URBAN FOOD TRANSFORMATION FOR EDMONTON

D9A THESIS RESEARCH REPORT

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RAIC SYLLABUS

THE DAY IS COMING WHEN A SINGLE CARROT, FRESHLY OBSERVED, WILL SET OFF A REVOLUTION

- Paul Cezanne

URBAN FOOD TRANSFORMATION FOR EDMONTON

Contents

1.0 EXECUTIVE SUMMARY

1.1 Thesis Statement

Exploring opportunities to increase urban food production through adaptive reuse of brownfield, abandoned, or underutilized spaces and buildings within Edmonton city limits is an important urban design initiative to progress the goals of enhanced health, liveability and resilience of the built environment supporting greater urban density to control the rate of urban sprawl.

1.2 Summary

Citizens of the City of Edmonton (Alberta, Canada) have for a number of decades enjoyed relatively consistent growth, prosperity and abundance which, without benefit of casting a wider gaze to regional and global trends and issues surrounding the very nature of increasing urbanization and urban ecology, would seem to be amenable and without immediate need of reinvention or intervention. As the world increasingly comes to the realization of what the impact a global population of Nine or Ten (or more) Billion inhabitants will be, the need for incremental change in the culture and societies' attitudes towards traditional patterns of urbanism in North America becomes evident. In order to make cities more healthy, liveable and inviting, the historic debate surrounding the ideal balance of "urb in rus" or "rus in urb" and the role it may play in achieving more compact urban forms thereby preserving the surrounding nature that supports the existence of people in cities, and cities themselves, gains renewed vigour. New explorations into how urban development can be adapted to become more self sufficient, healthy and lovable are necessary to acknowledge and begin the work to address these issues. The formal introduction, or re-introduction, of urban agriculture into the urban fabric is an avenue that holds a great deal of promise to bolstering these aims.

Presently, future generations are headed towards ever more dependency on technology and the industrial food chain to derive sustenance. Traditional farming knowledge in the Edmonton region is in decline, every increasingly subject to a globalized commercial/industrial complex which is moving towards a near total displacement of the family farm and regional connection to local food production. This combined with the phenomena of nature depravation that has become a prevalent concern in Canada's larger cities, inhibits the ability for new generations of urban dwellers to amply engage with the workings of plants (& animals) breeding indifference, ignorance of nature's

fragilities and robbing them of the physical and mentally beneficial aspects of interactions with nature and growing of food.

To enable a new introduction of “rus in urb”, or nature in the city, a stronger connection and relationship can be established through food. Locally grown food, close to Edmonton’s urban core, has the potential to provide greater opportunities for health, youth engagement, entrepreneurial opportunities for poorer communities and a centre of community focus than a more traditional landscaping sensibilities can. Through the interaction, engagement, knowledge transfer and economic opportunities afforded by urban food production, a resilience, or anti-fragility, is built within the people, social organizations and built environment by reducing ecological demands from without and creating a state of readiness within to withstand the worst effects of the unpredictable.

To integrate and explore this potential, following natures’ patterns of complete recycling pattern of growth and metabolization of waste, or employing a cradle to cradle model[1] provides the most compelling model for change. Harnessing underutilized spaces and buildings, as has been done in other cities in North America can, without prohibitive investment or intervention, be harnessed to the task of introducing a meaningful and significant urban agriculture into Edmonton’s urban fabric.

2.0 EDMONTON AND REGION TODAY

2.1 Pressures

The problems faced by cities today are complex, varied and many. Only the most urgent and most evident are addressed due to the limiting factors of time, economic capacity and ability of leaders and citizens to collaborate and cooperate around a shared vision.

It is this fact, which makes the true reckoning of the myriad of problems in any city almost beyond the capacity of any one person to fathom.

Some of the key problems facing Edmonton today stem from the need to accommodate the enormous growth being generated by the province’s resource wealth. With the growth comes increased need to house people, provide transportation infrastructure, deliver health care, provide fire and police protective services, to educate, nourish and deal with waste.

The 2011 Statistics Canada census revealed that 1,159,869 people make Edmonton’s metropolitan area their home with 812,201 living within city limits which covers approximately xx km2. This equates to a population density of xx people / km2 (or xx people per square mile).[2]

Edmonton’s growth rate is above the national average at 12.1 per cent since the last census in 2006.[3]

[1] (McDonough & Braungart, Cradle to Cradle, Remaking the Way We Make Things, 2002)
[2] (The Canadian Press, 2012)
[3] (The Canadian Press, 2012)

Edmonton's youth currently represents xxx of the population. With the recent boom in births, a new generation of Edmontonians are emerging.

Edmonton's population is expected to reach xx by 2050.

As the capital city in a Province that is currently the focus of a Pan-Canadian and North American push for energy development, while still demonstrating environmental stewardship, it can be argued that Edmonton as the capital city has an important role to play in joining cities like Vancouver in a quest to become an exemplar of sustainability and provide sustainable pathways for citizens, businesses and rural neighbours to contribute and bolster issues such as food sovereignty, access and sustainability. By doing so it can provide the physical nourishment and intellectual stimulation necessary to repair and improve the physical and mental well being of its citizens.

2.3 State of the Family Farm, Urbanization and its Effect

As the urban footprint of Edmonton's city limits continues to expand, prime farmland is lost. As most cities were originally founded around a key water source and agricultural production, (the first local food systems) this is typical of most cities, especially in North America.

A soil area's ability to grow crops is ranked in a seven-class system in Canada. Class 1 are the soils that have the most consistent characteristics for growing food including depth, mixture of soil media, nutrients and climate. The most productive farmland that does not require significant intervention to grow food can be found where seams of Class 1 to Class 3 soils are found.

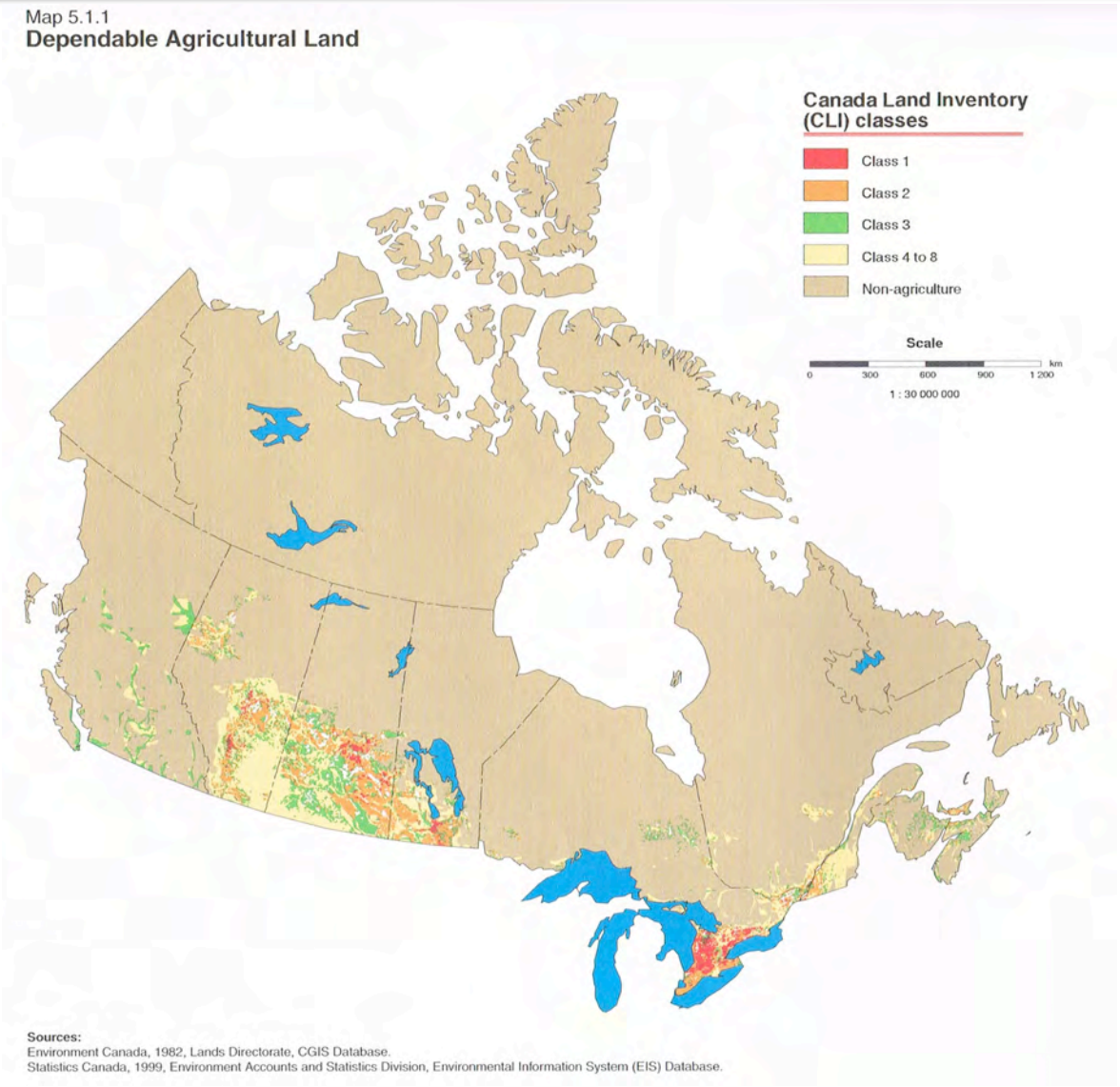


Figure x – Diagram illustrating the quantity of dependable agricultural land according to the seven class ranking system. (Human Activity and the Environment, Statistics Canada,p 127)

Class 1 soils are “quite a scarce resource covering a mere 0.5% of the country” according to the Canada Land Inventory.[4] The Edmonton region has been blessed with a great deal of Class 1 soil, however the majority of it is gone and what is left is disappearing in favour of new industrial and residential development to the cities’ Northwest, and expansion towards the International Airport in the South. Combined with expansions to surrounding communities of Fort Saskatchewan, Sherwood Park, St. Albert, Leduc, Beaumont, Spruce Grove and Stony Plain, nearly all Class 1 soils in the region will be gone within the next few decades.

[4] (Ontario Envirothon)

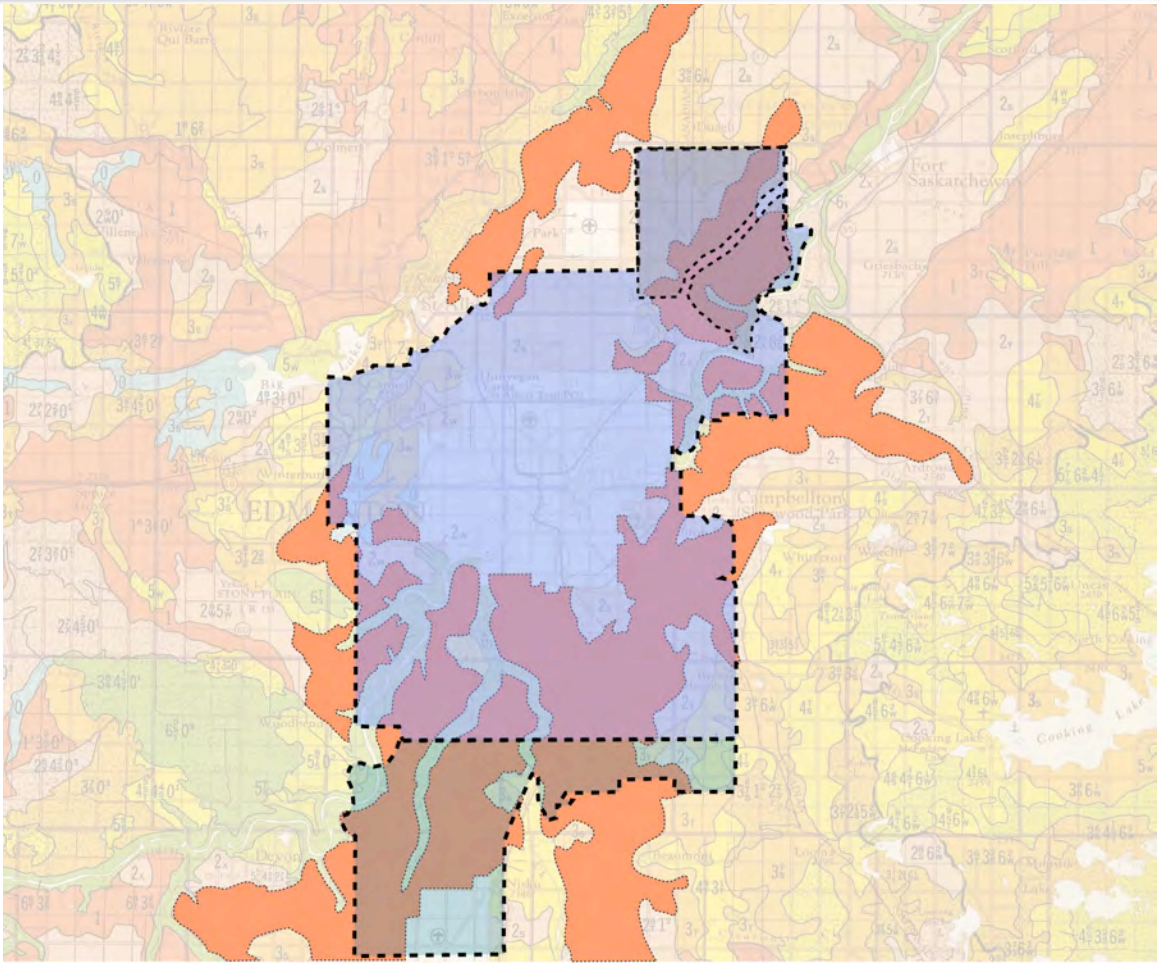


Figure x – Diagram illustrating quantity of class 1 soils permanently lost to the ever expanding footprint of city limits and urban expansion and sprawl. (image by author)

Family farms in the Edmonton area are also accordingly disappearing. Farming land is being rezoned to residential or industrial zoning classes and sold for many times its original worth in the service of growing food.

The Nikiforuk family is one example. In 1998 the third generation farm a few km North of the city was home to a cow/calf operation of up to 400 head.[5] In February of 2014 the herd has been reduced to 25 head and is no longer used for farm income but simply for hobby purposes and as a means of managing pasture around the property.[6] Recent Drought and the Bovine Spongiform Encephalopathy, (also known as BSE) outbreak in 2003 were the major causes cited for decisions over time that led to the decline in their family farming operation.[7] His experience with the farming community in and around Edmonton is that family farming is in sharp decline with farming operations struggling through the difficult times being bought out by

[5] (Nikiforuk, 2014)
[6] (Nikiforuk, 2014)
[7] (Nikiforuk, 2014)

Hutterites or large corporate farming operations.[8] Farming locally is becoming sustainable only on an enormous scale making family farming a daunting prospect, usually needing to be subsidized by other businesses or occupations.

Nikiforuk himself is now facing the same prospect, having to abandon the home quarter he grew up on to make way for development of The City of Edmonton's new eco-industrial park development which is awaiting only an anchor tenant before being redeveloped as an industrial complex, recently communicated to local residents at a March 18, 2014 open house presentation by the city.[9]

Figure x – Photo of Northeast farmland inside Edmonton city limits slated for rezoning and conversion from agricultural to industrial land. (Photo by author, February 2014)

[8]

[9] (The City of Edmonton, 2014)

Increasingly therefore Edmonton is becoming reliant on industrial food production which typically travels great distances to reach the supermarkets in Edmonton. This food that has to travel great distances in many cases does not typically embody the same nutritional value as locally grown.

