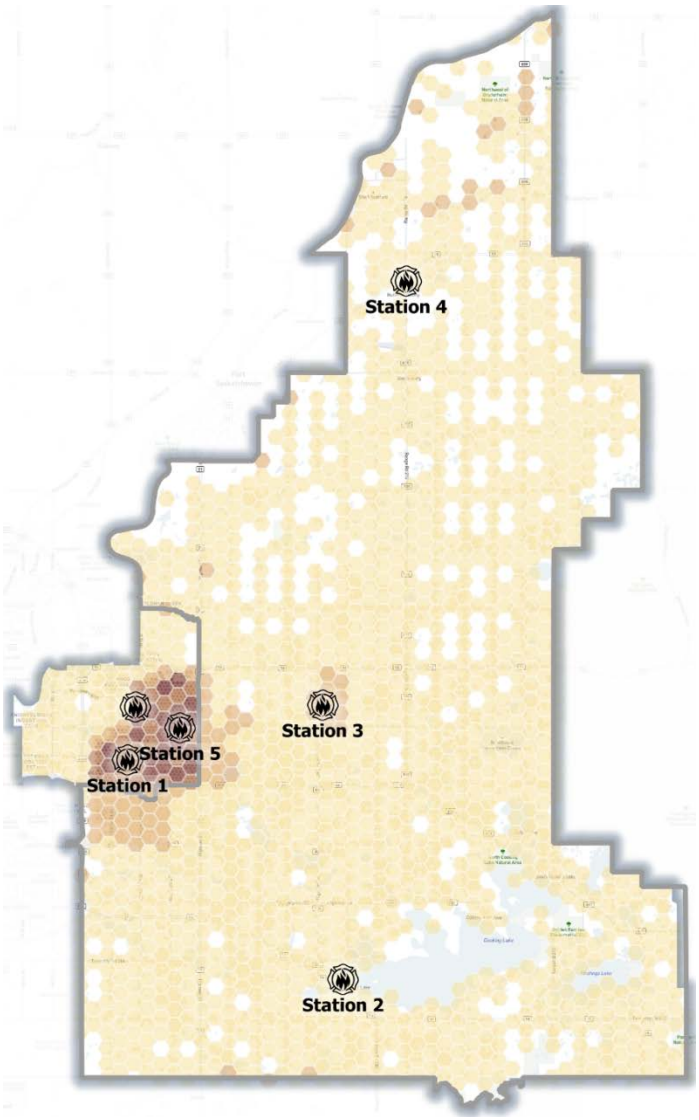


Figure 8: Demographic Impact of Risk (Rural Service Area)

What does the above analysis mean?

It implies that population density, employment density, and ages of persons relate directly to the volume and/or nature of calls or incidents. The above graphics indicate the relative location of demographic risk and the probable service demand on SCES.

Building Stock

Two aspects of building stock impact of risk were analyzed using data acquired from the County:

- Occupancy Type Risk Level - a categorization based on building code (i.e., Alberta Building Code) categorizations which considers the relative risk of different structures and usage.
- Hazardous Material Storage - the presence of significant hazardous material storage on site.

The data was combined into a single building stock profile for risk impact by using a five-point scale of the highest-rated risk occupancy to the entire hex. The risk ratings related to the size, nature, and occupancy activity within a given building or facility.

If the hex contained any hazardous material storage, an additional point was included. Urban building stock risk is driven primarily by the industrial and commercial facilities to the west and north of Sherwood Park and along Baseline Road.

The darker color hexes represent higher occupancy type risk.

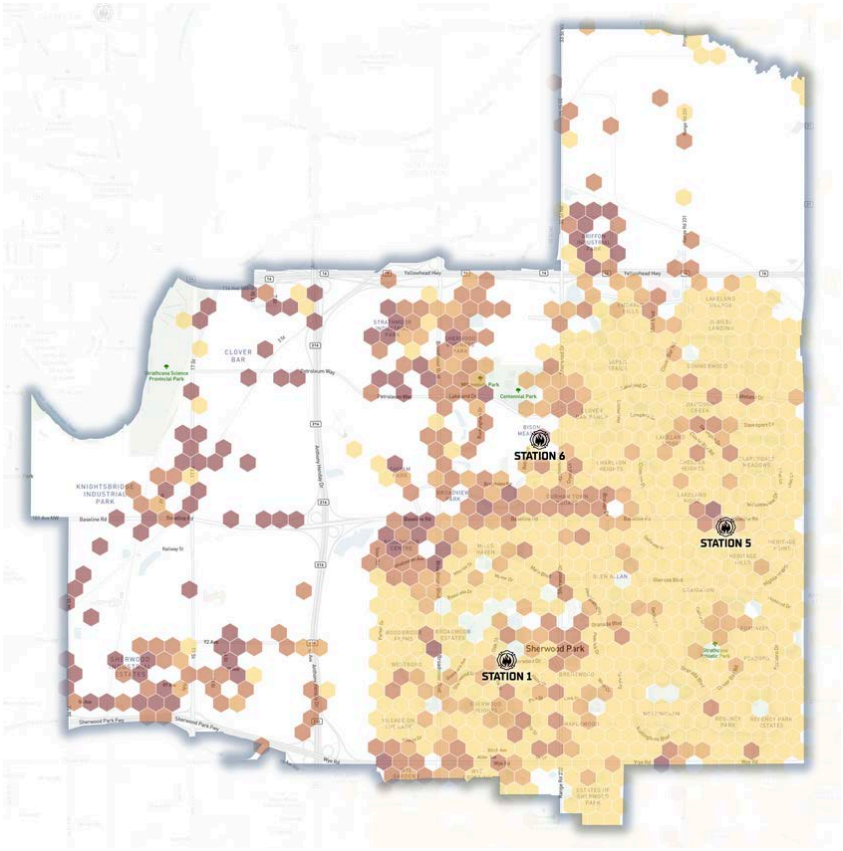


Figure 9: Building Stock Impact of Risk (Urban Service Area)

Rural building stock risk is highest in the northern tip of the County centered around the Scotford facility. There are also smaller clusters of risk at the South Cooking Lake Airport and in Ardrossan.

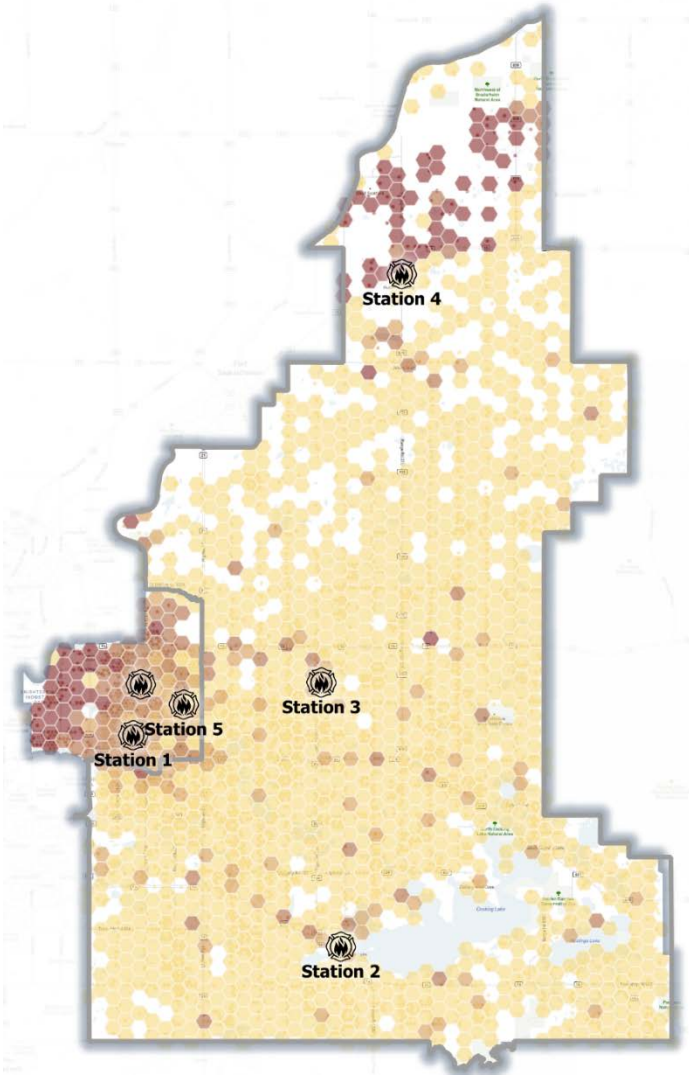


Figure 10: Building Stock Impact of Risk (Rural Service Area)

What does the above analysis mean?

It implies that building stock or occupancy types relate directly to the complexity and/or nature of calls or incidents. The countywide view demonstrates that the risk surrounding the Scotford facility approaches the impact of occupancy risks with industry to the west of Sherwood Park. The above graphics indicate the relative location of building stock risk and the potential service demand on SCES.

Hazards

A comprehensive Hazard Risk Vulnerability Assessment was completed by SCES in 2018 (see Appendix E). For the purposes of this CRA, only spatially enabled data has been included.

Three aspects of hazards impact of risk were analyzed using data acquired from the County and EMRB:

- Wildland Interface Fires - the region where structures and development intersect with undeveloped wildland or vegetative fuels. The data informing this hazard area was derived from the EMRB geospatial datasets.
- Hazardous Material Transport - Pipeline, rail, and hazmat-rated roads taken from the EMRB geospatial dataset.
- Hazardous Material Storage - the presence of significant hazardous material storage on site. Taken from SCES internal risk datasets.

The data was combined into a single hazards profile for risk impact by using a single point for the presence of a wildland interface and hazardous materials using major pipelines, rail, and roadways for location. Where a hex had more than one hazard, we summed the score. This provides equal weighting to each of these dimensions of hazards.

Urban hazards are found where wildlands intersect with residential and commercial areas, and where rail, pipeline, or hazmat storage exist. Hazards risk is also concentrated in residential areas of Sherwood Park based on fire and EMS calls.

Risk associated specifically with the location, nature, and size of energy refinery and processing activities was not assessed; however, these should be explored in future CRAs. Some of these risks are represented in the industrial cumulative risk assessments completed within the County including most recently in 2018.

The darker color hexes represent higher risk from the select hazards.

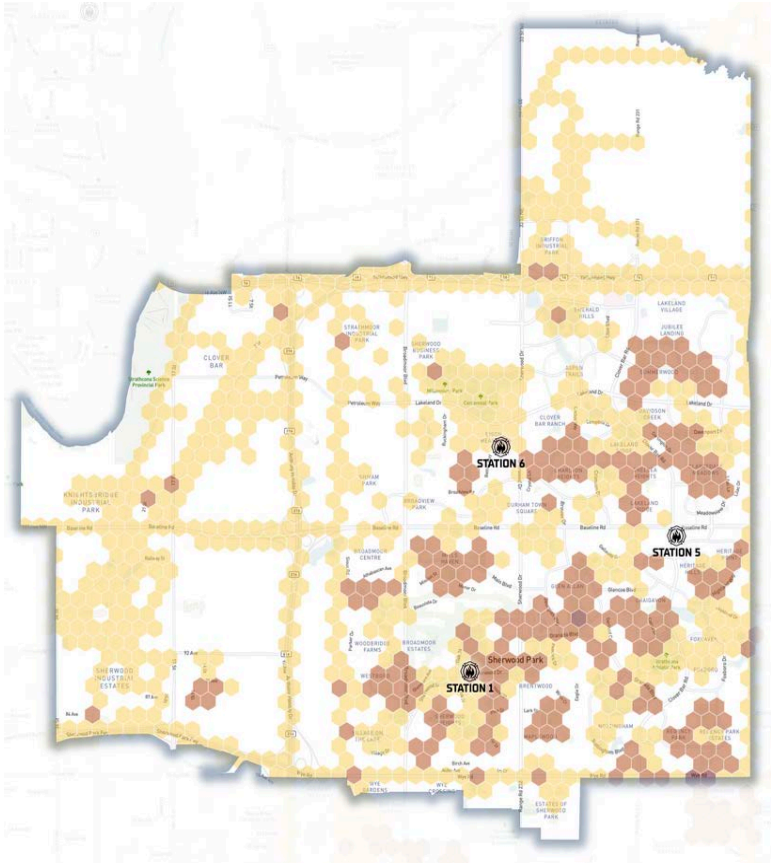


Figure 11: Hazards Impact of Risk (Urban Service Area)

Like the urban areas, higher risk from hazards is found where wildlands intersect with residential and commercial areas, and at a handful of points where rail, pipeline, or hazardous materials storage intersect. The majority of rural hazard impact is found in the more densely populated country residential areas south of Sherwood Park and typically relate to fire and EMS calls.

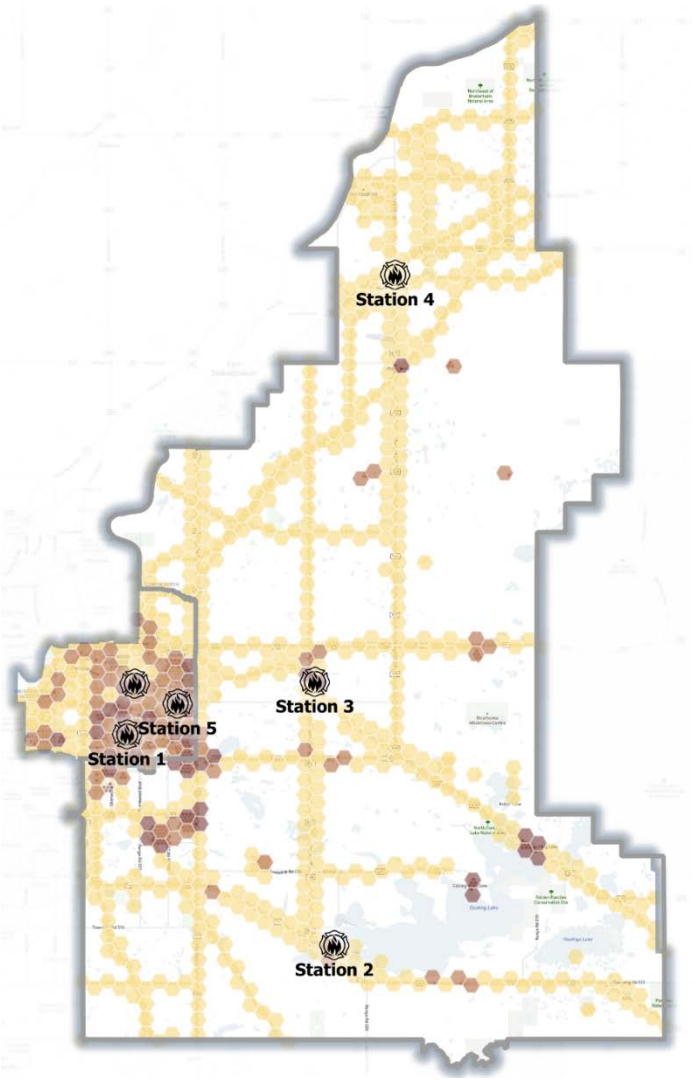


Figure 12: Hazards Impact of Risk (Rural Service Area)

What does the above analysis mean?

While not all hazards (e.g., weather, hostile acts) have been geographically or spatially modelled at this time, data that is available (e.g., wildland interface fire risk, hazardous materials, hazardous material

transport) implies risk that relates directly to the complexity and/or nature of calls or incidents. The above graphics indicate the relative location of hazards risk and the potential service demand on SCES.

Economic

Two aspects of economic impact of risk were analyzed using data acquired from County Tax Assessment and the EMRB:

- Assessed value - the total assessed value in dollars taken from the property tax registry
- Employment population - the total number of people employed within the area

The data was combined into a single economic profile for risk impact by weighting each component equally into a hex.

The economic impact of risk within Sherwood Park is concentrated in areas with commercial or industrial facilities. These areas represent both the cost to rebuild the structure and the cost of the lost employment due to a major event. The economic risk is also concentrated along the major commercial corridors (Baseline Road and Sherwood Drive) as well as the industrial and commercial areas west of 216 and surrounding Millennium Place in the north.

The darker color hexes represent higher economic risk.

