

2018-01

# GIS as a Decision Support Tool in Regional Food System Policy Implementation

Letizia, Jessica

---

Letizia, J. (2018). GIS as a Decision Support Tool in Regional Food System Policy Implementation (Master's thesis, University of Calgary, Calgary, Canada). Retrieved from <https://prism.ucalgary.ca>. doi:10.11575/PRISM/5450

<http://hdl.handle.net/1880/106369>

*Downloaded from PRISM Repository, University of Calgary*

UNIVERSITY OF CALGARY

GIS as a Decision Support Tool in Regional Food System Policy Implementation

by

Jessica Letizia

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF ENVIRONMENTAL DESIGN

GRADUATE PROGRAM IN ENVIRONMENTAL DESIGN

CALGARY, ALBERTA

JANUARY, 2018

© Jessica Letizia 2018

## ABSTRACT

In response to increased urbanization, population growth, and changing climate patterns, cities and regions all over North America are implementing food strategies, including the Calgary Regional Partnership's (CRP) *Food Secure*, released during the spring of 2017. This strategy aims to ensure the Calgary Region has access to a local food supply over the 60 next years. However, regional stakeholders and decision-makers lack a cross-scalar information system to support strategy implementation and monitoring over time. The purpose of this research was to identify the types of spatial data resources needed to support regional decision-makers in food strategy implementation, monitoring, and management. A number of significant spatial data gaps as well as a lack of stakeholder understanding about the need for relevant data emerged from key regional stakeholder questionnaires done for the CRP.

The results of this research identify the types of spatial data and decision-support requirements that could be integrated into the CRP's current geographic information system (GIS) to create the capacity for food strategy decision-support.

**Key Words:** Calgary Region, Calgary Regional Partnership, CRP, data, decision-support, food system, GIS, spatial analysis, spatial data

## PREFACE

As the Regional GIS Program Lead for the Calgary Regional Partnership (CRP), I have taken a reflective, practitioner approach to understand how the work being done in the regional food system can be more effective. Through my role with the CRP, I was part of the team that created the *Food Secure* Strategy and was introduced to the reality that there is a great deal of regional food system data missing. During my Master of Environmental Design thesis work, I have been able to critically review the data needed to support regional food security and re-examine how the CRP's GIS technology could be designed more effectively as a spatial decision-support (SDS) tool in practice.

## ACKNOWLEDGEMENTS

I would first like to thank my thesis advisor Dr. Mary-Ellen Tyler from the Environmental Design Faculty at the University of Calgary. Dr. Tyler's support and candour made this process a comprehensive and enjoyable learning experience. She provided countless instances of thoughtful guidance, while also encouraging and supporting me to make important decisions using my own wisdom and expertise.

I would also like to thank the numerous experts, colleagues, peers, and family members who provided me with the required information, support, and space I needed to perform this thesis research. This work would not have been possible without their endless patience, offers of assistance, and words of encouragement.

# TABLE OF CONTENTS

Abstract.....	ii
Preface .....	iii
Acknowledgements.....	iv
List of Tables .....	viii
Preface .....	iii
List of Figures .....	ix
Definitions.....	xi
List of Abbreviations and Acronyms .....	xiii
1    Implementing the Calgary Region Food Strategy.....	1
2    Understanding the Regional Food System .....	4
2.1    Review of the Food Strategies Literature .....	7
2.1.1    Local Food System Components.....	9
2.1.2    Food Policy Goals .....	11
2.1.3    Food System Data Use for Policy Development .....	12
2.1.4    Use of GIS or Spatial Analysis.....	14
2.1.5    Use of Decision-Support Methods and Technologies.....	14
3    GIS as a Decision Support Tool .....	16
3.1    Overview .....	16

3.2	What is Decision Support? .....	20
4	CRP Food Secure Strategy .....	23
4.1	Food Secure Background.....	23
4.2	Calgary Region Food System .....	24
4.3	Food Secure Strategy Goals .....	25
4.4	Food System Data for the Calgary Region.....	27
5	State of Calgary Region Food System Information.....	28
5.1	State of CRP GIS.....	28
5.2	State of Regional Food System Data .....	29
5.2.1	Goal 1 Spatial Data Requirements .....	30
5.2.2	Goal 2 Spatial Data Requirements .....	32
5.2.3	Goal 3 Spatial Data Requirements .....	33
5.2.4	Goal 4 Spatial Data Requirements .....	35
5.2.5	Goal 5 Spatial Data Requirements .....	37
5.2.6	Goal 6 Spatial Data Requirements .....	38
5.2.7	Summary of Food Secure Spatial Data Requirements.....	39
6	Redesigning the Calgary Region GIS for Food System Decision Support .....	41
6.1	Role of Stakeholders and Decision-Makers .....	41
6.2	Questionnaire Results .....	44
6.2.1	Question 1 Results .....	45

6.2.2	Question 2 Results .....	46
6.2.3	Question 3 Results .....	48
6.2.4	Question 4 Results .....	50
6.2.5	Question 5 Results .....	51
6.2.6	Summary of Questionnaire Answers .....	52
7	Next Steps.....	53
7.1	How can the CRP GIS be More Active in Regional Food System Decision-Making? .....	53
7.2	Future Application.....	53
7.3	5-Year Priorities.....	54
7.3.1	Collection of Regional Food System Data .....	54
7.3.2	Dedicated Design of CRP GIS Program.....	55
7.3.3	Data awareness and Capacity Building .....	55
7.4	Conclusion .....	56
	References .....	57
	Appendix .....	60
	Appendix 1 – Calgary Region Food Secure Goals, Indicators, and Actions.....	60
	Goal 1: The Calgary Region is a leader in food planning and governance .....	60
	Goal 2: People are aware of the connection between the food they eat and where it comes from .....	62
	Goal 3: All residents have access to safe, affordable, and healthy food .....	63
	Goal 4: The Calgary Region has a diverse and collaborative regional food economy .....	64



Goal 5: The Calgary Region efficiently and sustainably produces and processes a variety of food that sustains its population.....	66
Goal 6: Organic and non-organic food waste in the Calgary Region is diverted.....	68
Appendix 2 – List of Websites .....	70

## LIST OF TABLES

Table 2.1-1: Identification of Local Food System Components	Page 10
Table 2.1-2: Food Policy Goals	Page 11
Table 2.1-3: Food System Data Uses and Challenges	Page 12
Table 2.1-4: References to Decision-Making	Page 14
Table 5.1-1: Current State of CRP GIS	Page 29
Table 5.2-1: <i>Food Secure</i> Goal 1 Spatial Data Requirements	Page 30
Table 5.2-2: <i>Food Secure</i> Goal 2 Spatial Data Requirements	Page 32
Table 5.2-3: <i>Food Secure</i> Goal 3 Spatial Data Requirements	Page 33
Table 5.2-4: <i>Food Secure</i> Goal 4 Spatial Data Requirements	Page 35
Table 5.2-5: <i>Food Secure</i> Goal 5 Spatial Data Requirements	Page 37
Table 5.2-6: <i>Food Secure</i> Goal 6 Spatial Data Requirements	Page 38
Table 6.2-1: Question 1 Results	Page 45
Table 6.2-2: Linkages Between Food System Work and <i>Food Secure</i>	Page 46
Table 6.2-3: Understanding the Food System	Page 48

# LIST OF FIGURES

Figure 2-1: The City/Regional Food System	Page 5
Figure 2-2: Food System Components	Page 6
Figure 2-3: Food Systems Thinking	Page 7
Figure 2.1-1: Municipal/Regional Food Policy Across Canada	Page 8
Figure 2.1-2: Municipal Food System Components Diagram	Page 10
Figure 3.2-1: GIS Concept Illustration	Page 16
Figure 3.1-2: Screenshot of a GIS Layer and Associated Attribute Table	Page 17
Figure 3.1-3: Components of a GIS	Page 18
Figure 3.1-4: Applying GIS to Support Decision-Making	Page 19
Figure 3.1-5: Sample of GIS Applications Around the World	Page 20
Figure 3.2-1: High Level Conceptual Model of a DSS	Page 22
Figure 4.2-1: Map of the Calgary Region	Page 24
Figure 4.2-2: Calgary Region Food System	Page 25
Figure 5.1-1: State of the CRP GIS	Page 28
Figure 5.2-1: <i>Food Secure</i> Goal 1 Sample Data	Page 31
Figure 5.2-2: <i>Food Secure</i> Goal 2 Sample Data	Page 33
Figure 5.2-3: <i>Food Secure</i> Goal 3 Sample Data	Page 35
Figure 5.2-4: <i>Food Secure</i> Goal 4 Sample Data	Page 36
Figure 5.2-5: <i>Food Secure</i> Goal 5 Sample Data	Page 38

Figure 5.2-7: Summary of <i>Food Secure</i> Spatial Data Requirements	Page 39
Figure 6.1-1: Food Secure Engagement at a Glance	Page 42
Figure 6.1-2: Map of Questionnaire Participant Locations	Page 43
Figure 6.1-2: Questionnaire Participants	Page 43
Figure 6.2-1: Thematic Content Analysis Steps	Page 45

## DEFINITIONS

**Attribute:** non-spatial information associated with a spatial feature that describes its characteristics (Bolstad 2001).

**Attribute Table:** a table that contains non-spatial information about features in a GIS layer (Price 2012).

**Calgary EATS!:** The City of Calgary *Food System Assessment and Action Plan* was completed in response to growing citizen demand and community awareness of the value of a sustainable food system (Calgary EATS! 2012, 5).

**Calgary Region:** Covers the geographical area surrounding the City of Calgary including the Municipal District of Bighorn and the municipalities within it; the Municipal District of Foothills and the municipalities within it; Rocky View County and the municipalities within it; and, Wheatland County and the municipalities within it (Calgary Regional Partnership 2017).

**Cloud Storage:** a model in which data is stored remotely on servers accessed from the Internet, or 'cloud' ("ArcGIS Help" 2017).

**Decision-Support System:** a computerized information system used to support organizational decision-making for making more informed decisions in a timely and efficient manner (Das and Choudhury 2014).

**File Geodatabase:** a collection of files that can store, query, and manage both spatial and non-spatial data ("ArcGIS Help" 2017).

**Food Policy:** any decision made by a government agency, business, or organization which affects how food is produced, processed, distributed, purchased, and protected (Hamilton 2002 as cited in MacRae and Donahue 2013, 5).

**Food Security:** when all people, at all times have physical, social, and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy lifestyle (Calgary Regional Partnership 2017).

**Food System:** biological processes and physical infrastructure involved in feeding a population, including the growing, harvesting, processing, packaging, transporting, marketing, and consumption of food, and the disposing of food waste (MacRae and Donahue 2013).

**Food Systems Thinking:** an awareness of how one component in a food system affects other components in the system, as well as the environment, the economy, and society (Bolstad 2001).

**GIS (Geographic Information System):** computer-based system used to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information (Harder 2015).

**Indicators:** “facilitate the monitoring of progress towards the identified goals” (Sonnino 2013, 191).

**Layer:** logical collections of geographic data representing features, combined to create maps, and used for spatial analysis (“ArcGIS Help” 2017).

**Local Food Infrastructure:** facilities such as processing plants, warehouses, food retailers, and community kitchens among others that enables the local food economy to function (Edmonton Food Policy Council 2012).

**Shapefile:** a simple format for storing the geometric location and attribute information of geographic features as a point, line, or polygon (Harder 2015).

**Spatial Analysis:** a modelling process that derives results by computer processing, then examines and interprets those results. Useful for evaluating, estimating, predicting, interpreting, and understanding (Tomlinson 2007).

**Spatial Data:** data that is connected to a specific place on the earth’s surface (Sugamaran and DeGroote 2011).

**Spatial Decision-Support System:** an integrated set of flexible capabilities for decision-making involving the three major components of databases, modelling, and user interfaces (Sugamaran and DeGroote 2011).

## LIST OF ABBREVIATIONS AND ACRONYMS

<b>CMP</b>	Calgary Metropolitan Plan
<b>CRP</b>	Calgary Regional Partnership
<b>DS</b>	Decision Support
<b>DSS</b>	Decision Support System
<b>EVDS</b>	Environmental Design
<b>GIS</b>	Geographic Information Systems
<b>SDS</b>	Spatial Decision Support
<b>SDSS</b>	Spatial Decision Support System

# 1 IMPLEMENTING THE CALGARY REGION FOOD STRATEGY

*“Food is an important part of our culture, landscapes and the health of citizens living in the Calgary Region” (Calgary Regional Partnership 2017, 5).*

City regions all over the world are grappling with challenges to achieve and sustain food security, ecosystem management, biodiversity, conservation, and climate change adaptation and mitigation (Forster and Escudero 2014). In response to this, organizations and government agencies are devoting increasing resources to community-based regional food initiatives (Anderson et al. 2014), and the Calgary Region is no different.

The 2012 update of the Calgary Regional Partnership’s (CRP) *Calgary Metropolitan Plan* (CMP), identified food security as an emerging and important regional land use and economic development priority. Specifically, the CRP recognized the need for region-wide strategies and actions to ensure continued access to safe, affordable, and sustainably produced food for the Calgary Region’s population (Calgary Regional Partnership 2014). Also in 2012, Calgary EATS! published *Calgary’s Food Assessment and Action Plan*, which aimed to “create a sustainable and resilient food system for the Calgary Region” (Calgary EATS! 2012, 2). This report suggested that within the Calgary Region there was an “opportunity to collaborate with the regional municipal districts on a shared vision for a sustainable food system” (Calgary EATS! 2012, 76). Finally, in the spring of 2017, the CRP Board approved the Calgary Region *Food Secure Strategy*, which represents a shared vision for a regional, sustainable food system – “abundant, locally-produced food that feeds the Calgary Region” (Calgary Regional Partnership 2017, 15) .



The components of the Calgary Region food system, initially identified by Calgary EATS! and addressed in the CRP strategy, include:

- Production
- Processing
- Distribution
- Access
- Consumption
- Food Waste Recovery

(Calgary EATS! 2012, 16)

However, to achieve and sustain food security in the Region, it is important to understand the opportunities, barriers, and limitations that currently exist within the Regional system. Having said that, very little work has been done in this area and there is currently a lack of up-to-date, accurate information and data on the regional food system's structural and functional components and dynamic interconnections. As Pierce (2014) has pointed out, it is difficult to achieve a local food goal without a sense of the land base required, the types of foods that are grown locally, and where they are grown in relation to the local population.

Assuming that relevant food system data can be identified, it can best be understood in its regional spatial context as geographically-referenced data that can be visualized. It is this visualization capacity that makes GIS technology a potentially powerful decision-support tool. A GIS can be used to "capture, manage, analyze, and display all forms of geographically referenced information" (i.e. spatial data) (ESRI 2017) and has enormous potential to reshape policy thinking and provide a solid framework for decision-making (Fleming 2014). In the context of the CRP's strategic policy objectives, GIS technology has the potential to spatially map components and interconnections within the regional food system. The opportunity to visualize and engage in 'what-if' scenarios enables patterns to be identified, opportunities and constraints to be revealed, and areas of intervention to be uncovered.

The purpose of this reflective practitioner approach is to critically re-examine the spatial data requirements necessary to support the implementation of the CRP *Food Secure* Strategy, and to illustrate how GIS technology could provide decision-support in implementing and evaluating the regional *Food Secure* Strategy.

Four related objectives of this thesis are to:

- Review the literature on current North American food strategies to identify if and how they are tackling data issues and using decision-support tools.
- Review the results of the CRP's regional food system stakeholder questionnaires to identify what stakeholders know or need to know about the regional food system.
- Review the decision-support literature to identify opportunities for the use of GIS in decision-support related to regional food strategy implementation needs.
- Identify spatial data requirements necessary to enable implementation and monitoring of the CRP's *Food Secure* Strategy.

## 2 UNDERSTANDING THE REGIONAL FOOD SYSTEM

*“The food system incorporates a holistic approach that involves all aspects from production, processing, and distribution, to consumption, disposal and diversion of food” (Calgary EATS! 2014, 3).*

There is so much to consider when discussing the topic of food. It is much more than health and nutrition; but also security, affordability, sustainability, environmental impact, and economy (MacRae and Donahue 2013). How all of these relate is a food system – a complex set of activities and inter-connected relationships including food production, processing, distribution, access, consumption, and waste (Sommerfreund, Cook, and Emanuel 2015).

Adding to this complexity, food systems are also vulnerable to outside influences such as politics, natural disasters, and economic market dynamics, to name just a few, and a shock to the system can have enormous ripple effects throughout (Toth, Rendall, and Reitsma 2015). Therefore, policies that support and uphold sustained growth throughout the local food system are vital for ensuring food security (Qureshi, Dixon, and Wood 2015).

Food systems are dynamic and complex systems, and local municipal decision-makers are not typically food system experts, or even familiar with food systems at all (Calgary EATS! 2012). Furthermore, they are often faced with competing priorities and interests (Forster and Escudero 2014). Figure 2-1 illustrates the complexity usually involved in both urban and rural municipal food systems.



Figure 2-1: The City/Regional Food System (MacRae and Donahue 2013, 7)

Food systems vary from region to region based on local economic, environmental, and social factors. In 2012, Calgary EATS! defined the components of the Calgary Region food system as follows:

- **Production:** the planting, growing, raising, and harvesting of food, including urban and rural agriculture.
- **Processing:** the process of modifying food to create a different product.

- **Distribution:** the distribution, storage, selling, and purchasing of food.
- **Access:** the accessibility and affordability of food.
- **Consumption:** the act of consuming and enjoying food.
- **Food Waste Recovery:** the diversion, management, and utilization of food waste.

(Calgary EATS! 2012, 16)

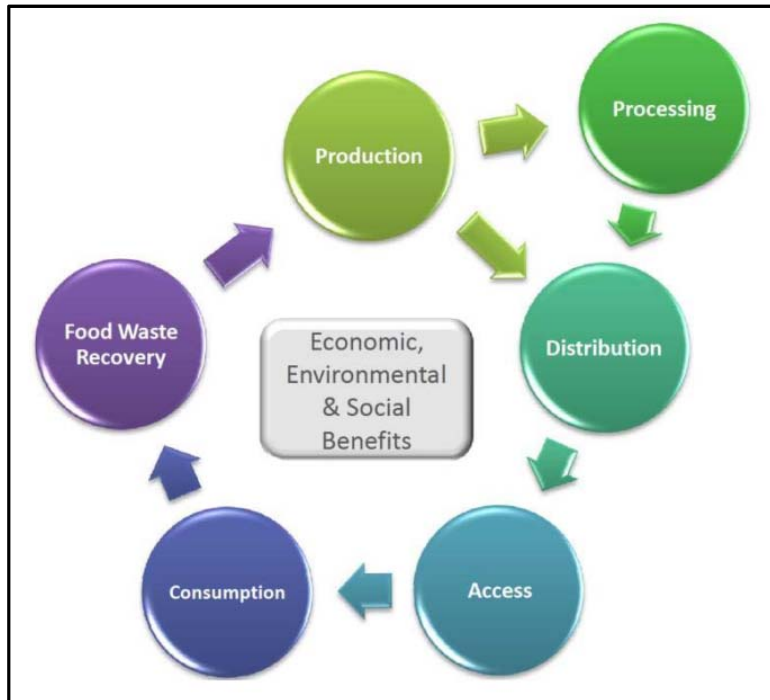


Figure 2-2: Food System Components (Calgary EATS! 2012, 16)

Municipalities - especially urban ones - often have limited authority over their local food system, yet they are severely impacted by the loss of agricultural land, the effects of climate change, public health problems, food accessibility and affordability, and decreasing local food infrastructure (MacRae and Donahue 2013). Improved coordination of research, policy, and stakeholder engagement can aid municipalities in strengthening local food systems, by allowing

them to play a role in the prevention and mitigation of systems shocks (Misselhorn et al. 2012).