One example of the impact of this reality can be found in the book, The Industrial Diet. In the book, Professor Anthony Winson at the University of Guelph discusses the false notions that we have about the health of industrially produced food. In a chapter titled, "The Simplification of Whole Food" he points out that industrial producers do not necessarily cultivate species that are the healthiest but instead ones that are the most marketable and profitable: in other words, able to survive long voyages while maintaining certain aesthetic qualities that triggers the highest rates of purchase. He noted recent research by Dr. Rong Tsao, (Agriculture Canada, Guelph Ontario) that measured the levels of anti-oxidative phytochemicals which are linked to the prevention and reduction of cancers, cardiovascular diseases and increased immune system function in apples and showed that some of the most popular industrially grown and distributed varieties had as much as 300% less of these compounds than what had been more traditionally grown.[10] The research also extrapolated a high degree of probability that this was true for various other fruits and vegetables. Dr. Rui Hai Liu and of Cornell University conducted similar research on onions and found as much as an 1100% difference between the most phytochemical potent and least potent varieties. This research included direct tests of antioxidant activity directly on two types of cancer cell cultures.[11] The same research also went on to point out that the effect of these chemicals was found only in whole fruits and vegetables in natural combinations that "cannot simply be mimicked by dietary supplements".[12]

[10] (Winson, 2013, p 157,158)
[11] (Winson, 2013, p 159)
[12] (Winson, 2013, p 159)

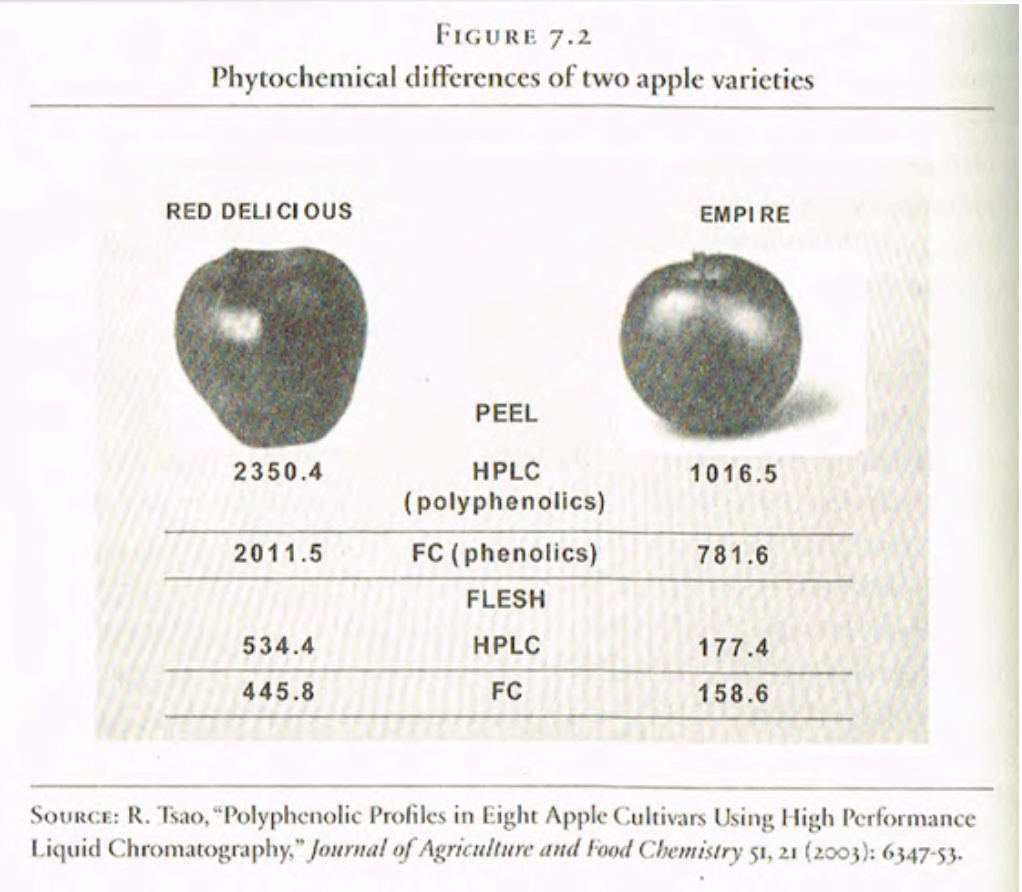


FIGURE 7.2
Phytochemical differences of two apple varieties

RED DELICIOUS		EMPIRE
	PEEL	
2350.4	HPLC (polyphenolics)	1016.5
2011.5	FC (phenolics)	781.6
	FLESH	
534.4	HPLC	177.4
445.8	FC	158.6

SOURCE: R. Tsao, "Polyphenolic Profiles in Eight Apple Cultivars Using High Performance Liquid Chromatography," *Journal of Agriculture and Food Chemistry* 51, 21 (2003): 6347-53.

Figure x – Excerpt from the book, The Industrial Diet, showing the phytochemical differences between two apple varieties (Anthony Winson, The Industrial Diet, Page 159)

The loss of both the knowledge and culture of growing food locally is therefore a declining resource that should be recognized, studied further and compensated for in Edmonton's long range urban development plans.

2.4 Wild Urban Areas

Edmonton has done an excellent job maintaining an important wildlife corridor provided by its' river valley. Edmonton's river valley parkland at 7,400 hectares (18,286 acres) is one of the largest wild areas in close proximity to a major city in North America. Twenty-two parks and 150km (93 miles) of multi-use trails providing ample opportunities for recreation and exercise.

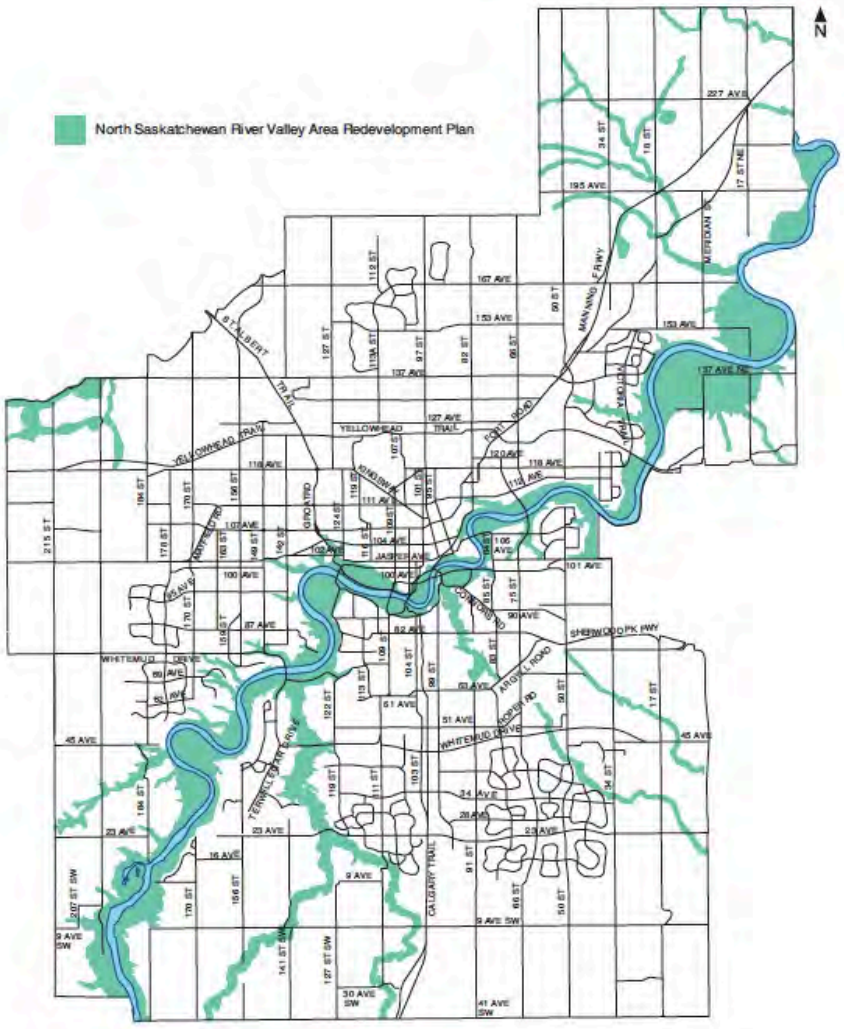


Figure x – Diagram showing extent of Edmonton's river valley and ravine system. (image taken from, "A Guide to Environmental Review Requirements In the North Saskatchewan River Valley and Ravine System", December 2000, Page 4)

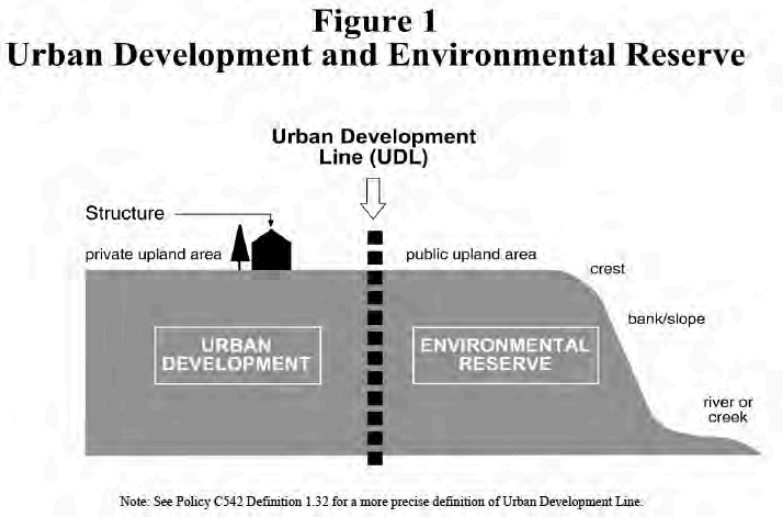


Figure x – Diagram showing extent of Edmonton's river valley development plan boundary. (image taken from North Saskatchewan River Valley Area Redevelopment Plan, Bylaw 7188, Office Consolidation, July 2012, Page 16)

This corridor is not only important as a recreational resource but is a significant natural resource providing a haven within the city for various species of plants, insects, invertebrates, birds and animals. Development of the river valley is restricted and managed by The City of Edmonton's North Saskatchewan River Valley Area Redevelopment Plan which seeks to preserve this resource by recognizing, "the Plan Area as containing natural resource areas which will be preserved and enhanced for recreational, scenic and ecological purposes".[13]

[13] (The City of Edmonton, 2012, p 11)

Figure x – Views from Edmonton's river valley, http://www.edmontonrivervalley.com/links.html Downloaded November 17, 2013.)

The plan recognizes the river valley as the, "most unique natural feature of Edmonton and the largest urban open space in North America. As an integral part of the City's urban fabric, the System represents a unique set of problems and opportunities", and that "the River Valley may become threatened by commercial and industrial uses" and therefore requires a process of environmental assessment prior to any new development taking place.[14]

The recognition of the value of the natural resource, establishing boundaries and providing guidelines and regulations for preservation is an important precedent when considering the potential for establishing urban food production development within the city.

2.5 Regional issues of Health and Nature

It has been recognized by public institutions that health issues rank among the most important facing society today. The Alberta government released a wellness strategy aimed at making "Alberta a healthier place to live, work and raise a family".[15] According to the October 2nd, 2013 news release, "The cost for treating preventable illnesses is rising every year and is a significant

[14] (The City of Edmonton, 2012, page 5)
[15] (Alberta Health, 2013)

contributor to increasing health costs. Health care spending accounts for 45% of Alberta's budget".[16] The press release cites several health statistics relating to preventable diseases stating, "Almost 217,000 Albertans were living with Diabetes in 2010, costing approximately $215 million in direct costs", "Heart disease and stroke costs the Canadian economy more than $20.9 billion every year in physician services, hospital costs, lost wages and decreased productivity", and "More than half of Albertans are considered overweight or obese".[17]

The Government of Alberta's Strategic Approach to Wellness report discusses the concept of shifting some of the focus from improving the healthcare system to improving how wellness is integrated into, "our families, schools, communities and workplaces, in our parks and playgrounds, the places we live, the air we breathe, the water we drink and the choices we make", and defining wellness as when, " we are at our best when we are whole: when our physical, mental, emotional and spiritual states are healthy."[18]

Health minister Dave Rodney and Chief Medical Officer of Health Dr. James Talbot both echo the concern that, "We are currently facing threats to our health that may roll back the gains in increased life expectancy we have achieved in the past 100 years. Rates of chronic disease and injury continue to rise in Alberta and across the country. The prevalence of obesity is so great, especially in children, that there is a good likelihood that this generation of children will become sick with preventable diseases like diabetes, heart disease, kidney failure and cancer at much earlier ages and be reliant on the health system for much longer than their parents ever were."

[16] (Alberta Health, 2013)
[17] (Alberta Health, 2013)
[18] (Alberta Health, 2013)

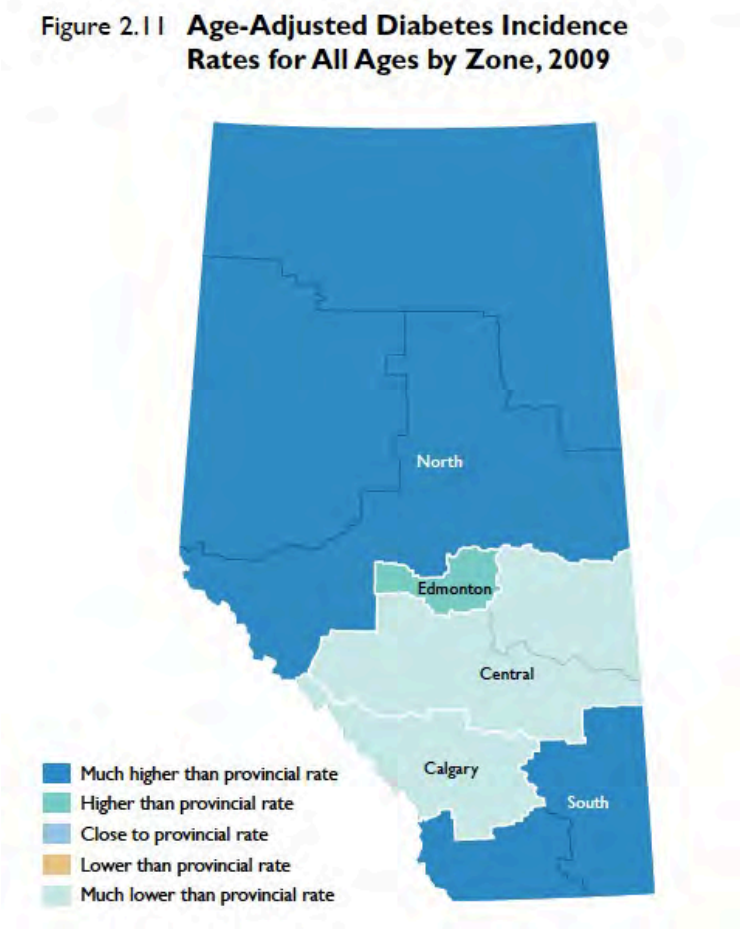


Figure x – Map of Alberta, Canada, showing age adjusted diabetes rates by region. (http://www.albertadiabetes.ca/AlbertaDiabetesAtlas2011.php, Downloaded November 2, 2013.)