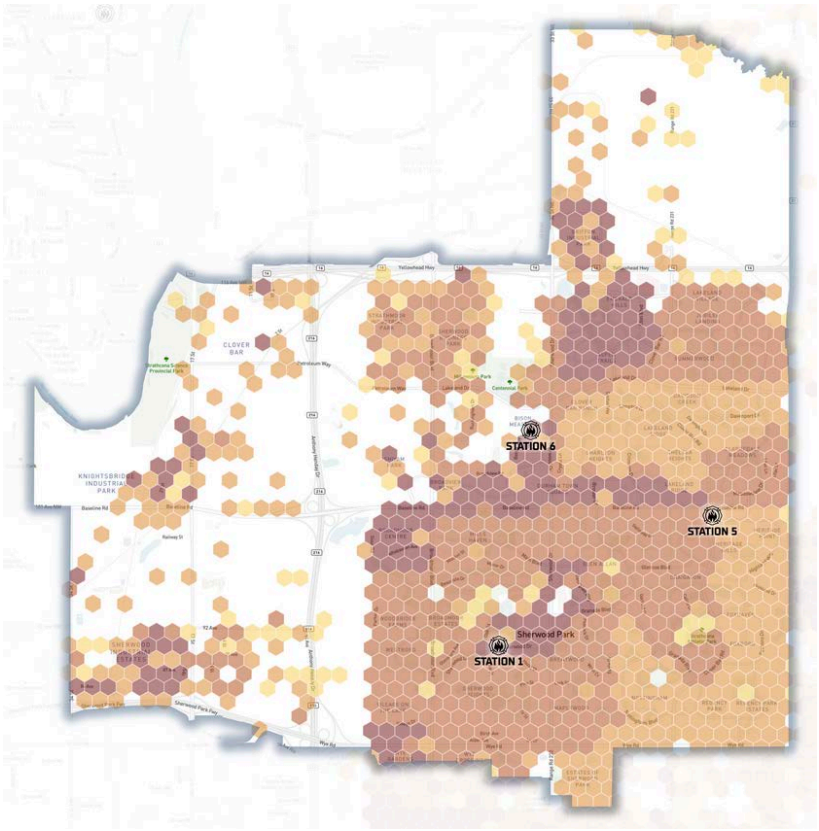


Figure 13: Economic Impact of Risk (Urban Service Area)

The economic impact in the rural County is highest in the areas immediately adjacent to Sherwood Park to the south and east and driven by the value of country residential properties along with the higher concentrations of employment represented within Ardrossan, South Cooking Lake, and the Scotford facility in the north.

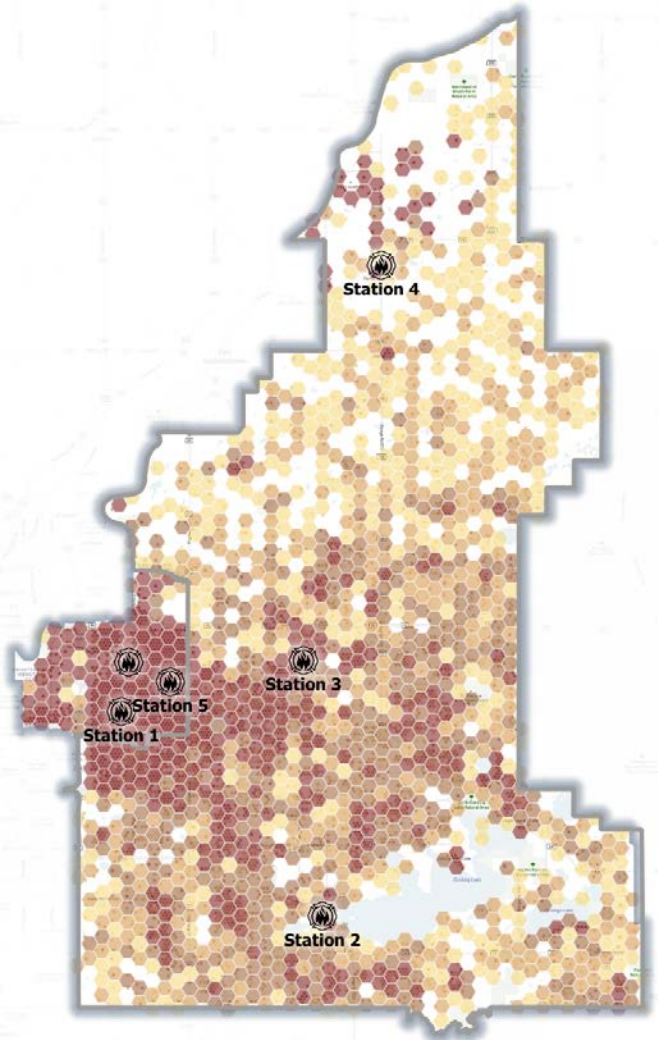


Figure 14: Economic Impact of Risk (Rural Service Area)

What does the above analysis mean?

It implies that should various risk occur; the potential loss or disruption impacts economic value in the County. The above graphics indicate the relative location of economic risk and the potential economic risk within the County.

Critical Infrastructure Systems

The Critical Infrastructure profile refers to the facilities or services that contribute to the interconnected networks, services, and systems that meet vital human needs, sustain the economy, and protect public safety and security.

The following is a sample of some these critical infrastructure systems:

System	Relevance to community risk
Water	• Essential for fire suppression and sprinkler systems • Advantage of hydrant protected environments • Need for tanker services in non-hydrant protected environments
Telecommunications	• Transmission of critical information • Operation of 9-1-1 centres (Public Safety Answering Points) • Control of oil/gas valves • Communication towers and transmitters to support emergency services
Rail	• The location, transmission, and distribution of power, oil, gas products • Potential exposure points • Consideration of firefighter and other response agency scene safety
Roads	• The convergence of traffic and exposure for road incidents • The paths for optimal emergency response

Table 2: Sample Critical Infrastructure Systems

The geographic location of pipelines, rail, and roads and the probability of incidents (i.e., hazards - vehicle accidents) has been incorporated into the impact and/or probability of risk for several of the risk profiles in this CRA.

Following are illustrations of some critical infrastructure in the region:

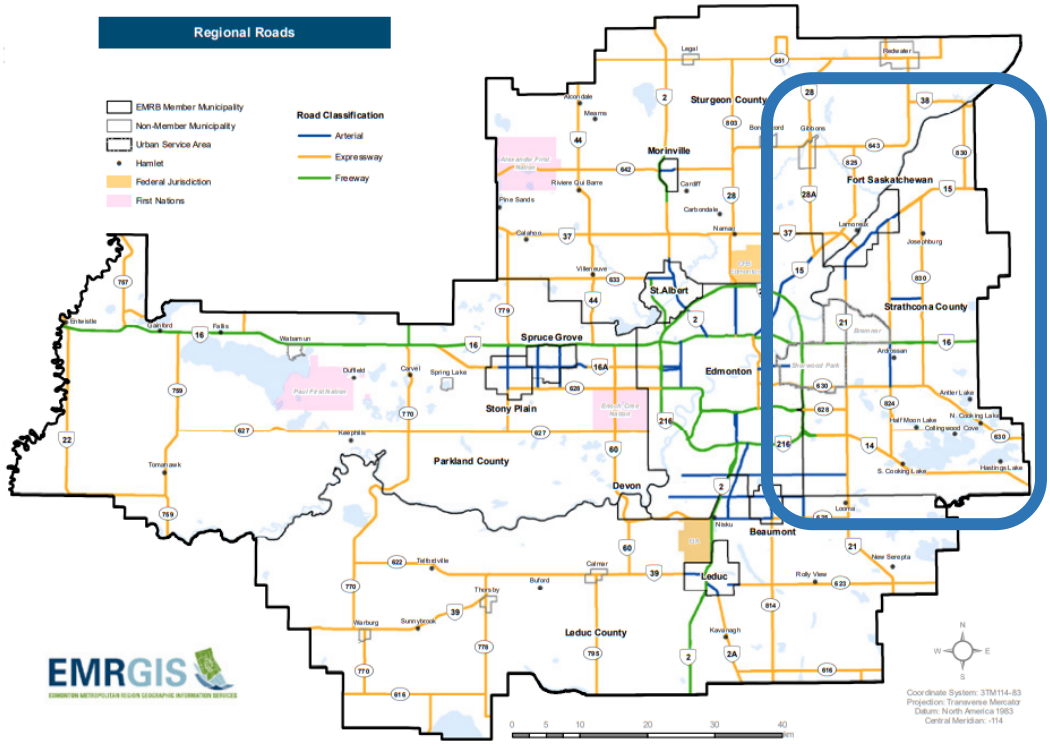


Figure 15: Roads

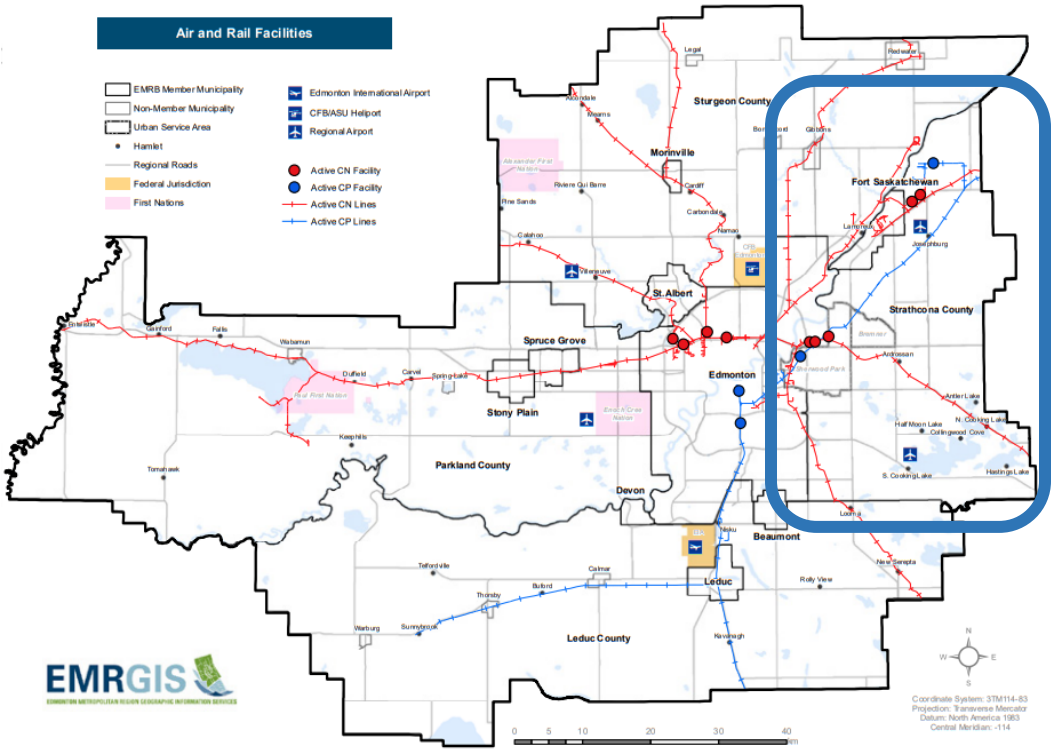


Figure 16: Air Rail

Public Safety Response Agencies

The Public Safety Response profile refers to the agencies and organizations in the community and region (e.g., police, EMS, fire/rescue) that may respond to certain types of incidents. The presence or absence of these agencies and how they work in the County have a direct and indirect impact on overall community risk.

The following is a sample of these public safety response agencies:

Agency	Example of types of Incidents they respond to	Agency role in an incident in the County
Fire and Emergency Services	• Fire • Medical • Rescue • Dangerous goods • Speciality rescue	• Support SCES response • Provide key mutual aid and auto aid assistance • Provide primary specialty services
RCMP and Enforcement Services	• Motor vehicle collisions • Medical incidents • Fire incidents • False fire incidents • Public assistance	• Traffic control, scene stabilization, investigation • Patient contact, initial first aid, scene stabilization, investigation • Scene stabilization, investigation • Assist in coordinating public information
Alberta Health Services (Ambulance)	• Motor vehicle collisions • Medical incidents • Fire incidents • Public assistance	• Patient stabilization, transport, reporting • Standby for firefighter safety, patient stabilization, transport, reporting • Assist in coordinating public information
Strathcona County Victim Services	• Attempted homicide • Serious assault • Domestic violence • Sexual assault	• Support to victims and witnesses of crime and trauma • Arrange referrals to community organizations • Give information and guidance through the criminal justice process • Aid with victim of crime assistance program
Alberta Search and Rescue	• Search and rescue/ missing persons	• Provides emergency assistance to first responders and emergency management • Ground search and rescue • Canine unit support

Table 3: Sample Public Safety Response Agencies

On the frontline are various emergency services including police, fire, and ambulance or EMS. The type, nature, and location of these services is integral to emergency response once risk manifests (e.g., medical call, fire, industrial explosion, mass-casualty incident).

Following is an illustration of the fire station locations (i.e., full-time (red), part-time (blue)) in the region:

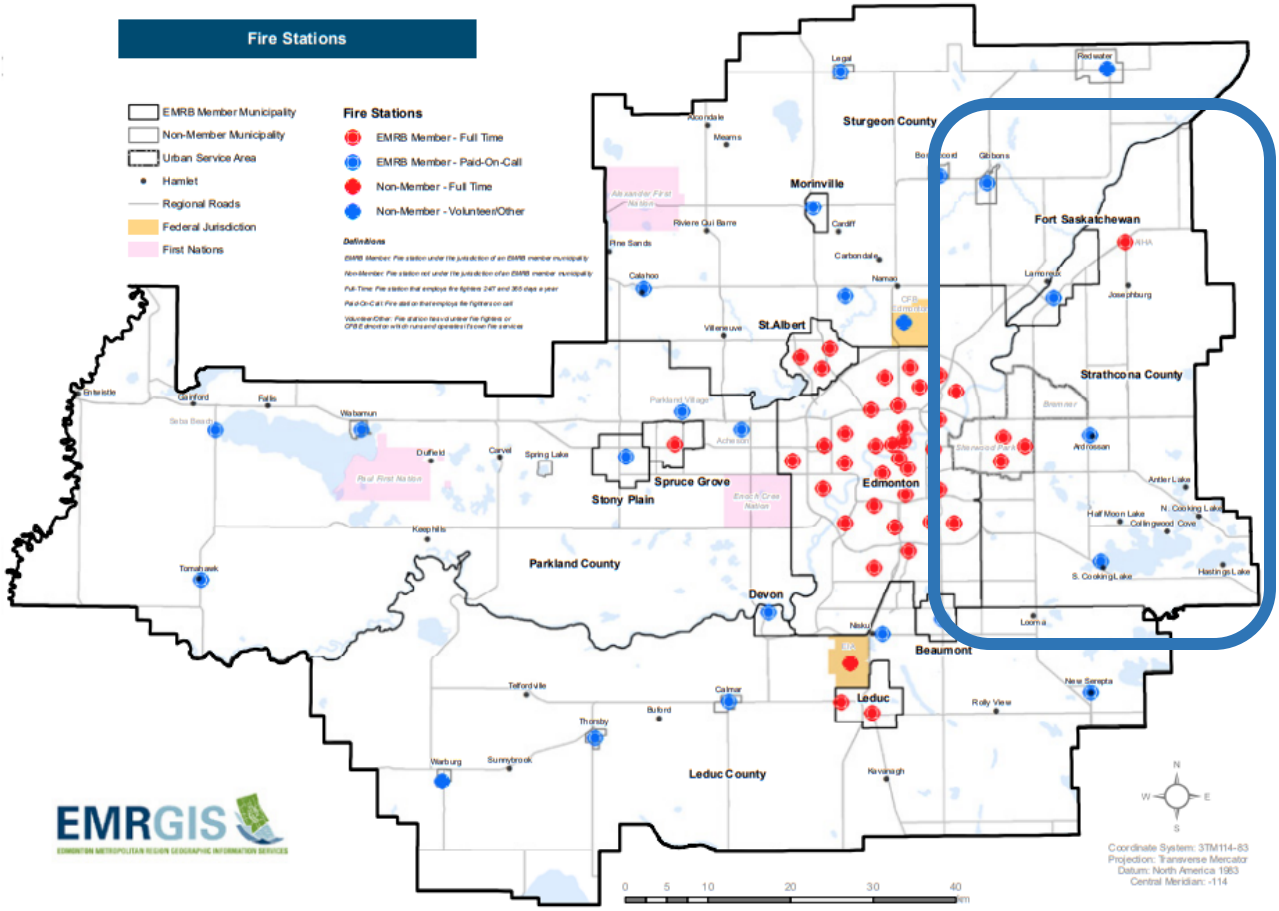


Figure 17: Fire Stations

A comprehensive identification and analysis of how community risk is mitigated by these agencies has not been completed; however, such identification, analysis and mitigation should be considered in future CRAs.