Food systems thinking recognizes that all food issues are linked, involve multiple stakeholders, and require integrated solutions (MacRae and Donahue 2013). Implementing a food systems approach, therefore, requires a number of activities such as collaboration amongst all stakeholders, application of common objectives and metrics, and the creation of supportive policy (MacRae and Donahue 2013). The concept of food systems thinking is further explained in Figure 2-3.

**FIGURE 1**  
**FOOD SYSTEMS THINKING**

**1. “Systems thinking” recognizes that:**

- Complex issues are linked.
- There are multiple actors in the system and they are connected.
- Integrated solutions are required.

**2. “Systems thinking” is a means to:**

- Express and act on strategy.
- Engage and align diverse actors.
- Link health, environment and justice concerns with economic success.

**3. A “food system approach” is about recognizing the connections between:**

- Supply chain players and other sectors, and among players within other sectors;
- Connections between these diverse players and consumers; and
- Ensuring reliable food production and supply and the sustainable use of natural capital.

**4. “Operationalizing a food system approach” requires:**

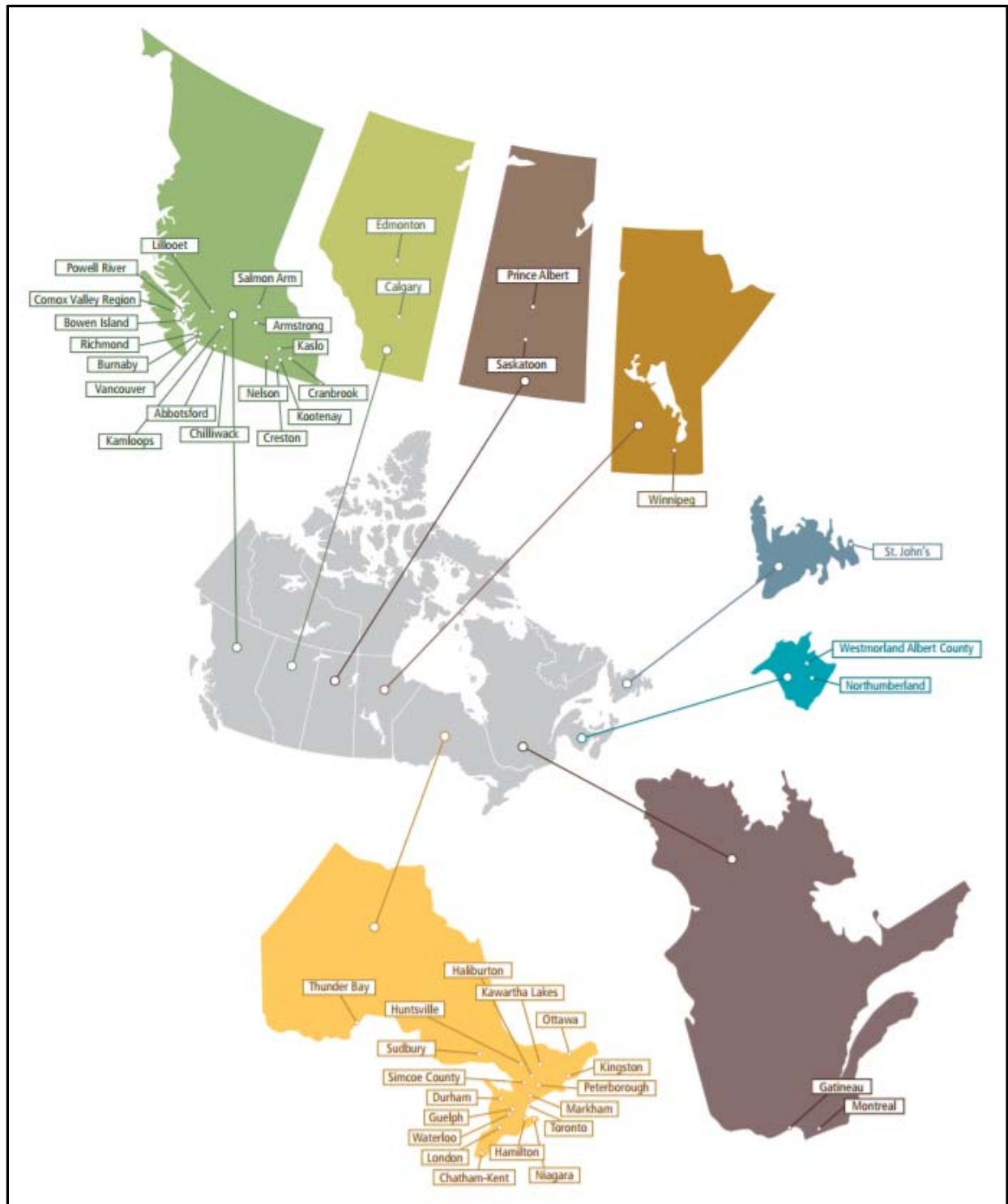
- Supporting highly-collaborative supply chains.
- Collaborating with non-traditional actors beyond the supply chain.
- Understanding consumer food needs and health/well-being considerations.
- Understanding evolving societal expectations for how food is produced/supplied.
- Understanding how sustainability, equity, health and social expectations are managed at every stage in food production/supply.
- Deploying common objectives and metrics – this can include setting a bold target or destination.
- Aligning and creating supportive government policy and regulations.
- Working in multiple venues and on multiple topics

Understanding the connections can be used to create the necessary dialogue to apply systems thinking to specific issues.

**Figure 2-3: Food Systems Thinking (MacRae and Donahue 2013, 5)**

## 2.1 Review of the Food Strategies Literature

In a 2013 study, MacRae and Donahue found that 64 municipalities and regions across Canada were working on improving their local food system through the implementation of policies, programs, and citizen interventions. These municipalities are geographically represented in Figure 2.1-1. The rationale for municipal action was not just to produce more food for local consumption, but to improve environmental sustainability, health, and economic development (MacRae and Donahue 2013). The primary focus of the majority of municipal actions involved stakeholder engagement for collaborative problem solving (MacRae and Donahue 2013). However, there is no guarantee that collaboration alone is sufficient if there is a fundamental lack of information or uncertainty about food system function.



**Figure 2.1-1: Municipal/Regional Food Policy Across Canada (MacRae and Donahue 2013, 17)**

For the purpose of this thesis, the City of Seattle and three Canadian municipal food strategies mentioned in MacRae and Dohanue (2013), were selected as precedents for urban food system

strategies. In the absence of other regional strategies to compare to, these four cities were chosen based on their geographic size or location:

- *Calgary EATS! A Food System Assessment and Action Plan for Calgary, 2012*
- *Fresh: Edmonton's Food and Urban Agriculture Strategy, 2012*
- *What Feeds Us: Vancouver Food Strategy, 2013*
- *City of Seattle Food Action Plan, 2012*

These four precedents were examined and compared using the following five information categories in order to better understand how large municipalities across North America are thinking about food system policies:

1. Local (or regional) food system components.
2. Food policy goals.
3. Food system data use for policy development.
4. Use of GIS or spatial analysis.
5. Use of decision-support methods and technologies.

The results of these precedent comparisons are presented in the following sub-sections (2.1.1 to 2.1.5).

### 2.1.1 Local Food System Components

Regional food systems can impact the lives of vulnerable populations, enhance biodiversity, foster more resilient ecosystems, and improve agricultural food security (Forster and Escudero 2014). Table 2.1-1 summarizes food system components identified in the four selected food strategies. While all four documents identify components related to production, processing, distribution, and access, the City of Edmonton has the only strategy that includes “education and governance” as a food system component.



**Table 2.1-1: Identification of Local Food System Components**

FOOD SYSTEM COMPONENTS	
CALGARY	<ul style="list-style-type: none"> <li>• Production</li> <li>• Processing</li> <li>• Distribution</li> <li>• Access</li> <li>• Consumption</li> <li>• Food waste recovery</li> </ul>
EDMONTON	<ul style="list-style-type: none"> <li>• Food Production</li> <li>• Processing</li> <li>• Storage and distribution</li> <li>• Buying and selling</li> <li>• Eating and celebration</li> <li>• Food waste and recovery</li> <li>• Education and governance</li> </ul>
SEATTLE	<ul style="list-style-type: none"> <li>• Production</li> <li>• Processing and cooking</li> <li>• Distribution</li> <li>• Access</li> <li>• Consumption</li> <li>• Waste management related to food</li> </ul>
VANCOUVER	<ul style="list-style-type: none"> <li>• Food production</li> <li>• Food processing/distribution</li> <li>• Food Access</li> <li>• Food Waste Management</li> </ul>

Figure 2.1-2 illustrates these system components but note that of the four municipal strategies, only the City of Seattle *Food Action Plan* does not include a food system diagram.



**Figure 2.1-2: Municipal Food System Components Diagrams**

### 2.1.2 Food Policy Goals

Food policies typically focus on regionally specific goals (MacRae and Donahue 2013) and ideally reflect local food system stakeholder input (Bailey 2011). According to Le Vallee (2013), food policy goals should be strategic, achievable, actionable, and measurable in order to properly track and assess performance. Table 2.1-2 outlines the goals identified in the four municipal food strategies reviewed. While the language differs, all four documents generally address the same policy goals focussed on local, accessible, and healthy food. This similarity is likely due the evolution of the concept of food security over time – initially, the focus was on the availability of food, but over the last few years has expanded to include accessibility of food and sustainability of the system (Berry et al. 2015).

**Table 2.1-2: Food Policy Goals**

<b>FOOD POLICY GOALS</b>	
CALGARY	<ol style="list-style-type: none"><li>1. Local</li><li>2. Accessible</li><li>3. Secure supply</li><li>4. Environmentally sustainable</li><li>5. Healthy</li><li>6. Community Development</li></ol>
EDMONTON	<ol style="list-style-type: none"><li>1. A stronger more vibrant local economy</li><li>2. A healthier, more food-secure community</li><li>3. More attractive, vibrant and unique places</li><li>4. Healthier ecosystems</li><li>5. Less energy, emissions, waste</li></ol>
SEATTLE	<ol style="list-style-type: none"><li>1. Healthy food for all</li><li>2. Grow local</li><li>3. Strengthen the local economy</li><li>4. Prevent food waste</li></ol>
VANCOUVER	<ol style="list-style-type: none"><li>1. Support food-friendly neighbourhoods</li><li>2. Empower residents to take action</li><li>3. Improve access to healthy, affordable, culturally diverse food for all residents</li><li>4. Make food a centrepiece of Vancouver’s green economy</li><li>5. Advocate for a just and sustainable food system with partners and at all levels of government</li></ol>

### 2.1.3 Food System Data Use for Policy Development

According to MacRae and Donahue (2013), metrics should be identified and collected to assess the effectiveness of food system policy initiatives. To do so, would require systematic and ongoing data collection, but none of the four strategies reviewed appear to have invested in this level of evaluation. In fact, as Le Vallee (2013) reports, there are numerous food system data gaps that exist across Canada. Table 2.1-3 identifies how all four of the strategies reviewed identify the importance of food system data, but all indicate there are significant data challenges that need to be addressed, and none identify collecting data or identifying indicators as an important action for policy development, evaluation, or implementation.

**Table 2.1-3: Food System Data Uses and Challenges**

	<b>DATA USES</b>	<b>DATA CHALLENGES</b>
CALGARY	<ul style="list-style-type: none"><li>• “Mapping of a land inventory identifying City-owned sites with the potential for urban agriculture/food production which includes baseline data, maps, issues, opportunities, and practices from other jurisdictions.”</li><li>• “This is the first time there has been a consolidated effort to look at the food system as a whole and the resulting high-level action plan identifies what needs to be done and by whom to close the gaps and collect the appropriate data.”</li><li>• “Cross-sectional analysis of Calgary's food system, providing comprehensive baseline data to clearly identify the strengths and weaknesses of each component of Calgary’s food system.”</li><li>• “Establish geospatial relationships between food outlets and specific vulnerable populations (i.e. look for gaps between the amount of food nominally available in the City</li></ul>	<ul style="list-style-type: none"><li>• “Absence of data to establish baselines, develop indicators and measure progress toward the targets.”</li><li>• “Given the breadth of the Calgary food system, the diverse stakeholders, along with resource and data limitations, this assessment is not fully comprehensive...”</li><li>• This analysis was completed within the limitations associated with data availability, time, and resources.”</li><li>• [The gap analysis] also identified where information and data was missing that would be needed to measure progress.”</li></ul>

	of Calgary and the actual access to food)."	
EDMONTON	<ul style="list-style-type: none"> <li>• "Online information centre (said to be a fundamental resource)."</li> </ul>	<ul style="list-style-type: none"> <li>• "Often there is no existing information or research available that would help frame the answers properly."</li> <li>• "The coordination of resources and information sharing should be strengthened."</li> </ul>
SEATTLE	<ul style="list-style-type: none"> <li>• "Use data to assess conditions, inform priorities, and track progress"</li> </ul>	<ul style="list-style-type: none"> <li>• "Currently, the database does not contain information about many characteristics that would help assess site suitability for agriculture."</li> <li>• "Implement a pilot program...to gather more data about the potential to grow food on City-owned sites."</li> <li>• "People would like to see more opportunities for businesses, organizations, and public agencies to share knowledge and information..."</li> </ul>
VANCOUVER	<ul style="list-style-type: none"> <li>• "Research reveals the importance of starting with a baseline of those data that are attainable and realistic, while recognizing that in many cases proxies must be used."</li> <li>• "In addition to measuring existing food assets, additional data gaps still exist in the food system. These data gaps will contribute to making realistic, pragmatic and meaningful decisions towards Vancouver's Food Strategy goals."</li> <li>• "Information to support this element of monitoring and evaluation will be developed as actions are implemented."</li> </ul>	<ul style="list-style-type: none"> <li>• "Evaluating and monitoring a city's food system is a complex undertaking due to its inherently multi-faceted nature and the challenge of obtaining and updating meaningful data at a municipal or neighbourhood scale."</li> </ul>

#### 2.1.4 Use of GIS or Spatial Analysis

Ruhf (2015) suggests that GIS-based analysis and mapping can play an important role in decision-support by providing rich visualization, pattern detection, and spatial analysis in food system policy development and management. Essentially, GIS technology supports policy makers to leverage their ancillary information and spatial data to support their decision-making more effectively and efficiently (Das and Choudhury 2014).

Having said that, the only strategy to mention the utilization of GIS in any way, was the *Calgary EATS! Food System Assessment and Action Plan*. In it, it states that the strategy was “supported by [GIS] analysis” (Calgary EATS! 2012, 6). This is significant as GIS can help stakeholders better understand the food environment (Sweeney et al. 2015) and only one of four strategies considered using it.

#### 2.1.5 Use of Decision-Support Methods and Technologies

None of the four strategies discuss ‘decision support’ tools, but they do reference ‘decision-making’ and ‘policy decisions’ frequently and many references to decisions also refer to the need for more data or information. Table 2.1-4 summarizes references to decision-making found in reviewing the four food strategies. It is worth noting that there is no mention of the word ‘decision’ or ‘decision-making’ in the City of Seattle *Food and Action Plan*.

Table 2.1-4: References to Decision-Making

REFERENCES TO MAKING DECISIONS	
CALGARY	<ul style="list-style-type: none"><li>• “...country residential development and urban sprawl impact agricultural production and there is a concern that acreage owners, without a farming background or understanding of farming practices are influencing policy and <b>decision making</b> within municipalities.”</li><li>• “[Life Cycle Assessment] is a valuable tool to influence both policy and operational <b>decisions</b> within the food system.”</li><li>• “Policy makers, particularly at the local level, are not as familiar with food systems and as a result its importance in <b>decision making</b> is low. This has been the case for Calgary.”</li></ul>
EDMONTON	<ul style="list-style-type: none"><li>• “Education and governance involves the many levels of learning and knowledge transfer around growing, preparing, preserving, enjoying food,</li></ul>

	<p>and the health benefits derived from food, as well as how communities choose to link food systems into policy and <b>decision-making</b>.”</p> <ul style="list-style-type: none"> <li>• “Some [food] councils are closely linked to municipal <b>decision-making</b> and have clear lines of communication with municipal government. while others have an arm's length relationship to local government and are more focused on grassroots action.”</li> <li>• “The Advisory Committee responded by developing a framework for that ongoing <b>decision making</b> on these issues. This framework provides the tools that will help inform the complex decisions for those elected to make them.”</li> </ul>
SEATTLE	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
VANCOUVER	<ul style="list-style-type: none"> <li>• “The next section of the food strategy uses the Vancouver Food Charter principles and emerging priorities as a springboard to set the stage for a series of food system goals that will guide <b>decision-making</b>, while also providing accessible user friendly ways of expressing the future of Vancouver’s food system.”</li> <li>• “In addition to measuring existing food assets, additional data gaps still exist in the food system. These data gaps will contribute to making realistic, pragmatic and meaningful <b>decisions</b> towards Vancouver’s Food Strategy goals. Information to support this element of monitoring and evaluation will be developed as actions are implemented.”</li> </ul>

# 3 GIS AS A DECISION SUPPORT TOOL

*“Spatial analysis allows you to solve complex problems and better understand where and what is occurring in the world and goes beyond mapping alone to let you study the characteristics of places and the relationships between them – in other words, it lends perspective to your decision-making” (Harder 2015, 62).*

## 3.1 Overview

A geographic information system (GIS) can be described as “a computer-based system that aids

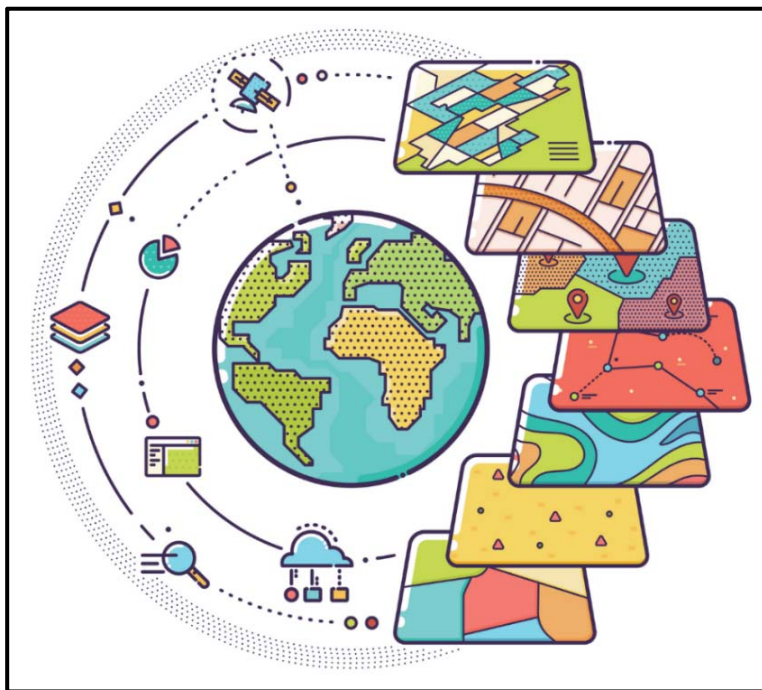


Figure 3.1-1: GIS Concept Illustration (Naschy 2017)

in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information” (Bolstad 2001, 1). In other words, it is a tool used to help visualize and interpret multiple layers of data related to positions on the earth’s surface in order to understand relationships, patterns, and trends (ESRI 2017) and is conceptualized in Figure 3.1-1.