One method of creating wellness singled out in the report is urging parents to, “ensure that their children eat fresh fruits and vegetables “ citing statistics that indicate, “More than 50% of individuals over the age of 12 do not eat the daily recommended number of fruit and vegetables.”[19] The report also cites the linkage between exercise and physical and mental health, “44% of individuals over the age of 12 are not physically active enough to achieve health benefits and more than 50% of Albertans 20-64 are overweight or obese. Exercise is known to improve mental health and decreases the risk of heart attacks and osteoporosis.”[20]

The report goes on to link factors that build wellness to, “influenced by conditions such as the proximity of recreational spaces, agreeable scenery, and street and neighborhood design”,

[19] (Alberta Health, 2013, p 7,11)
[20] (Alberta Health, 2013, p 11)

"Early Childhood Development", "Education and Learning", " Food Security" and "Built environment" and "Natural Environment" all as key contributors to wellness.[21]

3.0 IS CHANGE REQUIRED?

3.1 The Concept of Anti-fragility (or Resilience)

Nassim Nicholas Taleb, in his book The Black Swan, uses the rare bird as a metaphor for unexpected events and defines it as, "an outlier, as it lies outside the realm of regular expectations, because nothing in the past can convincingly point to its possibility. Second, it carries an extreme impact (unlike the bird). Third, in spite of its outlier status, human nature makes us concoct explanations for its occurrence *after* the fact, making it explainable and predictable".[22]

It is as he puts it, "our blindness to randomness", which fosters our inability to build resilience and goes on to point out, "Why do we keep focusing on the minutiae, not the possible significant large events, in spite of the obvious evidence of their huge influence?".[23] It is at times our knowledge that betrays us into a false sense of security, a belief that we know what will or will not happen and in doing so leaves us unprepared to experience a "Black Swan".

Can it be said that the very fact that Edmonton is well served in terms of its natural resources and food needs, and very unlikely to experience a food shortage be the very foundation upon which a robust Urban Food System should be explored? Are Edmontonians exempt from the same health trends that other North Americans are; experiencing epidemic rates of obesity, diabetes, heart disease, and other diseases, incrementally eroding opportunities for vigorous health? Are Edmontonians as mentally healthy as they could be? How valuable to the city is the nourishment, health and economic opportunities for the poorest urban core dwellers? In order to combat sprawl, what will make the core of cities more attractive and liveable for families?

Could a catastrophic series of events conspire to rob Edmonton of its food supply, even temporarily? Is the industrially produced food supply sustainable and/or providing sufficient nutrition value? Is the fact that Edmonton has been a historic centre for agricultural knowledge actually beginning to experience a decline out of complacency and economic/societal/geographical change?

Complete, scientifically verified, statistically irrefutable answers to these questions will not be found in one place, from one person or group or perhaps in one person's lifetime. It is necessary however that steps towards grassroots incremental change be made as this has proven to be

[21] (Alberta Health, 2013, p 22, 23)
[22] (Taleb, The Black Swan, The Impact of the Highly Improbable, 2010, p 33)
[23] (Taleb, The Black Swan, The Impact of the Highly Improbable, 2010, p 33)

the most prolific source of innovation and improvement of the human condition.[24] Urban agriculture has the characteristics to be this type of catalyst or at least be the ground zero for it. As Taleb puts it, "If everything top-down fragilizes and blocks antifragility and growth, everything bottom-up thrives under the right amount of stress and disorder. The process of discovery (or innovation, or technological progress) itself depends on antifragile tinkering, aggressive risk bearing rather than formal education".

Taleb also argues that recognizing clearly what you don't know, in other words the answers to these questions, is more important than finding the answers as they are often fit to suit and therefore can be misleading. This is best conveyed by the analogous tale of Procrustes's Bed (Greek mythology) who took in strangers to feed and house, as recounted by Taleb, "He wanted the bed to fit the traveler to perfection. Those who were too tall had their legs chopped off with a sharp hatchet; those who were too short were stretched".[25] Instead of earnest self-evaluation and true accounting and anticipation of problems leading to holistic and sustainable solutions, modern society tends to first attempt this same type of surgical alteration in problem simplification to arrive at answers that ultimately prove inadequate. It is typically not until this point is reached, along with the requisite waste in human, resource and biological capital, before it truly understands the deficiencies and failures of such an approach and attempts a more complete reckoning.

Whether or not there is an urgency behind the need to establish urban food production requires a world view that takes into account environmental and social ethics as well as a multi-disciplinary understanding developed across and between a wide spectrum of technical, medical, psychological, sociological, anthropological, engineering and design professions. This is necessary in order for the contributing factors to be fully expressed and holistic solutions to the problems developed.

3.2 The Concept of Natural Capital

Warren Buffet and his partner George Soros are widely recognized as the world's most successful investors.[26] Warren Buffet, chairman, president and CEO of Berkshire Hathaway Inc., is known as the "Oracle of Omaha" for his prophetic ability to study economic behavior and understand a businesses' worth, allowing him to buy companies for low valuations and realize their compounding growth potential over long periods of time making him consistently one of the world's top five richest men. Berkshire Hathaway has averaged an annual growth of 19.7% for the last 48 years as compared to 9.4% growth averaged by the S&P 500.[27] Central to his success both in business and life is the concept of principal preservation and that he visualizes each dollar not for its present worth, but what it is worth in the future, "If a dollar today was going to be worth ten some years from now, then in his mind the two were the same".[28] According to biographer Alice Schroeder, "Yet notable though his fortune may be, Buffett's legacy will not be

[24] (Taleb, The Black Swan, The Impact of the Highly Improbable, 2010, p 47)
[25] (Taleb, The Bed of Procustes, Philosophical and Practical Aphorisms, 2010, p 9)
[26] (Tier, 2005, p 3)
[27] (Wikipedia, 2013)
[28] (Schroeder, 2008, p 65)

his ranking on the scorecard of wealth; it will be his principles and ideas that have enriched peoples lives".

When approached by a relative to borrow money for an endeavor which Warren Buffet felt was too speculative and without sufficient margin of safety he pointed out, "If you are going to drive 10,000 pound trucks across a bridge repeatedly, it is well to build one that can withstand 15,000 pound loads rather than one that can withstand 10,001 pounds…It is a big mistake to have lots of financial obligations and no cash reserve".[29] This concept of ensuring resilience in all his life's endeavors was instilled and reinforced by the experiences passed on by of one of his key mentors, Benjamin Graham of Columbia University, New York, which Warren attended in the spring of 1951. Graham had, "experienced four financial panics and three depressions" and taught Warren Buffet the power of understanding a stocks "Intrinsic value".[30] It is this strategy that allowed Buffet not only to survive, but in a recent example, actually prosper from the recession in 2008 by absorbing a great number of subprime mortgages from other failed lenders through a Berkshire Hathaway subsidiary Clayton Homes.[31]

This strategy of capital preservation and positioning is a prime example of what Nicholas Nassim Taleb refers to as "profiting from a Black Swan Event" elegantly demonstrating the concept of "anti-fragility" which he defines as, "anything that has more upside than downside from random events (or certain shocks) is anti-fragile; the reverse is fragile".[32]

These principals and ideas of economics and philosophy are fully relatable in terms of understanding human interaction with natural systems and their carrying capacity. Without a realizing not only the current value, but the future value of nature and ecology, society operates without a reserve and in a fragile state, working with the $10,001 noted by Buffet as a state of poor planning and vulnerability. This state of fragility only becomes apparent when the worst happens: drought, disease, dramatic economic shifts and at that point the damage is done leaving hindsight and the cautionary tale as all that is left. Until that time, the suspension of belief remains intact and all appearing well and adequate. Through the abstraction of natural capital as economic capital, better planning and a better fate result.

Various human activities and resource extractions are dramatically drawing down the Earth's carrying capacity, which can be thought of as "natural capital". Natural capital, as defined in the book Natural Capitalism by L.Hunter Lovins, Amory Lovins and Paul Hawken, is defined as, "all the familiar resources used by humankind: Water, minerals, oil, trees, fish, soil, air, et cetera. But it also encompasses living systems, which include grasslands, savannas, wetlands, estuaries, oceans, coral reefs, riparian corridors, tundra's, and rainforests."[33] Nature deficit disorder among human populations is exhibited when these are thought of only as raw commodities or obstacles, without pause to contemplate them as tapestries or elegant compositions, or without recognition of the energy, time and gestation required to form and replenish them. Industrial process and urban sprawl makes rapid and large scale

[29] (Schroeder, 2008, p 521)
[30] (Schroeder, 2008, p 146)
[31] (Yang, 2008)
[32] (Taleb, Antifragile, Things That Gain From Disorder, 2012, p 45)
[33] (Hawken, Lovins, & Lovins, Natural Capitalism, Creating the Next Industrial Revolution, 1999, p 35)

deconstruction, or “spending” (or borrowing), of this natural capital possible without much notice, recognition or, most importantly, accounting of the embodied costs.

Without healthy natural systems, metaphoric “cash in hand” dwindles making replenishment more and more imperative to avoid foreclosure and eventual bankruptcy. The vulnerability created by low capital availability (or in Warren Buffet’s bridge analogy - additional structural capacity) means that the system upon which human’s depend for existence could be crippled by additional unforeseen events or stresses. This can be characterized as a state of fragility.

Among the best examples of living with limited capital is the experiment known as Biosphere 2. In 1991 eight individuals sequestered themselves into Biosphere 2 where they lived for 2 years. The explicit goal was to employ the best modern knowledge, technology and effort towards creating a refined, efficient and sustainable habitat for the purposes of modelling the processes of Biosphere 1 (Earth). The hope was to establish the technological feasibility of the colonization of Mars. The experiment ended after two years and 20 minutes with the reality that the eight could not meet all their needs for survival with the 1.28 Hectares (3.14 Acres) of land provided.[34]

Figure x – Aerial view of Biosphere 2 North of Oracle Arizona. http://www.ted.com/talks/jane_poynter_life_in_biosphere_2.html Downloaded November 23, 2013.)

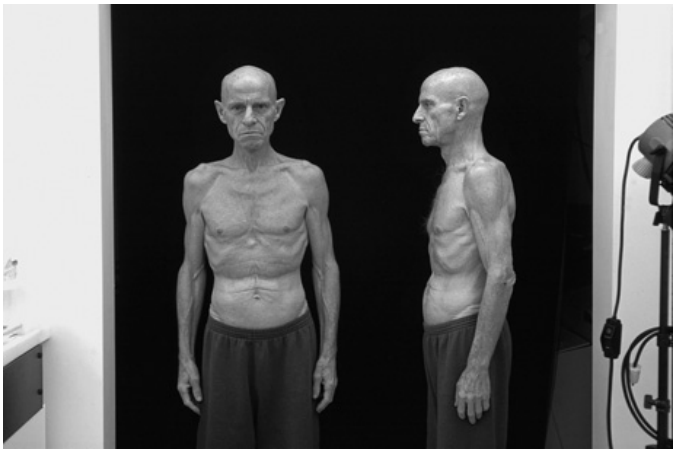
After only a short period of time within the sealed dome, oxygen levels dropped to 14.5% (from the normal 21%) with CO2 and nitrous oxide levels on the rise.[35] Although it was later discovered that curing concrete and high levels of organic material in the soil were large drivers of the oxygen consumption, it made it clear how important the concepts of carbon sequestration and nature systems are for robust provision of life giving elements.

[34] (The University of Edinburgh)
[35] (The University of Edinburgh)

Biosphere 2 made it abundantly clear that there is no escaping the complexity and interconnectedness of human beings, the natural world, and the life giving services it provides.

Although it established that humans require more than 0.16 (0.39 Acre) of a Hectare per person to survive (and that 1750 calories, while sufficient to maintain basic health, gave rise to significant social dysfunction as growing hunger manifested in many uncivilized behaviours[36]) it remains the domain of incomplete academic study and pure speculation as to what minimum amount of land is required per person for humankind to exist sustainably on the Earth. Applying the analogy, the sum of money in the bank that is required to avoid foreclosure and bankruptcy cannot, at this point, be established with any true certainty.

In addition to what natural capital is required to keep us alive, the effort and inputs to provide the goods and services we enjoy are more and more poorly understood by subsequent generations of human beings. The food we enjoy requires a great deal of effort to produce, even in industrial terms when viewed in terms of energy input vs. output. As Biosphere 2 team member Jane Poynter pointed out in her TED talks presentation in Los Angeles, March of 2009, it would take her 4 months to make a pizza, (by growing the wheat, milking the goats and making cheese) where in current western civilization people are accustomed to picking up a phone and having as much pizza as they can afford delivered to their front door in ½ hour. The system of division of labour and industrial production has resulted in levels of convenience that has disconnected people from the environment and what demands are placed on it by even the simplest whim. Layered on top of this problem is the fact that increasingly the food produced and distributed through industrial systems goes to waste from processing (including rejection because of aesthetic blemishing of natural products that are perfectly edible), expiry dates that have to take into account long transport distances, oversupply (or overbuying by the consumer) and numerous other factors.[37] According to a recent UN report, 1.3 billion tonnes of food is currently being wasted globally.[38]



[36] (The University of Edinburgh)
[37] (United Nations Environment Programme, 2013)
[38] (United Nations Environment Programme, 2013)

Figure x – Self-portrait by Dr. Roy Walford of his extreme weight loss due to the high nutrient but low calorie diet experienced while living in Biosphere 2. http://www.cabinetmagiazine.org/issues/41/turner.php, Downloaded November 23, 2013.)

One critique of the 1991 Biosphere 2 mission stated that its success was compromised by the fact that the team was not adequately trained for the mission and in some cases had little knowledge of agriculture and what it would take to grow food under the circumstances they were presented with.[39] While somewhat of a scathing indictment on the scientific rigor of the experiment, it provides a totally appropriate example of the general state of agricultural knowledge among average individuals of modern heritage and the importance of the specific skills and knowledge necessary to successfully farm and feed oneself.

If it is understood that some ratio of Natural Capital, (sun, oxygen, various organic and inorganic compounds, water, land, plants, animals, insects, microbes) is necessary to sustain mankind, and that amount is not currently known - should it not be the highest imperative to identify its intrinsic value and preserve as much of it as possible? Could such an imperative be characterized as a method of building resiliency?

ADD WORLD POPULATION STATISTICS, LAND AREA AND WHAT IS KNOWN ABOUT HOW MANY HUMANS THE PLANET CAN SUPPORT

3.3 Water Capital for Life and Agriculture Everywhere

Next to oxygen, fresh water is one of the most important elements to life on earth and its volume is essentially a fixed amount. Only 2.5 percent of the water on earth is freshwater fit for animal and human uses. With 37% of this element frozen in glaciers and polar ice caps, 62% in underground aquifers, 1% is left available on the Earth's surface in streams, rivers and lakes.[40] Of this readily available water, the US Geological Survey estimates only half of this volume, or 0.03% of total water reserves, is available to humanity.[41] Of this total, 85% is concentrated in 28 lakes, 12 of which are located in North America. Canada is home to 20% of the 0.03% world total.

[39] (The University of Edinburgh)
[40] (Freshwater & Talagi, 2010), page 5
[41] (Freshwater & Talagi, 2010), page 5

The Stockholm Environment Institute (1997) has estimated that, allowing for predicted population growth and assuming moderate projections of development and climate change, the proportion of the world's population living in countries of significant water stress will increase from approximately 34% in 1995 to 63% in 2025.