Community Service Organizations

The Community Service Organization profile refers to community agencies, organizations or associations that can provide services that support SCES in the delivery of public safety, education, inspections and enforcement, or emergency response. The presence or absence of these organizations and how they work in the County have a direct and indirect impact on overall community risk.

The following is a sample of community service organizations:

Organization	**Types of assistance provided in the County**
Canadian Red Cross	Canadian Red Cross work in partnership with first responders, public officials, emergency managers, and alongside other voluntary sector organizations to provide vital services to the public. This assistance may come in the form of emergency food and clothing, emergency lodging, reception and information, personal services, and family reunification services.
Salvation Army	The Salvation Army provides immediate and long-term recovery assistance in cooperation with local authorities. The Salvation Army's Emergency Disaster Services program can provide food and hydration resources, emotional and spiritual care, donations management, social services, long-term recovery and training and volunteers.
St. John's Ambulance	St. John's Ambulance provide day-to-day and community disaster and emergency aid services. The organization has the capacity to provide health care and first aid in reception centres, casualty care at the scene of an event, patient transportation, and evacuation assistance.
Strathcona Radio Volunteers	Strathcona Radio Volunteers provides radio communication along with general manpower to public service, charity, and general events in and around Strathcona County. The club also provides backup communication to the Emergency Services of Strathcona County
Local Faith based organizations	Local faith-based organizations provide public education and other supports within the County. These organizations may also be able to identify at risk populations within the community.
School Boards	Partnering with school boards and other agencies that work with children can provide opportunities for fire and life safety education.
Senior Care Agencies	Senior Care Agencies provide at-home care and assisted living services to seniors. They can assist in identifying occupants who are at increased fire risk due to unsafe living conditions (e.g., absence of a working smoke alarm) which may require follow up or inspection.

Table 4: Sample Community Service Organizations

A comprehensive identification and analysis of how community risk is mitigated by these agencies has not been completed; however, such identification, analysis and mitigation should be considered in future CRAs.

Past Loss and Event History

The Past Loss and Event History profile refers to the community's past emergency response experience, including the following:

- The number and types of emergency responses, injuries, deaths, and dollar losses.
- Comparison of the community's fire loss statistics with provincial fire loss statistics.

Given significant changes in Alberta's Fire Commissioners Office, fire and related reporting and the absence of comparable fire loss statistics in Alberta and for that matter Canada, such data will not be presented in this CRA.

Call Type and Volume Trends

The context for historical system performance is closely related to trends in call types and related call volumes. The 2012 Standards of Cover and Master Plan identified the total call volume in 2011 as ~5,900 incidents with ambulance responses as having a small increase from previous years while rescues increased moderately from previous years.

The following reflects the service events by SCES fire (in **red**) and EMS including ambulance (in **blue**) for January 1, 2017, through December 31, 2021:

Incident Type	2017	2018	2019	2020	2021
Fire	1,638	1,263	1,227	1,178	1,432
EMS (Medical First Response)	0*	78*	206	424	643
EMS (Ambulance)	5,925	6,344	6,536	6,686	8,679
Total	7,494	7,861	8,190	8,437	10,793

Note: * reflects changes in the fire response protocol and/or incident type capture of medical first response.

Table 5: Call Type and Volume Trends

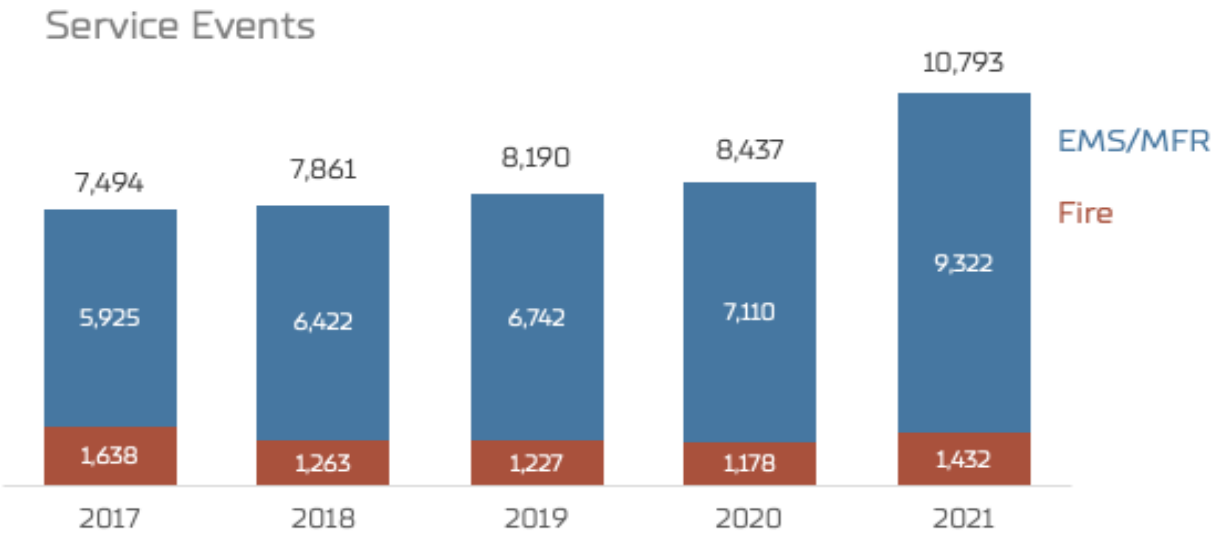


Figure 18: Service Events

Fire Loss

Using data from the FDM (Fire Data Management system) the fire loss (i.e., structure fires) and related injuries and fatalities is:

Criteria	2017	2018	2019	2020	2021
Injuries	6	7	1	2	5
Fatalities	2	1	0	0	0
Property Loss (Millions)	9.51	7.59	7.00	4.19	15.25
Property Saved (Millions)	181.62	94.95	199.67	89.89	148.45

Table 6: Fire Loss

What does the above analysis mean?

It implies that EMS calls continue to rise with a sharp spike in 2021, however, there is no clear data on the nature of injuries or fatalities directly related to medical response events. This data is not tracked or readily available from Alberta Health Services.

For fire calls, injuries and fatalities have been relatively low given the nature of structure fires notwithstanding any loss or injury due to fire is tragic. Fire losses were on a trend for being lower prior to the 2021 spike. The explanation for this spike has not been documented in this CRA.

Overall, the analysis points to the importance of public education, inspections, enforcement, and when needed a timely and effective emergency response.

Composite Risk Analysis

In this section we will create a single view of risk impact with risk probability by combining the risk profile assessments for which data is available.

This “composite risk” will give a ranking of risks where mitigation should be focused on reducing "risk impact". Next, we will present a view of “risk probability” based on historical incident rates and a forecast of future call growth.

Composite Impact of Risk

The composite impact of risk combines five risk profiles (demographic, building stock, hazards, economic, and critical infrastructure). For this CRA, each of the profiles are scored on a five-point scale, so mathematical combination is possible. Based on feedback from the SCES team we weighted the scoring of building stock at 40%, and each of demographic, hazard, and economic profiles at 20%. Critical infrastructure systems were incorporated into the hazards profile. The images below show the resulting composite impact of risk.

High risk impact in the urban service area is primarily within Sherwood Park and driven by a combination of the five profiles. This composite impact of risk map below suggests that risk mitigation within Sherwood Park is an important consideration for the County.

The area to the west and north of Sherwood Park is dominated by a large light and heavy industrial sector. In fact, the County is unique within North America given its large industrial exposure. This risk is driven by the occupancy types (e.g., industrial, heavy commercial) and the presence of hazardous materials.

The darker color hexes represent higher composite impact risk.

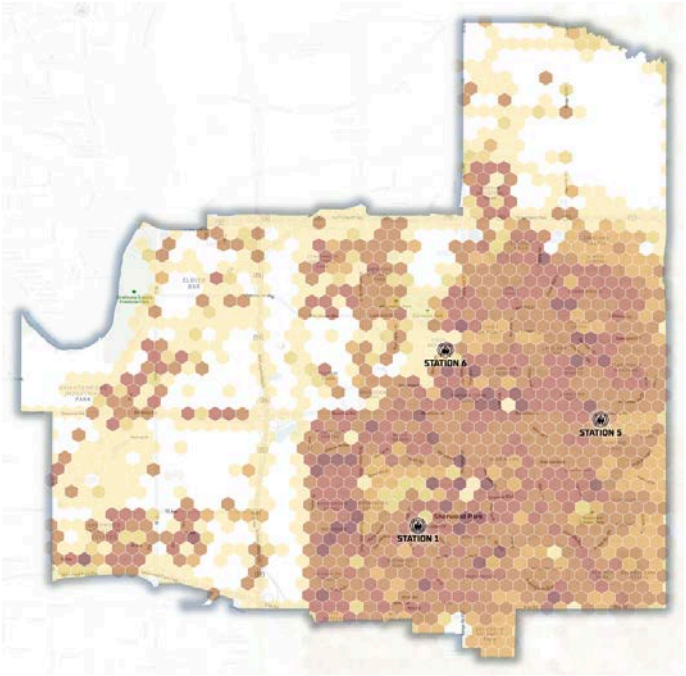
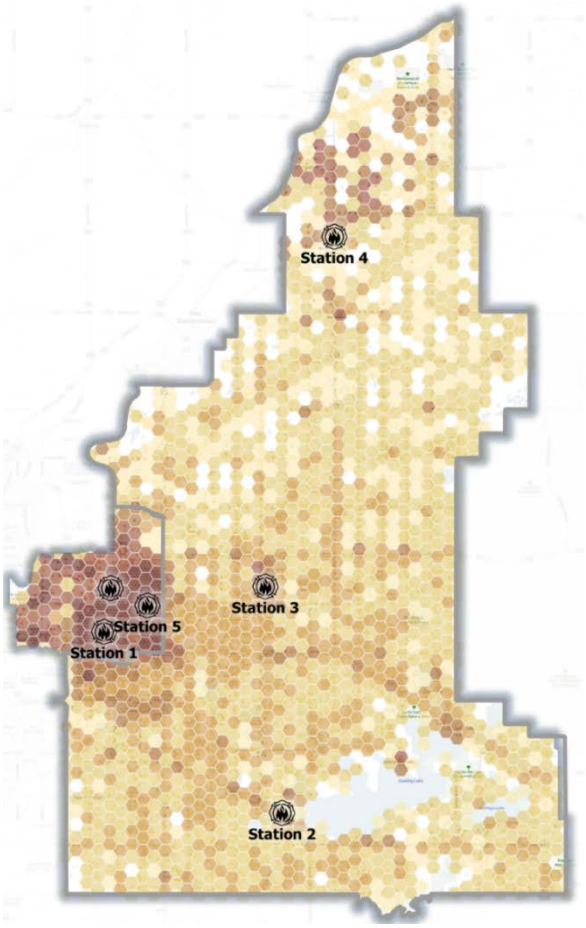


Figure 19: Composite Impact of Risk (Urban Service Area)

Like the urban service area, the rural service area is characterized by three distinct risk zones that influence risk - Heartland, around Sherwood Park, and South Cooking Lake.

Risk impact in the southern half of the County is driven by country residential and wildland interface - particularly in the area immediately adjacent to Sherwood Park. The northern tip of the County has



several high impact industrial risks centered around the Scotford facility.

Figure 20: Composite Impact of Risk (Rural Service Area)

What does the above composite analysis mean?

It implies that on balance when looking at various data from the nine risk profiles that greatest potential impact of risks is located in the urban areas, associated industry and heavy industrial areas and along critical infrastructure locations.

Composite Probability of Risk

Understanding the probability of risk is critical in properly prioritizing risk treatment efforts. Much of the probability is based on past loss and event history and the years of call history. Historical incident

probability is a strong predictor of future incident probability. An efficient use of resources requires that probability be considered. For example, although a nuclear power plant may have extreme impacts in the event of an incident, if the probability of incident occurrence is once every thousand years, then scarce risk treatment resources should not be allocated.

Urban probability risk is highest in the downtown core of Sherwood Park with additional hotspots along the major commercial corridors (Wye Road, Baseline Road, and the northern portion of Cloverbar Road). In addition to these, there are a handful of retirement centres, industrial facilities, and major intersections which generate a disproportionate number of incidents.

Following is an illustration of call volumes for all fire and EMS (including ambulance calls) across the County from 2017 - 2021. The total call volume was 43,217 events.

Each circle represents the relative volume of all calls within a sub-set of each of the six fire zones:

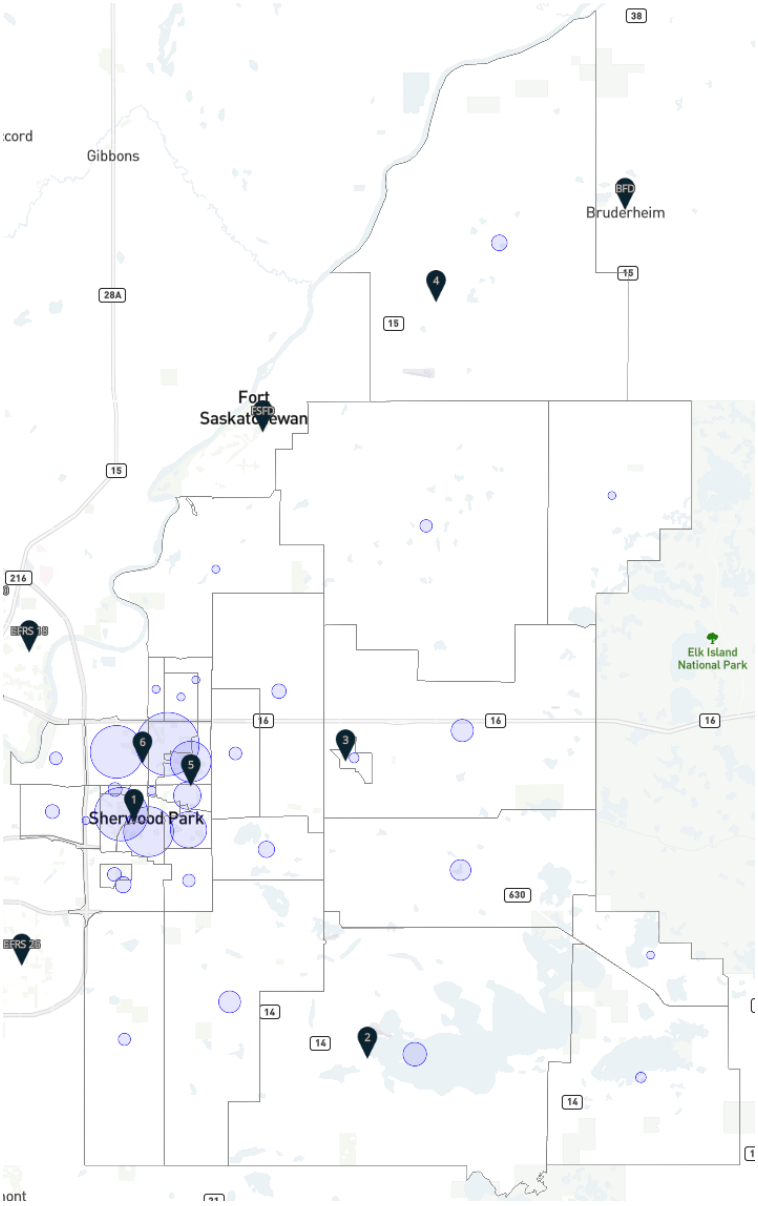


Figure 21: Call Volumes within Fire Zones 2017-2021

The above illustration clearly reflects the increased risk in the urban service area from the occurrence of various events.

Following is an illustration of call volumes for only fire calls (including structure fires, alarms, rescue) across Sherwood Park from 2017 - 2021. The total call volume was 3,648 events.