GIS ‘layers’ are logical collections of geographic (or spatial) data that

represent features such as land parcels, points of interest, streets, buildings, parks, vegetation, water bodies, etc. that can be combined, recombined, and spatially represented using a combination of points, lines, or polygons (Tomlinson 2007). In addition, non-spatial information

called ‘attributes’ that help describe the feature, can be linked to layers through a table and the more attributes there are, the more powerful and dynamic a GIS can be (Bolstad 2001). Some examples of non-spatial attribute information that describes a feature’s characteristics are parcel ID numbers, street names, addresses, and postal codes, just to name a few.

To help visualize how a GIS works, Figure 3.1-2 shows a community garden GIS layer, in which garden locations are symbolized with green dots. There is also a corresponding attribute table of non-spatial information. The record highlighted in the attribute table at the bottom of the figure corresponds to a symbol on the map which enables the user to access additional information about that feature such as the name and location of a specific community garden.

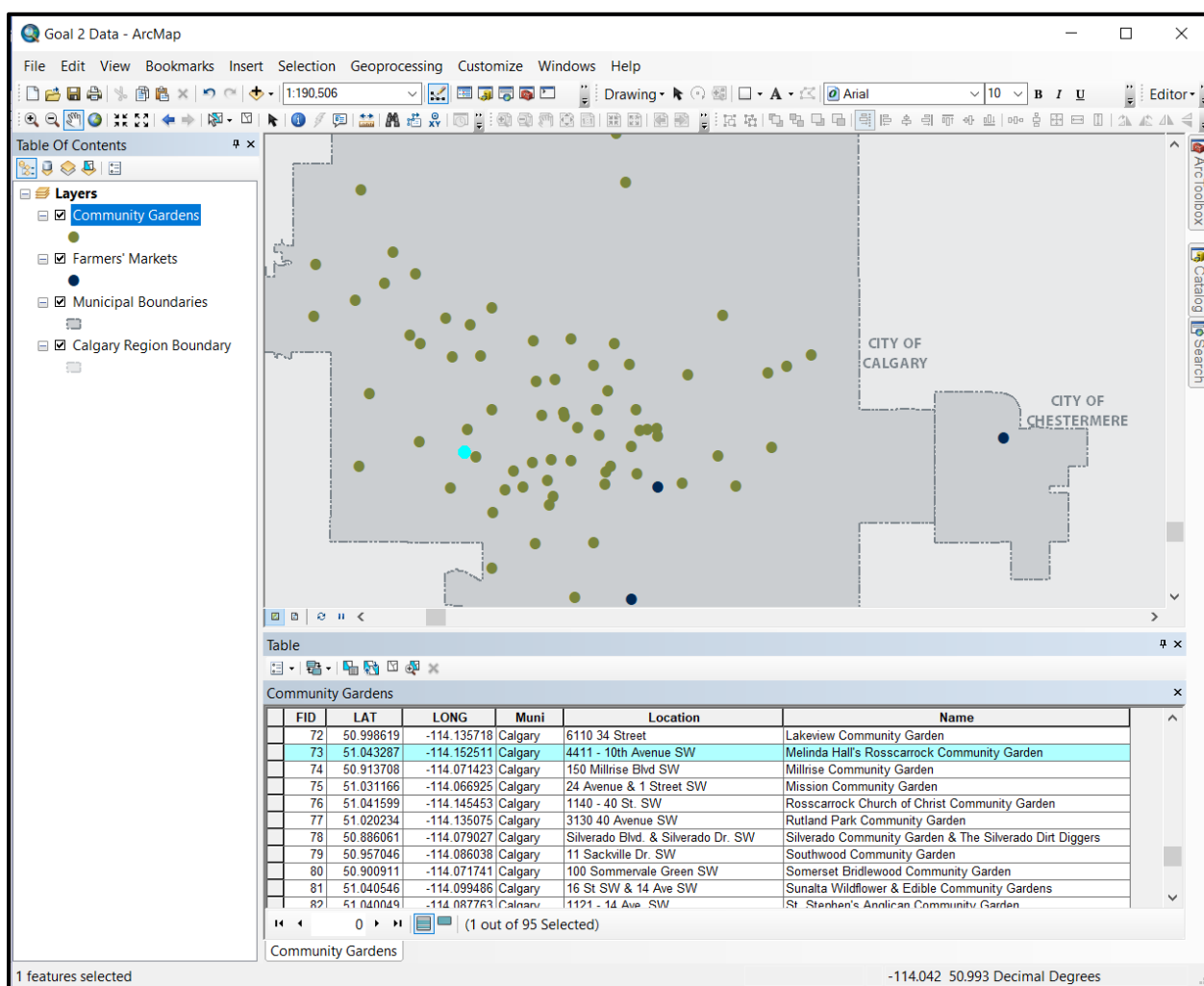


Figure 3.1-2: Screenshot of a GIS Layer and Associated Attribute Table



There are five key integrated components of a GIS (Bolstad 2001):

- **People:** manage GIS data and technology and apply it to real-world problems.
- **Data:** geographic (or spatial) data.
- **Analysis:** performed on data to help make decisions.
- **Hardware:** computer the GIS operates on.
- **Software:** provides the tools necessary for managing, analyzing, and displaying geographic data and information.

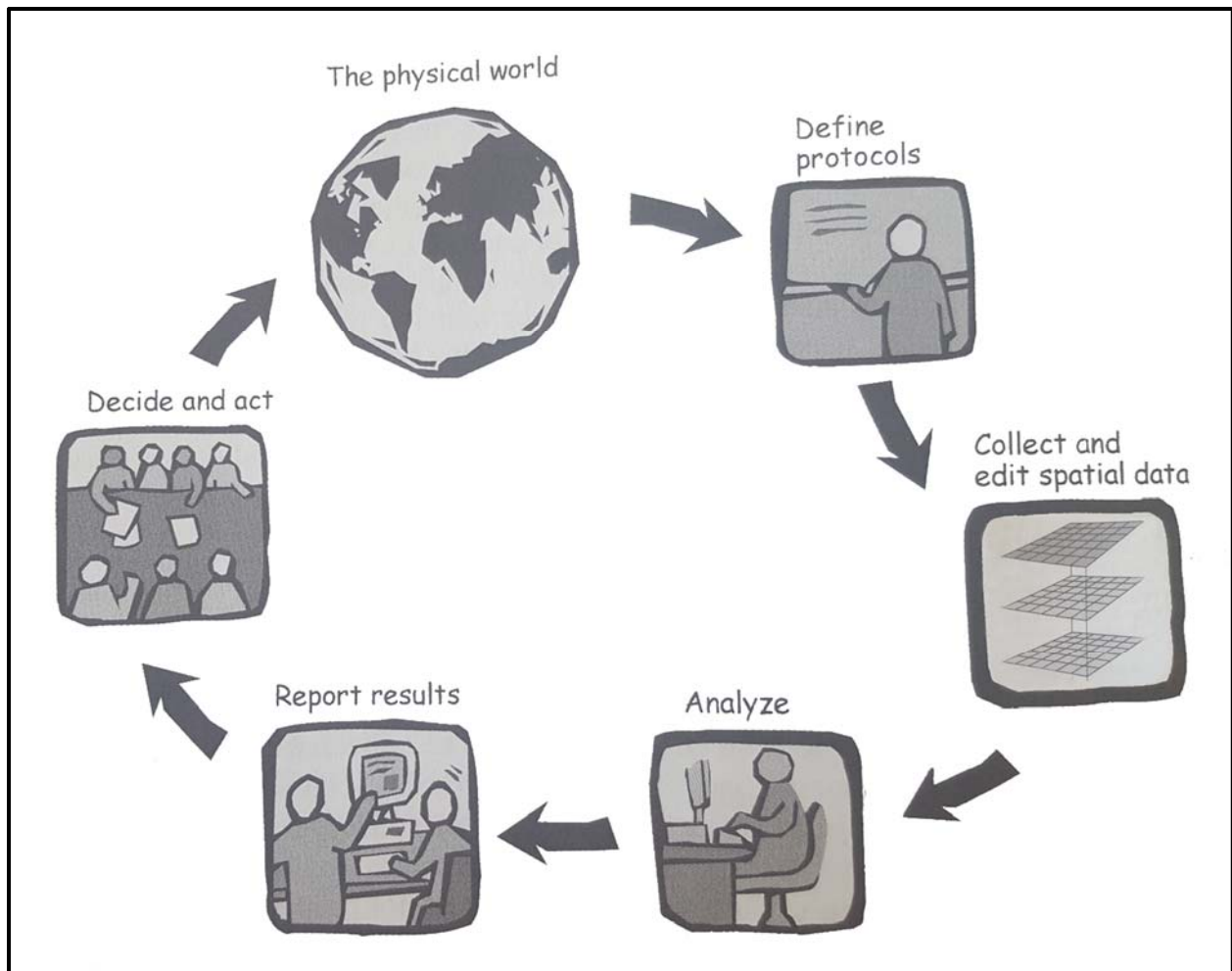


Figure 3.1-3: Components of a GIS ("Society of Exploration Geophysicists Wiki" 2017)

According to ESRI (2017), a simple five-step process will enable organizations to apply GIS to a geographically-related decision.

1. **Ask** what the problem you are trying to solve is.
2. **Acquire** the data needed to complete the project.
3. **Examine** your data for completeness and accuracy.
4. **Analyze** your data – core strength of a GIS – through a variety of modelling and computer-processing tools.
5. **Act** by sharing your analysis results through reports, maps, tables, charts, etc.

Roger Tomlinson, often referred to as the 'Father of GIS', states that GIS spatial analysis turns data into useful information (Tomlinson 2007). To that end, GIS has been applied in almost every industry and organizations of any size; therefore, there is a growing awareness and interest in the economic and strategic value of it as a decision-support tool (ESRI 2017).



**Figure 3.1-4: Applying GIS to Support Decision-Making (Bolstad 2001, 18)**

GIS has been used within planning, engineering, property assessment, or public works departments of government agencies as those areas rely heavily on tracking and verifying georeferenced information (Bolstad 2001). In addition, GIS has also been applied to social issues such as police work, protecting endangered species, reducing pollution, coping with natural disasters, epidemiology, and public health (“ESRI ArcNews” 2007). The application of GIS in decision-support is illustrated in Figure 3.1-4 above and the range of GIS applications is illustrated in Figure 3.1-5 below.

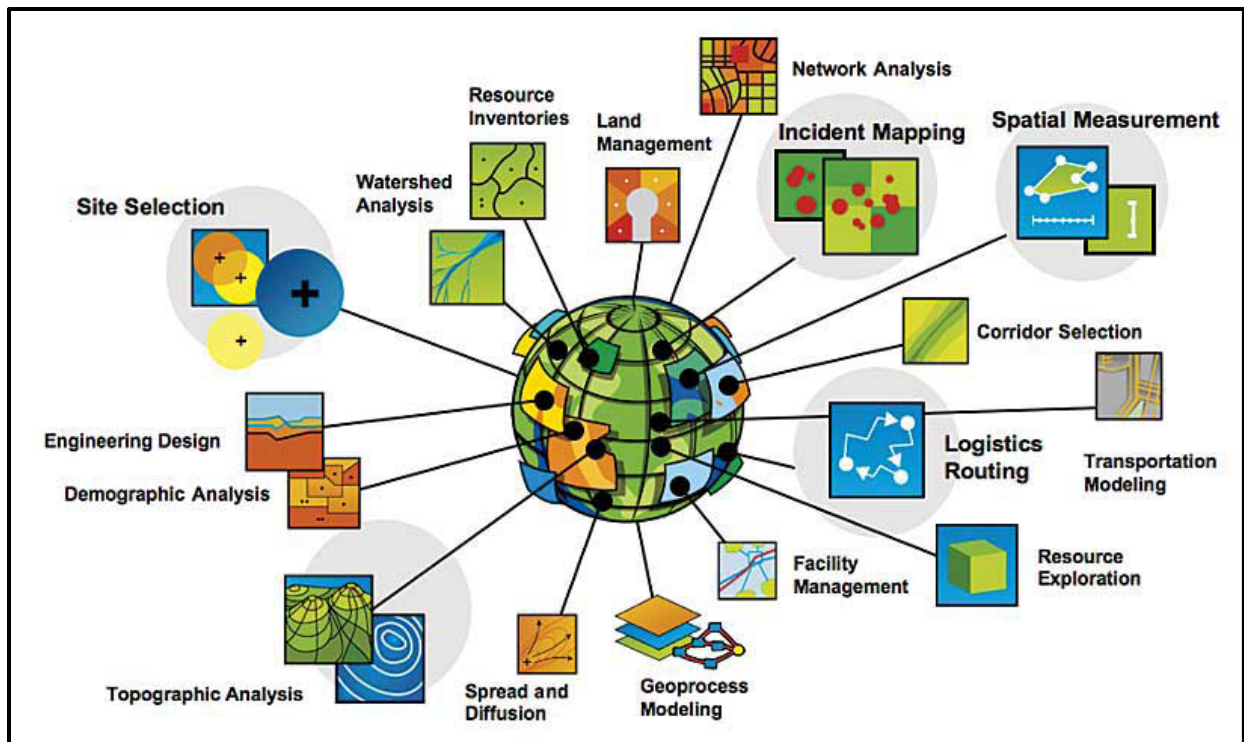


Figure 3.1-5: Sample of GIS Applications Around the World (“ESRI ArcNews” 2007)

Despite wide use and application in specific areas, the full potential of GIS in decision-support has not yet been realized (Weinryb Grohsgal 2013). Specifically, it is still more frequently used to simply store and create data inventories, access information, and perform simple mapping, rather than being used for decision-support scenario modelling or analysis (Weinryb Grohsgal 2013). The work of many GIS professionals is often a “bottom-up push” to get departments or organizations to share data and make GIS use part of doing business (Bolstad 2001). However, this is just a small part of the potential capacity for GIS application.

The above all-too-common scenario is unfortunate because the combination of robust and accurate spatial data (and accompanying attributes) in combination with analysis becomes a valuable policy-making or decision support tool (Fleming 2014).

## 3.2 What is Decision Support?

Elected officials are ultimately responsible for determining the best course of action to respond to problems and challenges that arise in their jurisdiction, and how they respond eventually

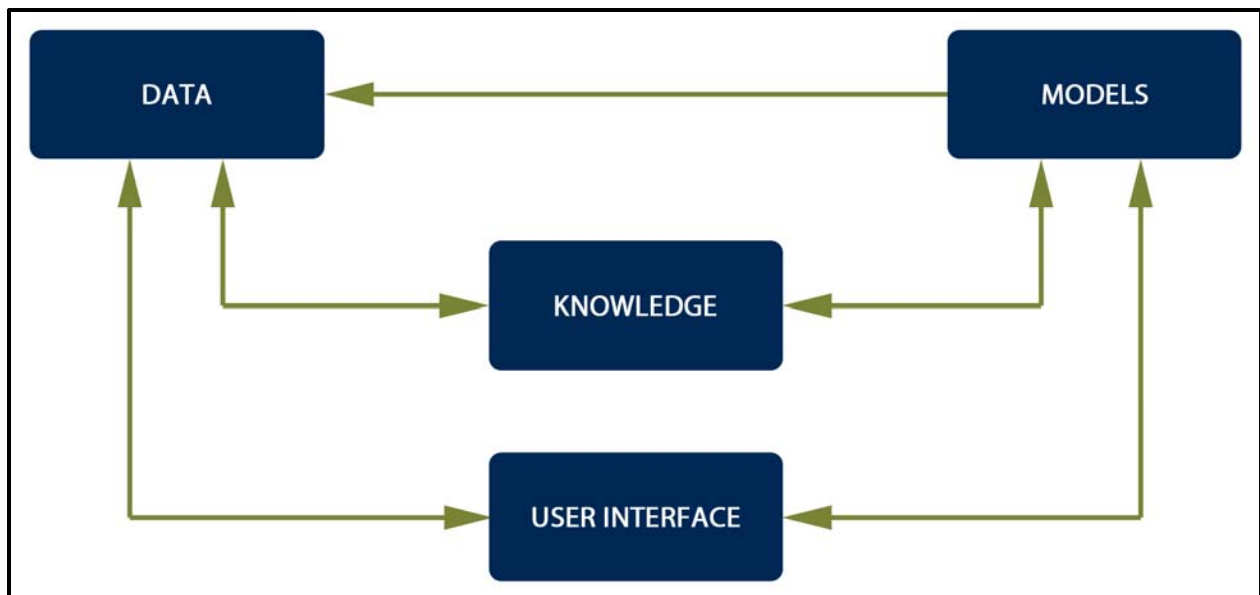
informs public policy (Fleming 2014). The task of setting policy is an important part of directing action in problem solving, therefore, it is imperative that policy-makers have access to good data and solid analysis to base their decisions on (Papathanasiou and Kenward 2014). In other words, a GIS (i.e. spatial decision support tool), can, and should, be used to support research, policy development, and decision-making when appropriate (Malczewski and Rinner 2015).

Decision Support System (DSS) is an “umbrella term” spanning a broad range of systems and functional support capabilities but it is essentially a computerized system based on two major pillars: information systems and decision analysis (Jankowski, Fraley, and Pebesma 2014). Figure 3.2-1 illustrates a conceptual model of a DSS. As such, decision-support is an analytic process involving the systematic evaluation of feasible options or solutions (Kerselaers et al. 2015). This process can be a very useful tool for policy-makers in trying to balance different stakeholder interests (Kerselaers et al. 2015).