Predicted decline in per capita availability of water resources, by region, 1995–2025

Region	Annual renewable water resources (m3 per person)		
	1995	2000	2025
Asia	4,000	3,400	2,300
Europe	4,200	3,900	3,900
Africa	5,700	4,500	2,500
North America	17,000	15,400	12,500
South America	38,000	33,400	24,100
Australia & Oceania	84,000	75,900	61,400

Source: Comprehensive Assessment of the Freshwater Resources of the World, (Stockholm Environment Institute, 1997)

Figure x – Excerpt, Declining availability of fresh water, Desalination in Pacific Island Countries, A Preliminary Overview, Secretariat of the Pacific community (SOPAC) report, 2012, page 6.

Fresh water is a natural product of the water cycle. The water cycle, fueled by the sun's energy and a complex system of energy absorption and exchange, naturally recycles and purifies. The process however is not entirely predictable, is not equal in every region and takes time. The only method of producing fresh water immediately and artificially is by an industrial desalinization process. Desalination technology is energy intensive and produces a problematic amount of waste in the form of brine, spent membranes (Reverse Osmosis or RO process) and energy bi-products which are typically the result of fossil fuel combustion or nuclear waste. Brine, in the form of concentrated salts, contaminates land it is placed on making it unfit for biological life, salinates fresh water supplies through environmental weathering and soil percolation when left in piles or, if discharged back into the ocean, may kill or endanger coastal terrestrial and aquatic wildlife.[42] Desalination plants are also problematic due to the sea life destruction that results through intakes and pollution from acids and anti-fouling agents (biocides) used to keep internal components free of scale or organic material build-up.[43]

[42] (Benkendorff, 2008), pages 2-4
[43] (Benkendorff K. , 2008)

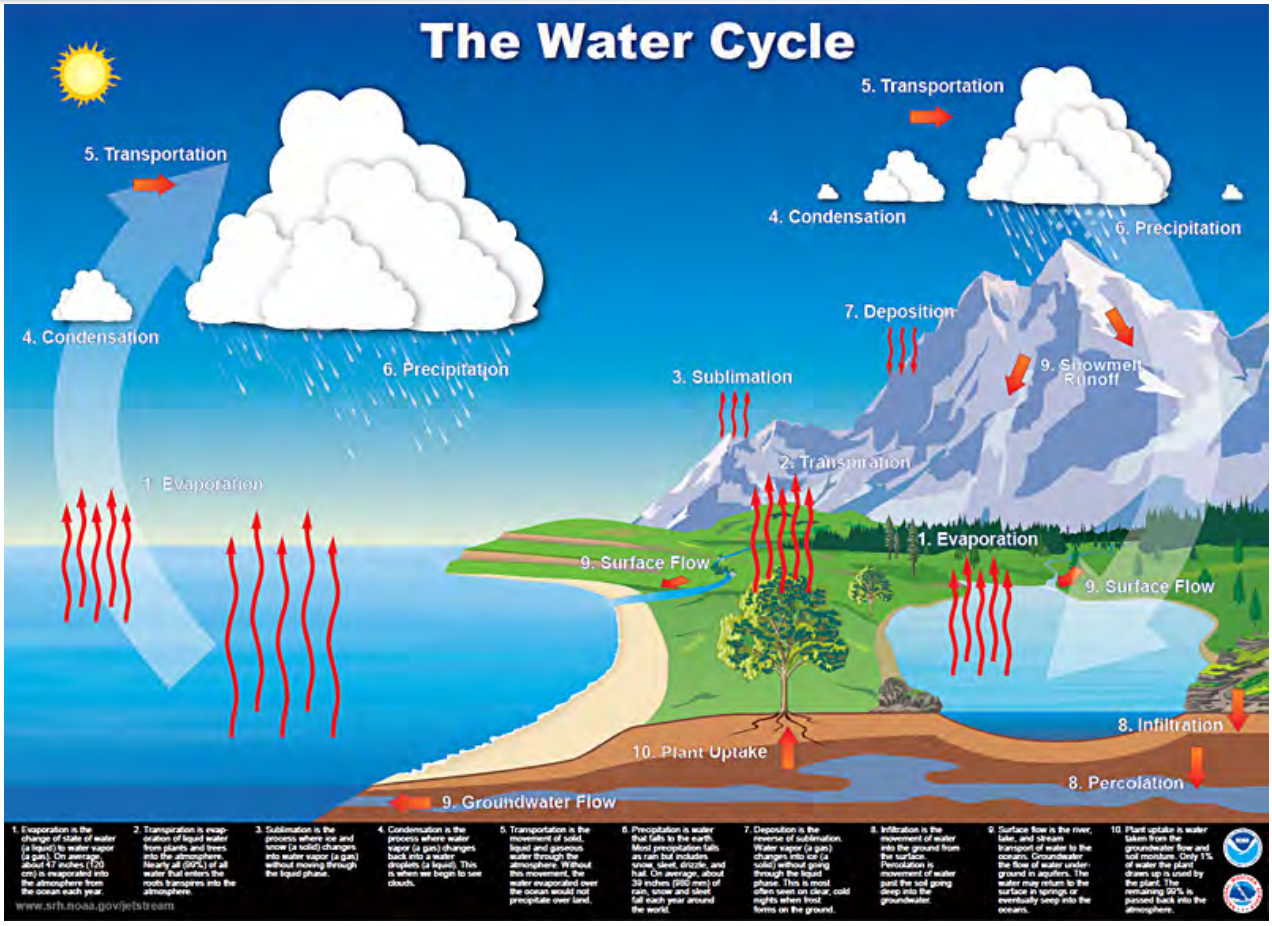


Figure x – National Oceanic and Atmospheric Administration Water Cycle Poster, http://www.education.noaa.gov/Freshwater/Water_Cycle.html, Downloaded November 30, 2013.)

Figure x – Salt piles, desalination plant in Sicily, Italy representing piles of unresolved ecological debt that requires stewardship and eventual repayment. http://www.savingwater.co.za/2010/02/16/21/desalination-at-best-is-a-short-term-solution/,

Remaining stocks of fresh water are declining throughout the world and in some areas the lack of fresh water is desperate. Fresh water is being lost, virtually forever in some cases (due to toxicity and radioactive elements which will take hundreds to thousands of years to decay or otherwise stabilize to safe levels), to agricultural pollution, industrial pollution and biological imbalance.

Gulf countries Kuwait, Bahrain, Qatar, Oman, Saudi Arabia and the United Arab Emirates currently import 90% of their food from external sources at a cost of $6.7 billion dollars per year.[44] This is principally due to chronic water shortages.

Contamination of coastal watersheds, which industrial food production is a large contributor through the overuse of nitrogen fertilizers and over-irrigation, is causing the destruction of coastal ecosystems as reported by the United States Geological Survey (USGS). In a report by Paul M Barlow of the USGS entitled, “Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast, he notes, “many of the environmental issues related to coastal ecosystems-red tides, fish kills, loss of sea grass habitats, and destruction of coral reefs-can be attributed to the introduction of excess nutrients (Nitrogen and Phosphorus) from freshwater discharges (National Research Council, 200)”.[45] Although significantly less populated, the West Coast of North America faces the same challenges to the coastal waters of the Pacific Ocean as populations increase.

In addition, rising sea levels, due to global climate change, will also contribute to seawater intrusion into fresh water aquifers.[46]

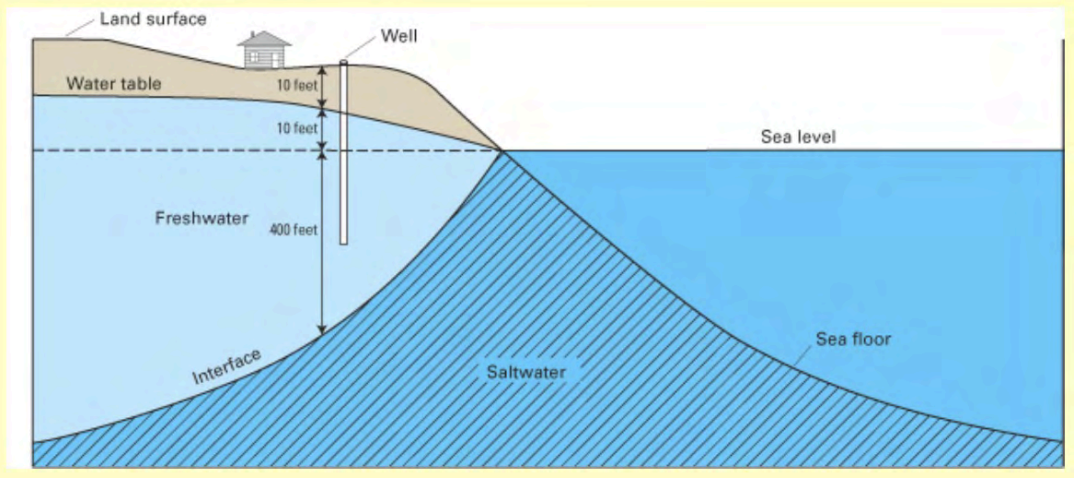


Figure x – Freshwater / saltwater coastal interface, United States Geological Survey document, Ground Water in Freshwater-Saltwater Environments of the Atlantic Coast, circular 1262,Paul M. Barlow, published 2003, Page 15

[44] (Gonn, 2010)
[45] (Barlow P. M., 2003, p 3)
[46] (Ohio State University, 2007)

Government officials around the world are recognizing looming fresh water shortages. The term "Peak Water" traces its heritage to "Peak Oil" meaning generally that the apex of the availability curve has been reached for the resource and it will begin to decline over time. A Forbes magazine article published in July 9, 2011, written by Peter Gleick, CEO of the Pacific Institute and a MacArthur Fellow, stated, "the demand for water is outstripping the supply, causing political disputes and economic uncertainty" and, "recently, new water challenges have emerged in regions once thought to be relatively water rich, like the southeast and even the Great Lakes region. And there is strong evidence that the United States as a whole may have already passed the point of peak water, including peak renewable, nonrenewable, and ecological water".[47]

Figure x – Photo of typical grocery store in downtown Edmonton. (Photo by Author, September 2013)

Industrial agriculture is among the largest consumers of fresh water. One of the largest players in the industrial food chain lies in the Salinas and Monterey valleys of California. These regions however are experiencing not only drought, but major drinking water issues related to nitrate pollution predominantly caused by the agriculture industry.

[47] (Gleick, 2011)

Figure x – Typical prepackaged produce from downtown grocery store originating from Salinas valley, California. (Photo by Author September 2013)

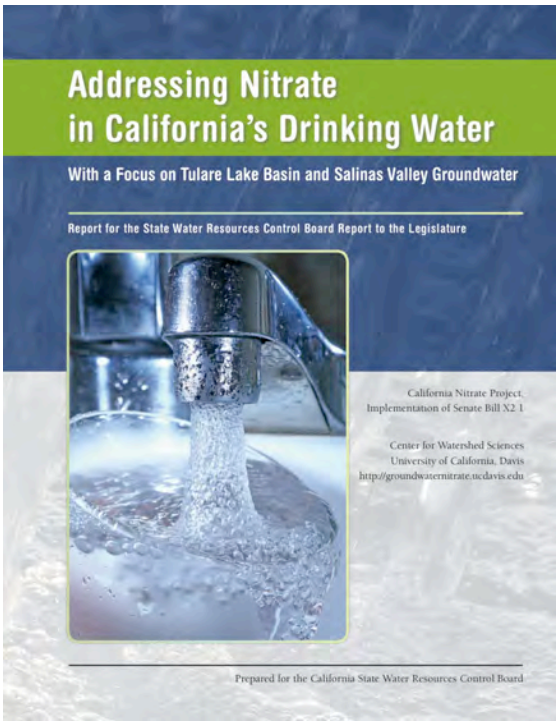


Figure x – Report to the State of California Legislature on status of Nitrite Pollution Problem, http://groundwaternitrite.ucdavis.edu/files/138956.pdf, downloaded Nov 4, 2013

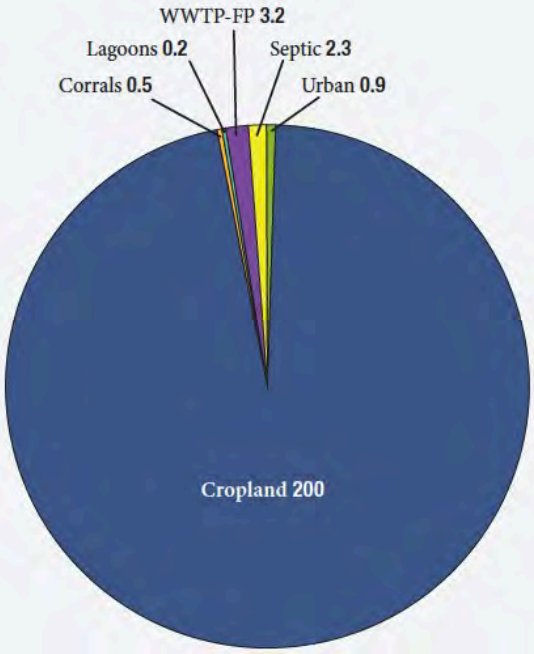


Figure ES-1. Estimated groundwater nitrate loading from major sources within the Tulare Lake Basin and Salinas Valley, in Gg nitrogen per year (1 Gg = 1,100 t).

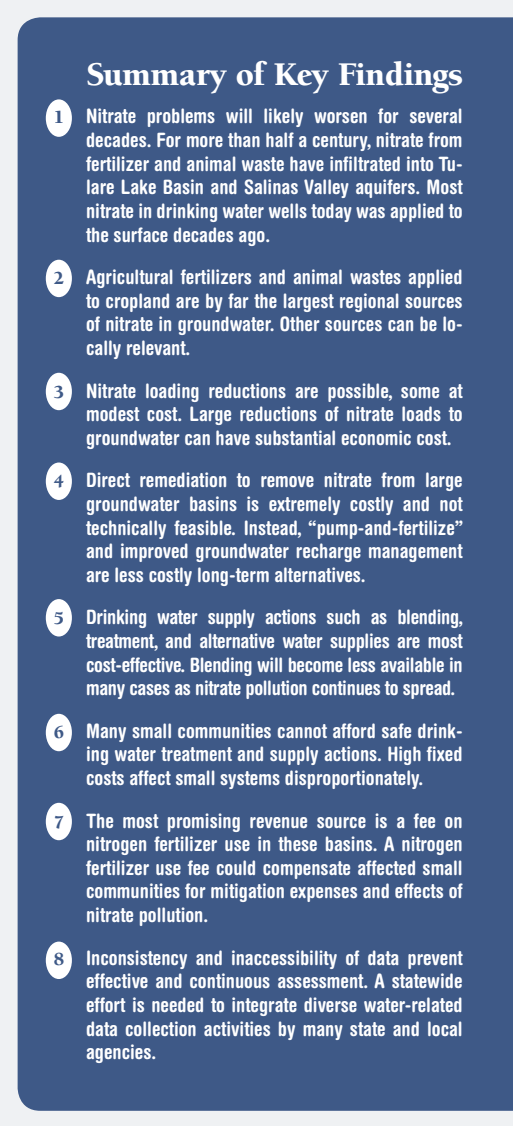
Key Issues

Groundwater is essential to California, and nitrate is one of the state's most widespread groundwater contaminants. Nitrate in groundwater is principally a by-product of nitrogen use, a key input to agricultural production. However, too much intake of nitrate through drinking water can harm human health.