Each circle represents the relative volume of fire calls within a sub-set of each of the fire zones:

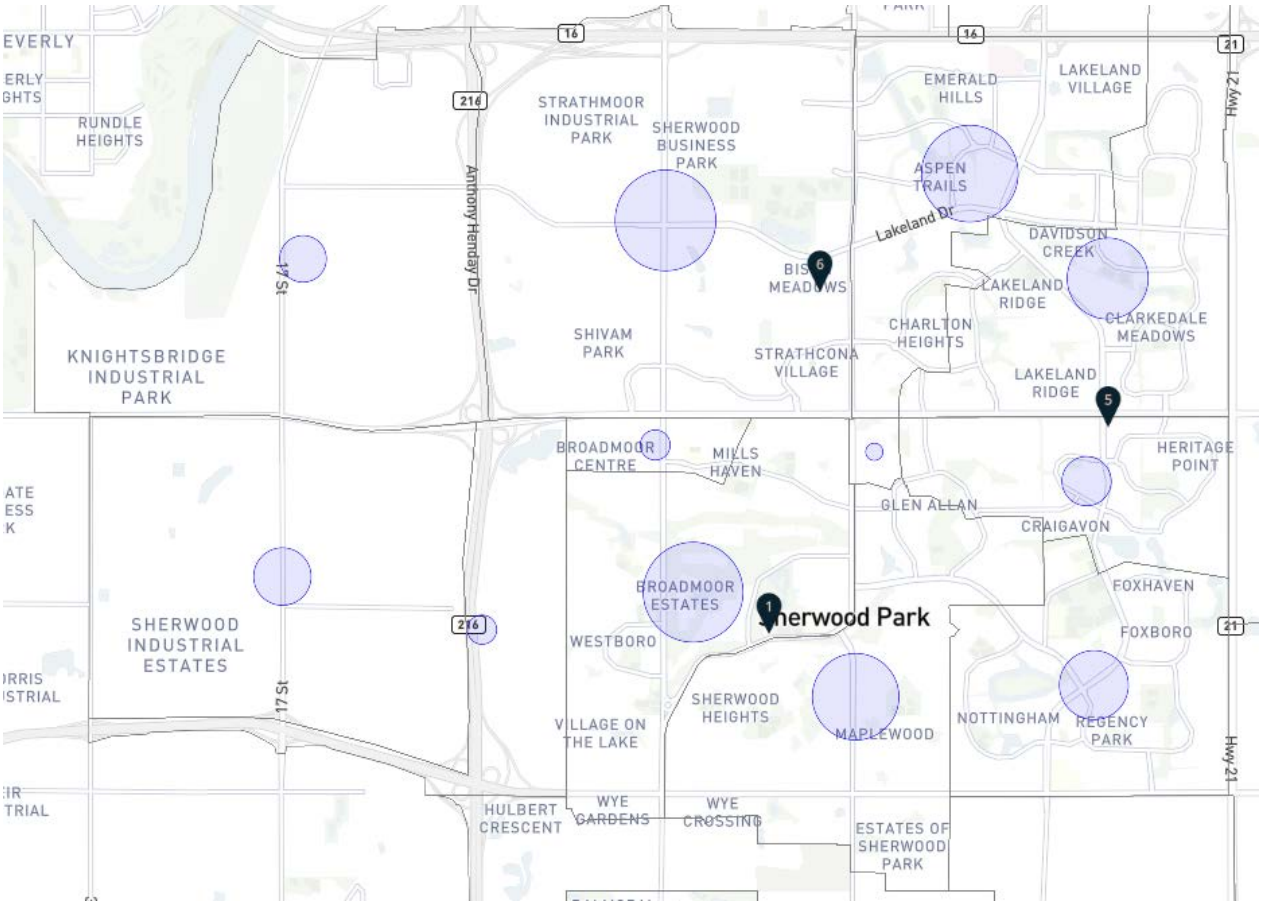


Figure 22: Call Volumes within Fire Zones 2017-2021

The following illustration provides the relative concentration of fire calls at a hex level.

The darker color hexes represent higher risk.

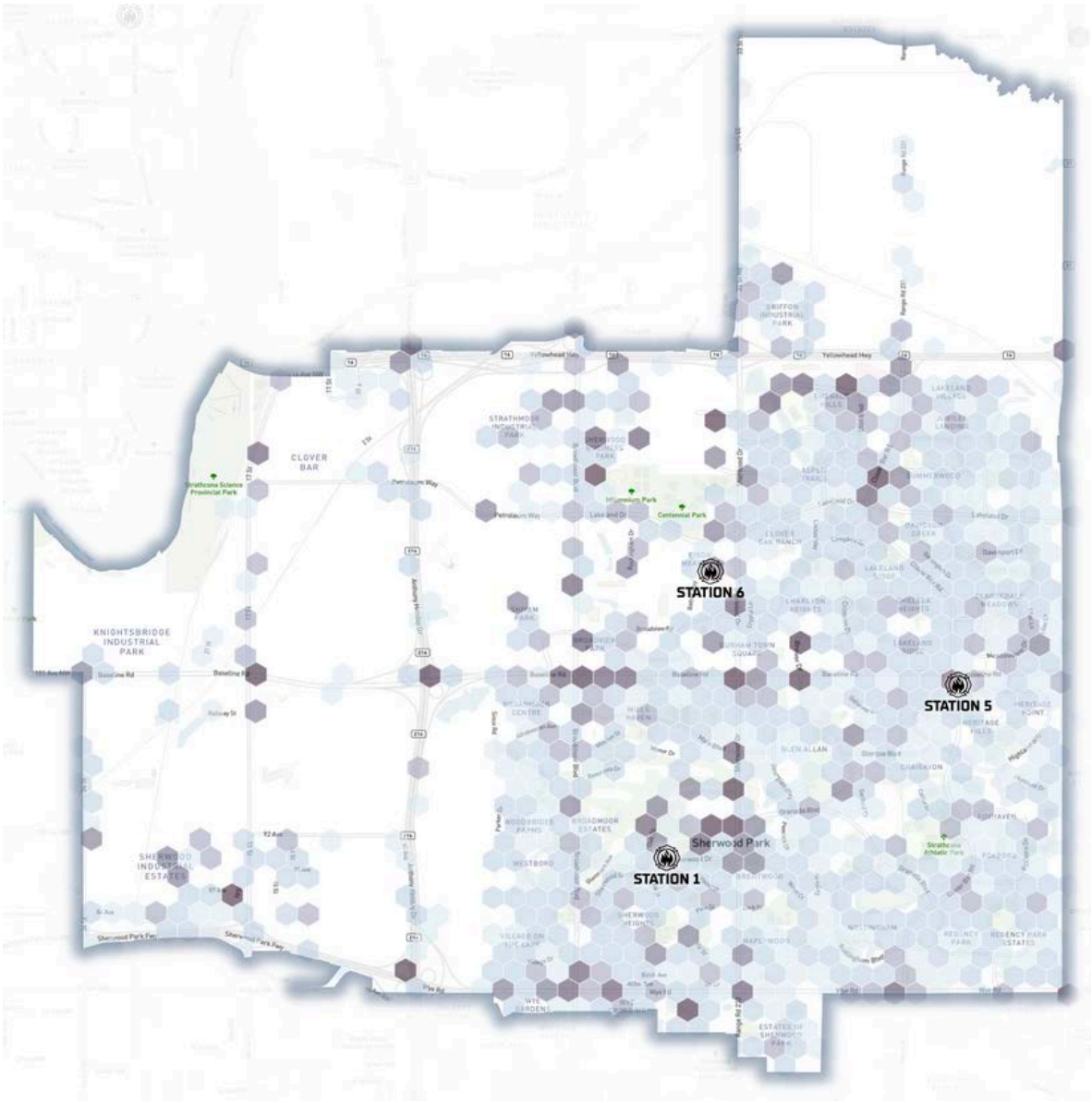


Figure 23: Composite Probability of Risk (Urban Service Area)

The above illustration clearly reflects the increased risk in specific areas of the urban service area from the occurrence of fire, rescue, alarm, and related events.

The rural service area probability risk appears closely related to country residential areas and along major roadways. There are a handful of additional sites with higher probability - the two most important being the Scotford facility and Ardrossan.

The larger circles represent higher risk (e.g., higher call volumes).

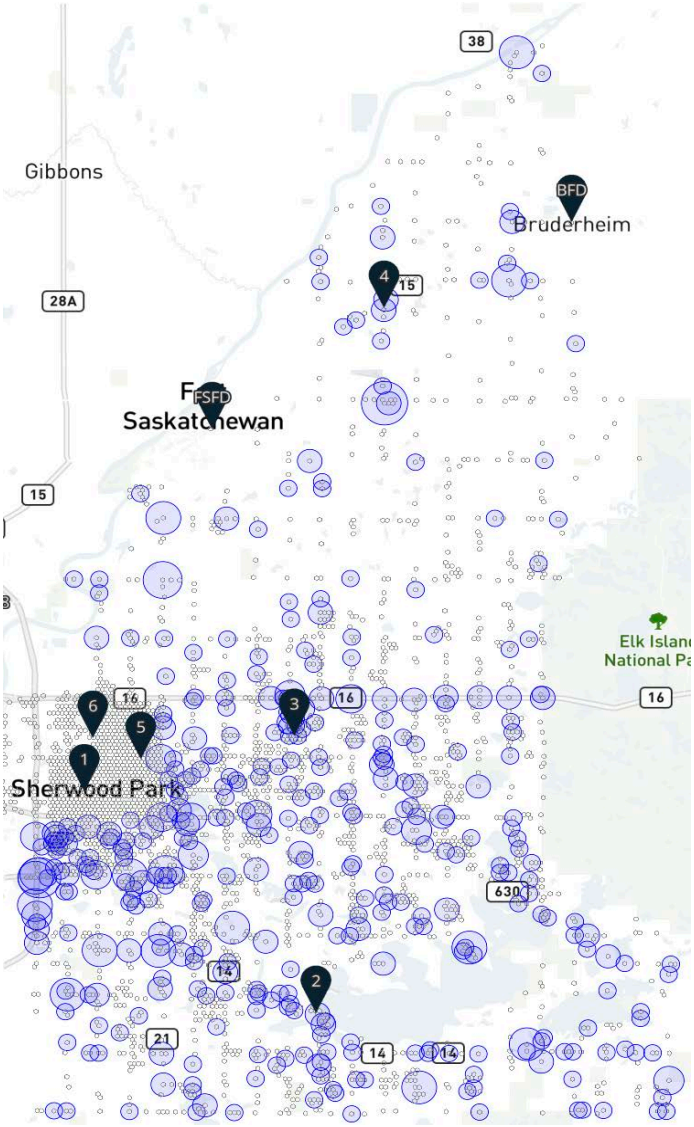


Figure 24: Composite Probability of Risk (Rural Service Area)

What does the above composite analysis mean?

It implies that on balance when looking at various data from the nine risk profiles that greatest potential probability of risks is located in the urban areas, associated industry and heavy industrial areas and along critical infrastructure routes.

Key Findings

In this section, we summarize the main risks facing the County and look at risk treatment options by utilizing the impact/probability scoring. We then discuss how this risk is likely to evolve in the future.

Current Risks

Strathcona County presents a unique risk profile within North America with a large industrial area in addition to urban and rural service. Key hazards include:

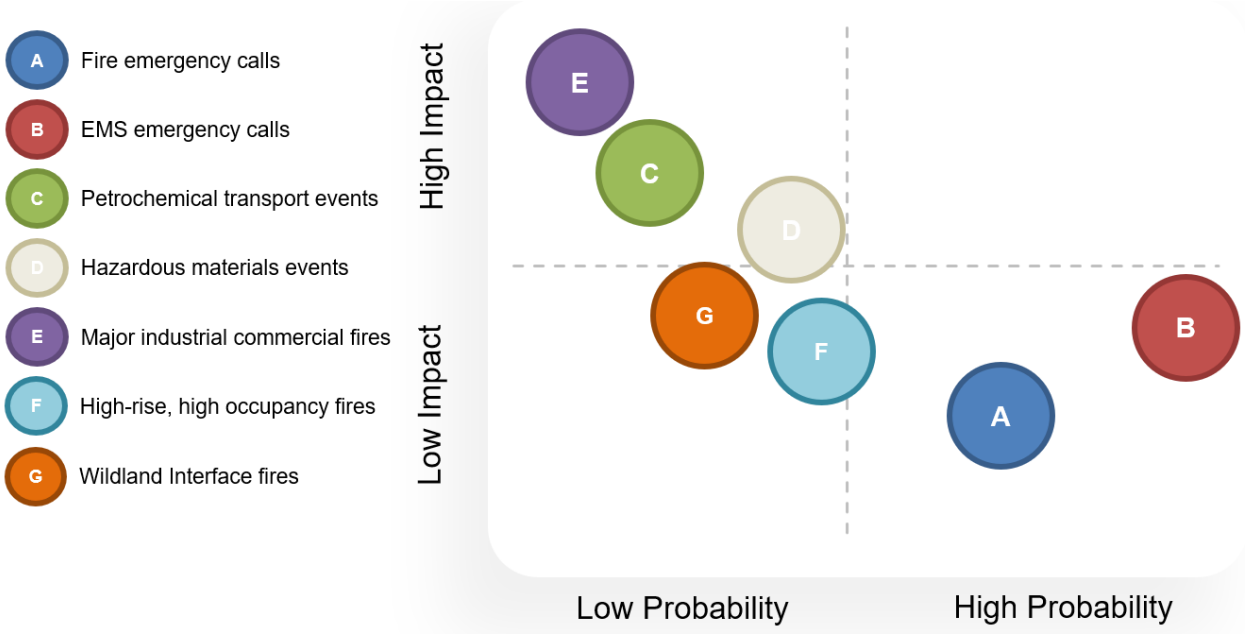


Figure 25: Key Hazards

The HRVA and HIRA were used to estimate the risk for a few key hazards and threats as illustrated in Figure 4 and Figure 25 in the body of this report. It should be noted that the referenced Figures do not fully align with the HRVA completed in 2018 nor the HIRA completed in 2020 by SCES (see Appendix E).

Additionally, the Fire Underwriters Survey (FUS) is a useful tool toward understanding risk in addition to informing fire protection gradings. The FUS should be used to inform community risk and any community risk reduction strategies.

A single County Risk Register should be developed using information from the FUS, a HRVA, a HIRA, and the Cumulative Risk Assessment (for industry). Ideally, one concise and common methodology, set of terminology, and other scales for probability, impact, and vulnerability should be developed.

The following are risk reduction strategies for some of the above hazards:

Major Industrial & Commercial Fires (High Impact, Low Probability)

Industrial facilities pose the most obvious risks facing the County. The industrial parks along the North Saskatchewan River are primarily associated with petroleum refining and supporting industries. The

Scotford facility and its supporting structures in the Heartland area present a significant risk impact as well.

These structures fall under the high hazard scoring in traditional occupancy type risk metrics due to the environmental, demographic, and economic implications of an incident. In many cases they border wildland areas and main commuter corridors like the Anthony Henday Drive and the Yellowhead Freeway.

Risk reduction includes engineering, education, enforcement, and emergency response, but joint training, pre-planning, and comprehensive emergency management are also necessary.

Petrochemical Transport Events (High Impact, Low Probability)

Petrochemical transport - particularly Bitumen - has grown immensely in recent years. But unlike the heavy industrial facilities and storage tank farms, it is often less visible, and its geographic impact is more dispersed and difficult to predict. There are two main rail lines that travel through the industrial areas, and both have on-grade crossings throughout the County. The first parallels the western edge of the County and moves primarily North-South. The second passes from the refinery area, north of Sherwood park and then heads southeast along highway 630.

The nature of what is being transported has a significant impact and varies by rail car. In general, though, it makes sense to treat bitumen and petrochemical transport as high-risk and thus pay particular attention to on-grade crossings and proximity to residential areas.

Risk reduction should be focused on engineering, education, enforcement, and emergency response; but as with other industrial risks, pre-planning and coordination with regional emergency management is necessary. Although the probability of incidents is low, as we have seen in other jurisdictions, the impact can be devastating.

Hazardous Material Events (Moderate Impact, Moderate Probability)

Associated with the refinery operations are several large hazardous materials and storage sites or “tank farms.” Petrochemical storage is the most visible risk facing the County. These storage facilities are found throughout the industrial parks on the western and northern portions of the county.

Like the industrial facilities, these storage sites are categorized as high-risk due to the environmental, demographic, and economic impact of an incident.

Risk reduction includes engineering, education, enforcement, and emergency response, but joint training, pre-planning, and comprehensive emergency management are also necessary.