In spite of the number of available DSS tools, most are not applied in practice. Reasons for this lack of use have been identified as incompatibility with the task, strict or limiting rationale, too generic, or too complex (Das and Choudhury 2014). However, Das and Choudhury (2014) have also estimated that between 55% and 80% of the data collected by public-sector organizations is spatial and suitable for GIS use and SDS analysis. Spatially-enabled DSS (SDSS) tools, including GIS, could be used to capitalize on the abundance of spatial data that exists within many municipalities and improve the decision-making process (Malczewski and Rinner 2015).

According to Malczewski and Renner (2015), most spatial decisions range between structured and unstructured and are usually referred to as semi-structured. The structured portion of a semi-structured problem can benefit from an automated computer solution but the unstructured aspects need input from decision-makers (Malczewski and Rinner 2015). Kerselaers et al. (2015), suggest that one of the weaknesses of an SDSS is the tendency of users to use the system to only create maps. Map outputs are not objective ‘truth’ and only reflect the data available which may or may not be appropriate (Kerselaers et al. 2015). Therefore, the use of GIS in decision-support needs to be more than just an “electronic mapping tool” (Das and Choudhury 2014, 2). The

workflow illustrated in Figure 3.2-1 needs to be used to actively involve decision-makers in engaging with the system.



**Figure 3.2-1: High Level Conceptual model of a DSS (adapted from Sugamaran and DeGroote 2011)**

Given the potential for GIS to be used effectively as a DSS tool, the following Chapter presents the Calgary Regional Partnership’s 2017 Food System policy, *Food Secure*, as an example of a food system policy that can benefit from greater use of GIS as a DSS tool.

## 4 CRP *FOOD SECURE* STRATEGY

*“VISION: Abundant, locally-produced food that feeds the Calgary Region”*

(Calgary Regional Partnership 2017, 15).

### 4.1 *Food Secure* Background

As outlined in section 3.1 above, one of the first steps for an organization to apply GIS to a geographically related decision is to ask what the problem is. For the Calgary Region, the issue to address was regional food security. In recent years, the need for a “regional food strategy” has gained recognition from local and regional government policy makers (Ruhf 2015). For example, in 2012, the CRP, a voluntary collaboration of municipalities in the Calgary Region, identified the need for a regional food policy in the *Calgary Metropolitan Plan*. Specifically, policy 3.b.9, Food Security in a Growing Region, states that:

*“CRP and member municipalities recognize the need for strategies and collaborative actions to ensure continued access to safe, affordable and sustainably-produced food for the region’s population”* (Calgary Regional Partnership 2017, 31).

As a result of this commitment, the CRP released their *Food Secure* Strategy in the Spring of 2017 with the primary goal of ensuring the Calgary Region will benefit from reliable access to food as it grows to over three million people by the year 2076 (Calgary Regional Partnership 2017). This projected population increase will significantly increase development pressures on both regional infrastructure and agricultural land use. Additionally, changing climate patterns have also had an impact on the regional food system in recent years such as severe flood events and prolonged drought (Calgary Regional Partnership 2017). Furthermore, the Calgary Region wants to capitalize on positive factors such as being one of the sunniest regions in Canada, making it a potential

leader in solar power (Calgary Regional Partnership 2017). This is significant as it presents a number of alternative and innovative food production and land use opportunities throughout the Region (Calgary Regional Partnership 2017).

The 2017 *Food Secure* Strategy represents the results of a “collaborative approach that draws on local ideas and knowledge of many regional food experts” (Calgary Regional Partnership 2017, 1) and is meant to be a starting point for municipalities to collectively improve food security (Calgary Regional Partnership 2017).

## 4.2 Calgary Region Food System

The physical boundary of the Calgary Region spans four rural municipalities and includes three cities, nine towns, and several hamlets and villages, depicted in Figure 4.2-1 below.

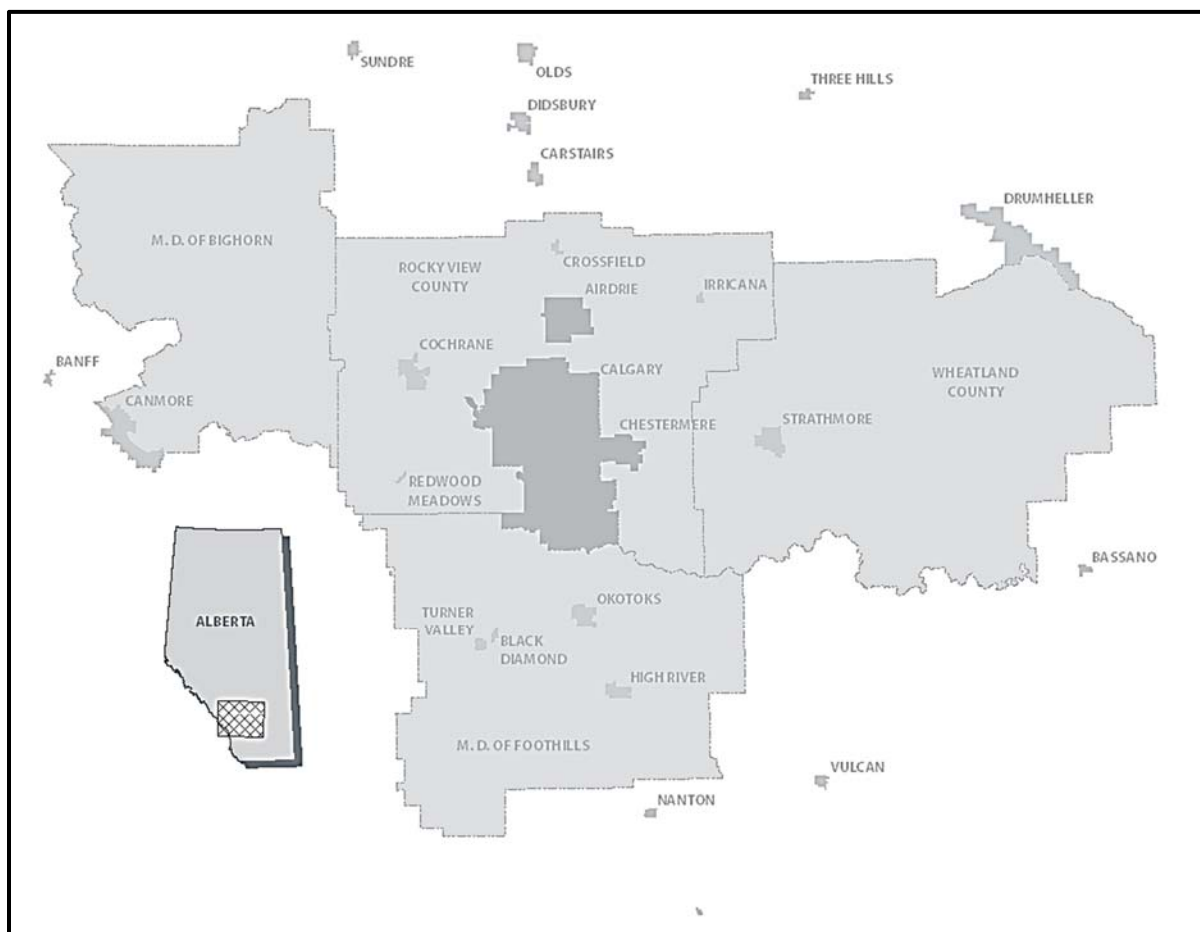


Figure 4.2-1: Map of the Calgary Region (Calgary Regional Partnership 2017, 2)

Expanding on the food system outlined by Calgary EATS! (Figure 2.2 on page 6), the CRP illustrated the Calgary Region food system as shown in Figure 4.2-2 below.

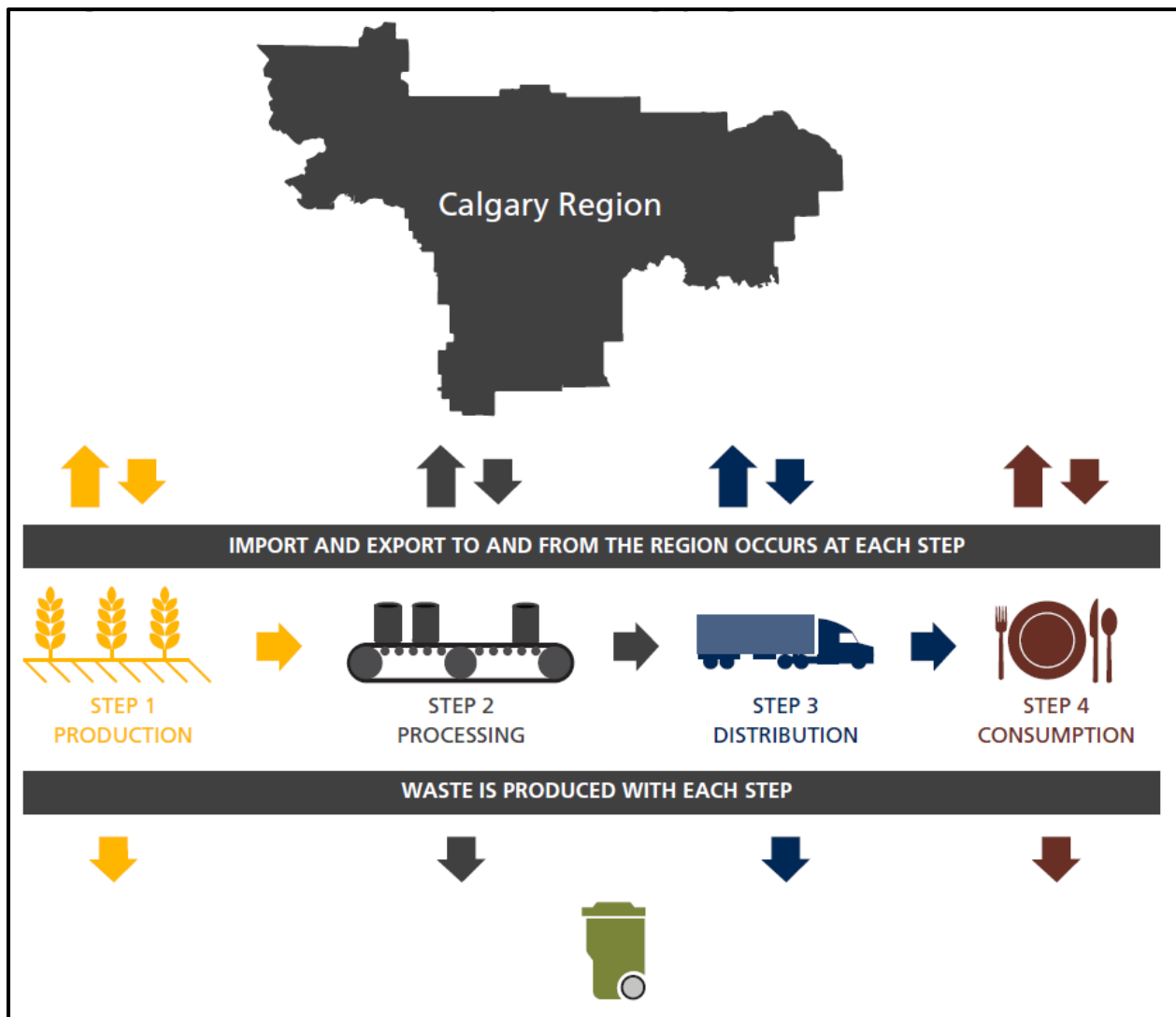


Figure 4.2-2: Calgary Region Food System (Calgary Regional Partnership 2017, 11)

### 4.3 Food Secure Strategy Goals

The *Food Secure* Strategy is meant to be the first step in understanding the food system in the Calgary Region through a series of six ambitious goals, supported by long-term strategies, catalyzing actions, and indicators intended to help measure the success of the work being done (Calgary Regional Partnership 2017).



The six goals of the *Food Secure* Strategy, resulting from the comprehensive engagement process, are:

**1. “The Calgary Region is a leader in food planning and governance.”**

The strategies, actions, and indicators in this goal focus on convening regional food stakeholders and supporting local food policy-making (Calgary Regional Partnership 2017, 18).

**2. “People are aware of the connection between the food they eat and where it comes from.”**

The strategies, actions, and indicators in this goal focus on defining what ‘local’ means to the Region and supporting local food awareness and consumption (Calgary Regional Partnership 2017, 20).

**3. “All residents have access to safe, affordable, and healthy food.”**

The strategies, actions, and indicators in this goal focus on identifying areas of food insecurity throughout the Region and leveraging existing and new initiatives to support those areas (Calgary Regional Partnership 2017, 22).

**4. “The Calgary Region has a diverse and collaborative regional food economy.”**

The strategies, actions, and indicators in this goal focus on supporting and strengthening food distribution throughout the Region, encouraging innovation, and bolstering regional food tourism (Calgary Regional Partnership 2017, 24).

**5. “The Calgary Region efficiently and sustainably produces and processes a variety of food that sustains its population.”**

The strategies, actions, and indicators in this goal focus on maximizing growing spaces and optimizing growing practices throughout the Region (Calgary Regional Partnership 2017, 26).

**6. “Organic and non-organic food waste in the Calgary Region is diverted.”**

The strategies, actions, and indicators in this goal focus on identifying and reducing pre- and post-consumer food waste and packaging (Calgary Regional Partnership 2017, 30).

For a complete list of *Food Secure* strategies, actions, and indicators, see Appendix 1.

## 4.4 Food System Data for the Calgary Region

*Food Secure* is intended to be a “living strategy” that will continue to evolve as the Calgary Region grows and changes, with action required from a range of stakeholders throughout the Region (Calgary Regional Partnership 2017). Having said that, one of the commitments the CRP has made from the onset is to work towards developing the data required to understand the baseline of the regional food system in order to better action the Strategy (Calgary Regional Partnership 2017) which is also step 2 in applying GIS to a geographically-related decision (see section 3.1).

Currently, there is a general lack of consistent, good quality food system data for the Calgary Region, and very little of the data that does exist, is spatial (Calgary Regional Partnership 2017). Therefore, implementing many of the actions presented in the strategy will require gathering, creating, and sharing data that will support the implementation of the *Food Secure* Strategy for the CRP and regional food system stakeholders.

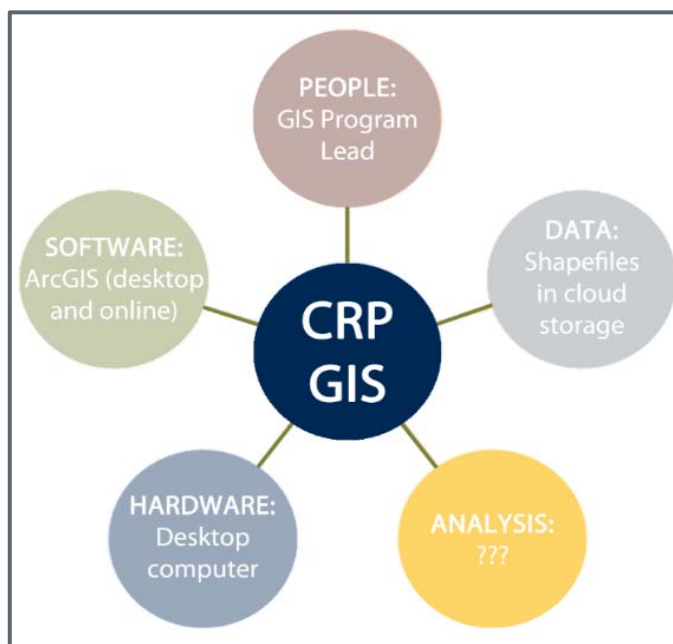
Chapter 5 will present the spatial data requirements necessary to support the implementation of the *Food Secure* Strategy and measure its success over time.

# 5 STATE OF CALGARY REGION FOOD SYSTEM INFORMATION

*“What data?”* (CRP Food System Questionnaire Participant)

## 5.1 State of CRP GIS

According to Das and Chaudhury (2014), data acquisition, manipulation, and management are important and essential functions of a GIS, however most systems could and should also be used to support data analysis and decision-making. The CRP GIS program is capable of providing cartography and minimal data analysis, however, the state of the current system is still very much focussed on data acquisition, manipulation, and management rather than analysis and decision-support. This is mostly due to a lack of time, so additional resources would help evolve the program over time.



As outlined in Figure 3.1-3 (page 19), there are five major components of a GIS:

- People
- Data
- Analysis
- Hardware
- Software

Using these five generic components as a reference, the current state of the CRP GIS is outlined in Table 5.1-1.

Figure 5.1-1: State of the CRP GIS

**Table 5.1-1: Current State of CRP GIS**

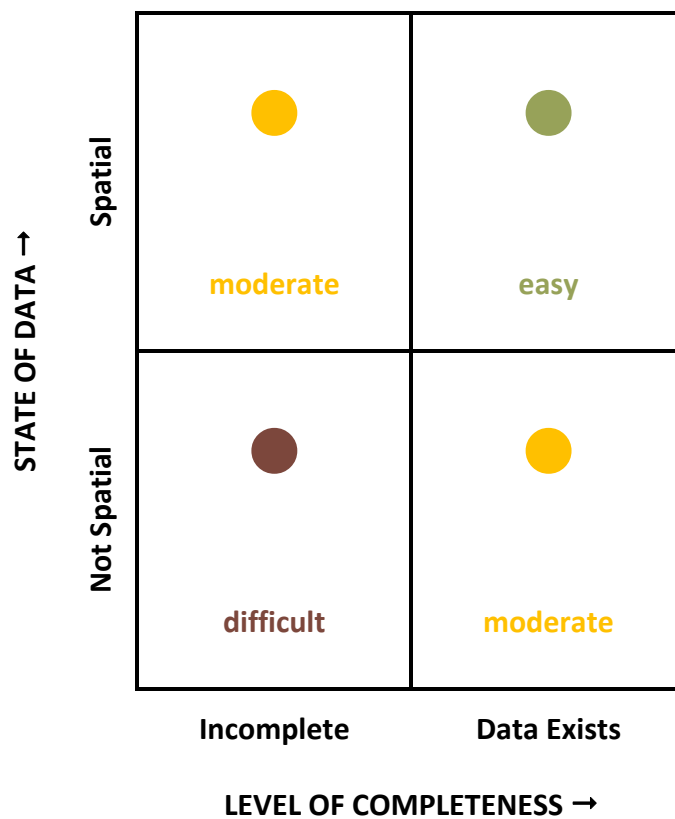
COMPONENT	CURRENT STATE
People	<ul style="list-style-type: none"> <li>• Full-time Regional GIS Program Lead (with background in Physical Geography and GIS) that provides GIS support to CRP's three primary program areas:               <ul style="list-style-type: none"> <li>○ CMP Implementation and Regional Servicing</li> <li>○ Economic Prosperity</li> <li>○ Transportation &amp; Complete Mobility</li> </ul> </li> <li>• Occasional short-term contract staff (mostly GIS practicum students or recent GIS program graduates) when necessary</li> </ul>
Data	<ul style="list-style-type: none"> <li>• Stored in Dropbox (i.e. cloud storage) in shapefile format</li> <li>• Some regional data available on the Calgary Region Open Data site</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>• Currently underutilized</li> </ul>
Hardware	<ul style="list-style-type: none"> <li>• One desktop computer (PC)</li> <li>• One laptop computer (PC)</li> <li>• One laser printer</li> </ul>
Software	<ul style="list-style-type: none"> <li>• ESRI software including:               <ul style="list-style-type: none"> <li>○ ArcGIS Desktop 10.5 (Advanced License) x 2</li> <li>○ CityEngine Extension x 1</li> <li>○ Network Analyst extension x 1</li> </ul> </li> <li>• ArcGIS Online Site (i.e. online mapping)</li> <li>• Open Data Site</li> <li>• Adobe Acrobat and Photoshop CS5</li> </ul>

## 5.2 State of Regional Food System Data

The lack of spatial data in the Calgary Region mirrors the situation across the country, according to the results of research conducted by the Conference Board of Canada (Le Vallee 2013). Therefore, it is necessary to identify the types of spatial data and attribute information necessary to support the implementation of the regional food strategy - step 3 of applying GIS to a geographically-related decision - and to redesign the current CRP GIS to enable it to function as a DSS for policy implementation (i.e. actions) and performance evaluation (i.e. indicators). Chapter 6 addresses these two tasks.