California's governments, communities, and agricultural industry have struggled over nitrate contamination for decades. **The California Department of Public Health (CDPH) has set the maximum contaminant level (MCL)** for nitrate in drinking water at 45 milligrams per liter (as nitrate). Nitrate concentrations in public drinking water supplies exceeding the MCL require water system actions to provide safe drinking water.

For this study, the four-county **Tulare Lake Basin and the Monterey County portion of the Salinas Valley are examined**. About 2.6 million people in these regions rely on groundwater for drinking water. The study area includes four of the nation's five counties with the largest agricultural production. It represents about 40% of California's irrigated cropland (including 80 different crops) and over half of California's dairy herd. Many communities in the area are among the poorest in California and have limited economic means or technical capacity to maintain safe drinking water given threats from nitrate and other contaminants.

Figure x – Excerpts from the report to the State of California Legislature on status of Nitrite Pollution Problem, http://groundwaternitrite.ucdavis.edu/files/138956.pdf, downloaded Nov 4, 2013, page 3



Summary of Key Findings

1. Nitrate problems will likely worsen for several decades. For more than half a century, nitrate from fertilizer and animal waste have infiltrated into Tulare Lake Basin and Salinas Valley aquifers. Most nitrate in drinking water wells today was applied to the surface decades ago.
2. Agricultural fertilizers and animal wastes applied to cropland are by far the largest regional sources of nitrate in groundwater. Other sources can be locally relevant.
3. Nitrate loading reductions are possible, some at modest cost. Large reductions of nitrate loads to groundwater can have substantial economic cost.
4. Direct remediation to remove nitrate from large groundwater basins is extremely costly and not technically feasible. Instead, "pump-and-fertilize" and improved groundwater recharge management are less costly long-term alternatives.
5. Drinking water supply actions such as blending, treatment, and alternative water supplies are most cost-effective. Blending will become less available in many cases as nitrate pollution continues to spread.
6. Many small communities cannot afford safe drinking water treatment and supply actions. High fixed costs affect small systems disproportionately.
7. The most promising revenue source is a fee on nitrogen fertilizer use in these basins. A nitrogen fertilizer use fee could compensate affected small communities for mitigation expenses and effects of nitrate pollution.
8. Inconsistency and inaccessibility of data prevent effective and continuous assessment. A statewide effort is needed to integrate diverse water-related data collection activities by many state and local agencies.

Figure x – Excerpts from the report to the State of California Legislature on status of Nitrite Pollution Problem, http://groundwaternitrite.ucdavis.edu/files/138956.pdf, downloaded Nov 4, 2013, page 2

The only technological solution to produce fresh water is desalination of seawater or saline fresh water reserves. This is a large-scale undertaking, which requires significant energy inputs to separate the salt and other contaminants from H_20.

Utilizing Nuclear power for desalination plants is popular due to the substantial power demand required. Nuclear power does not generally consume much in the way of fossil fuels, except in its construction, decommissioning and waste handling and in industry circles is considered a an effective weapon in reducing greenhouse gas emissions. It is however not a resilient power source as it requires a great deal of capital input, maintenance a high level of technical/theoretical knowledge, training and vigilance to ensure the nuclear reaction, (that produces heated steam to run electricity producing turbines) and spent fuel does not escape

into the environment outside of the reactor or containment facilities. A runaway reaction can occur in minutes, destroy its containment and disburse radioactive materials into the environment.[48] Although accidents are rare, when they occur they are likely to be catastrophic as was the case in the Chernobyl (1986) reactor incident and remains a possibility with the recent Fukushima-Daiichi (2011) incident. Radiation from the Chernobyl reactor has created a significant "exclusion zone" that will be un-inhabitable for 180 to 320 years which is the amount of time it will take for the cesium 137 expelled to sufficiently decay to a background level that will not affect human or animal health.[49]

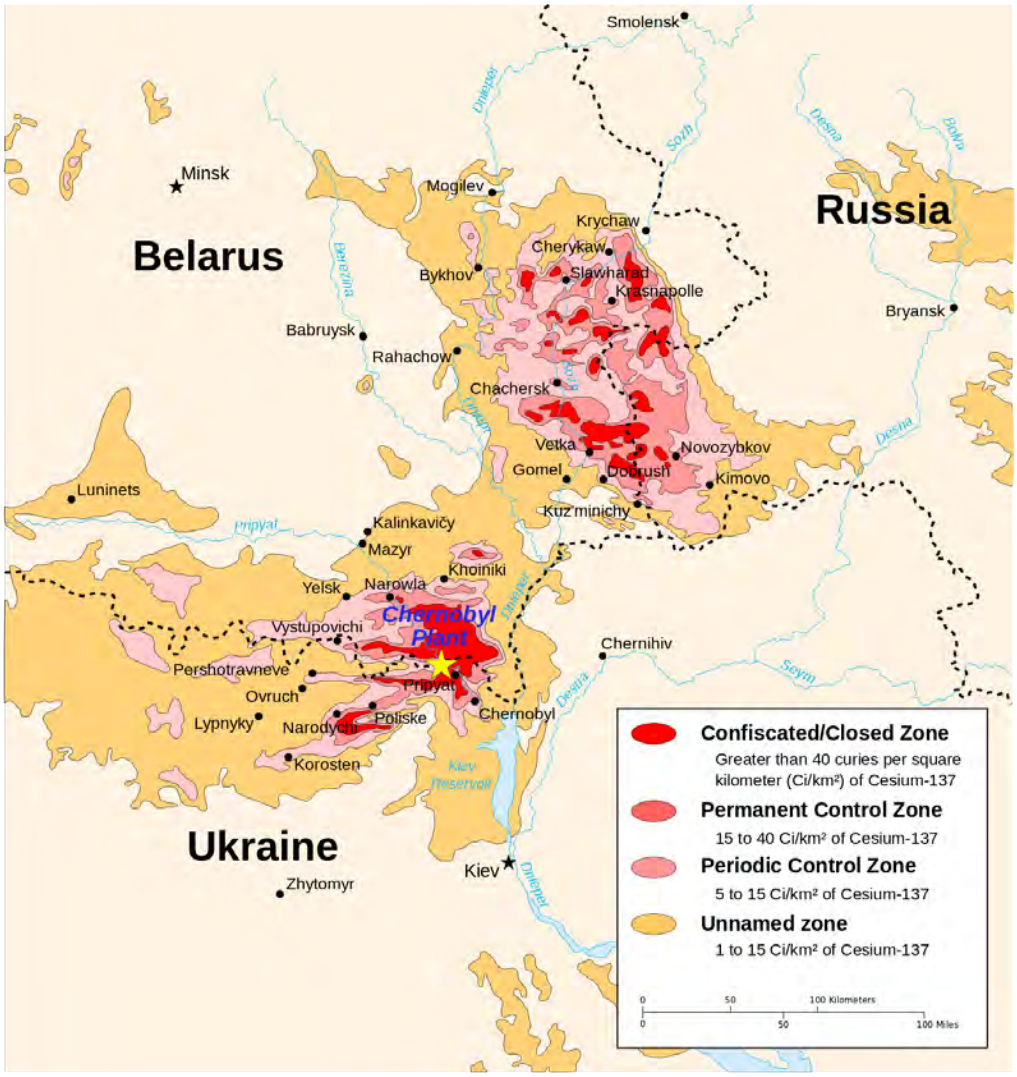


Figure x – The Wikipedia Chernobyl exclusion zone map, http://upload.wikimedia.org/wikipedia/commons/thumb/2/23/Chernobyl_radiation_map_1996.svg/1398px-Chernobyl_radiation_map_1996.svg.png

[48] (Malko, p 19)
[49] (Keim, 2007)

Handling and storage of spent nuclear fuel and nuclear by-products poses threats to life and health that can last hundreds, thousands or billions of years (Thorium 232 has a half-life of 14 billion years).[50] It has been recently discovered that some of the 70-year-old radioactive products of the Manhattan Project, used in the construction of the nuclear bombs dropped on Hiroshima and Nagasaki, are causing more environmental problems than the bombs themselves. According to nuclear expert Robert Alvarez, the bomb making by-product, Thorium 230, mixed with soil at the West Lake Landfill in Bridgeton, Missouri, is "60,000 times more radioactive than uranium and will become more radioactive over the next 9,000 years".[51] Thorium 230 has a half-life of 75,380 years meaning that disposal and caretaking will require diligent multi-generational stewardship to keep it from contaminating surrounding areas.[52] The community is fighting to have the contaminants removed and disposed of in a nuclear waste facility, but the waste is to remain, based on an Environmental Protection Agency (EPA) decision that favours a defend in place strategy.[53] California's now dormant San Onofre Nuclear Generation Station (known as SONGS) located on the Southern coast of California is what Robert Alvarez calls, "one of the largest threats to public safety in America".[54] In a June 8, 2013 LA Times article, it was noted that, "An estimated three million pounds" of spent Cesium 137 (89 times that which was present in Chernobyl)[55] "is so radioactive that no repository exists that can handle it, meaning it will have to remain in concrete casks on the coast for decades, if not indefinitely".[56] Transfer of the current spent pool storage to dry-cask is being delayed by political controversy and inaction despite the fact that $25 billion in government funding is available to enable the work while, "drainage of a spent fuel pool from an earthquake at one of San Onofre's reactors could result in a catastrophic atmospheric release, resulting in lethal exposures to people within a 10-mile radius."[57] Full decommissioning of the plant is expected to require 3 billion dollars and several decades to complete.[58]

San Onofre, Fukushima, West Lake Landfill and Chernobyl serve as only a few examples of catastrophic (and lethal) fragility – the product of hazardous process which, though technically feasible and safe in the majority of instances, fail or are mishandled in sufficient frequency to be regarded as a last resort technological solution. When considering technical feasibility, rarely are the risk factors of human failings originating in politics, management, economic cycles and corruption (private and public sector), ever truly quantified and accounted for in a formal manner that suitably informs sound decision making.

Moving from production of fresh water to consumption, California, is home not only to the problems associated nuclear facilities but also to particularly prolific industrial agricultural regions, including the Salinas and Monterey valleys, and chronic drought. In an October 13th, 2013 press release, "Governor Signs Clean Water for Californians Bill Package, Legislation to address California's drinking water crisis", legislative assembly member Luis Alejo noted that,

[50] (Canadian Nuclear Safety Commission, 2011)
[51] (Bissell, 2013)
[52] (Wikipedia, 2013)
[53] (Environmental Protection Agency, 2013)
[54] (Alvarez, 2013)
[55] (Alvarez, 2013)
[56] (Vartabedian, 2013)
[57] (Alvarez, 2013)
[58] (Vartabedian, 2013)

"21 million people in California live in communities that rely on a contaminated groundwater source for drinking water. Of these, 2.1 million Californians are served by systems that have recently violated drinking water safety standards". As with the finances of the state California, fresh water capital is overdrawn.

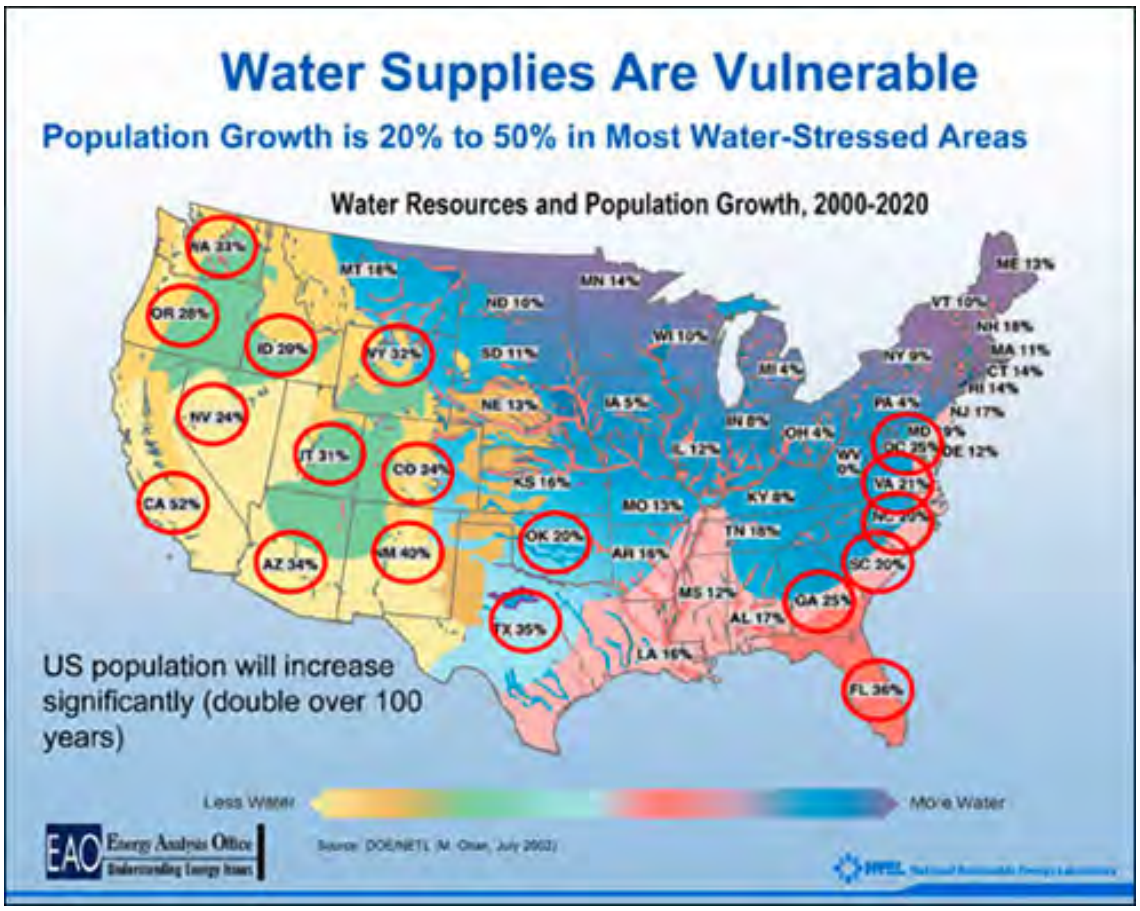


Figure x – Map of the United States highlighting areas of freshwater stress, http://www.nlineenergy.com/the-problem, downloaded Nov 23, 2013

At the start of 2014, the Governer of California, xxx, has made the earliest declaration of drought in the states recorded history. (** add references) Dr. xxxx of XXX has recently completed computer modeling studies that provide one possible answer as to why California has become so dry. With a population of xxx and a land area of xxx, the extreme urbanized area present in California has led to vast expanses of building structures, parking lots and freeways that are causing enormous heat island effects, blocking the lands ability to naturally recharge its underground freshwater aquifers, and recharging of the atmospheric water through evapotranspiration. (** add references) Dr. xxx has noted these effects and is in charge of land use reforms in his native country of xxx demonstrating that the problem requires a global rethinking of urban form and substance.