Wildland Interface Fires (Moderate Impact, Medium Probability)

Strathcona County has large tracts of forest and grasslands that periodically lead to wildfires. In most cases, the fires have been contained before they do substantial damage to structures in the County. The major risk, though, is where these features are near residential, commercial, and industrial structures. The North Saskatchewan river valley and other wildland interface areas near Sherwood Park are of particular concern.

Here, engineering, education, and emergency response are particularly important. Fire smart programs, fire breaks, exclusion zones are necessary to reduce both the impact and probability of wildfire incidents.

Note: The Standards of Cover will consider risk reduction strategies for fire and EMS emergency calls including high rise/high occupancy fires.

Future Risks

The preceding analysis is a snapshot in time of both the impact and probability of some risks in the County. Looking forward there are a number of forces that will reshape the County and change the risk profile or landscape. Strathcona County is at the front end of an aggressive growth plan. The approved development areas will nearly double the urban footprint within the County and increase the total SCES calls or incidents by ~60%.

In addition to population growth, there will be more employment, more traffic, and more urban density. A key feature of the County's growth is the move toward multi-family and high-rise dwellings. These types of occupancies will continue to evolve the nature of risk within the community.

High-rise occupancies in particular demand more than just appropriate first response, they require an effective response force which means a significantly larger number of firefighters available quickly for on-scene incident stabilization. The risk treatments for high-risk and high-rise locations will need to include engineering, enforcement, education, and economic incentives in addition to a more robust emergency response.

An important consideration is the level of population and employment growth projected by the County. The following populations projections[5] reflects some of this future growth:

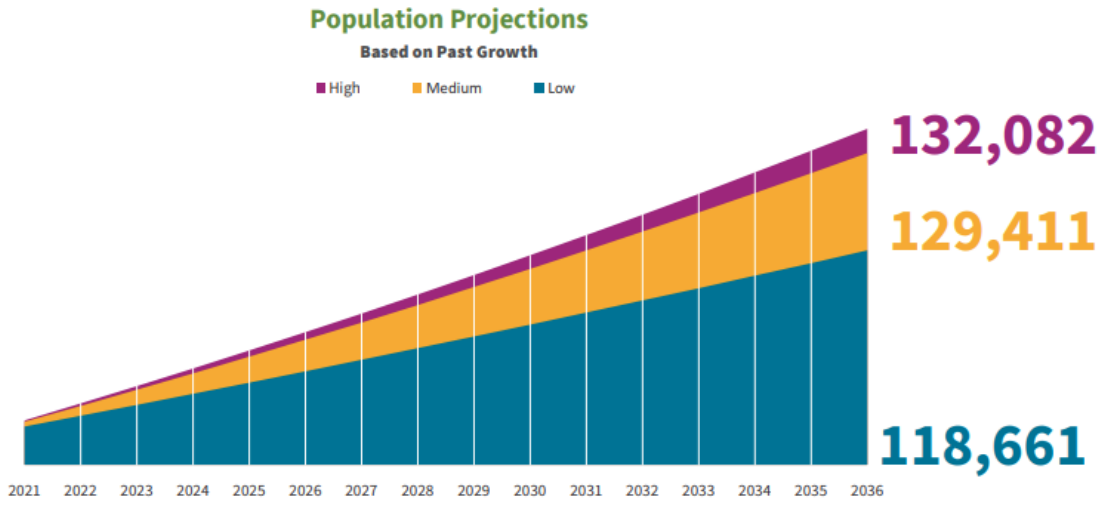


Figure 26: Strathcona County Population Projections

Over the next twenty years, the urban footprint within the County will double, the population will grow by 60% and employment will exceed seventy thousand. This new development will drive growth in emergency incidents to the point where the County can expect a doubling of incident volume between 2022 and 2044.

[5] Strathcona County Recreation and Culture Community Profile, 2019

This growth in population will drive employment and translate into additional incident or call demand. We project that by 2044, SCES will respond to over 10,000 emergency calls each year - effectively double the current ~5,000 emergency calls.

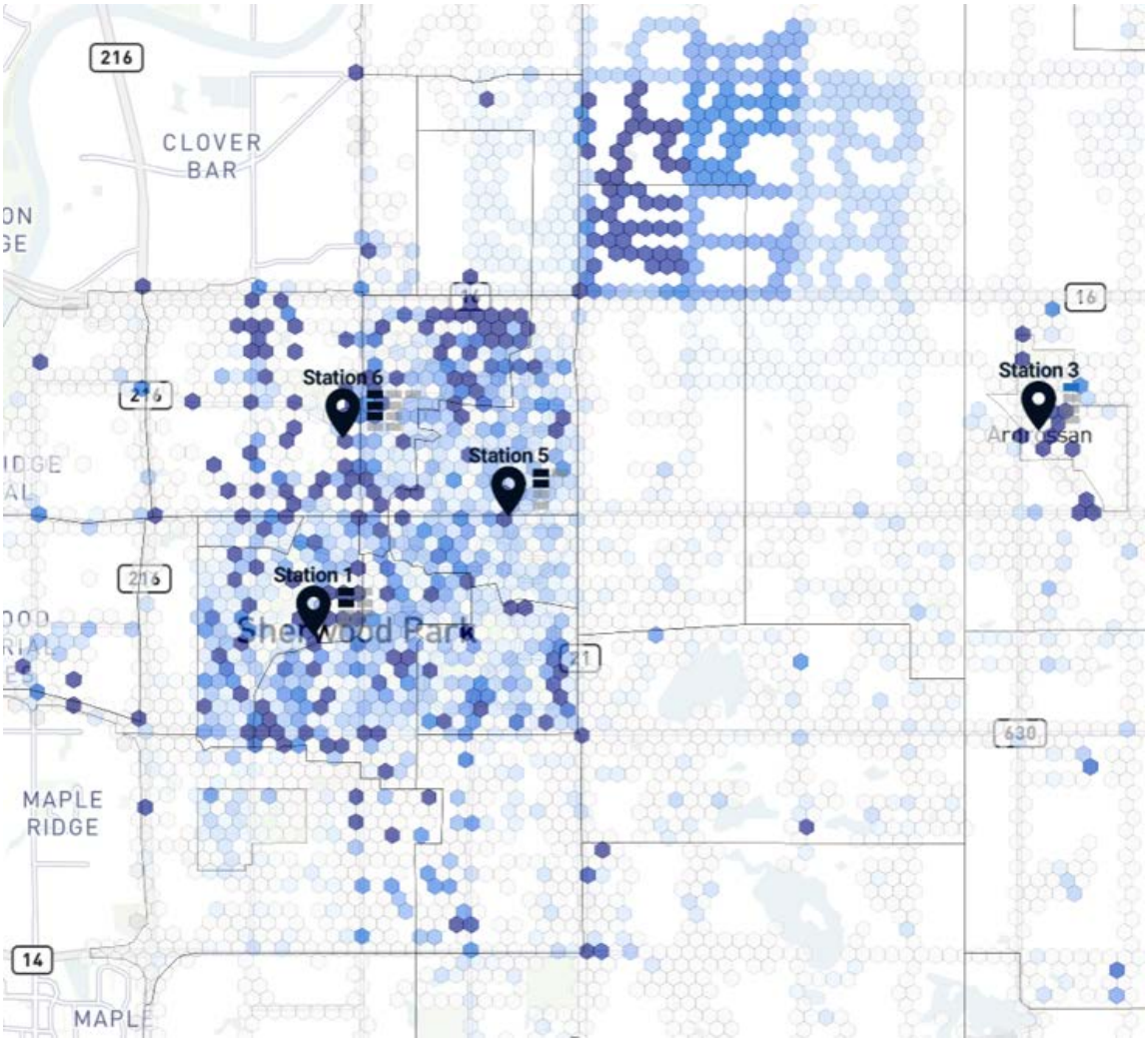


Figure 27: Incident Growth (Urban and Rural Service Areas)

Recommendations

Based on this 2022 Community Risk Assessment (CRA), the following recommendations are proposed for consideration by SCES:

1. **SCES should use the CRA findings and analysis to inform services and service targets within the Standards of Cover 2022 - the commitment side of risk.** Community risk reduction strategies supporting the 5 Es - education, enforcement, engineering, emergency response, and economic incentives should be identified for key community risks. Based on the Community Risk Assessment 2022, SCES should optimize education, enforcement, and engineering strategies and interventions to reduce the dependency on emergency response to address risk, both now and in the future.

2. **Within SCES, Community Risk Reduction (CRR) should be integrated in all or most programs and services, where appropriate.** The CRR plan should include identification of goals and accountabilities that support the use of the 5 Es model. In time, this should be extended across the County with other departments and community partners.

3. **SCES should develop a list of community risk stakeholders to optimize access to community risk data, inform future community risk assessment, and support collaboration of a Community Risk Reduction Plan (CRRP).**

4. **SCES should ensure alignment of CRA terminology, risk analysis scales (i.e., probability and impact), and the CRA use and alignment with other departmental risk instruments (e.g., Industrial Cumulative Risk Assessment).** Specifically for each risk profile, all data sets should be reviewed for relative weighting of importance to the community. **This should result in a single County Risk Register.**

5. **SCES should ensure an enhanced (e.g., current, metadata, more data sets) collection of community risk data supporting each of the nine risk profiles.** This data should be supported by clear meta data to ensure its source, use, and validity for interpretation, and be available in a geo-spatial format for analysis and modelling.

6. **SCES should maintain (i.e., update and review) the CRA on a regular basis (e.g., bi, or tri-annually) so as to inform a SOC update which is typically completed every 5 years.** The updated CRA should be used to inform a CRRP. A useful tool is "Community Risk Assessment: A Guide for Conducting a Community Risk Assessment".[6]

7. **SCES should champion a CRRP, the roadmap for community risk reduction, ensuring it is developed, implemented, and maintained on a regular basis.** The CRRP should have defined strategies, goals, and measures and may begin with a focus on SCES initiatives within the community. The CRRP should be a whole of community effort.

[6] https://strategicfire.org/wp-content/uploads/2016/04/Community-Risk-Assessment-Guide-v1.5.pdf

Conclusion

Community Risk Assessments (CRA) are an integral activity that informs Community Risk Reduction (CRR). The CRR should be documented in a Community Risk Reduction Plan (CRRP).

This CRA is one component that can inform the Standards of Cover and the Master Plan by utilizing the 5 Es of community risk reduction and recognizing the following:

1. There will never be a perfectly safe community. The public accepts a certain level of risk exposure even after all the mitigation efforts are in place. Transparent reporting to stakeholders allows for an informed balancing of risk and investment.

2. Community risk reduction is the responsibility of all stakeholders and citizens, not just a small group within SCES. Front line firefighters, other County departments, and groups throughout the region have both the capability and responsibility to reduce risk.

3. Timely, accurate community risk data and information is foundational to the community. By directing efforts toward the appropriate risks within the County, SCES can have an outsized impact on risk reduction.

4. Prevention is far more cost effective than cure. It is no accident that all but the last “E” deal with the demand side of risk. Community risk reduction is difficult to measure, but intuitively, reducing the number of incidents has far-reaching impacts.

Appendix A - EMRB

Strathcona County is a key member of the Edmonton Metropolitan Region Board (EMRB)[7]. For the County, fellow Board member municipalities, and other urban and rural neighbors, regional risk is an imperative for everyone.

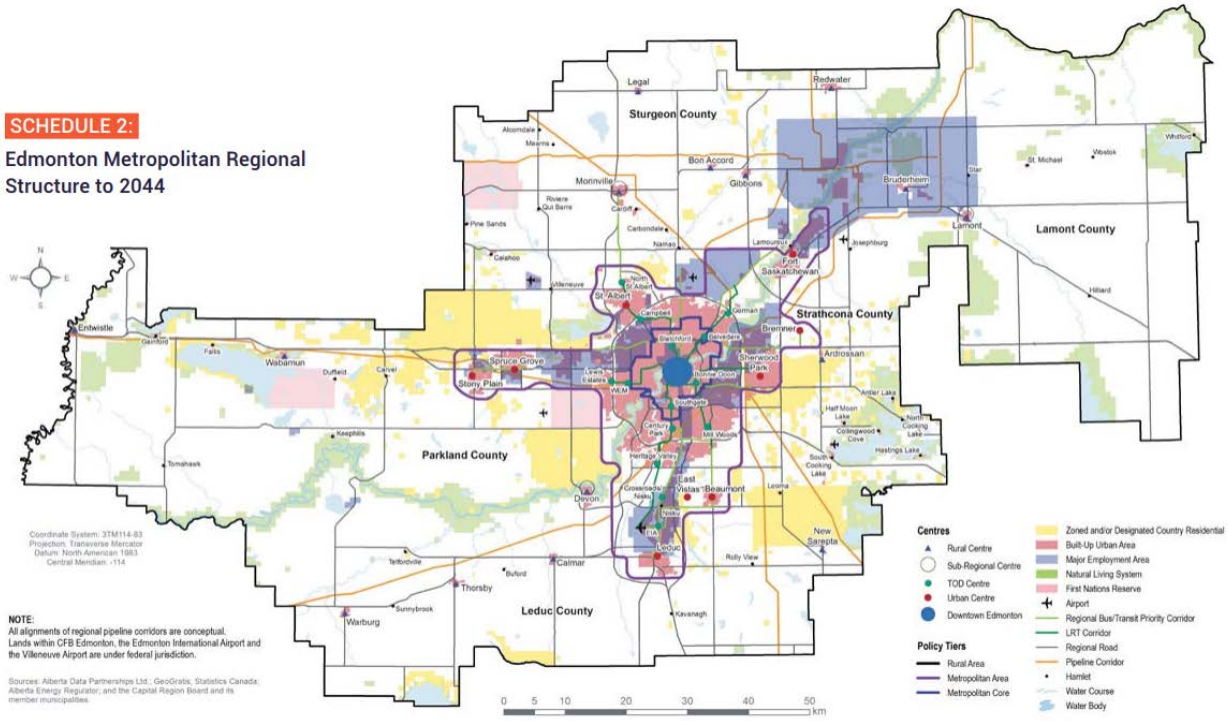


Figure A1: Edmonton Metropolitan Region

Whether it be water bodies, high population areas, country residential areas (in yellow), major employment areas (e.g., Alberta's Industrial Heartland in purple), heavy industry, critical infrastructure (e.g., pipeline corridors, major roads, air, and rail), and natural living systems - various risk is present across the region and within the County.

Many of these risks have been incorporated into a CRA risk profiles for the County, where data was available.

[7] Maps are from the EMRB Growth Plan and EMRGIS website.

Appendix B - Past County Risk Assessments

Risk is understood through various lenses within the County. Risk may be seen or perceived differently by citizens, Council, municipal administration, County departments, business, industry, not-for-profit, and other stakeholders.

The County and SCES have conducted numerous risk assessments over the last 10-20 years. The following are some past risk assessments:

Date	Assessment	Relevance
2020	COVID-19 Risk Assessment	This assessment looked at risks specifically related to COVID-19 and the readiness of the County for a pandemic response.
2020	Hazard Identification Risk Assessment (HIRA)	This assessment of hazards and threats was completed by SCES using the Alberta Community Emergency Management Program (CEMP) online self assessment toolset.
2018	Heartland Heavy Industrial Area Cumulative Risk Assessment Study	This assessment is an update to prior industry related Cumulative Risk Assessments. This targeted risk assessment completed by Doug McCutcheon used the risk model from the Major Industrial Accidents Council of Canada (MIACC).
2018	Hazard Vulnerability Risk Assessment (HRVA)	This risk profile or risk register and associated self assessment methodology developed by iStrategic Advisors was focused on hazards and threats in the County.
2017	Joint Planning Study	This City of Edmonton and Strathcona County assessment considered joint or border planning considerations with risk management elements.
2012	Integrated Risk Assessment Plan	This Master Plan and Standards of Cover focused assessment was completed by ESCI[8] and used a land use based graphical view based on the CFAI[9] Model.
2010	Consolidated Risk Assessment	This Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE) focused assessment was completed by Doug McCutcheon and contributed to by SCES included the County and regional, provincial, federal partners, and other agencies. Assessment included common hazards and threats with some scenario discussion of vulnerabilities
2009	Northeast Heavy Industrial Area Risk Assessment	This targeted risk assessment completed by Doug McCutcheon used the risk model from the Major Industrial Accidents Council of Canada (MIACC).
2007	IT Services and Risk Analysis	This risk analysis completed by Delta Factors for Information Technology focused on continuity requirements based on loss and disruption of some key IT systems, applications, and infrastructure

[8] Emergency Services Consulting International was the consulting firm to SCES for the 2012 Master Plan.