All of the actions and indicators outlined in the *Food Secure Strategy* (see Section 3.3) that have a spatial component have been examined and categorized based on accessibility and difficulty of data collection. Data that is spatial and complete is considered easy to obtain and assigned a



green dot, data that is spatial but not complete or not spatial but complete, is considered moderately easy to obtain and is assigned a yellow dot, and data that is neither spatial or complete is considered difficult to obtain and is assigned a red dot. It is important to note that while the spatial data identified in the tables below is comprehensive, it is not a complete list as it is difficult to ascertain exactly what will be needed until the work commences.



### 5.2.1 Goal 1 Spatial Data Requirements

*“Goal 1: The Calgary Region is a leader in food planning and governance”* (Calgary Regional Partnership 2017, 18).

**Table 5.2-1: Food Secure Goal 1 Spatial Data Requirements**

ACTION	SPATIAL DATA REQUIREMENT	DATA AVAILABILITY
Create a spatial inventory of stakeholders and their roles within the food system at the regional, provincial, and national scale with the intention of knowing who the	Municipal boundaries	
	Stakeholder locations	

stakeholders are, what they are doing, and when and why they are doing it.		
Support municipalities in the exploration of policy that reduces land fragmentation, reduces agricultural and land development conflicts, and focuses on greater separation between agricultural land uses and development.	Area structure plans	●
	Land use	●
	Human footprint	●
	Priority growth areas	●
	Soil quality	●

## Summary

Two out of the 11 actions outlined in Goal 1 of the CRP *Food Secure* Strategy have spatial data requirements which work out to at least seven GIS layers needed that range in availability from easy to moderate. Of those seven layers, three have been assigned an ‘easy’ score as the CRP already owns that data as depicted in the map below.

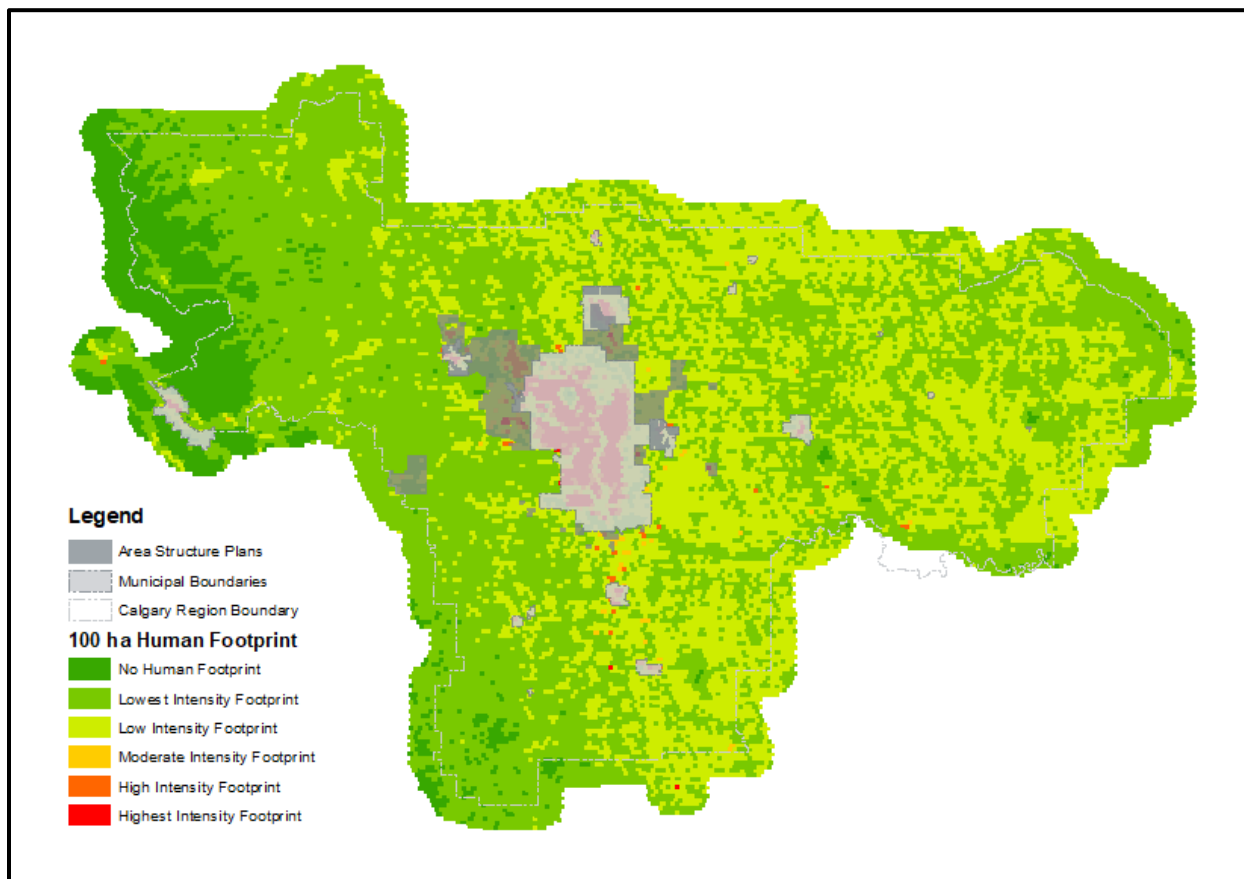


Figure 5.2-1: *Food Secure* Goal 1 Sample Data

## 5.2.2 Goal 2 Spatial Data Requirements

*“Goal 2: People are aware of the connection between the food they eat and where it comes from”*  
(Calgary Regional Partnership 2017, 20).

**Table 5.2-2: Food Secure Goal 2 Spatial Data Requirements**

ACTION/INDICATOR	SPATIAL DATA REQUIREMENT	DATA AVAILABILITY
A: Research and identify food types and amounts grown within the boundaries of the Calgary Region and identify existing gaps.	Farm locations (i.e. producers)	●
	Food types	●
A: Work with regional, provincial, and national stakeholders to create “local” food labelling and develop lists of locally produced products and where they can be purchased seasonally.	CSA access points	●
	Food types grown	●
	Food retailers	●
	Processors	●
	Producers	●
I: Number of community gardens in the Region.	Community gardens	●
I: Number of farmers’ markets in the Region (including number of local food vendors).	Farmers’ markets	●
I: Number of food retailers that subscribe to food origin labelling programs.	Food retailers	●
I: Number of producers/processors direct marketing or selling in the region.	CSA access points	●
	Producers	●
	Processors	●

NOTE: ‘A’ indicates action, and ‘I’ indicates indicator.

### Summary

Two out of the nine actions outlined in Goal 2 of the CRP *Food Secure* Strategy and four of four indicators have spatial data requirements which work out to at least eight GIS layers needed that range in availability from easy to difficult. Of those eight layers, two have been assigned an ‘easy’ score as the CRP already owns that data as depicted in the map below.

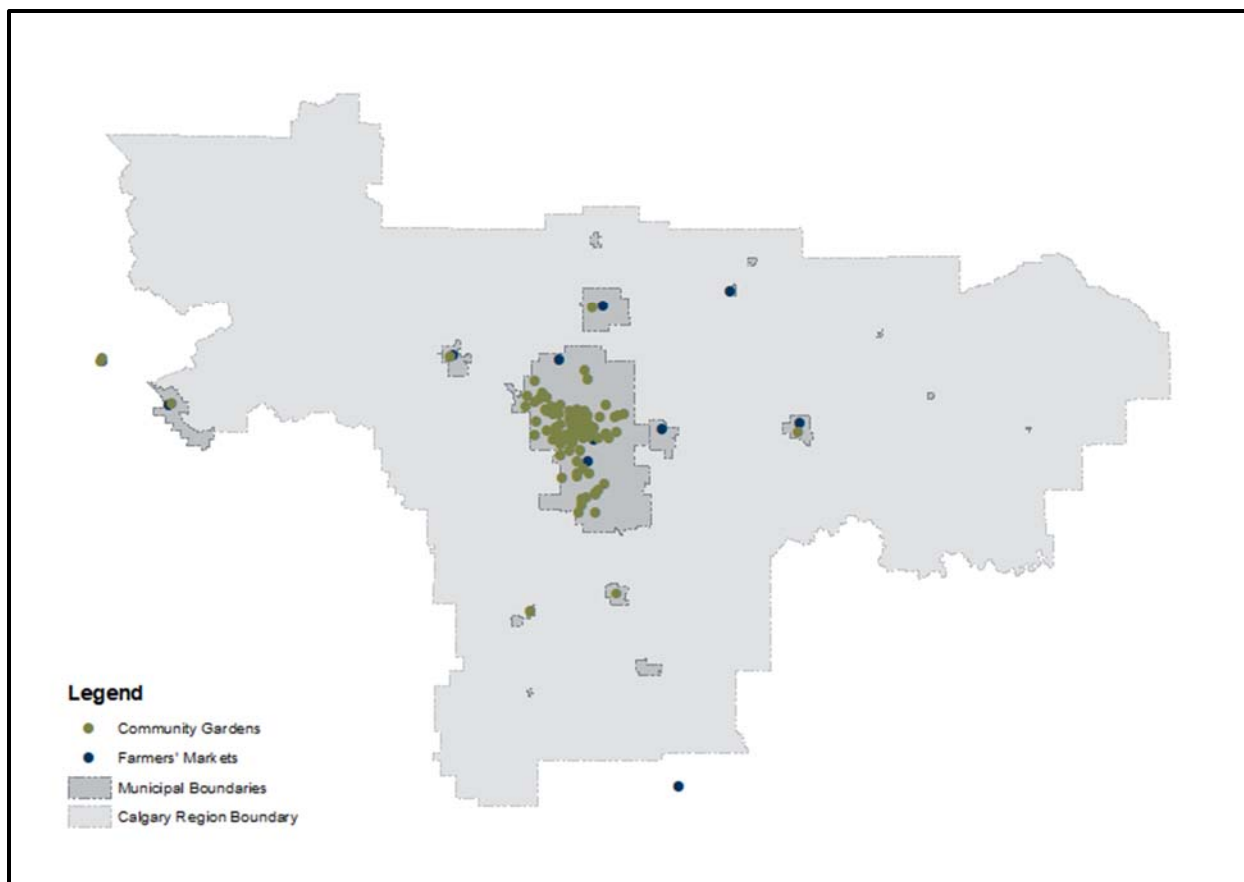


Figure 5.2-2: Food Secure Goal 2 Sample Data

### 5.2.3 Goal 3 Spatial Data Requirements

*“Goal 3: All residents have access to safe, affordable, and healthy food”* (Calgary Regional Partnership 2017, 22).

Table 5.2-3: Food Secure Goal 3 Spatial Data Requirements

ACTION	SPATIAL DATA REQUIRED	DATA AVAILABILITY
Identify and spatially represent urban food deserts and swamps throughout the Region and work to connect producers and processors looking for food distribution points to assist these areas.	Community gardens	●
	CSA access points	●
	Food retailers	●
	Pathways	●
	Roads	●
	Transit routes/stops	●



Work with rural municipalities to define food deserts and food swamps in the rural context.	Community gardens	●
	CSA access points	●
	Food retailers	●
	Pathways	●
	Roads	●
	Transit routes/stops	●
Assist community-level food programming to improve food access (i.e. community gardens, community kitchens, and food events), with a particular focus on food deserts and swamps.	Community gardens	●
	Community kitchens	●
	Food desert/swamps	●
Identify and spatially represent food banks throughout the Region	Food bank locations	●
Measure number of food insecure households in the Calgary Region.	Food desert/swamps	●
	Population density	●

## Summary

Five out of the six actions outlined in Goal 3 of the CRP *Food Secure* Strategy have spatial data requirements which work out to at least 11 GIS layers needed that range in availability from easy to difficult. Of those 11 layers, six have been assigned an ‘easy’ score as the CRP already owns that data as depicted in the map below.

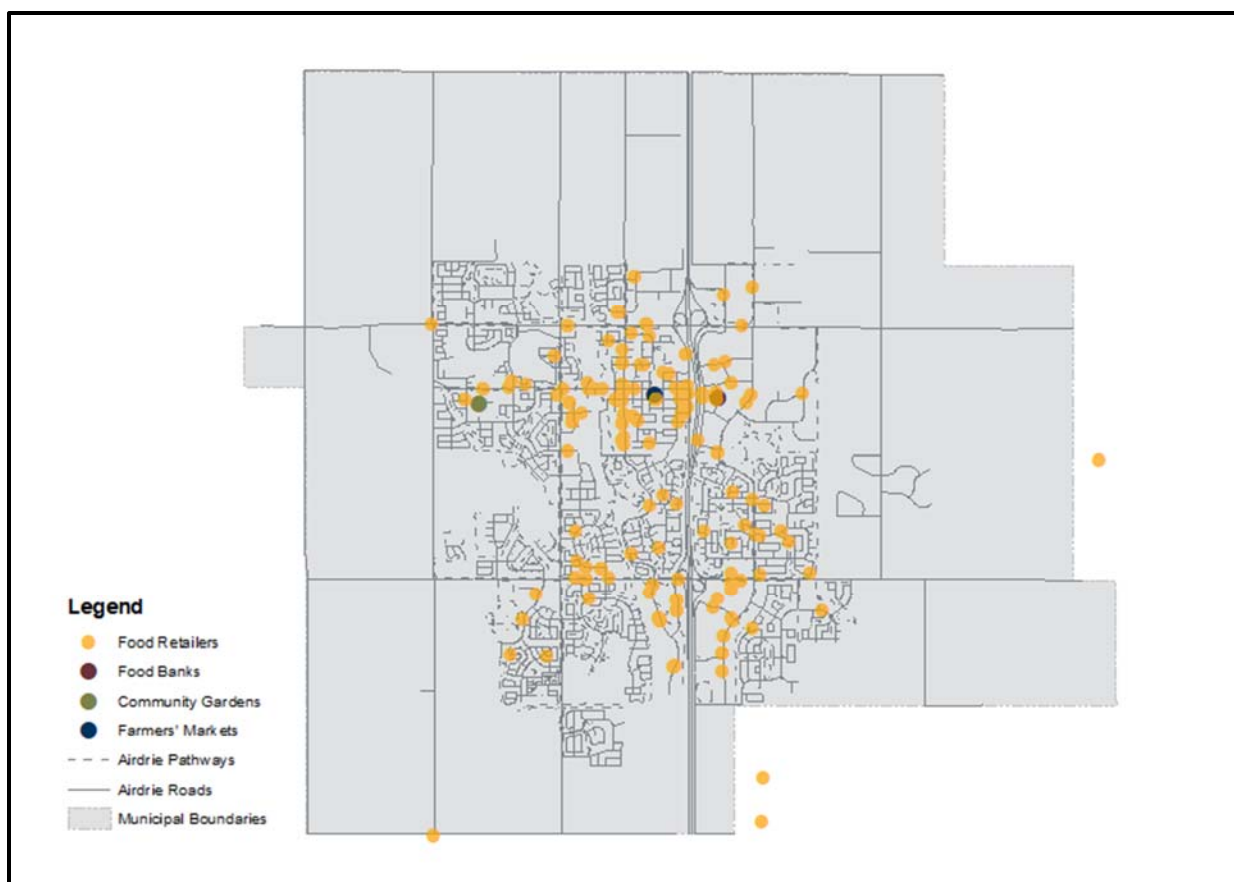




Figure 5.2-3: Food Secure Goal 3 Sample Data

#### 5.2.4 Goal 4 Spatial Data Requirements

*“Goal 4: The Calgary Region has a diverse and collaborative regional food economy”* (Calgary Regional Partnership 2017, 24).

Table 5.2-4: Food Secure Goal 4 Spatial Data Requirements

ACTION	SPATIAL DATA REQUIRED	DATA AVAILABILITY
Work with municipal, provincial, and federal governments, as well as food companies, to identify where local food is distributed to and where foreign food is exported from.	Processors	●
	Producers	●
	Food retailers	●
Explore ways to connect producers/processors in the Region with small- to medium-sized retail and wholesale buyers and resellers.	CSA access points	●
	Food retailers	●
	Processors	●
	Producers	●
Locate and identify existing and emerging centres of food system activity in the Calgary Region.	Food system activity nodes	●

Identify and spatially represent food banks throughout the Region.	Food bank locations	
Create a database of stakeholders in the food tourism sector and work to create synergies.	Food tourism vendors	

### Summary

Five out of the eight actions outlined in Goal 4 of the CRP *Food Secure* Strategy have spatial data requirements which work out to at least seven GIS layers needed that range in availability from easy to difficult. Of those 11 seven, only one has been assigned an ‘easy’ score as the CRP already owns that data as depicted in the map below.