North America however generally enjoys some of the best and most prolific fresh water reserves in the world in the form of the Great Lakes and glaciers. It may be inevitable that the United States will exert increasing pressure on Canada to sell its water South of the border. Once the North American Free Trade Agreement (NAFTA) was passed, the attempt to secure water sovereignty by passing the proposed Canada Water Preservation Act ended.[59]

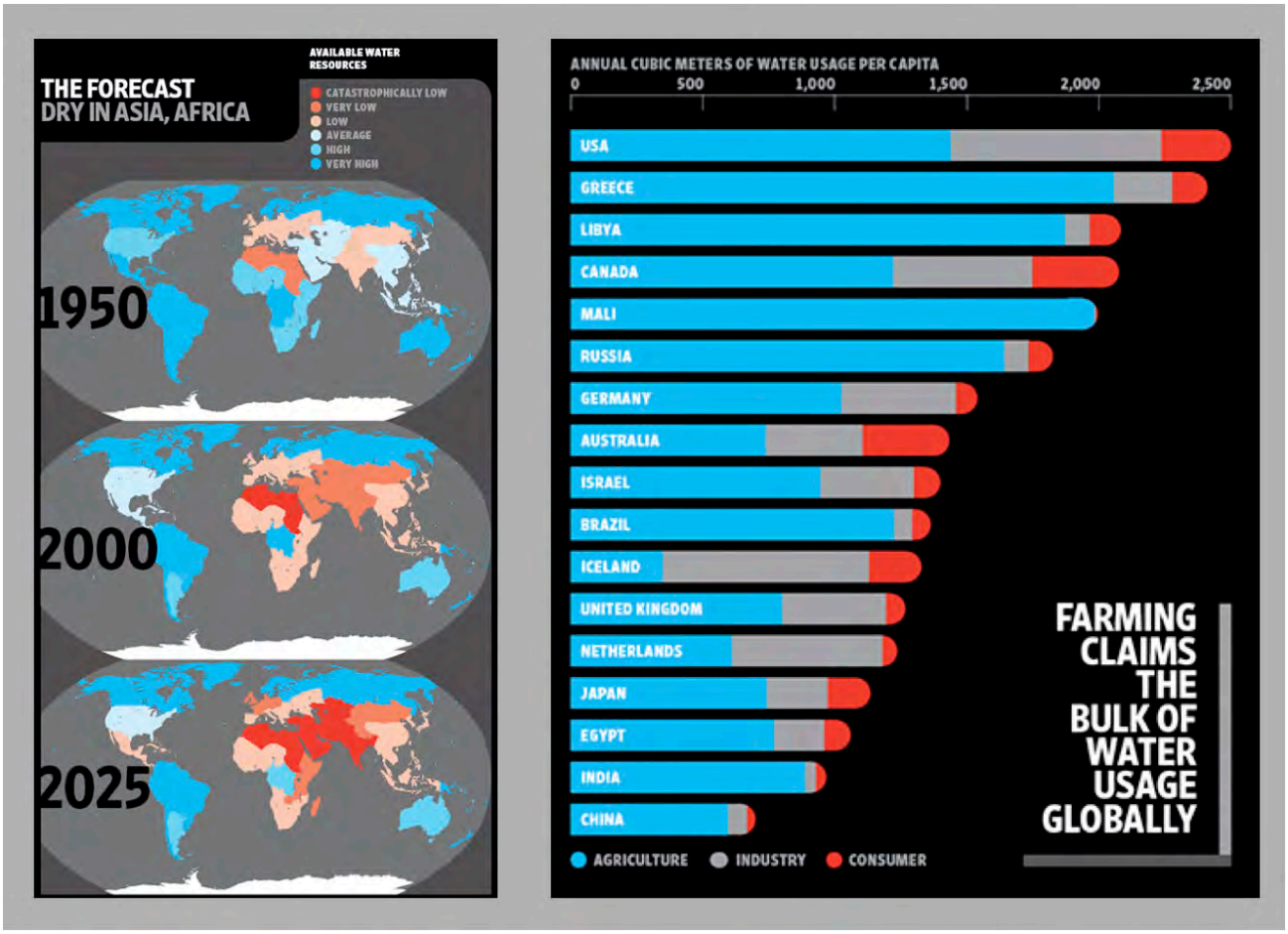


Figure x – Two charts illustrating world water stress and illustrating the role of agriculture, http://www.wired.com/science/planetearth/magazine/16-05/ff_peakwater?/currentPage=all, downloaded Oct 12, 2013

Although North America is generally well served by water resources, the demand and dwindling supply of water in Southern parts of North America has been an issue for many decades. In a 1962 speech by John F. Kennedy (Pueblo High School, Pueblo, Colorado), he heralded the passing of the Fryingpan-Arkansas act which would provide a legislative framework to push forward water diversion projects and called for wider action, “I’m glad to take part in a ceremony whose significance is far beyond this particular area. We are finally diverting water through the Continental Divide into the Arkansas River Basin, and we are going to make in this project an

[59] (Barlow M. , 2007, p 198)

example of what can be done in other parts of our country who also look for water and cannot find it".[60]

While wholesale transport of Canadian water South may appear unlikely, the audacious North American Water and Power Alliance (NAWAPA) proposal formulated by the Ralph M. Parsons Engineering Firm and the United States Army Core of Engineers in 1964, points to the enormous scale of American fresh water demands and the ends to which Americans have considered to support their growth. The outlet of the Colorado river has not reached the sea since 1998[61] which illustrates how the problem has increased in the 40 years since the NAWAPA proposal was first conceived. Agriculture currently absorbs approximately 78% of the river's water.[62] The NAWAPA scheme was to see a series of "Super Canals" and reservoirs built, (including the required nuclear powered lift stations to transport water over substantial changes in elevation), one of which would see a major British Columbia Valley flooded to form the rocky mountain trench reservoir as part of a chain to supply water to the driest areas of the Southwestern United States and Mexico where crop irrigation is one of the greatest water demands.[63] This would result in widespread habitat destruction and the submerging of several communities such as Prince George, British Columbia (Canada).[64]

Peter McBride

The long expanse where the Colorado River has run dry, not reaching the ocean.

Figure x – Image by photographer Peter McBride who, with conservation writer Jonathan Waterman travelled the length of the river by plane, boat and on foot. Rachel Nuwer, Not All Rivers Reach the Sea, http://green.blogs.nytimes.com/2011/11/17/all-rivers-do-not-run-to-the-sea/?_r=0, downloaded December 7, 2013

[60] (Kennedy, 1962)
[61] (Nuwer, 2011)
[62] (Nuwer, 2011)
[63] (Kelly, Page 48)
[64] (Reeves, 2009, p100)

Figure x – Lake Mead, which lies behind the Hoover Dam, has dropped 130 feet (40 metres) from year 2000 levels (Smithsonian.com article, "The Colorado Runs Dry"), image taken from http://web.mit.edu/12.000/www/m2012/finalwebsite/problem/coloradoriver.shtml, downloaded December 7, 2013

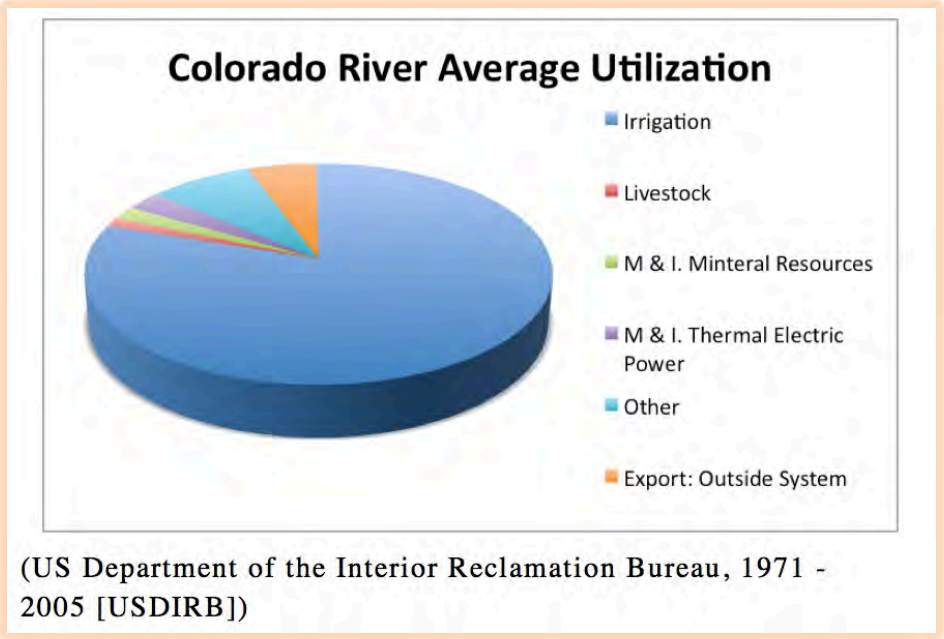


Figure x – Chart of Colorado River water usage. image taken from http://web.mit.edu/12.000/www/m2012/finalwebsite/problem/coloradoriver.shtml, downloaded December 7, 2013

Greater Phoenix continues to expand into the desert. The population of the American West is expected to grow, putting added pressures on dwindling water resources.

Pistachio Trees are irrigated in Arizona

Figure x – Chart of Colorado River water usage. image taken from http://web.mit.edu/12.000/www/m2012/finalwebsite/problem/coloradoriver.shtml, downloaded December 7, 2013

Figure x – Columbia River Treaty, reached and implemented in 1964, US Army Corp of Engineers, map of the Columbia Basin Water Management Division. http://www.nwd-wc.usace.army.mil/report/colmap.htm, downloaded December 7, 2013

Figure x – Super-canal conceptual plan including numerous hydroelectric dams and nuclear powered lift stations. Roland P. Kelly, North American Water and Power Alliance Paper, Page 49

On a much smaller scale plan than NAWAPA, the Columbia River Treaty was undertaken in 1964 between Canada and the United States sees Canadian water travel South to the United States.[65] It has taken 30 years to restore the food chain and biological productivity of the British Columbia reservoir waters to pre-dam levels through activities like active water fertilization distributed by ferry transport vessels initiated through the Fish and Wildlife Compensation Program.[66]

The NAWAPA plan, "died a victim of its own grandiosity" according to western historian William deBuys.[67] In addition to demonstrating the great demands that industrial agriculture puts on fresh water supplies, the NAWAPA and other dam and reservoir schemes serve as examples of the tendency to misapply technology by neglecting to recognize its inability to solve large scale problems without triggering commensurate large scale challenges. Currently the peak water situation, largely brought on by industrial agriculture (and urban sprawl) in the South and Southwestern United States continues without signs of resolution, running on a proverbial "credit line".

3.4 The State of Alberta's Water

Although Glaciers hold the majority of the available fresh water left in North America (outside of the great lakes), their abundance is ebbing as shown by consistent stream flow declines.[68] The Athabasca glacier, part of the Columbia Ice field, known as "Canada's hydrological apex" located along the Ice fields parkway between Banff and Jasper has retreated more than 1.5 km from where it once was in 1887.[69] Shawn Marshall of the University of Calgary, Alberta and Michael Demuth of the Geological Survey of Canada are in the midst of a four year survey to determine what the current rate of melt is and more accurately model the future of the water supply. What is currently known is that the retreat of the glaciers has "really accelerated" in the last 30 years and that the coming changes that will result, "are likely to have a far more damaging and exponentially more costly effect on our economy and quality of life than we presently anticipate".[70] As many as 300 glaciers have disappeared in that time.[71] Shawn Marshall's research predicts that the area covered by remaining glaciers will be reduced by 82% by the year 2100 which may mean that a hydroelectric dam may be the only alternative to preserve their reservoir function as these frozen fresh water assets melt.[72]

This contention is widely supported by Canadian researchers, scientists and economists involved in the further quantification of the future of Canadian fresh water reserves. Seventy-Five percent of Alberta's glacial ice/water storage feeds the headwaters of the North Saskatchewan, (Edmonton's water source), and Athabasca rivers.[73] Although consensus is that the research at hand is not comprehensive and a much more wide ranging and detailed study of

[65] (Wikipedia, 2013)
[66] (Fish & Wildlife Compensation Program Columbia Basin)
[67] (deBuys, 2013, p. 329)
[68] (Parks Canada)
[69] (Rood, Samuelson, Weber, & Wywrot, 2004)
[70] (Derworiz, 2012)
[71] (Derworiz, 2012)
[72] (Derworiz, 2012)
[73] (Marshall & White, 2010, p 49)

the glacial reserves is needed, some of the best historic data currently available in in the world showing the behavior of the mass balance of glaciers over an extended period of time has come from the monitoring equipment installed in 1966 at the Peyto Glacier in Banff National Park.[74] Surveys conducted between 1985 and 2005 have shown a 25% reduction in glacial area from 1053 km^2 to 786 km^2 in a 20 year period for the glaciers that feed Alberta's fresh water supply.[75] Since 1966 the yearly snow / ice accumulation measurement has shown positive growth on just five occasions.[76]

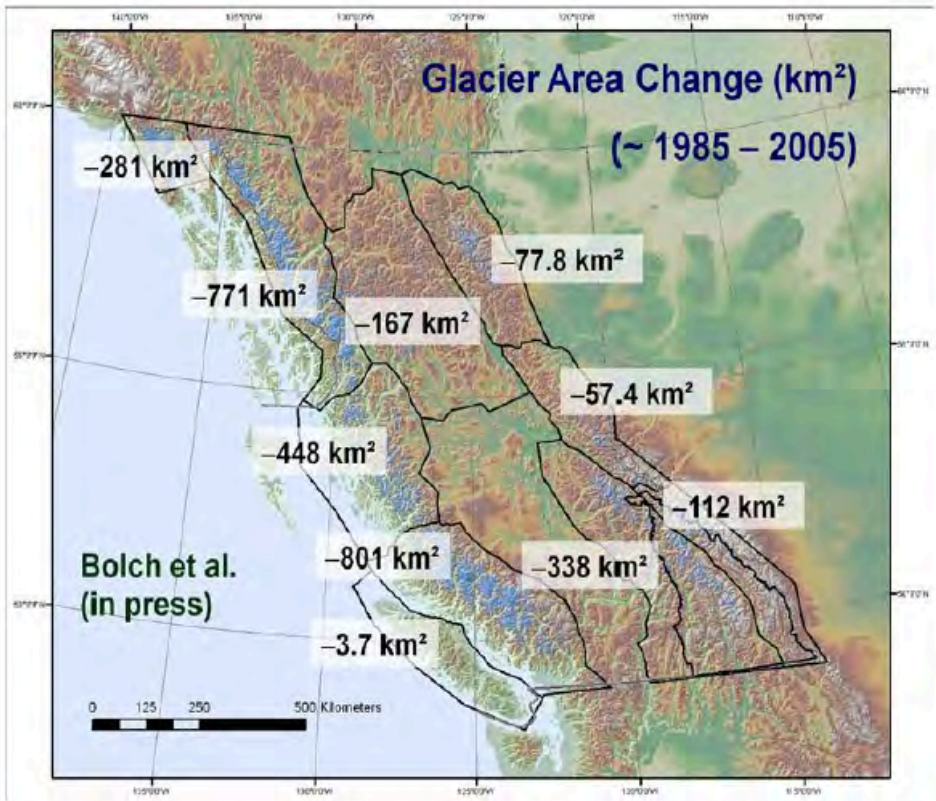


Figure 11. Changes in glacier area in major glacioclimatic regions of B.C. and Alberta from 1985 to 2005.