[9] Commission for Fire Accreditation International provides the accreditation of fire (and emergency) services through the Centre for Public Safety Excellence (CPSE).

Table B1: Past County Risk Assessments

Each of the above risk assessments have in varying ways contributed to an understanding of community risk.

Within SCES, the Community Safety division has built on these risk assessments and other risk information towards the following risk instruments:

- Municipal Emergency Plan (MEP) Risk Assessment Plan
- MEP Recovery vs. Risk Planning Process Comparison
- Strathcona County Risk Matrix Definitions and Scoring Guide
- Strathcona County Risk Matrix
- Strathcona County Risk Assessment Annex

Appendix C - Methodology

The essence of any risk management methodology includes three steps:

- Risk Identification
- Risk Analysis or Prioritization
- Risk Evaluation or Treatment

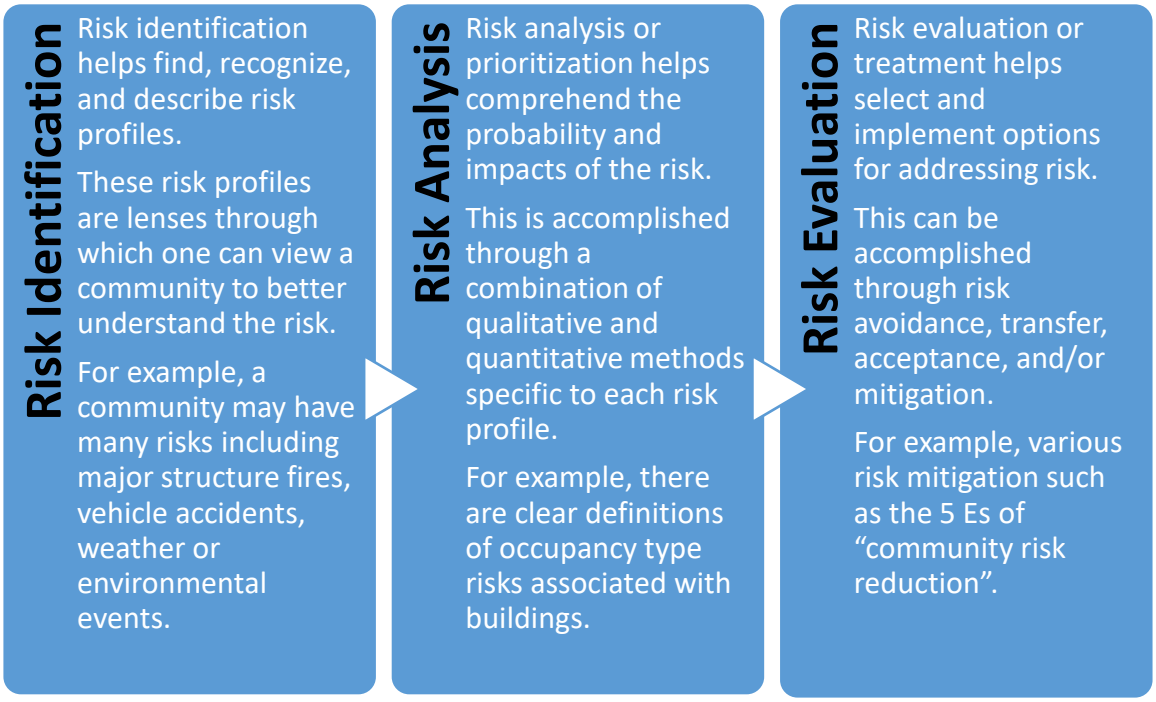


Figure C1: Risk Management Steps

The primary methodology used for this CRA is based on NFPA 1300: Standard on Community Risk Assessments and Community Risk Reduction Plan Development. NFPA 1300 has many elements common to other industry leading standards, guidelines and practices including:

- International Standards Organization (ISO) 31000 Risk Management Guidelines
- Canadian Standards Association (CSA) Z1600 Emergency and Continuity Management Program
- Federal Emergency Management Agency (FEMA) National Threat and Hazard Identification and Risk Assessment (THIRA)

The above demonstrate the need and opportunity for convergence of risk strategies and terminology that can be adopted across the whole of a community, resulting in a convergence of risk management efforts.

The project team used a data-driven approach with particular emphasis on the spatial (aka geographic location) of risk. This allows both a comprehensive accounting of risk and the ability to identify points of intersection between different risk profiles and risk data elements - for instance, a senior residence near a high-hazard industrial facility.

The result is a single risk score for each geographical unit (hexagon). The data we analyzed includes information provided by Strathcona County, Strathcona County Emergency Services, the Edmonton Metropolitan Region Board, and other available public sources.

In the following sections, we will characterize the County's risk impact for the demographic, building stock, hazards, and economic risk profiles. We will identify and quantify the risk at a granular geospatial level using a hexagonal projection over the map (thus incorporating the geographic profile).

We will provide descriptions of Critical Infrastructure Systems, Public Safety Response Agencies, and Community Service Organizations to round out the risk identification component of the assessment.

Next, we will combine the risk profiles data used in this CRA into Composite Impact and Composite Risk Probability (e.g., Past Loss and Event History profile) views. These two views of the County represent the single composite community risk, known at this time. Together, they form the basis of risk prioritization and provide direction for risk treatment.

Appendix D provides a spatial representation and discussion of each of these components individually as well as a more detailed description of methodology.

Appendix D - Risk Profiles

NFPA 1300 provides guidance on conducting a CRA, creating CRR strategies, and implementing a CRRP.

NFPA 1300 utilizes nine risk profiles to describe community risk as listed and defined[10] below:

1. Geographic - The physical features of the community, including the nature and placement of features such as highways, waterways, railways, canyons, bridges, landforms, and wildland-urban interfaces.
2. Demographic - The composition of the community's population, respecting matters relevant to the community, such as population size and dispersion, age, gender, cultural background, level of education, socioeconomic make-up, and transient population.
3. Building Stock - The types of buildings in the community, the uses of the buildings in the community, the number of buildings of each type, the number of buildings of each use and any building-related risks known to the fire department.
4. Hazard - The hazards (and threats) in the community, including natural hazards, hazards caused by humans, and technological hazards.
5. Economic - The economic sectors affecting the community that are critical to its financial sustainability.
6. Critical Infrastructure Systems - The capabilities and limitations of critical infrastructure, including electricity distribution, water distribution, telecommunications, hospitals, and airports.
7. Public Safety Response Agencies - The types of incidents responded to by other entities in the community, and those entities' response capabilities.
8. Community Services Organizations - The types of services provided by other entities in the community, and those entities' service capabilities.
9. Past Loss and Event History - The community's past emergency response experience, including the following analysis:
    a. The number and types of emergency responses, injuries, deaths, and dollar losses.
    b. Comparison of the community's fire loss statistics with provincial fire loss statistics.

For each of risk profiles 1-8, we have taken a risk assessment approach that attempts to quantify risk impact by gathering multiple layers of spatial data and then combining them at a fairly disaggregate level. We divide the community into "hexes" which are ~150m across. The "hex" is the level of aggregation with which we combine the different elements and profile data.

A hex may contain half a dozen commercial or industrial structures and up to twenty-five residential structures. For some of the profiles, we need to disaggregate larger spatial units into the hexes, while in others, we need to aggregate the more granular data into the hex. For simplicity, we limited the levels to a five-point scale within each profile with the darker colours representing higher associated risk.

[10] Ontario Fire and Prevention Act, Community Risk Assessments.

For risk profile 9, we have taken historical data for calls to incidents to quantify risk probability and incorporated same into composite views of risk.

Demographic Profile

Within the demographic profile, we weigh the importance of each element equally. So, the images that represent the demographic risk impact apportion 25% to each of Over-65, Under-20, Employment, and Overall population densities. Where data was not available at a sufficiently disaggregate level, we apportion the more aggregate data equally to the hexes within the aggregation unit.

The darker the hexes the greater density.

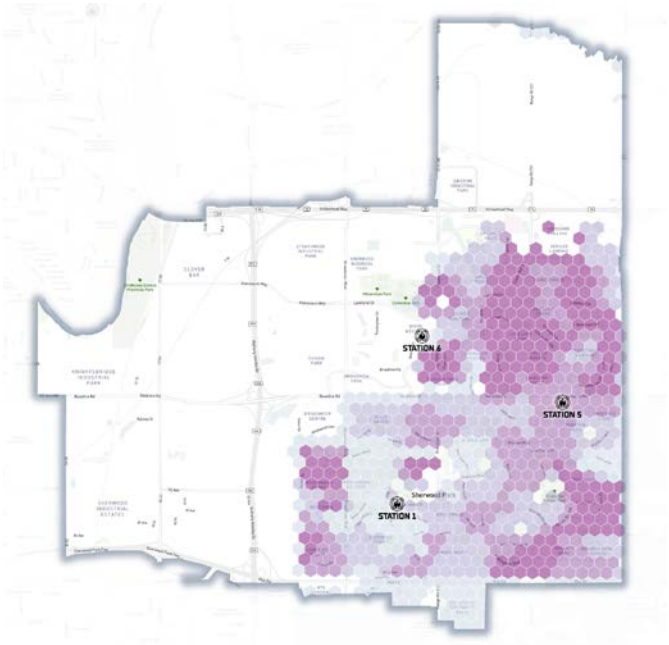


Figure D1: Urban Service Area Population

Sherwood Park Population

The northern half of Sherwood Park exhibits higher population density along with the Southeast and Southwest corners.

Rural Strathcona County Population

Rural Strathcona County exhibits a much lower population density, particularly in the northern half of the County. The areas immediately adjacent to Sherwood Park to the south and east approach the density of Sherwood Park proper.

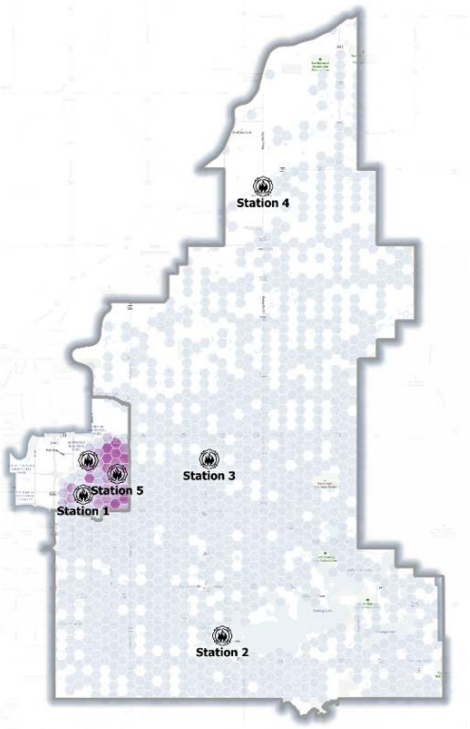


Figure D2: Rural Service Area Population

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Sherwood Park Elderly Population

People over the age of 65 tend to require emergency services at a higher rate than the general population and in some cases, they represent mobility challenges.

Within Sherwood Park, the elderly population (over 65 years of age) tend to live in the central part of the community although there are pockets in the extremities. The central part of Sherwood Park contains a number of senior residences, and these facilities will continue to increase as the population ages.

The darker the hexes the greater density.

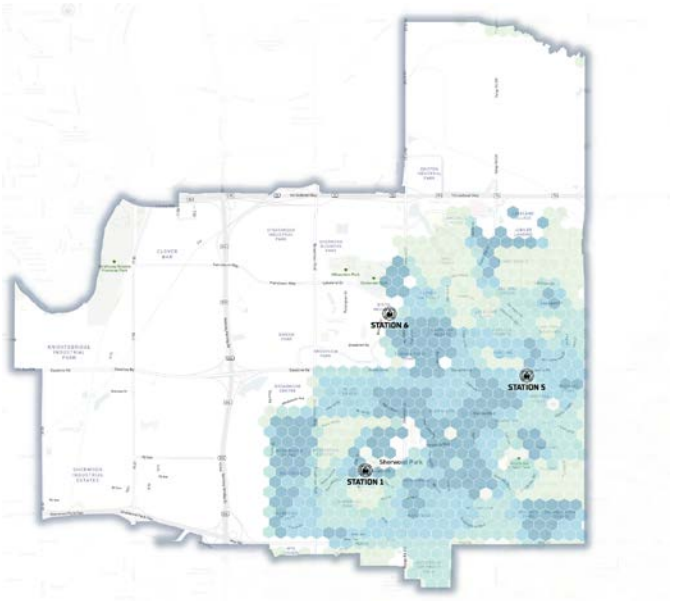


Figure D3: Urban Service Area Elderly Population

Rural Strathcona County Elderly Population

Within Rural Strathcona County, the Elderly population tends to follow the overall population density with most of the elderly in the southern half of the County. The areas immediately adjacent to Sherwood Park exhibit the highest density.

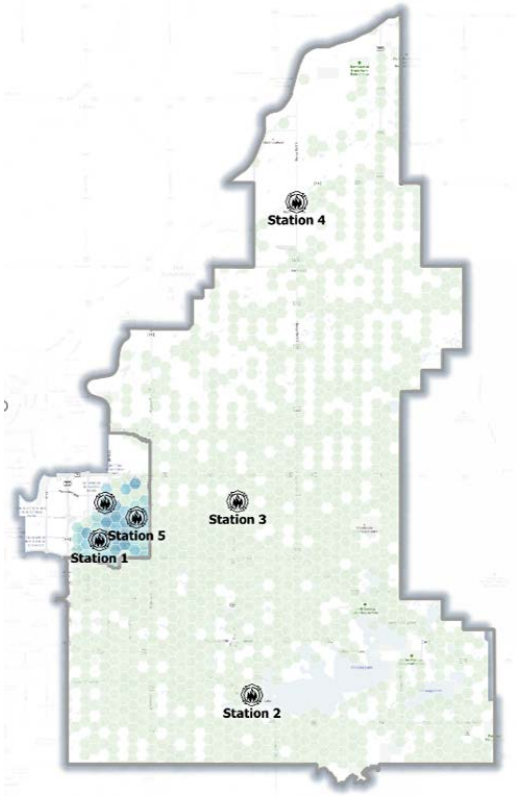


Figure D4: Rural Service Area Elderly Population

Sherwood Park Under-20 Population

People under the age of 20 have a different risk profile than the general population. They generate calls at a lower rate, but in general, society treats these incidents with higher importance.

Youth and children primarily live in the northern half of Sherwood Park, though there are large pockets in the Southeast.

The darker the hexes the greater density.

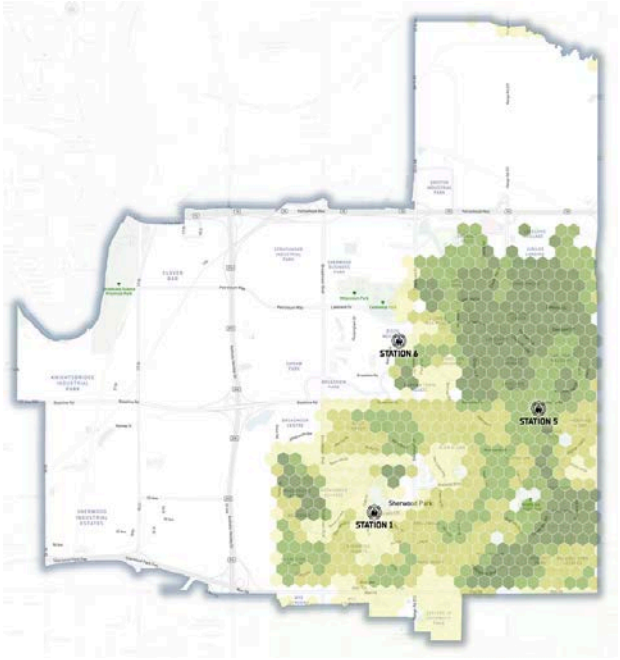


Figure D5: Urban Service Area Under-20 Population

Rural Strathcona County Under-20 Population

Within rural Strathcona County, the patterns of Under-20 population mirror the patterns of the total population. The majority live in the southern half of the County and areas adjacent to Sherwood Park exhibit the highest density.