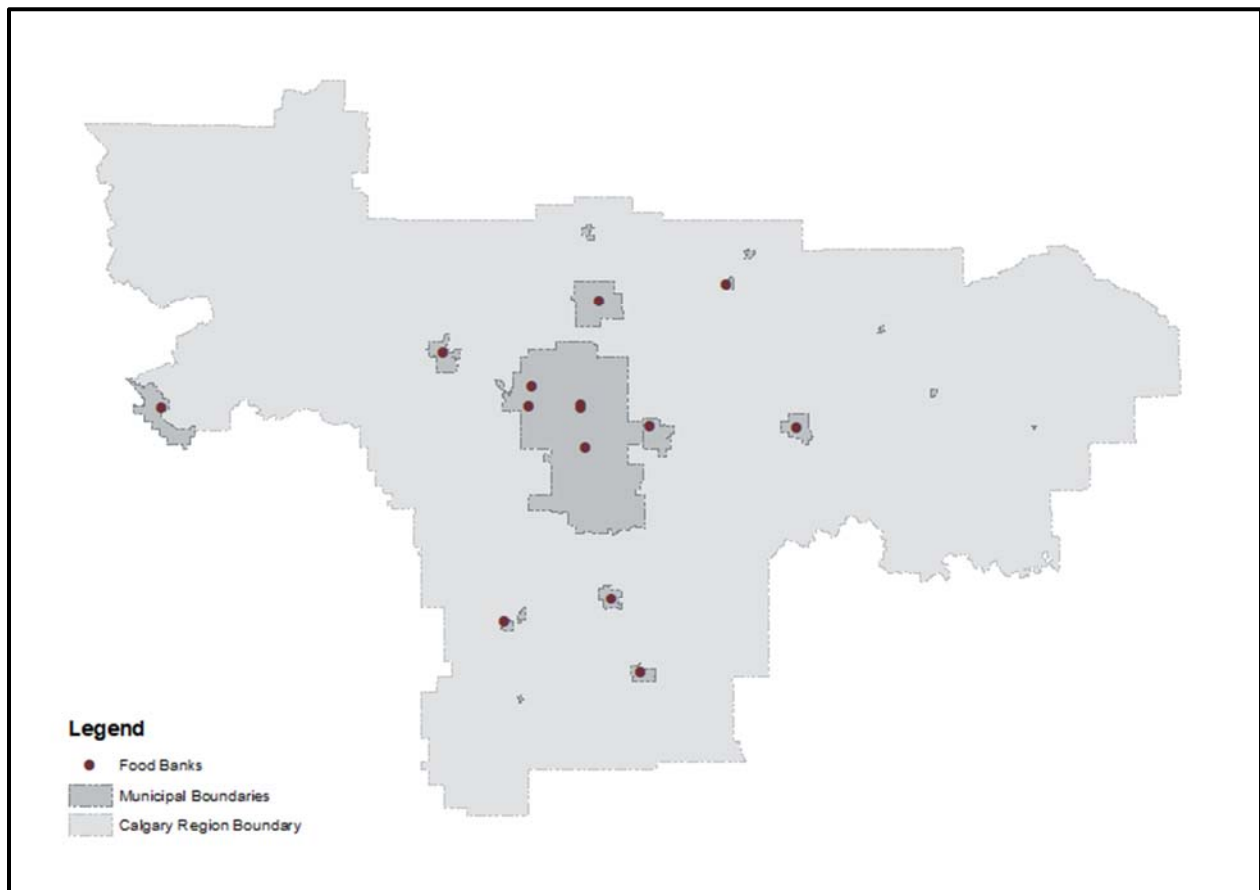


Figure 5.2-4: *Food Secure* Goal 4 Sample Data

## 5.2.5 Goal 5 Spatial Data Requirements

*“Goal 5: The Calgary Region efficiently and sustainably produces and processes a variety of food that sustains its population” (Calgary Regional Partnership 2017, 26).*

**Table 5.2-5: Food Secure Goal 5 Spatial Data Requirements**

ACTION	SPATIAL DATA REQUIRED	DATA AVAILABILITY
Create a regional urban land inventory to identify suitable spaces for urban agriculture.	Environmental reserve	●
	Green spaces	●
	Land use	●
	Parks	●
	Public utility lots	●
	Schools	●
	Suitable roofs	●
	Sun Exposure	●
	Vacant land	●
Research alternative year-round growing facilities and determine suitable locations throughout the Region to reduce import requirements over time.	Land use	●
	Proximity to energy sources	●
	Sun exposure	●
	Vacant land	●

### Summary

Two out of the seven actions outlined in Goal 5 of the CRP *Food Secure* Strategy have spatial data requirements which work out to at least eight GIS layers needed that range in availability from easy to difficult. Of those eight layers, only one has been assigned an ‘easy’ score as the CRP already owns that data as depicted in the map below.

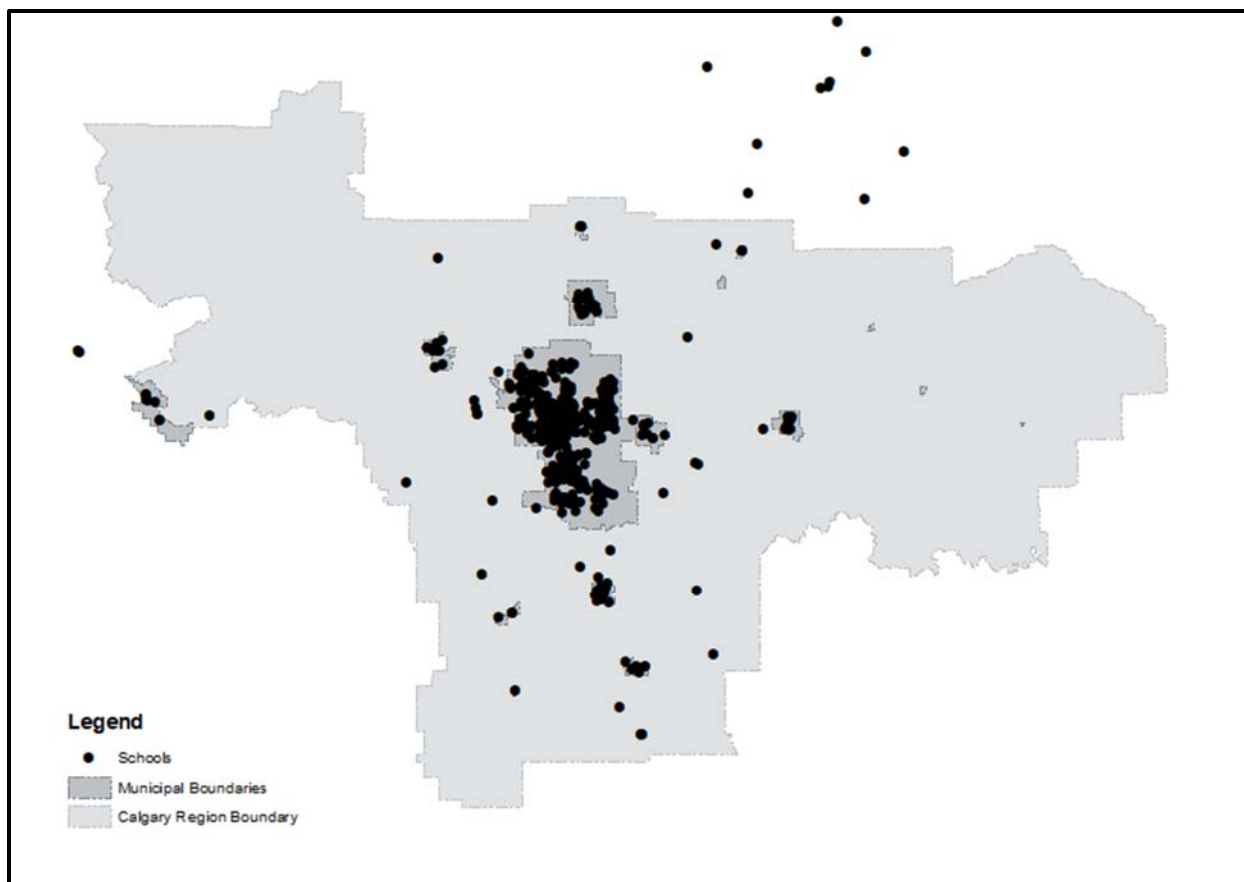


Figure 5.2-5: *Food Secure* Goal 5 Sample Data

### 5.2.6 Goal 6 Spatial Data Requirements

*“Goal 6: Organic and non-organic food waste in the Calgary Region is diverted”* (Calgary Regional Partnership 2017, 30).

Table 5.2-6: *Food Secure* Goal 6 Spatial Data Requirements

ACTION	SPATIAL DATA REQUIRED	DATA AVAILABILITY
Monitor and communicate the amount of organic and non-organic food waste that is being diverted from the landfill through the compilation of a regional food waste database.	Landfill locations	●
	Transfer site locations	●
	Compost facilities	●

#### Summary

One out of the seven actions outlined in Goal 6 of the CRP *Food Secure* Strategy have spatial data requirements which work out to at least three GIS layers needed that range in availability from

easy to difficult. Of those three layers, none have been assigned an ‘easy’ score as the CRP doesn’t currently own any of them.

### 5.2.7 Summary of *Food Secure* Spatial Data Requirements

Seventeen out of the 48 total actions, and four out of 20 total indicators outlined in the *Food Secure* Strategy have distinct, obvious spatial data requirements which work out to at least 32 GIS layers needed. Of those layers, nine have been classified as easy to obtain, 14 have been classified as moderately easy to obtain, and nine have been classified as difficult to obtain. That means, in order to undertake at least 35% of the actions in the strategy, there are a minimum of 32 spatial data layers that are necessary. Additionally, 20% of the indicators in the strategy directly rely on spatial data collection which could impact the comprehensive measurement of strategy implementation progress.

It is important to point out that while the analysis of the catalyzing actions in the *Food Secure* Strategy revealed that a significant amount of data is required to implement a large portion of the actions, it is likely a low estimate. Not until the work is being completed will it be possible to really know the extent of data that will be required.

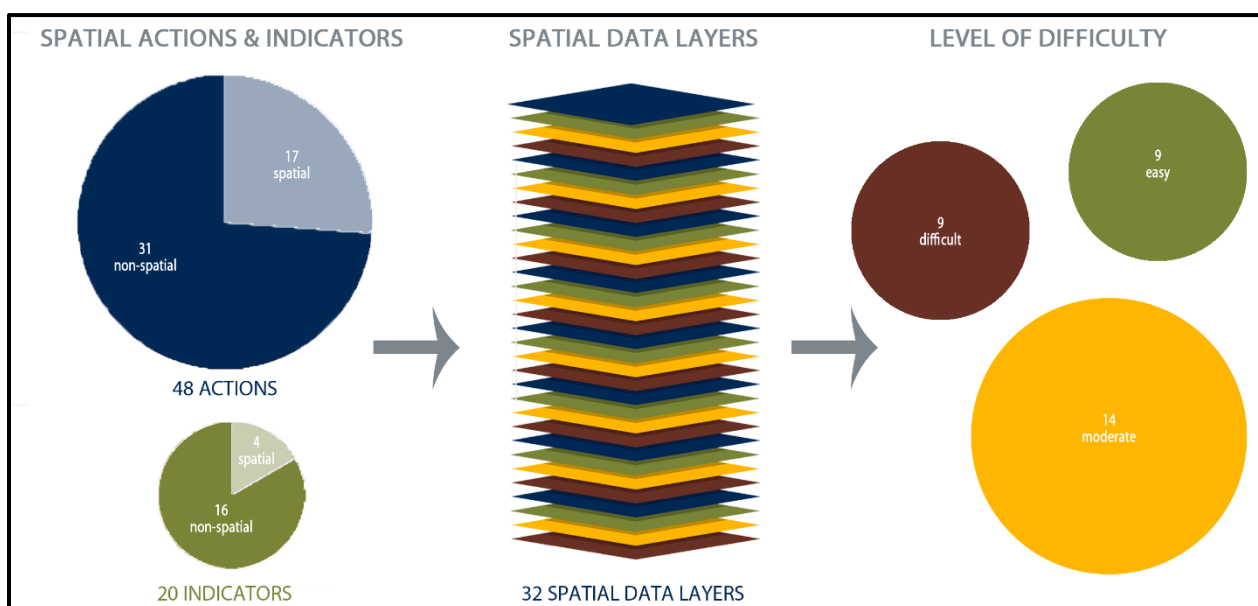


Figure 5.2-7: Summary of *Food Secure* Spatial Data Requirements

Based on this, as a first step, it will be important to prioritize the order in which these 32 layers are collected and created in relation to existing opportunities and challenges surrounding data collection in the Calgary Region. As some layers rely on the acquisition of others, a good first step would be to prioritize the acquisition of all green layers. Once that is complete, another assessment and re-categorization might be necessary.

# 6 REDESIGNING THE CALGARY REGION GIS

## FOR FOOD SYSTEM DECISION SUPPORT

*“Several organizations use GIS to support strategic decision-making”*(Das and Choudhury 2014, 6).

### 6.1 Role of Stakeholders and Decision-Makers

The development of the Calgary Region *Food Secure* Strategy involved a stakeholder engagement process that resulted in the generation of over 900 ideas from workshops, tradeshow booths, and online surveys (Calgary Regional Partnership 2017). Stakeholders represented all of the food system components and were classified into three groups: deliberate, ideate, and validate (Calgary Regional Partnership 2017).

The *deliberate* group involved six representatives who provided direction about the strategy content; the *ideate* group was composed of over 70 stakeholder representatives who participated in two workshops aimed at generating actions and outcomes; and, the *validate* group of over 100 people was asked to prioritize ideas and fill in gaps via email survey (Calgary Regional Partnership 2017).

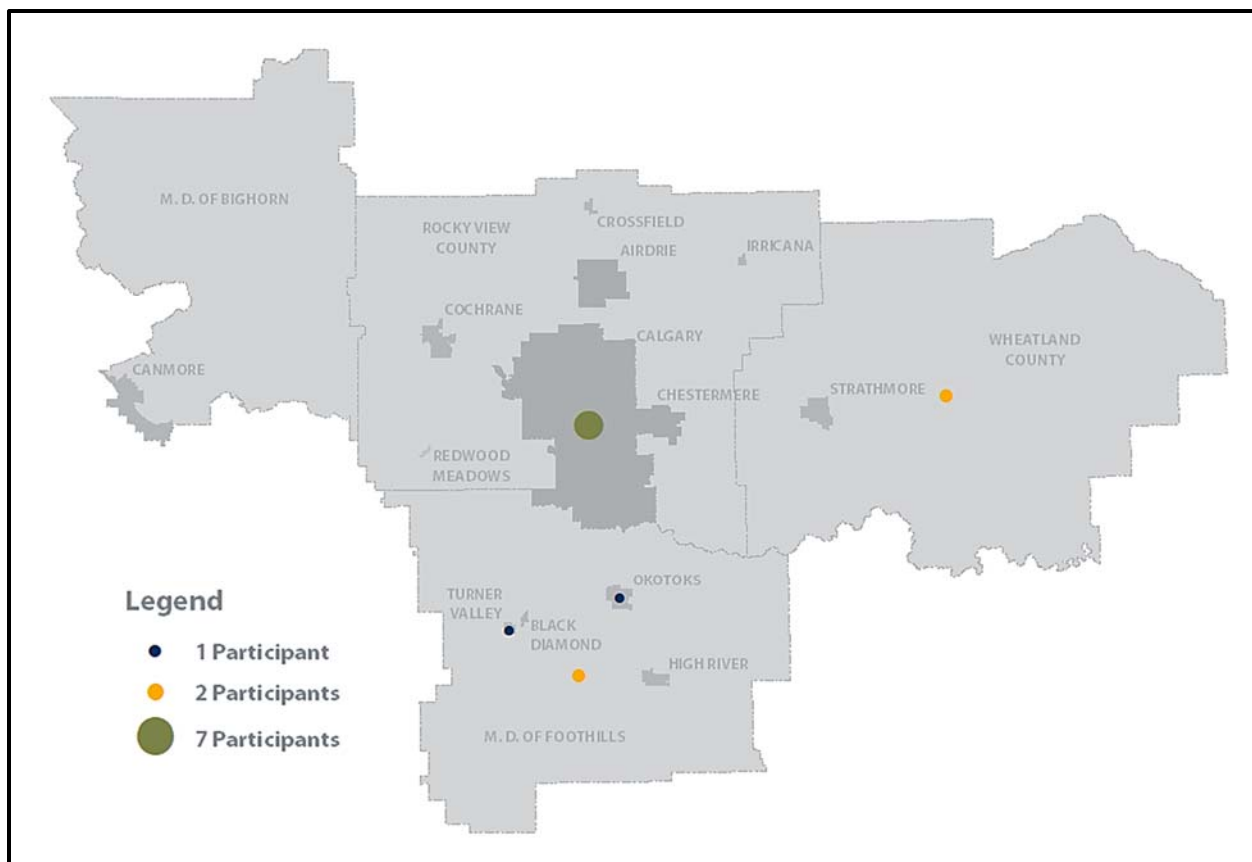




Figure 6.1-1: *Food Secure Engagement at a Glance* (Calgary Regional Partnership 2017, 14)

Despite this extensive consultation, there was no explicit discussion of data or spatial information requirements. Therefore, to supplement the stakeholder information collected to inform the strategy, in the winter of 2016/2017, 50 questionnaires to food system stakeholders throughout the Calgary Region were distributed to identify past, present, and future food system work being done by municipalities, organizations, and individuals within the Region as well as food system data gaps and potential data sources. For the purpose of this thesis, the questionnaire answers will help inform how GIS can be successfully utilized to support food system policy decisions in the Calgary Region.

Only 14 of 50 questionnaires were returned representing a 28% response rate. Figure 6.1-2 depicts where the respondents are located within the Calgary Region.



**Figure 6.1-2: Map of Questionnaire Respondents**

The 14 respondents represent six food system decision-makers and eight decision-informers and are identified in Figure 6.2-3.

FOOD SYSTEM POLICY DECISION-MAKERS		FOOD SYSTEM POLICY DECISION-INFORMERS					
POLITICIANS	MUNICIPAL STAFF	PRODUCER	PROCESSOR	DISTRIBUTOR	ACCESS	CONSUMPTION	WASTE
City of Calgary Councillor	City of Calgary Sustainability Consultant	Farmer (M.D. of Foothills)	FARE Community	Hillhurst-Sunnyside Community Association	Hillhurst-Sunnyside Community Association	FARE Community	City of Calgary Waste & Recycling
M.D. of Foothills Councillor	City of Calgary Waste & Recycling Services	New Urban Farm Partnerships	Eau Claire Distillery	Poplar Bluff Organics		Eau Claire Distillery	Living Soil Solutions
	Town of Okotoks Senior Planner	Poplar Bluff Organics					
	Wheatland County Environmental Coordinator						

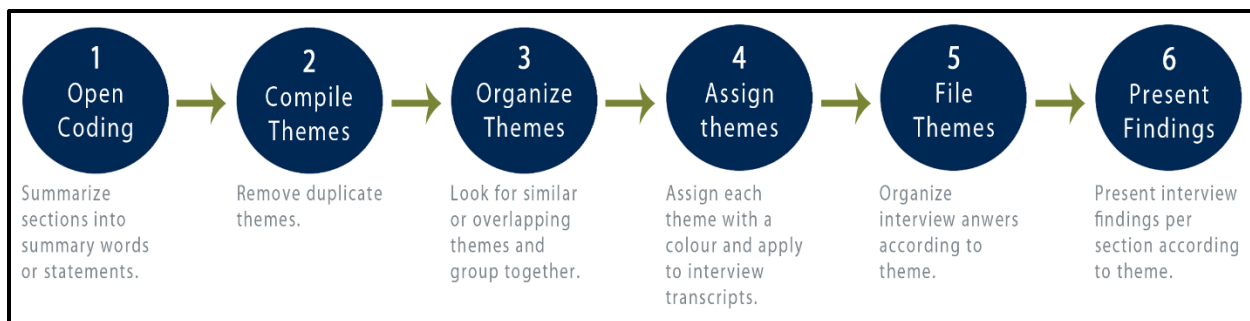
**Figure 6.1-3: Questionnaire Participants and the Organizations They Represent**

The following five questions were included in each questionnaire:

1. What work are you, or your organization, currently doing within the regional food system and/or what work are you, or your organization, planning on doing within the regional food system in the future?
2. Can you identify linkages between the work you or your organization are currently doing, or planning on doing in the future, and the Regional *Food Secure* Strategy?
3. Do you think there is a value in understanding the food system in relationship to the following, and can you identify any opportunities or constraints specific to each of the following:
  - a. Land use?
  - b. Economic development?
  - c. Transportation?
  - d. Data?
4. Do you know of any regional food system data sources?
5. Is there specific information that you need in order to make decisions related to the regional food system and/or that will help with the work you or your organization are doing in the regional food system?