Figure x – Change in the size and volume of the Athabasca Glacier over time. http://www.ecorevolution.it/ita/pho/gb.html, Downloaded December 8, 2013

[74] (Marshall & White, 2010, p 31)
[75] (Marshall & White, 2010, p 29)
[76] (Marshall & White, 2010, p 32)

Figure x – Change in the size and volume of the Athabasca Glacier over time. http://www.ecorevolution.it/ita/pho/gb.html, Downloaded December 8, 2013

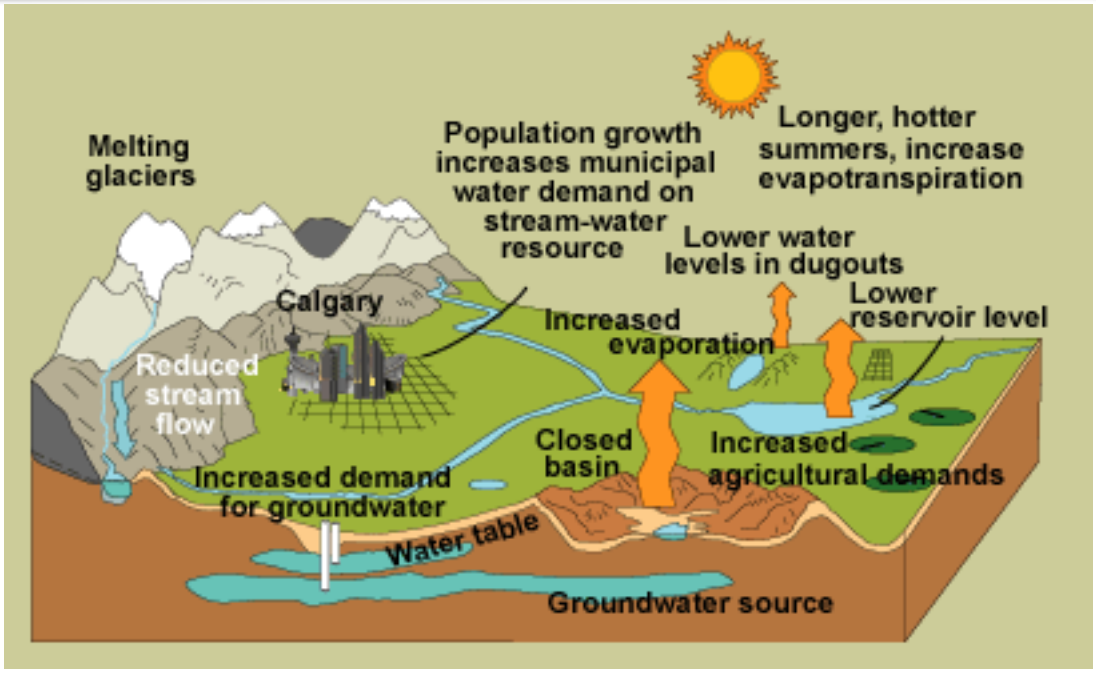


Figure x – Glaciers and water cycle on the Alberta Prairie. http://www.nrcan.gc.ca/earth-sciences/climate-change/community-adaptation/poster/746, Downloaded November 13, 2013

Falling fresh water reservoirs can also be witnessed on the Alberta landscape. Several Alberta lakes including Beaverhill Lake, Cooking Lake, Isle Lake, Miquelon Lake, Muriel Lake, and Wizard Lake have experienced moderate to severe water level loss with up to three years of consecutive water losses.[77] Other lakes, such as Skeleton Lake have been in conflict with local industry and the town of Boyle over water use, which has drastically reduced lake levels.[78] Several lakes in Elk Island National Park have completely dried up and Astotin lake, the biggest lake in the park, has been cut off from its historic stream supply by development downstream and is in danger of drying up which will have significant negative repercussions for the National Park.[79] The Beaverhill watershed, which is responsible for the water into Elk Island Park, is impacted by urban development decisions, including the development of roads and wetland disturbance, in Edmonton and Sherwood Park.[80]

With use allocations of average natural recharge hovering between 30-90%[81] and ample groundwater resources[82], overall Northern Alberta and Edmonton should remain water secure for many decades to come with ample reserves in the proverbial bank. The drain on these capital reserves however is evident and trending down, which means that planning, and

[77] (Government of Alberta, 2013)
[78] (Skeleton Lake Stewardship Association (SLSA))
[79] (Parks Canada, 2010, p 10)
[80] (North Saskatchewan Watershed Alliance)
[81]
[82]

stewardship, including enshrining new attitudes to water use and conservation are necessary to foster long-term water anti-fragility.

Natural capital as it relates to water quantity in Alberta is one of two facets of water issues with quality in the form of Eutrophication being the other. Eutrophication in Western Canada is a growing issue, which is putting stress on the aquatic food chain and is largely the result of agricultural development and poor watershed planning.[83] Green plants are the base of the food chain and through photosynthesis, provide food for other organisms.[84] Their abundance determines the productivity of all higher levels of the food chain and originates from the presence of the building blocks for photosynthesis, Phosphorous and Nitrogen.[85]

Known as algae, they present themselves as three distinct types: Phytoplanktons (diatoms, chrysophytes, cryptophyes, Dinoflagellates), green algae (chlorophytes) and blue-green algae (cyanobacteria). Cyanobacteria, or blue-green algae are inedible to organisms and are generally toxic to humans and animals.[86] Although algae provide food for many forms of animal aquatic life, inordinately high levels of algae, which eventually decay at lake bottoms, consume dissolved oxygen in water which results in suffocation of fish, the top layer of predators in the aquatic food chain.[87] In both aquatic and terrestrial species, the loss of top predators or "keystone species" are central the healthy ecosystems and without them, collapse is the eventual result.[88]

Healthy ecosystems are the basis for all life making preservation of their natural order and balance imperative for human civilization, particularly urbanization.

[83] (Schindler & Vallentyne, 2008, p XI)
[84] (Schindler & Vallentyne, 2008, p 1)
[85] (Schindler & Vallentyne, 2008, p 1)
[86] (Schindler & Vallentyne, 2008, p 8)
[87] (Schindler & Vallentyne, 2008, p 3)
[88] (Botkin, Keller, & Heathcote, 2006, p 99)

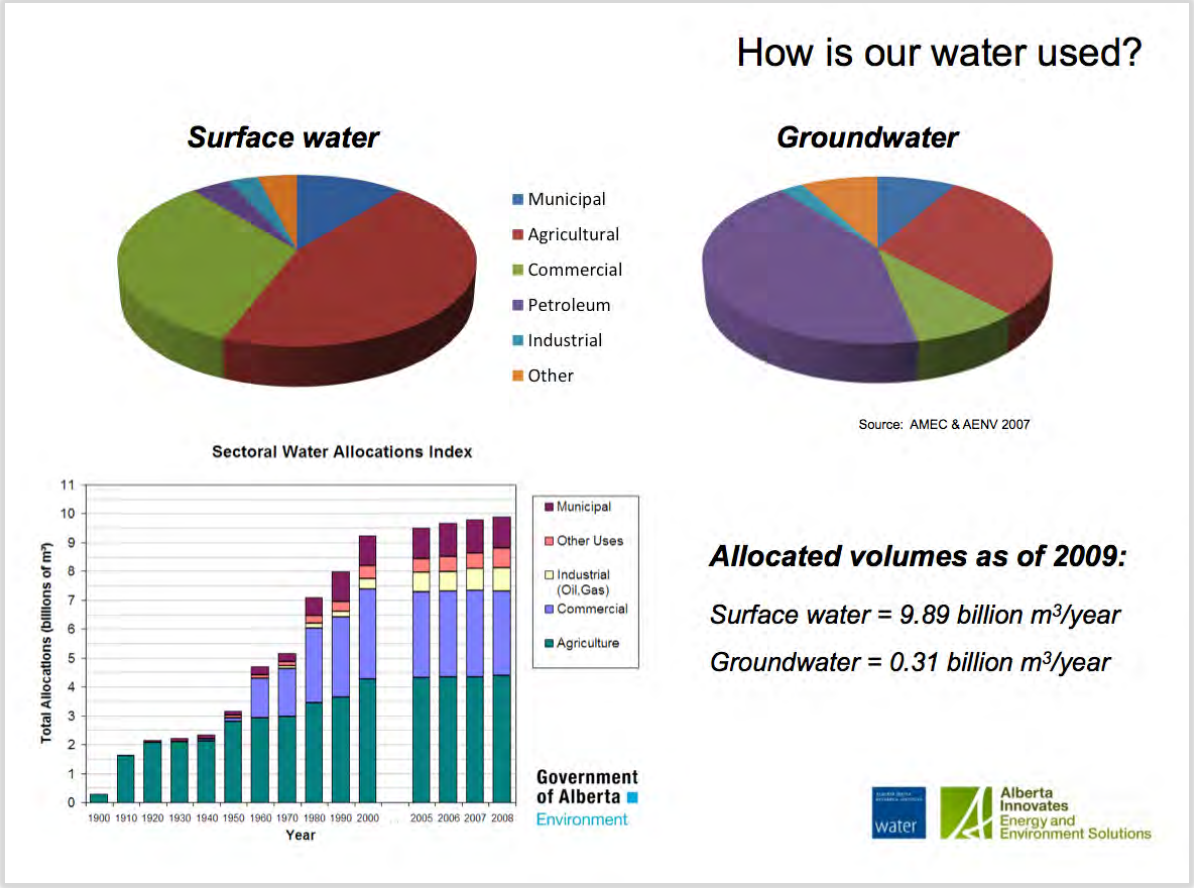


Figure x – Water level status of Alberta lakes from Environment and Sustainable Resource Development. http://environment.alberta.ca/01719.html, Downloaded December 8, 2013

In Southern Alberta, water security is already an acute concern and the subject of ongoing contested debate between government water licensing bodies, local stewardship groups, farmers and municipalities.

Due to the economic boom and associated population growth, streams and lakes South of the Red Deer River Basin were closed to new water withdrawals in 2006.[89] This nearly derailed the 1.5 billion dollar Cross Iron Mills development, which included a new horse racing track and retail shops, as its' water demands could not be satisfied while surrounding districts such as the municipal district of Rocky View could themselves not secure enough water for their citizens.[90] Local farmer Fred Munchrath was quoted during public hearings, "Water is going to be the next oil".[91]

[89] (D'Aliesio, Tapped Out: Water Woes, Part One, The clash over Alberta's water, 2008)
[90] (D'Aliesio, Tapped Out: Water Woes, Part One, The clash over Alberta's water, 2008)
[91] (D'Aliesio, Tapped Out: Water Woes, Part One, The clash over Alberta's water, 2008)

Lake	Ranking of Annual Lake Levels								
	2004	2005	2006	2007	2008	2009	2010	2011	2012
1) Baptiste Lake	N	BN	N	AN	BN	MBN			
2) Bear Lake	N	N	MBN	AN	BN	n/a	n/a	MAN*	N*
3) Beaverhill Lake	MBN	n/a	n/a	BN	MBN	n/a	MBN	n/a	n/a
4) Calling Lake	AN	AN	N	AN	N	N	N	N	BN*
5) Cardinal Lake	N	MAN	N	MAN	MAN	n/a	n/a	BN*	BN*
6) Chip Lake	N	AN	BN	AN	N	N			
7) Cooking Lake	BN	BN	BN	BN	MBN	MBN	MBN	MBN	MBN
8) Fawcett Lake	N	N	N	N	N	BN	BN	N	BN*
9) Gregg Lake	N	MAN	N	N	AN	n/a	n/a	n/a	AN*
10) Gregoire Lake	AN	MAN	AN	AN	AN	AN	AN	AN	MAN*
11) Isle Lake	N	N	BN	N	MBN	MBN	MBN	AN	
12) Lac La Biche	N	AN	AN	N	N	AN	N	N	N*
13) Lac Ste. Anne	BN	N	BN	AN	N	BN	MBN	BN	N*
14) Lake Athabasca	N	AN	N	N	N	N	BN	BN	N*
15) Lake Claire	AN	MAN	AN	AN	AN	N	N	N	N*
16) Lesser Slave Lake	N	AN	BN	AN	AN	N	BN	AN	AN*
17) Little Fish Lake	n/a	n/a		n/a	BN	MBN	n/a	n/a	
18) Marie Lake	MAN	AN	N	MAN	AN	N	MAN	MAN	
19) Miquelon Lake	BN	BN	MBN	MBN	MBN	MBN	n/a	MBN	MBN
20) Muriel Lake	BN	BN	BN	BN	MBN	MBN	MBN	MBN	MBN*
21) Obed Lake	N	N	BN	n/a	N	n/a		n/a	n/a
22) Pigeon Lake	MBN	N	BN	N	N	MBN	MBN	N	N*
23) Pine Lake	BN	MAN	AN	AN	N	N	AN*	N*	n/a
24) Rock Lake	N	AN	BN	N	BN	n/a		AN*	n/a
25) Shiningbank Lake	MBN	N	N	N	MAN	n/a	n/a	AN*	N*
26) Sturgeon Lake	AN	AN	BN	N	BN	BN	MBN	AN	
27) Sylvan Lake	BN	BN	N	AN	MAN	AN	AN	MAN	MAN*
28) Utikuma Lake	MBN	MBN	BN	N	AN	N			
29) Wabamun Lake	MBN	N	N	AN	N	N	BN	N*	N*
30) Wizard Lake	N	N	N	N	MBN	MBN	MBN	AN	N
31) Wolf Lake	AN	AN	N	N	N	BN	N	AN	

Legend: N-Normal Condition, BN-Below Normal, MBN-Much Below Normal, AN-Above Normal, MAN-Much Above Normal, n/a - Not Enough Data, Blank-Data has not been reported, *Data Considered as Preliminary

Alberta Environment and Sustainable Resource Development

Figure x – Water level status of Alberta lakes from Environment and Sustainable Resource Development. http://environment.alberta.ca/01719.html, Downloaded December 8, 2013

Figure x –Algae bloom and Eutrophication is prevalent in the United States, http://www.thesudburystar.com/2013/09/27/blue-green/algae-detected-in-lake-nepawassi, Downloaded December 8, 2013

Figure x – Image from online article, "Lake Erie's Toxic Algae Bloom Seen From Space: Green Scum Rampant In The Great Lakes, Posted October 14, 2013. http://www.huffingtonpost.com/2011/10/14/lake-eries-toxic-algae-bloom_n_1010902.html, Downloaded November 13, 2013.