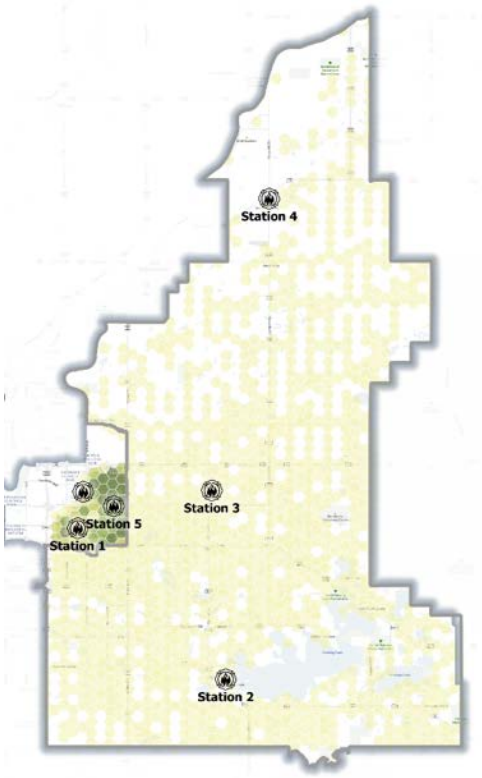


Figure D6: Rural Service Area Under-20 Population

Sherwood Park Employment

People spend a significant amount of time outside their homes - often at work or school. Daytime population was not available on a sufficiently granular level, so we have used the employment population as a rough proxy.

Employment is concentrated in the North and West industrial areas as well as the major commercial corridors (on Wye Road, Baseline Road, and near the city centre).

The darker the hexes the greater density.

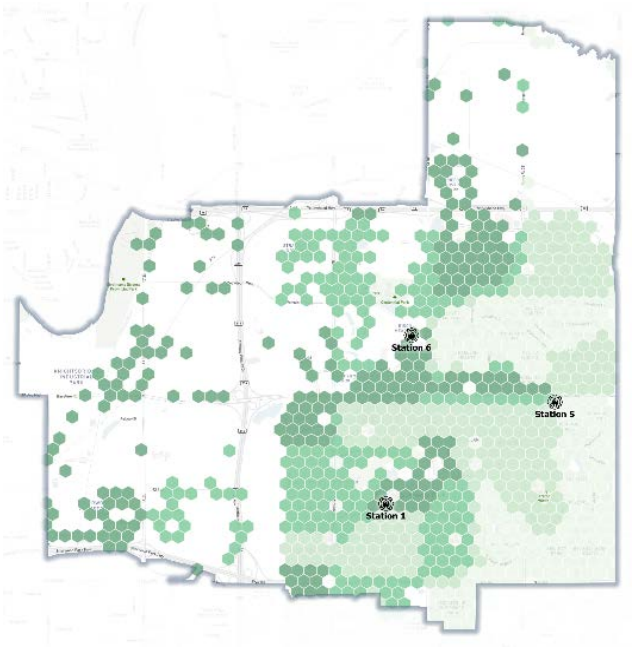


Figure D7: Urban Service Area Employment

Rural Strathcona County Employment

Employment population in Rural Strathcona County is dominated by the Scotford facility at the extreme north end of the County. There are smaller pockets of employment in Ardrossan and South Cooking Lake.

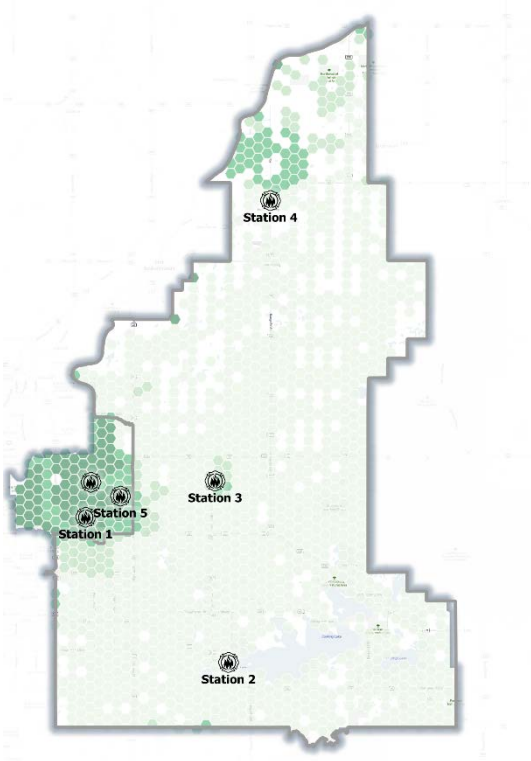


Figure D8: Rural Service Area Employment

Building Stock Profile

The building occupancy profile is made up of two components - building stock or occupancy risk score and the presence of hazmat storage. The building occupancy risk score was calculated from a standard 5-point scale of risk based on occupancy type. Hazmat storage was based on a simple yes/no. Data was derived from SCES Fire Prevention and Inspection group.

The darker the hexes the greater occupancy risk.

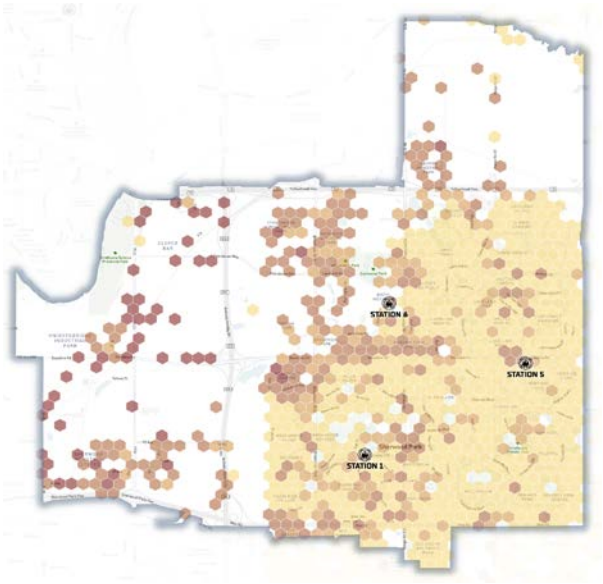


Figure D9: Urban Service Area Occupancy Risk

Sherwood Park Occupancy Type

Building occupancy risk is primarily in the western industrial parks and in the northwestern quadrant of Sherwood Park. Within Sherwood Park proper, there are higher risk commercial structures and multi-family residences.

Rural Strathcona County Occupancy Type

Within the rural portions of the county, high-risk occupancies are primarily located in the north in the industrial area near Josephburg.

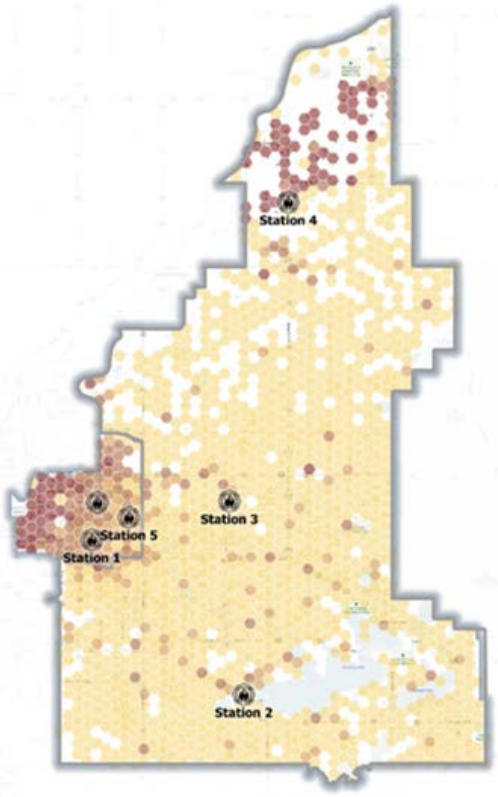
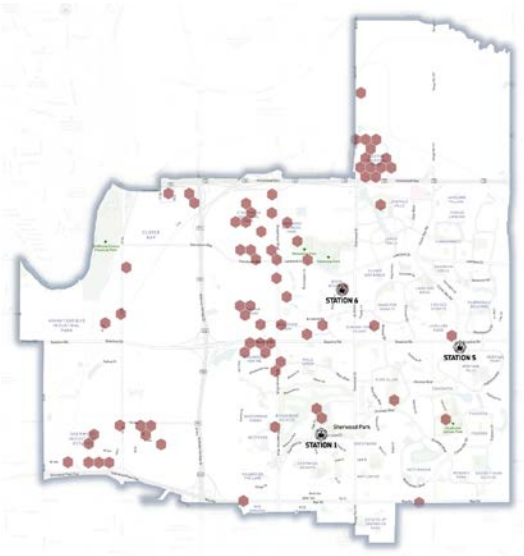


Figure D10: Rural Service Area Occupancy Risk

Hazards Profile

The hazards profile is made up of three available data components - hazardous material storage, hazardous material transport, and wildland interface risk. The data used to populate this profile came from SCES Fire Prevention and Inspections along with the Edmonton Metropolitan Region Board.



Sherwood Park Hazardous Material Storage

The storage of hazardous materials may not be fully known nor shared publicly. Without a detailed understanding of the specific materials, volumes, and storage mechanisms, this risk profile is intended as a placeholder for future clarification by working with industry and commercial property stakeholders.

The majority of hazardous material storage in Sherwood Park is associated with the industrial and commercial areas to the north and west of the urban area.

The darker the hexes the greater hazardous materials risk.

Figure D11: Urban Service Area Hazardous Materials Risk

Rural Strathcona County Hazardous Material Storage

In the rural service area, there is understood to be less hazardous material storage and thus assumed to be of relatively low-risk.

What is anticipated is that major industrial areas including the Heartland Industrial area in the north and west areas of the County likely contains numerous and varied hazardous materials storage (see Cumulative Risk Assessment).

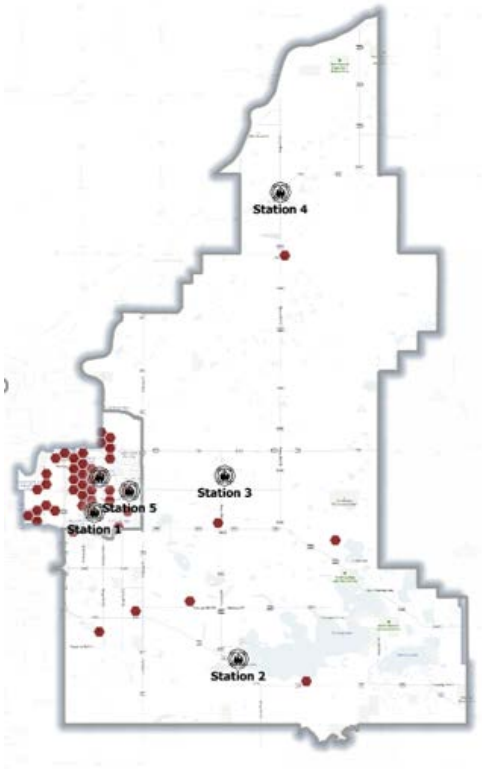


Figure D11: Rural Service Area Hazardous Materials Risk

Sherwood Park Hazardous Material Transportation

Hazardous material transportation is primarily concentrated in the industrial parks to the north and west of Sherwood park.

Other hazardous materials transport through pipelines and other low-pressure systems has not been analyzed.

The darker the hexes the greater hazardous materials transport risk.

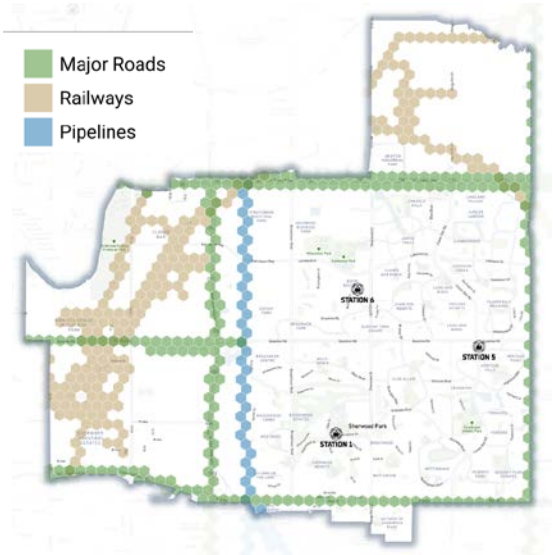


Figure D12: Urban Service Area Hazardous Materials Transport Risk

Rural Strathcona County Hazardous Material Transportation

Hazardous material transportation is spread throughout the County though the bulk of material is transported on the main rail lines (in brown).

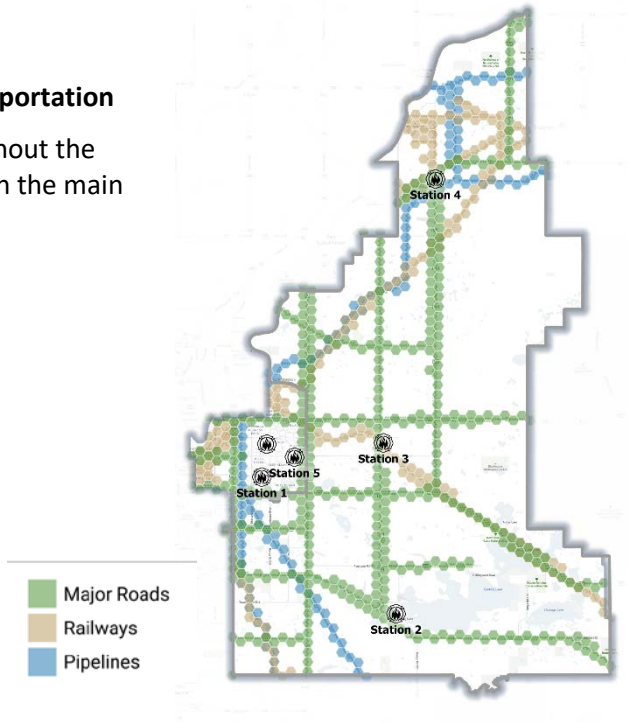


Figure D12: Rural Service Area Hazardous Materials Transport Risk

Sherwood Park Wildland Interface

Sherwood Park has a number of neighborhoods which border natural or forested areas, and which have some risk associated with wildfire spread.

The darker the hexes the greater wildland interface fire risk.

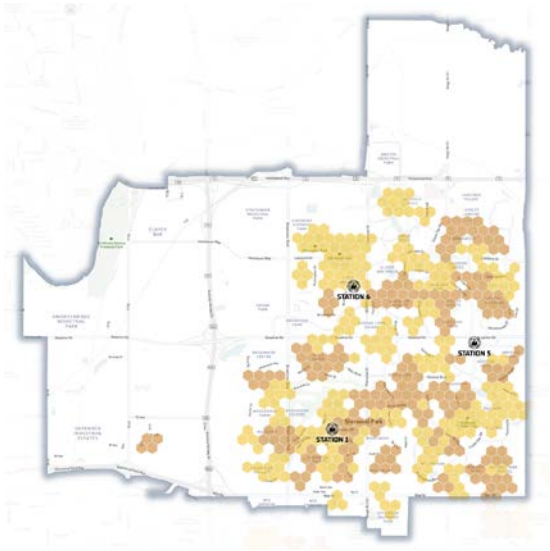


Figure D13: Urban Service Area Wildland Interface Fires Risk

Rural Strathcona County Wildland Interface

In the rural areas there are a handful of areas where country residential, industry, and/or neighboring communities are adjacent to forested or parkland areas. Most of these are to the near south of Sherwood Park.

There are numerous other natural living areas across the rural service areas including the far north and east areas of the County.