## 6.2 Questionnaire Results

The questionnaire results were analyzed using the inductive approach, the most common approach used for analyzing qualitative data (Burnard et al. 2008). According to Burnard et. al. (2008), the inductive approach relies on the data to generate the framework of the analysis and is therefore more suitable when little or nothing is known about the data. The specific method utilized under this approach was thematic content analysis (arising from the approach known as grounded theory) which involved manually analyzing interview transcripts, identifying high level themes, and grouping answers accordingly (Burnard et al. 2008). Figure 6.2-1 depicts the steps involved in the analysis.



**Figure 6.2-1: Thematic Content Analysis Steps**

### 6.2.1 Question 1 Results

*What work are you, or your organization, currently doing within the regional food system and/or what work are you, or your organization, planning on doing within the regional food system in the future?*

Based on the inductive approach, the collective answers from all 14 questionnaires were organized into ‘themes’ relative to their correspondence to specific food system components as illustrated in Table 6.2-1 below.

**Table 6.2-1: Question 1 Results**

FOOD SYSTEM COMPONENT	THEMES	FREQUENCY
Production	<ul style="list-style-type: none"> <li>Urban farming</li> <li>Community gardens</li> <li>Cattle farming</li> <li>Vegetable farming</li> </ul>	4 2 1 1
Processing	<ul style="list-style-type: none"> <li>Craft spirits</li> </ul>	1
Distribution	<ul style="list-style-type: none"> <li>Farmed vegetable distribution to sellers</li> <li>Good Food Box program</li> <li>Urban food distribution program</li> </ul>	1 1 1
Access	<ul style="list-style-type: none"> <li>Farmers’ markets</li> <li>Healthy food program</li> <li>Emergency food access program</li> </ul>	2 1 1
Consumption	<ul style="list-style-type: none"> <li>Food hall</li> </ul>	1
Food Waste Recovery	<ul style="list-style-type: none"> <li>Food waste prevention and diversion programming</li> <li>Curbside organics pickup</li> </ul>	3 2

## 6.2.2 Question 2 Results

*Can you identify linkages between the work you or your organization are currently doing, or planning on doing in the future, and the Regional Food Secure Strategy?*

Given the responses to this question as reported below in Table 6.2-2, no distinct themes emerged which suggests that much of the food system work in the Calgary Region operates in 'silos' with few linkages among system components.

**Table 6.2-2: Linkages Between Food System Work and Food Secure**

GOAL	FOOD SYSTEM WORK
<i>Goal 1: The Calgary Region is a leader in food planning and governance.</i>	<ul style="list-style-type: none"> <li>• "We collaborate with other municipalities in the region and with Alberta Agriculture."</li> <li>• "Take opportunities to incorporate <i>Food Secure</i> actions into other programs and projects."</li> <li>• "Municipalities in the Calgary Region access and expand their policies and bylaws to allow for local food production and sales."</li> <li>• "There is a needed opportunity to fulfil in coordinating regional stakeholders to identify challenges, opportunities and establishing a coordinated approach to regional food issues."</li> </ul>
<i>Goal 2: People are aware of the connection between the food they eat and where it comes from.</i>	<ul style="list-style-type: none"> <li>• "We...support initiatives aimed to increase farm-to-table awareness."</li> <li>• Food-land connection marketing.</li> <li>• "Our work will help to convey the message why local food is important and where to find local food and support the local food producers."</li> <li>• "There is potential as our provincial lands project develops for a type of food campus to emerge."</li> </ul>
<i>Goal 3: All residents have access to safe, affordable, and healthy food.</i>	<ul style="list-style-type: none"> <li>• "Assist community-level food programming to improve food access."</li> <li>• Partner with community-level food programming to improve food access.</li> </ul>
<i>Goal 4: The Calgary Region has a diverse and collaborative regional food economy.</i>	<ul style="list-style-type: none"> <li>• "Our provincial lands project will offer the opportunity for new Canadians to integrate into the broader social and economic community, to liaise with specific supports within our community to achieve their goals and to form social networks with diverse communities, both new Canadian and the existing population."</li> </ul>

	<ul style="list-style-type: none"> <li>• “We are representative of the future of small agri-food producers. Innovation, craft and farm-to-glass/plate producers are the fastest growing part of Alberta’s economy and are the incubator system for future big food brands. It ties to agriculture, tourism, agri-food, exports and manufacturing. All are high labour component jobs, which help our economy and make us less reliant on outside suppliers.”</li> </ul>
<p><i>Goal 5: The Calgary Region efficiently and sustainably produces and processes a variety of food that sustains its population.</i></p>	<ul style="list-style-type: none"> <li>• “[Our] planning documents...support the preservation of agricultural land in the County.”</li> <li>• “Enable residents to produce some of their own food through community gardens, urban hens, and enabling municipal bylaws.”</li> <li>• “As part of our research and monitoring we will be able to identify local markets, where they are and how they change and grow over the course of our project including CSA’s, collaborator restaurants, markets and farmers’ markets.”</li> <li>• “[We] will continue to advocate for the development of public land access points for urban farming, thereby increasing the amount of locally grown food to all sectors of the city as well as increasing public awareness of food growing potential within the city.”</li> <li>• “Currently conservation easements are on natural land and we're trying to get the land use framework expanded to include cultivated land.”</li> <li>• “[W]e are working on protecting the natural environment and watershed, educating public, supporting primary agriculture production, planning and development to encourage processing and niche ag operations.”</li> </ul>
<p><i>Goal 6: Organic and non-organic food waste in the Calgary Region is diverted.</i></p>	<ul style="list-style-type: none"> <li>• Food waste prevention and diversion programming</li> <li>• “Implementation of municipal compost bin programs.”</li> <li>• Focus on food waste diversion in food hall.</li> <li>• Focus on food packaging reduction in food hall.</li> <li>• “We are trying to divert as much food waste as possible from the waste stream in Calgary, either through prevention or diversion.”</li> </ul>

### 6.2.3 Question 3 Results

*Do you think there is a value in understanding the food system in relationship to the following, and can you identify any opportunities or constraints specific to each of the following: land use, economic development, transportation, and data?*

Similar to Question 2 answers, no significant themes emerged. Participants clearly recognized a multitude of opportunities and constraints, but most were specific to the role each participant plays in the regional food system.

**Table 6.2-3: Understanding the Food System**

GOAL	OPPORTUNITIES	CONSTRAINTS
Land Use	<ul style="list-style-type: none"><li>• “Innovation opportunities in greenhouses.”</li><li>• “...you can map out where the regions that you need to focus in on, then you can come up with strategic partnerships using GIS and food transportation to actually tie those pieces together.”</li><li>• “There are opportunities to facilitate community projects (such as community gardens, community kitchens, food banks, local food production and distribution) that we should be considering when we are proposing land use policies and regulations.”</li><li>• “[There is] value of food growing spaces as placemaking.”</li><li>• Conservation easements on cultivated land.</li><li>• Rooftop gardens/green roofs</li><li>• Urban agriculture opportunities</li></ul>	<ul style="list-style-type: none"><li>• Government bureaucracy and “red tape.”</li><li>• “Awareness of decision makers and NIMBYism are potential constraints to implementing these policies and regulations...”</li><li>• “Current land use bylaws have hard delineation between agricultural use and acreages.”</li><li>• Too many restrictions on where and how you can grow food – especially in urban areas.</li><li>• Urbanization x 3</li><li>• “Currently there are many barriers to producing and processing food in terms of land use regulations.”</li><li>• “Loss of farmland.”</li></ul>
Economic Development	<ul style="list-style-type: none"><li>• “Target emerging restaurateurs... to give them an opportunity to be successful...”</li></ul>	<ul style="list-style-type: none"><li>• “Canadians are wasting 31 billion dollars a year by wasting food.”</li></ul>

	<ul style="list-style-type: none"> <li>• “The employment sector of urban farming as well as the opportunity offered by value added products and integrated projects within the food producing sector are a tremendous growth opportunity.”</li> <li>• “There is a huge opportunity for small agri-food producers to create value added agriculture products.”</li> <li>• We grow a lot of grain so there is an opportunity to support the growing beer and spirits culture.</li> <li>• Building “farm/garden communities” similar to lake or golf communities.</li> <li>• Food hubs x 2</li> <li>• Food tourism</li> <li>• “Fixing the food waste issue could result in numerous economic opportunities for Calgarians, ranging from cost savings for producers and citizens, to a wide range of new business opportunities for entrepreneurs, to decreased government dollars spent on food insecurity/poverty alleviation.”</li> <li>• “Increased focus on diversion supports economic development by generating the need for organic waste haulers and processors.”</li> <li>• “Food production (including in urban areas) has the potential to create employment and increase the local supply of food which means more money can be spent and remain in the local economy.”</li> </ul>	<ul style="list-style-type: none"> <li>• We lack the infrastructure to support emerging unique market opportunities.</li> </ul>
--	---	---



	<ul style="list-style-type: none"> <li>• “Unique market opportunities emerging.”</li> </ul>	
Transportation	<ul style="list-style-type: none"> <li>• “Transport requirements can be significantly decreased with proximity to markets as well as production partners.”</li> <li>• “Transportation costs from California and other North American produce suppliers, should mean that there is a cost advantage for growers here at home.”</li> <li>• “There is an opportunity for food access to be taken into account when transportation routes are being planned.”</li> </ul>	<ul style="list-style-type: none"> <li>• “The cost of transporting goods is high because we're a huge country with a relatively small population...”</li> <li>• “An enormous amount of land is devoted to our transportation corridors that is taken out of production and eco-service offering.”</li> <li>• Impact on infrastructure</li> <li>• Infrastructure not properly planned out in a number of instances</li> <li>• Assumption that all Calgary Region residents are able to drive to get their food</li> </ul>
Data	<ul style="list-style-type: none"> <li>• “Data is necessary so that a case can be made for more resources and attention committed to this part of the food growing sector. The ability to get business loans, access to programming and supportive market structures can be influenced with good data support.”</li> <li>• There is a lot of data out there</li> <li>• There is an opportunity to data share – “perhaps leading to more collaborative and regionally focused programming.”</li> </ul>	<ul style="list-style-type: none"> <li>• “You need a significant amount of data to make informed decisions.”</li> <li>• “We are missing good data on urban farming, the size of the employment sector, the amount of participation in the food economy, the economic participation, the effect on community development and cohesion, citizen health and well-being.”</li> <li>• There is a lot of data out there</li> <li>• “Data is dispersed and there is no central agency.”</li> <li>• “We lack data in many areas.”</li> </ul>

#### 6.2.4 Question 4 Results

*Do you know of any regional food system data sources?*

Most of the interview participants were not aware of any regional food system data sources, and the few that were did not identify sources that the CRP is not already aware of. The fact that

regional food system policy decision makers and decision informers are not aware of food system data sources suggests there is a need for more education about the critical role of data in food system policy development, as well as how a food system decision-support tool, such as the CRP GIS, could function to support food system planning and management.

### 6.2.5 Question 5 Results

*Is there specific information that you need in order to make decisions related to the regional food system and/or that will help with the work you or your organization are doing in the regional food system?*

The answers to this question varied significantly as listed in descending order:

- No (3)
- Policy/Process examples (2)
- Producer Inventory/Food Grown in the region (2)
- Food Waste (1)
- Economic Growth Data (1)
- Land contamination risk information (1)
- Municipal food system data (1)

The highest number of responses (3 of 14, or 21%), were “no.” This “no” response may reflect what Weinryb-Grohsgal (2013) remarked in his article for Harvard’s Data-Smart City Solutions Initiative, that government officials and staff “don’t know what they don’t know.” In other words, a lack of GIS knowledge or expertise prevents organizations from taking full advantage of GIS technology, and this inability to take full advantage results in a declining interest (Weinryb Grohsgal 2013). If this happens, then GIS is often relegated to a minor role with less opportunity to demonstrate its value (Weinryb Grohsgal 2013).

### 6.2.6 Summary of Questionnaire Answers

In Summary, over 50 Calgary Region food system stakeholders were asked to answer a questionnaire aimed at helping the CRP get a handle on the work that was being done, or planning on being done, within the regional food system. In addition, the questionnaire was also meant to gain insight into data sources the CRP could tap into, in order to get started on their commitment of collecting robust and accurate regional food system data. Fourteen responses came back from representatives from all over the food system, including government staff and officials. While their answers all varied significantly, they still lead to the general conclusion that a lot of ongoing and planned work within the regional food system could benefit from spatial data and GIS technology.

## 7 NEXT STEPS

*“Food Secure is structured around a set of high level principles which are supported by policies, and action-oriented direction to help inform decisions at the grassroots, municipal, and regional levels” (Calgary Regional Partnership 2017, 1).*

### 7.1 How can the CRP GIS be More Active in Regional Food System Decision-Making?

35% of the catalyzing actions and 20% of the indicators outlined in the *Food Secure* Strategy rely on at least one spatial data layer and its accompanying attributes. If one of the aims of the strategy is to “help inform decisions” (Calgary Regional Partnership 2017, 1) then it is critical that the spatial data and attribute information necessary to support strategy implementation be available and in a format suitable for a GIS to enable it to be used effectively for decision-support (Fleming 2014). Additionally, questionnaire results suggest that food system stakeholders in the Calgary Region work in silos without always considering other components of the food system or the surrounding natural and built environment.

This means enhancement of the CRP GIS program is necessary to better facilitate *Food Secure* implementation, measure progress, and to assist stakeholders with visualizing how their food-related work fits into the regional food system and facilitate multiple interest discussions.

### 7.2 Future Application

Many other municipalities and regions are interested in developing or expanding on local food strategies, and based on the methodology applied for this thesis, the following steps are recommended to follow in other jurisdictions:

1. Research food strategies from geographically similar areas (i.e. location, size, etc.) in order to better understand how they tackled food security for their municipality or region (section 2.1).
2. Assess the capacity of your organization to adopt GIS technology to support strategy creation, implementation, and monitoring (section 5.1).
3. Assess the state of local food system data availability in order to identify gaps and create a data acquisition plan (section 5.2).
4. Engage with local food system stakeholders in order to identify work that has already been completed, is in progress, or is planned for the future (section 6.1).

## 7.3 5-Year Priorities

Based on the results of this research, three priorities for utilizing GIS as a DSS in the Calgary Region for food policy are identified:

- Formal and systematic collection of regional data for all food system components.
- Dedicated design of CRP GIS Program for food system decision-support.
- Data awareness and capacity building of regional food system stakeholders.

### 7.3.1 Collection of Regional Food System Data

“Data is at the heart of GIS, and the volume of data involved in building a robust GIS program is substantial” (Bolstad 2001). Hence, as a first step, it is imperative that the 32 data layers (and their associated attributes) identified in Section 5 are collected in order to enable Calgary Region food system stakeholders to complete all of the actions outlined in the strategy.

As the data is collected, it should be shared on the Calgary Region Open Data site so that regional food system stakeholders can also access and benefit from it. Additionally, it will be important to plan for how the data will remain up-to-date in the long term, as maintaining data accuracy and quality is important (*GIS for the Community* 2013).

### 7.3.2 Dedicated Design of CRP GIS Program

GIS is often used as a SDSS, but to be used effectively, trained personnel and protocols are required, in addition to the appropriate hardware and software (Fleming 2014). The CRP GIS program is six years old and has, for the most part, been staffed by one program lead with the exception of temporary practicum students or contractors as needed. In the short term, data collection, organization, and maintenance remains the priority, however, in the longer term, it will be important to equip the program with capacity to provide analysis and decision-support.

That means that in order to be more effective, at least one more GIS staff person should be added. This will enable the CRP GIS program to provide robust, complete data collection, mapping, *and* rigorous analysis to support decision-making for all CRP program areas and regional municipalities. Essentially, the CRP will be able to complete steps four and five of ESRI's (2007) five-step process to applying GIS to a geographically-related decision: analyze the data and act.

### 7.3.3 Data awareness and Capacity Building

Spatial data and GIS technology provide policy-makers and policy-influencers with the framework for supporting the decision-making process (Calgary EATS! 2012). Fortunately, in recent years, online GIS applications have emerged that require no special training that help build GIS-capacity amongst non-GIS users (Harder 2015). This means that in many instances, empowering regional food system stakeholders to embrace GIS to support their decision-making will not require large investments of labour or capital. Therefore, once food system data has been collected and shared publicly (via the Calgary Region Open Data Catalogue), it will be important to both promote it and present it in a way that food system stakeholders (i.e. non-GIS users) will be able to access it easily and effectively. For example, online maps, applications, and live demonstrations will help stakeholders visualize how spatial data can be used more effectively to make more informed decisions about the regional food system.

## 7.4 Conclusion

This critical practice review of four municipal food strategies from different locations throughout North America found that they all described encountering data issues, and the CRP *Food Secure* Strategy is no different. It appears based on the review done for this thesis that approximately 34% of the *Food Secure* strategy cannot be implemented without more robust and accurate spatial data.

The CRP GIS program is uniquely positioned to acquire, create, and maintain a regional decision-support function for the food system maintenance and monitoring that can be shared in a variety of formats in an easy and accessible fashion. This will enable greater collaboration among food system stakeholders and ultimately support more informed and responsive food system management decision-making.

# REFERENCES

- "ArcGIS Help." 2017. Accessed November 24. <http://resources.arcgis.com/en/help/>.
- Bolstad, Paul. 2001. *GIS Fundamentals*. White Bear Lake, Minnesota: Eider Press.
- Burnard, P, P Gill, K Stewart, E Treasure, and B Chadwick. 2008. "Analysing and Presenting Qualitative Data." *British Dental Journal* 204 (8): 429–32. doi:10.1038/sj.bdj.2008.292.
- Calgary EATS! 2012. "CALGARY EATS! A Food System Assessment and Action Plan for Calgary." Calgary. <http://www.calgaryeats.ca/wp-content/uploads/2014/12/CalgaryEATS-FULL-Food-System-Assessment-Action-Plan-for-Calgary-May2012.pdf>.
- Calgary EATS! 2014. "Calgary EATS! Progress Report 2014." Calgary. [http://www.calgaryeats.ca/wp-content/uploads/2015/03/2015-0888-CalgaryEATS-Food-Report-for-Committee\\_Web-1.pdf](http://www.calgaryeats.ca/wp-content/uploads/2015/03/2015-0888-CalgaryEATS-Food-Report-for-Committee_Web-1.pdf).
- Calgary Regional Partnership. 2014. "Calgary Metropolitan Plan." Cochrane, Alberta. <http://calgaryregion.ca/cmp/bin2/pdf/CMP.pdf>.
- Calgary Regional Partnership. 2017. "Food Secure." Cochrane, Alberta. <http://calgaryregion.ca/dam/Website/reports/General/Regional-servicing-and-CMP-Implementation/CRP-Food-Security---FINAL/CRP Food Security - FINAL.pdf>.
- Das, Sumanta, and Malini Roy Choudhury. 2014. "An Integrated GIS and Spatial Decision Support System for Market Policy, Analysis, Research and Development." *International Journal of Geography and Regional Planning* 1 (1): 2–10.
- Edmonton Food Policy Council. 2012. "Fresh: Edmonton's Food & Urban Agriculture Strategy." Edmonton. [http://www.edmonton.ca/city\\_government/documents/FRESH\\_October\\_2012.pdf](http://www.edmonton.ca/city_government/documents/FRESH_October_2012.pdf).
- "ESRI ArcNews." 2007. <http://www.esri.com/news/arcnews/fall07articles/fall07gifs/p3p2-lg.jpg>.
- Fleming, Corey, ed. 2014. *The GIS Guide for Elected Officials*. Redlands, California: Esri Press.
- Forster, Thomas, and Arthur Getz Escudero. 2014. "City Regions as Landscapes for People, Food and Nature." Washington, DC. <http://peoplefoodandnature.org/wp-content/uploads/sites/4/2014/06/City-Regions-as-Landscapes-for-People-Food-and-Nature..pdf>.
- GIS for the Community*. 2013. 1st ed. Redlands, California: Esri Press.
- Harder, Christian, ed. 2015. *The ArcGIS Book: 10 Big Ideas about Applying Geography to Your World*. Redlands, California: Esri Press.



- Jankowski, Piotr, Grant Fraley, and Edzer Pebesma. 2014. "An Exploratory Approach to Spatial Decision Support." *Computers, Environment and Urban Systems* 45. Elsevier Ltd: 101–13. doi:10.1016/j.compenvurbsys.2014.02.008.
- Kerselaers, Eva, Elke Rogge, Ludwig Lauwers, and Guido Van Huylenbroeck. 2015. "Decision Support for Prioritising of Land to Be Preserved for Agriculture: Can Participatory Tool Development Help?" *Computers and Electronics in Agriculture* 110 (1). Elsevier B.V.: 208–20. doi:10.1016/j.compag.2014.10.022.
- MacRae, Rod, and Kendal J. Donahue. 2013. "Municipal Food Policy Entrepreneurs: A Preliminary Analysis of How Canadian Cities and Regional Food Districts Are Involved in Food Systems Change."
- Malczewski, Jacek, and Claus Rinner. 2015. "Chapter 1: GIScience, Spatial Analysis, and Decision Support." In *Multicriteria Decision Analysis in Geographic Information Science*, 331. Springer Berlin Heidelberg. doi:10.1007/978-3-540-74757-4.
- Naschy. 2017. "Vector Illustration of GIS Spatial Data Layers Concept for Business Analysis." Accessed April 4. <https://www.shutterstock.com/image-vector/vector-illustration-gis-spatial-data-layers-526267624>.
- Papathanasiou, Jason, and Robert Kenward. 2014. "Design of a Data-Driven Environmental Decision Support System and Testing of Stakeholder Data-Collection." *Environmental Modelling and Software* 55. Elsevier Ltd: 92–106. doi:10.1016/j.envsoft.2014.01.025.
- Price, Maribeth. 2012. *Mastering ArcGIS*. 5th ed. New York: McGraw-Hill.
- Qureshi, M Ejaz, John Dixon, and Mellissa Wood. 2015. "Public Policies for Improving Food and Nutrition Security at Different Scales." doi:10.1007/s12571-015-0443-z.
- Ruhf, Kathryn Z. 2015. "Regionalism: A New England Recipe for a Resilient Food System." *Journal of Environmental Studies and Sciences* 5 (4): 650–60. doi:10.1007/s13412-015-0324-y.
- "Society of Exploration Geophysicists Wiki." 2017. Accessed April 4. [https://wiki.seg.org/wiki/Geographic\\_Information\\_Systems](https://wiki.seg.org/wiki/Geographic_Information_Systems).
- Sommerfreund, Julie, Brian Cook, and Barbara Emanuel. 2015. "Toronto Food Strategy: 2015 Update." Toronto.
- Sonnino, Roberta. 2013. "The New Geography of Food Security: Exploring the Potential of Urban Food Strategies." *Geographical Journal* 182 (2): 190–200. doi:10.1111/geoj.12129.
- Sugamaran, Ramanathan, and John DeGroot. 2011. *Spatial Decision Support Systems: Principles and Practices*. Boca Raton, FL: CRC Press.
- Tomlinson, Roger. 2007. *Thinking About GIS*. Third Edit. Redlands, California: Esri Press.
- Toth, Attila, Stacy Rendall, and Femke Reitsma. 2015. "Resilient Food Systems: A Qualitative Tool for Measuring Food Resilience." *Urban Ecosystems* 19: 19–43. doi:10.1007/s11252-

015-0489-x.

Weinryb Grohsgal, Benjamin. 2013. "The Rocky Road to GIS." *Data-Smart City Solutions*.  
<http://datasmart.ash.harvard.edu/news/article/the-rocky-road-to-gis-276>.

# APPENDIX

## Appendix 1 – Calgary Region *Food Secure* Goals, Indicators, and Actions

### Goal 1: The Calgary Region is a leader in food planning and governance

#### GOAL 1 STRATEGIES

- **Convene Regional Food Stakeholders:** The complexity of the regional food system and food security requires a diverse set of stakeholders working collaboratively. Regularly connecting these stakeholders will help build relationships and coordinate action over time.
- **The Calgary Region has an enabling political environment to achieve this strategy's vision:** Municipalities in the Region need to understand how existing local policy may limit innovative food system practices within their municipal boundaries. Further analysis is required through a multi-level government approach to understand what factors impact local food production, distribution, and consumption. These barriers then need to be broken down to enable this strategy's vision.

#### GOAL 1 ACTIONS

- Create a spatial inventory of stakeholders and their roles within the food system at the regional, provincial, and national scale with the intention of knowing who the stakeholders are, what they are doing, and when and why they are doing it.
- Create a regional *Food Secure* working group that meets regularly to reflect and report on specific actions outlined in the report.
- Take all opportunities to incorporate *Food Secure* actions and results with other CRP programs and projects.

- Host a workshop with local decision makers in order to help them understand their role in the regional food system and what actions they can take in their municipality to assist this coordination.
- Generate periodic progress reports – reporting on *Food Secure* actions, identifying who is responsible for each action, and establishing new actions – and circulate to all regional food stakeholders.
- Share food related information, data, and resources (i.e. through the CRP Resource & Collaboration Hub, the Calgary Region Open Data site, etc.)
- Connect with local, provincial, and federal organizations in order to understand where the Regional food system fits within the national and global perspective.
- Actively involve provincial and federal stakeholders in *Food Secure* meetings and actions with the goal of influencing policy decisions.
- Municipalities in the Calgary Region assess and expand their policies and bylaws to support and/ or allow for local food production and sales.
- Develop a definition for food sustainability, including provisions for sustainable agriculture.
- Support municipalities in the exploration of policy that reduces land fragmentation, reduces agricultural and land development conflicts, and focuses on greater separation between agricultural land uses and development.

#### GOAL 1 INDICATORS

- Number of enabling food policies in municipal statutory plans.
- Food related workshop and event attendance.

Goal 2: People are aware of the connection between the food they eat and where it comes from

#### GOAL 2 STRATEGIES

- **Understand what “local” means to the Calgary Region:** What is local? There are many different definitions of the word that vary by context. Defining what local means to the Calgary Region will be essential to achieving and identifying future goals, actions, and measurements of success. Due to the challenging climate of the Calgary Region and the limitation this places on the types of food produced, a generic “one-size-fits all” definition may not be sufficient to define the meaning of the word in the Calgary Region.
- **Enable consumers to make local food choices:** Many consumers do not have the time, knowledge, or interest to research and understand the local food system or where the food they eat comes from. Increasing food educational opportunities can empower people to adjust their food habits. A public messaging campaign on the food-land connection will help build general awareness of where food comes from and improve demand for locally produced food. Involving regional and provincial stakeholders in the discussion will assist in improving food labeling requirements and clarity.

#### GOAL 2 ACTIONS

- Research and identify food types and amounts grown within the boundaries of the Calgary Region and identify existing gaps.
- Combine food research with regional stakeholder discussions to establish an accurate and relevant definition of “local” in the Calgary Region context.
- Identify potential partnership opportunities with regional food stakeholders in order to connect organizations, initiatives, and resources throughout the region for the purpose of improving information for consumers, including k-12 students.
- Work with regional, provincial, and national stakeholders to create “local” food labelling and develop lists of locally produced products and where they can be purchased seasonally.

- Leverage and scale existing community-based training and learning on food skills and literacy across the Calgary Region.
- Support and encourage universal school food programs in order to bridge the urban knowledge gap.
- Conduct quantitative and qualitative research to understand the relationship between food knowledge and skills across various demographic categories in the Region.
- Launch a public messaging campaign that incorporates existing and planned research as well as new labelling requirements.
- Gather data on the amount of money that consumers spend on locally produced food.

#### GOAL 2 INDICATORS

- Number of community gardens in the Region.
- Number of farmers' markets in the Region (including number of local food vendors).
- Number of food retailers that subscribe to food origin labelling programs.
- Number of producers/processors direct marketing or selling in the Region.

### Goal 3: All residents have access to safe, affordable, and healthy food

#### GOAL 3 STRATEGIES

- **Develop a comprehensive understanding of regional food insecurity:** More consistent data on household food insecurity across the Region will build a more complete picture of food access. Conducting a 'regional access needs assessment' at the household level will identify the areas and populations where targeted action is most needed.
- **Leverage and scale existing food initiatives:** There are several existing experts and initiatives within the food system of the Calgary Region. Building upon these assets will expand access to safe, healthy food throughout the Calgary Region.

### GOAL 3 ACTIONS

- Identify and spatially represent food deserts and swamps throughout the Region (building on the work Calgary EATS! has completed for the City of Calgary) and work to connect producers and processors looking for food distribution points to assist these areas.
- Work with rural municipalities to define food deserts and food swamps in the rural context.
- Identify gaps and overlaps of existing initiatives in order to resolve issues across the Region.
- Assist community-level food programming to improve food access (i.e. community gardens, community kitchens, and food events), with a focus on food deserts and swamps.
- Identify and spatially represent food banks throughout the Region.
- Measure number of food insecure households in the Calgary Region.

### GOAL 3 INDICATORS

- The number of people accessing food banks.
- Number of food deserts in the region.
- Number of food swamps in the region.
- Number of food insecure households in the region.

## Goal 4: The Calgary Region has a diverse and collaborative regional food economy

### GOAL 4 STRATEGIES

- **Develop the logistics, distribution, and deliver intermediaries to connect regional farm products to local consumer:** Currently, producers experience difficulty in accessing local markets. Linking local producers to local markets by developing intermediaries (i.e. entities or facilities designed to bridge supply and demand gaps) will encourage more local production, support aggregation of small farm outputs, develop market channels, and increase access to local food for consumers through economies of scale.

- **Encourage food system innovation in the Calgary Region:** Co-locating multiple food businesses, organizations, or research groups has the potential to promote innovation, value-added processing, and community building through jobs, research and education.<sup>35</sup> These can be created in new “food campuses” or within the existing urban fabric. Clustering food organizations can have significant positive economic and social impacts at the regional level and potentially the provincial level as it relates to synergistic relationships, transportation demand management, and community impact.
- **Leverage food tourism to connect local consumers to producers:** Combining agriculture and tourism provides the opportunity to showcase the local food system and make consumers aware of food produced in the Region. This will encourage and provide greater opportunities for consumers to buy locally produced food and bolster the food economy through tourism.

#### GOAL 4 ACTIONS

- Work with municipal, provincial, and federal governments, as well as food companies, to identify where local food is distributed to and where foreign food is exported from.
- Research and develop tools to measure the impact of local food on the economy.
- Explore ways to connect producers/processors in the Region with small to medium-sized retail and wholesale buyers and resellers.
- Develop a Calgary Regional Food Hub Feasibility Study to determine the viability and potential location(s) of a Regional Food Hub.
- Locate and identify existing and emerging centres of food system activity in the Calgary Region.
- Convene relevant Government of Alberta ministries to determine pricing and taxing of local versus imported food with the goal of making local food easier for consumers to purchase at a lower price.
- Identify and spatially represent existing food tourism initiatives and opportunities in the Calgary Region.



- Create a database of stakeholders in the food tourism sector and work to create synergies.

#### GOAL 4 INDICATORS

- Number of imports compared to the number of exports in the Calgary Region.
- Number of food tourism initiatives in the Calgary Region.
- Ratio of the type of producers in the Calgary Region.
- Economic value of farmers' markets in the Calgary Region with a focus on local food.

Goal 5: The Calgary Region efficiently and sustainably produces and processes a variety of food that sustains its population.

#### GOAL 5 STRATEGIES

- **Maximize new and preserve existing growing spaces in the Calgary Region:** The Calgary Region has many opportunities to create more growing spaces at different scales. By maximizing food growing spaces – of all shapes and sizes, from apartment balconies to large farms – the Calgary Region can build the capacity to feed itself to a larger extent by capitalizing on a variety of approaches and spaces. Effort must also be placed on continuing to preserve existing agricultural land by incentivizing farmers to keep their land in production by placing increased value on this land when development is under consideration.
- **Optimize growing practices for resource efficiency:** Promoting sustainable and innovative practices throughout the Calgary Region will help ensure long-term land and water supply. The limited growing season and the pressures on the Calgary Region's natural systems in conjunction with an increasing population will necessitate the growth of food with less energy, fuel, and water inputs.
- **Food Produced in the Region is used to sustain its population:** Enabling the consumption of locally produced foods will have many positive effects on the food system. It will reduce the monetary and environmental cost of distribution by reducing the amount of food that

the Calgary Region imports from elsewhere. This cost will further be reduced by eliminating redundant trade. Consumers will know when they purchase local food that they are supporting local producers and the local economy. Ensuring that enough food is kept in the Region to sustain the population will also make the system more resilient to shocks in the global food system.

#### GOAL 5 ACTIONS

- Create a regional urban land inventory to identify suitable spaces for urban agriculture.
- Research alternative year-round growing facilities and determine suitable locations throughout the Region to reduce import requirements over time.
- Assess existing and new growing practices in the Region to determine solutions that are resource-efficient, with a focus on growing food that is typically imported into the Calgary Region and on identifying true costs: monetary, social, and environmental.
- Explore and develop financial mechanisms, in partnership with the Government of Alberta, to allow existing farmers to retire/transition out of agriculture while keeping their land in agricultural use rather than developing it for urban purposes.
- Gather data on imports/exports of all food types, specifically within the Calgary Region, with a focus on identifying where redundant trade is occurring.
- Gather data on the amount of food consumed versus produced in the Calgary Region.
- Work with Calgary EATS! to organize and coordinate local food producers to create economies of scale in distribution.

#### GOAL 5 INDICATORS

- The variety of food produced in the Region.
- The number of commercial greenhouses in the Region.
- Amount of farmland in the Region.

## Goal 6: Organic and non-organic food waste in the Calgary Region is diverted

### GOAL 6 STRATEGIES

- **Pre-consumer food waste is redistributed and repurposed as a resource:** The Calgary Region has many opportunities to reconsider pre-consumer food waste as a resource. By focusing on pre-consumer areas of the food system, organizations and institutions can collaborate and innovate to take advantage of the economic, social, and environmental opportunities presented by food waste.
- **Post consumer food waste is eliminated:** Currently, there are few composting programs within the Calgary Region. Outside of these programs, any unwanted food scraps and expired goods are disposed of by way of the garbage bin. Composting will allow food to break down and decompose, regenerating soil in the process.
- **Non-organic food waste is identified and reduced:** Currently, little data exists on non-organic food waste, such as food packaging, in the Calgary Region. Developing methods of measuring and tracking this waste will provide a clearer picture of how much non-organic waste such as food packaging goes to landfills each year. Partnering with organizations to create awareness of this waste and how to reduce it will help citizens and organizations make informed choices when purchasing, producing, and processing food.

### GOAL 6 ACTIONS

- Monitor and communicate the amount of organic and non-organic food waste that is being diverted from the landfill through the compilation of a regional food waste database.
- Research, communicate, and implement new and innovative ways to reduce and repurpose pre- and post-consumer food waste throughout the Calgary Region.
- Encourage and assist in implementing municipal compost bin programs throughout the Calgary Region.

- Research and communicate options for alternative household food waste diversion throughout the Calgary Region.
- Identify potential partners to create or build on existing public awareness campaigns to share with citizens how much food is wasted throughout the Region (i.e. Calgary EATS!, Feed the 5000, etc.).
- Explore and develop methods of tracking the amount of non-organic food waste created in both the pre- and post-consumer portions of the food system.
- Explore and implement methods of reducing pre-consumer food waste in partnership with relevant stakeholders, with a focus on reducing food waste from food processing.

#### GOAL 6 INDICATORS

- The amount (tonnes) of organic and non-organic food waste that is being diverted from the landfill.
- Number of municipal organic waste programs.
- The amount of organic waste converted to compost.

## Appendix 2 – List of Websites

- **Calgary EATS!:** [calgary.ca/CA/cmo/Pages/Calgary-Food-System-Assessment-and-Action-Plan.aspx](http://calgary.ca/CA/cmo/Pages/Calgary-Food-System-Assessment-and-Action-Plan.aspx)
- **Calgary Metropolitan Plan:** [calgaryregion.ca/cmp](http://calgaryregion.ca/cmp)
- **Calgary Regional Partnership:** [www.calgaryregion.ca](http://www.calgaryregion.ca)
- **Calgary Regional Partnership Online Maps:** [calgaryregion.maps.arcgis.com](http://calgaryregion.maps.arcgis.com)
- **Calgary Region Open Data Catalogue:** [calgaryregionopendata.ca](http://calgaryregionopendata.ca)
- **Food Secure Strategy:** [tinyurl.com/crpfoodsecure](http://tinyurl.com/crpfoodsecure)
- **fresh:** [edmonton.ca/city\\_government/initiatives\\_innovation/food-and-urban-agriculture.aspx](http://edmonton.ca/city_government/initiatives_innovation/food-and-urban-agriculture.aspx)
- **Seattle Food Action Plan:** [seattle.gov/environment/food/food-action-plan](http://seattle.gov/environment/food/food-action-plan)
- **Vancouver Food Strategy:** [vancouver.ca/people-programs/vancouvers-food-strategy.aspx](http://vancouver.ca/people-programs/vancouvers-food-strategy.aspx)