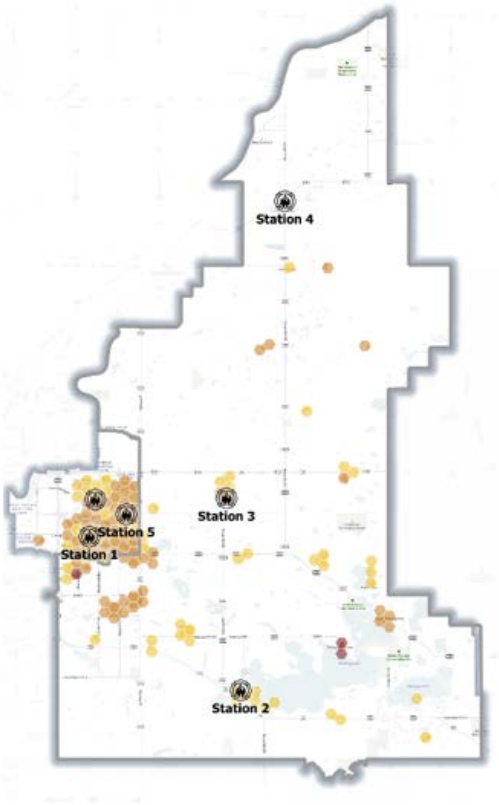


Figure D13: Rural Service Area Wildland Interface Fires Risk

Economic Profile

The economic profile is made up of two components - assessed value or economic value risk from the property tax register and employment or better stated potential loss of employment risk, taken from the Edmonton Metropolitan Region Board. We summarized each of these individually on a 5-point scale and then combined them into a single view by weighting them equally and again presenting them in a five-point scale.

The darker the hexes the greater economic risk.

Sherwood Park Economic Value

The assessed value within Sherwood Park looks uniform at the Hex level. Each hex represents a few million dollars in structure values and is more a reflection of urban density. The white areas are open fields, transportation corridors and undeveloped areas.

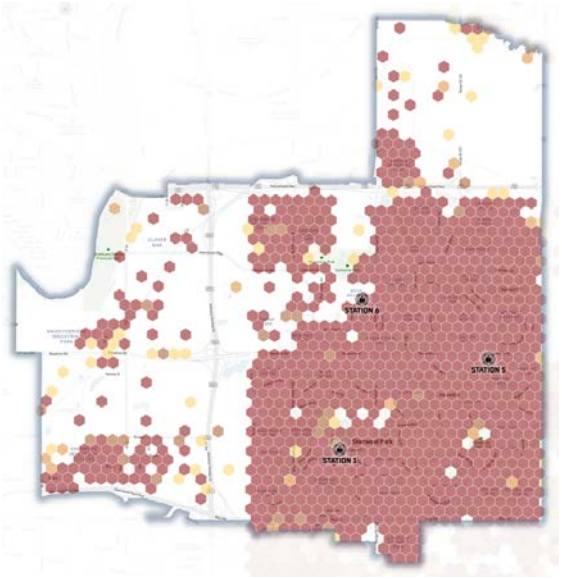


Figure D14: Urban Service Area Economic Value Risk

Rural Strathcona County Economic Value

Like population, the rural Assessed Value is higher in the southern half of the County and particularly high in the country residential areas immediately adjacent to Sherwood Park.

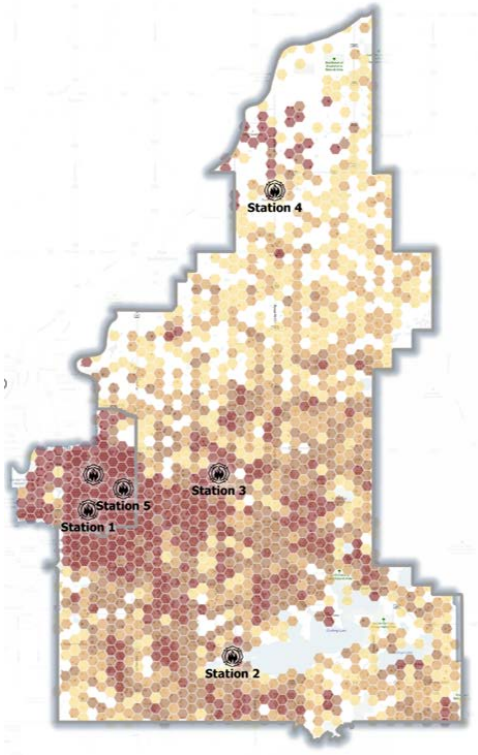


Figure D15: Rural Service Area Economic Value Risk

Sherwood Park Employment

Given the lack of data on daytime employment data, we used the employment data from the demographic profile as a proxy or placeholder for daytime employment population.

Employment is concentrated in the North and West industrial areas as well as the major commercial corridors (on Wye Road, Baseline Road, and near the city centre).

The darker the hexes the greater employment risk.

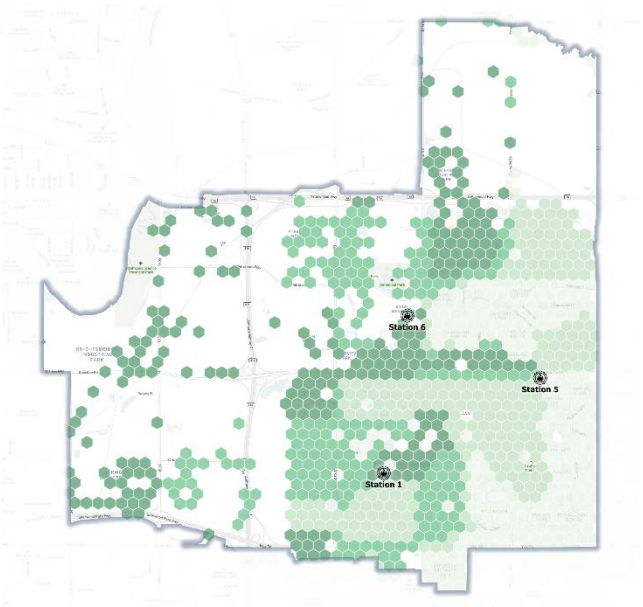


Figure D16: Urban Service Area Employment Risk

Rural Strathcona County Employment

Employment population in Rural Strathcona County is dominated by the Scotford facility at the extreme north end of the County. There are smaller pockets of employment in Ardrossan and South Cooking Lake.

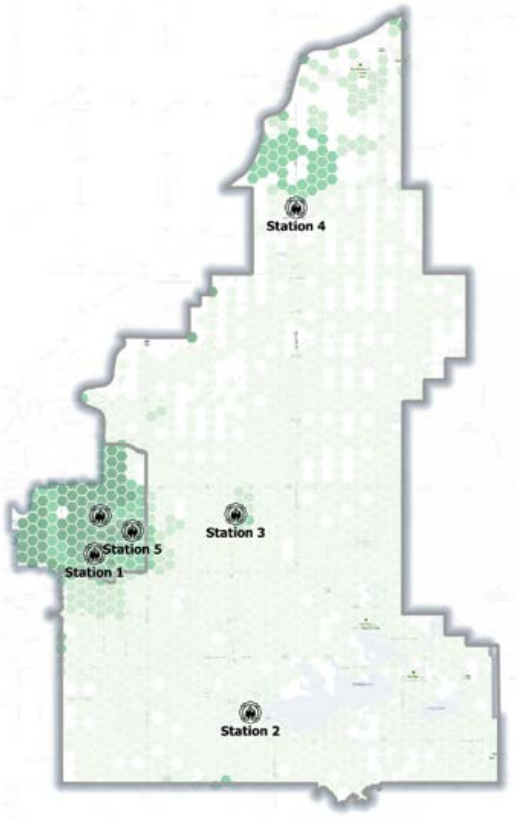


Figure D16: Rural Service Area Employment Risk

Appendix E - Hazard Risk Vulnerability Assessment and Hazard Identification Risk Assessment

A Hazard Risk Vulnerability Assessment (HRVA) was completed in 2018 by the Emergency Management Program of SCES in relation to a Business Continuity Plan project.

This HRVA (see Table E.1 below) identified many of the hazards and threats in the County. An analysis of these risks was completed by a small group of SCES stakeholders and did not have the benefit of insights across all of SCES nor other County departments and stakeholders.

The methodology employed for this HRVA included the following:

- Assess the relative probability and impact of each hazard or threat
- Calculate a cumulative impact score
- Multiple the probability against the cumulative impact
- Determine the pre-mitigation risk score
- Sort the list against highest pre-mitigation risk score
- Assess the relative vulnerability considering proximity and susceptibility, and existing controls (e.g., fire smart program for wildland interface fires)
- Determine the overall vulnerability influence (i.e., mitigating or aggravating) on the pre-mitigation risk score
- Resort the list against the mitigated or aggravated vulnerability influence

Subsequently, a Community Emergency Management Program (CEMP) Hazard Identification Risk Assessment (HIRA) was completed in 2020 by the Community Safety Division of SCES.

This HIRA (see Table E.2 below) is based on an automated online tool thus the specific methodology is not fully known; however, it appears the methodology employed for this HIRA included the following:

- Assess the factors influencing the relative frequency of the hazard
- Assess the social impacts and other consequences of the hazard
- Assess the factors influencing community vulnerability
- An automated ranking or priority of the hazards and threats is generated

The HRVA and HIRA were used to estimate the risk for a few key hazards and threats as illustrated in Figure 4 and Figure 25 in the body of this report and do not fully align with the HRVA completed in 2018 nor the HIRA completed in 2020.

Additionally, the Fire Underwriters Survey (FUS) is an extremely useful tool toward understanding risk in addition to informing fire protection gradings. The FUS should be used to inform community risk and any community risk reduction strategies.

A single County Risk Register should be developed using information from the HRVA, the HIRA, and the Cumulative Risk Assessment (for industry). Ideally, one concise and common methodology, set of terminology, and other scales for probability, impact, and vulnerability should be developed.

The HRVA is illustrated following:

Categories	Groups	Hazards and Threats	Probability	Impact (Buildings or Facility)	Impact (Critical Infrastructure)	Impact (People)	Impact (Services, Supply Chain)	Impact (Technology, Information)	Cumulative Impact	Risk Score (Pre-mitigation)	Risk Score (Post-Mitigation)
Technological	Technological - IT	IT Telecommunications Failure	4	2	3	2	3	3	13.0	52.0	52.0
Natural	Natural - Environmental	Grassland/Wildland Interface Fire	4	4	3	4	3	2	16.0	64.0	48.0
Natural	Natural - Disease	Human Health Emergency (Pandemi	4	2	1	4	3	1	11.0	44.0	44.0
Technological	Technological - Transportatio	Hazmat (Rail)	4	3	3	4	3	1	14.0	56.0	42.0
Technological	Technological - IT	IT Systems Failure (Cyber)	4	1	1	1	3	4	10.0	40.0	40.0
Technological	Technological - Transportatio	Roadway Emergency	4	1	1	3	3	1	9.0	36.0	36.0
Human-Induced	Human - Hostile Acts	Theft, Vandalism, Arson	3	4	2	2	1	3	12.0	36.0	36.0
Natural	Natural - Environmental	Flood (Surface, Overland)	3	3	1	3	3	2	12.0	36.0	36.0
Natural	Natural - Environmental	Flood (Waterway)	3	1	3	3	3	1	11.0	33.0	33.0
Technological	Technological - Utility	Water Damage	3	4	1	1	2	3	11.0	33.0	33.0
Technological	Technological - Utility	Water Supply Disruption	3	2	1	4	3	1	11.0	33.0	33.0
Natural	Natural - Environmental	Prolonged Extreme Cold Temperatu	4	1	1	3	2	1	8.0	32.0	32.0
Technological	Technological - Fire	High Occupancy Fire (Hospital, Sch	4	3	3	4	3	2	15.0	60.0	30.0
Natural	Natural - Environmental	Blizzard/Snow Storm	4	2	2	2	3	1	10.0	40.0	30.0
Natural	Natural - Environmental	Ice Storm/Hoar Frost	4	1	3	1	3	2	10.0	40.0	30.0
Human-Induced	Human - Hostile Acts	Terrorism	2	4	2	2	4	3	15.0	30.0	30.0
Technological	Technological - Utility	Natural Fuel (Gas) Disruption	3	2	2	2	3	1	10.0	30.0	30.0
Natural	Natural - Environmental	Tornado (>F2)	2	4	3	3	3	2	15.0	30.0	30.0
Technological	Technological - Utility	Electrical Power Disruption	4	3	3	3	2	3	14.0	56.0	28.0
Natural	Natural - Environmental	Extreme Wind (Plough/Shear Wind)	4	2	3	1	2	1	9.0	36.0	27.0
Natural	Natural - Environmental	Lightning	4	1	2	2	1	3	9.0	36.0	27.0
Technological	Technological - Hazardous	Oil, Natural Gas Emergency (Pipelin	4	2	2	2	2	1	9.0	36.0	27.0
Technological	Technological - Transportatio	Air Emergency (Crash)	3	1	2	2	3	1	9.0	27.0	27.0
Technological	Technological - Fire	High Intensity Industrial or Commerci	4	4	2	3	2	2	13.0	52.0	26.0
Human-Induced	Human - Hostile Acts	Active Shooter (Community, Workpla	3	1	1	4	1	1	8.0	24.0	24.0
Natural	Natural - Disease	Pest Disease or Infestation	3	2	1	3	1	1	8.0	24.0	24.0
Human-Induced	Human - Misc	Community Level Civil Unrest	2	2	3	3	3	1	12.0	24.0	24.0
Technological	Technological - Hazardous	Hazmat (Non Rail, Road)	4	3	2	3	2	1	11.0	44.0	22.0
Technological	Technological - Fire	High Intensity Residential Fire (HIRF	4	4	1	3	1	2	11.0	44.0	22.0
Technological	Technological - Transportatio	Structural Collapse (Bridge, Large B	2	2	3	2	3	1	11.0	22.0	22.0
Natural	Natural - Environmental	Fog (Low Visibility)	3	1	1	1	3	1	7.0	21.0	21.0
Natural	Natural - Environmental	Heat Wave/Drought	3	1	1	2	2	1	7.0	21.0	21.0
Natural	Natural - Disease	Animal Disease	2	1	1	4	3	1	10.0	20.0	20.0
Natural	Natural - Environmental	Earthquake (M5 or >)	1	4	4	4	3	4	19.0	19.0	19.0
Technological	Technological - Utility	Water Contamination	2	2	1	4	1	1	9.0	18.0	18.0
Human-Induced	Human - Misc	Loss of Staff	2	1	1	3	3	1	9.0	18.0	18.0
Technological	Technological - Utility	Sewage Disruption	2	2	1	3	2	1	9.0	18.0	18.0
Natural	Natural - Environmental	Hail (GR 2 cm or >)	2	2	1	2	2	1	8.0	16.0	16.0
Technological	Technological - Event	Radiological, Nuclear	1	4	3	4	4	1	16.0	16.0	16.0
Technological	Technological - Structure	Dam Failure (Breach)	1	3	4	2	2	1	12.0	12.0	12.0
Natural	Natural - Environmental	Landslide/Land Subsidence	1	1	2	1	2	1	7.0	7.0	7.0

Table E1 - HRVA (2018)

The HIRA is illustrated following:

Priority	Hazard	Risk Score	Risk Level
1	Blizzards	120	Extreme
2	Forest Fire (Wildfire)	108	Extreme
3	Extreme Cold	100	Extreme
4	Snow	75	Extreme
5	Major Road Accident (Vehicular)	60	Extreme
6	Tornado	54	Extreme
7	Hazmat (Fixed Site) - Pipeline / Storage Facility	48	Very High
8	Computer / Hardware / Software Failure	45	Very High
9	Pipelines	40	High
10	Civil Disturbance	36	High
11	Communication Equipment Failure	36	High
12	Hazmat (Transportation) - Rail	36	High
13	Hazmat (Transportation) - Road	36	High
14	Oil and Gas Emergency	36	High
15	Toxic Gas Release	36	High
16	Water Main Break	36	High
17	Rail Accident	30	Moderate
18	Water Pollution / Contamination	30	Moderate
19	Drought	27	Moderate
20	Agricultural Plant Disease / Pest Infestation	24	Moderate
21	Extreme Heat	24	Moderate
22	Floods (Rainfall / Run-off)	24	Moderate
23	Hail	24	Moderate
24	High Intensity Residential Fire	24	Moderate
25	Ice Storm	24	Moderate
26	facility disruption	24	Moderate
27	Chemical, Biological, Radiological, Nuclear Event	18	Low
28	Farm Animal Disease	18	Low
29	Wind	18	Low
30	staff disruption	16	Low
31	Airplane Crash	12	Low
32	Terrorism	12	Low
33	Bridge / Structural Collapse	10	Very Low
34	Earthquake	9	Very Low
35	Water Shortage	9	Very Low
36	Floods (Watercourse)	4	Very Low
37	Human Health Emergency	4	Very Low
38	Landslide	0	Very Low

Table E2 - HIRA 2020

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