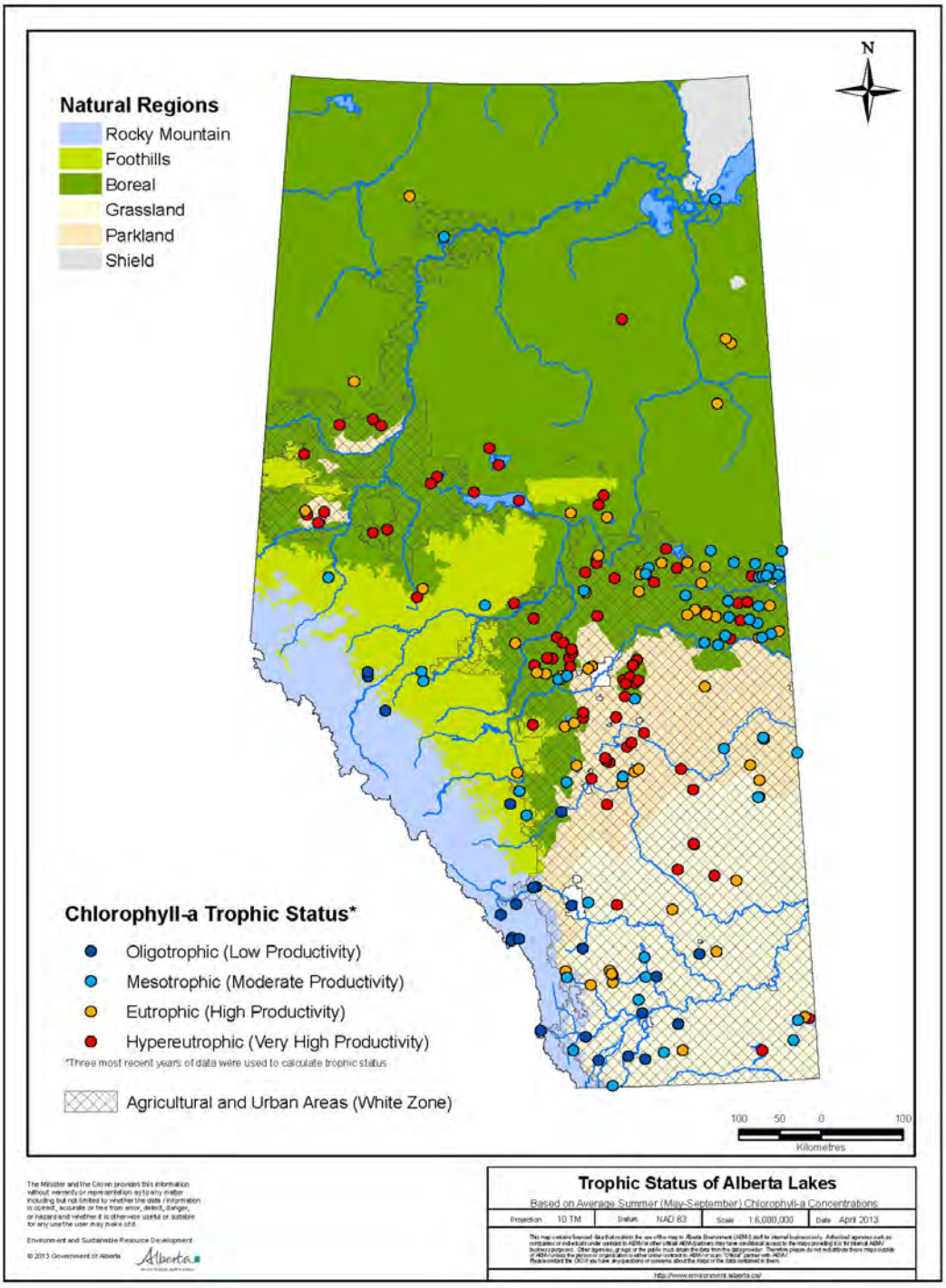


Figure x – Lakes with high Trophic Status and correspondence with Alberta's white zone (Agriculture and Urban development), image from Government of Alberta Website. http://www.ecorevolution.it/ita/pho/gb.html, Downloaded December 8, 2013

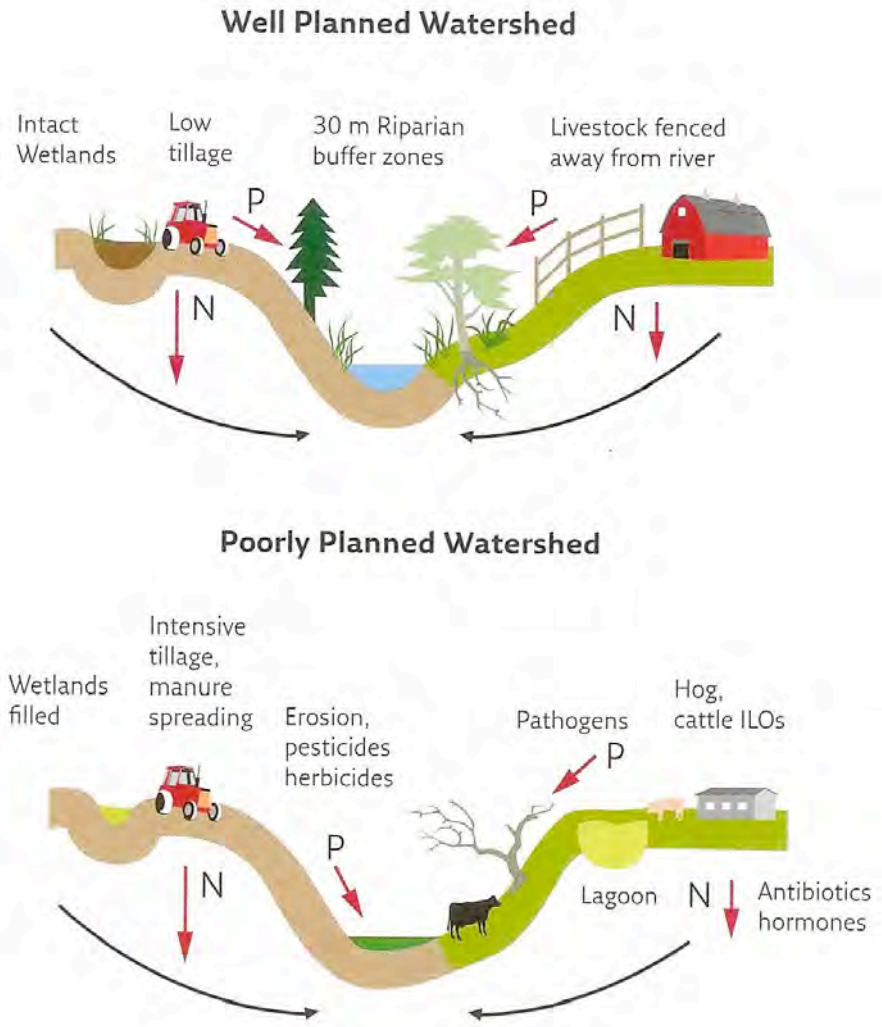


FIGURE 10.9: *Top: A well-planned watershed, where wetlands and riparian zones are protected, and various measures are used to keep nutrients from reaching lakes and streams. Bottom: The traditional way of treating a watershed, allowing development and agriculture to develop without any thought to water protection, is still generally used, because the science to support change is ignored by those who make land-use decisions.*

Drawing by Brian Parker and Lara Minja.

Figure x – Although generically prescribed under LEED®, urban planners need an interdisciplinary approach, consulting watershed experts to understand the effects of zoning and development on watershed management and wetland protection and its importance to water quality and biodiversity maintenance. Image excerpt from page 332, The Algal Bowl, Overfertilization of the World's freshwaters and Estuaries.

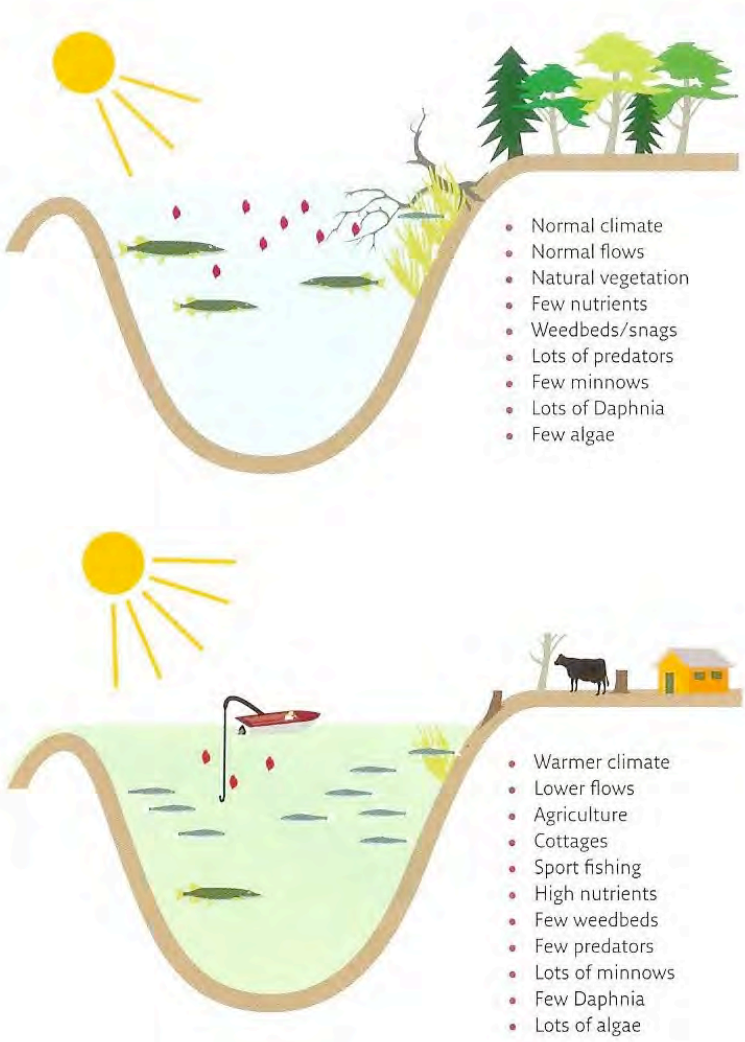


FIGURE 10.8: *A depiction of the cumulative effects of nutrient loading, land-use change, climate, and overfishing on the eutrophication of lakes. Top: A natural lake, with abundant top predators, normal water residence time, a catchment protected by natural vegetation, and normal climate. Note the clear blue water, the result of abundant zooplankton (represented here by* Daphnia, *the small red symbols). Bottom: The same lake after human habitation, land-use change, and agriculture have increased nutrient loads; overfishing has removed predators; fish habitat has been destroyed; and climate warming has reduced the outflow, causing increased retention of nutrients. Note that the water has become green, as a result of the combined effects, as described above.*

Drawing by Brian Parker and Lara Minja.

Figure x – The algae problem contributing to eco-system break-down in Alberta's freshwater bodies and the resulting the need for increased management of development pressures and improved planning. Image excerpt from page 331, The Algal Bowl, Overfertilization of the World's freshwaters and Estuaries.

To reverse these trends, teach the next generation about the importance of watershed management and incrementally build resilience into cities that will eventually face water restrictions prevalent in many world regions, both urban and rural planning must work hand in hand to develop policies and strategies that will mitigate potential negative impacts. By together focusing on water conservation and filtering via infiltration (vs. collection, transport and artificial treatment) must be coordinated to contribute positively to the health of fresh water bodies, including the problems noted in Alberta.[92] In cities where the majority of surface is hard paved and impermeable, storm water runoff is rarely harvested and simply flows into storm drains and goes downstream. Urban agriculture provides an opportunity to utilize this valuable surplus water capital, which can provide both a storm water management solution and grow food. It can also ensure that water stewardship and conservation garners closer attention and becomes culturally enshrined as a core value to be respected and treated with care by young and old alike.

<insert image of where trees have been cut back inability of land to absorb and retain water for evapotranspiration>

Alberta Urban Municipalities Association (AUMA), in response to Initiatives such as the RAMSAR convention, federal and provincial policies, has begun to process to enshrine the importance of watershed management and water conservation in the urban design realm.[93] The objectives contained in their 2013 Municipal Water Policy paper were to: “Raise the profile and understanding of wetlands; Contribute a municipal perspective to the implementation of provincial wetland policies; Create an enabling environment that facilitates the ability of municipalities to conserve and restore these essential bodies of water”.[94] AUMA states clearly that a new approach to urban water management is needed and recognizes that wetlands “are part of broader hydrological systems and ecosystems. Their ability to store water and provide habitat is connected to and affected by the health of other aspects of those systems. Development around wetlands, particularly that which may alter drainage patterns or encroach on adjacent natural and/or riparian areas, needs to consider this relationship”.[95]

Urban agriculture can contribute positively and closely align with this strategy.

Deployed in sufficient quantity in urban cores, vacant lot gardening and green roofs, urban agriculture keeps harmful fertilizer run-offs away from wetlands, streams and lakes, can contribute to the reduction of urban heat island effect, filter runoff and increase evapotranspiration of surface water assisting the recharge of the freshwater cycle in spite of increasing urbanization.[96]

[92] (Schindler & Vallentyne, 2008, p 273)
[93] (Alberta Urban Municipalities Association, 2013)
[94] (Alberta Urban Municipalities Association, 2013)
[95] (Alberta Urban Municipalities Association, 2013)
[96] (Environmental Protection Agency, 2013)

3.5 Energy Capital Required for Food

- Give debaters point of view – large scale more efficient in $ per ton/mile.

  - Give example of Cuba, contrast current system's dependence on fossil fuels
  - Ships that pass each other in the ocean carrying the same goods in opposite directions

- Biofuels pitted against food crops

- Energy and oil input into fertilizer

- Energy required for nuclear remediation

3.6 Forest Capital Lost for Food

- Lungs of the planet in S. America being cut down for cash crops

- African land ownership to feed Arab countries

3.7 Preservation of Natural Capital and Ownership rights

Biodiversity is the cornerstone of the natural world's prolific capacity for adaptation, resilience and continuation. Biodiversity is the basis for healthy food chains on which human beings depend for sustenance. Throughout the world as well as in Alberta, species collapse and extinction is having profound effects on Nature's carrying capacity.

Alberta Einstein was keenly aware of the dangers of natural capital depletion and man's inextricable relationship with the natural world stating, "If the bee disappeared off the surface of the globe, then man would have only four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man".[97]

Bee deaths are on the rise around the world, with many species becoming extinct. Causes linked to the die-off include colony collapse disorder (CCD), overwork from year round pollination, declining nutrition, winterkill, pesticides, viruses and fungal infections. The bee keepers and farmers that depend on bees for their living are sounding the alarm as losses of tens of billions of bees, representing ¼ of the US Bee population are projected to represent losses totaling between 8 and 12 Billion dollars as chronicled in the PBS special entitled "Silence of the Bees – Impact of CCD on US Agriculture".[98] In 2013, Manitoba experienced an unprecedented loss of 46% of the province's bees, Alberta loss of 23% as compared to the previous year's losses of xx[99]

As pollinators, bees are a critical link in the food chain and have some contemporaries in the form of birds and some other insects, but no substitute when it comes to their involvement in

[97] (Einstein)
[98] (PBS, 2009)
[99] (Canadian Association of Professional Apiculturists, 2013)

plant reproductive cycles. In China bee populations have declined to the point that workers must be hired to manually pollinate fruit trees.[100]

Figure x – Photo of dead bee colony, online article, "More Bee Losses Expected This Winter". http://friendsofhoneybees.net/archives/353, Downloaded November 16, 2013

Colony collapse disorder (CCD) remains a mystery with various theories or vectors that may be causing it. Fractured habitats owed to development, high fructose corn syrup diet, artificial insemination, genetically modified crops (which in some cases do not require pollination), singly or in combination are speculated to contribute to the poor nutrition and health of bees making them more susceptible to natural mortality vectors such as winterkill, viruses and fungi.[101] The Monsanto Corporation (parent company of Bayer Crop science) is the world leader in the production of genetically modified (GMO) seeds and related agricultural chemicals including neonicotinoids which the Harvard School of Public Health has directly linked to CCD through repeated experiments.[102] Most disturbing to note is that as far back as the year 1923 this fragility in Bee populations was predicted by Rudolph Steiner, an opponent to the industrialized breeding and application of Bees to commercial agriculture.[103]

[100] (China Daily, 2012)
[101] (Schiffman, 2012)
[102] (Schiffman, 2012)
[103] (Schiffman, 2012)

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Another tragic loss — 37 million honeybees found dead in Canada

7/2/2013

Barely two weeks after 25,000 bees were found dead in a parking lot in Oregon, another round of bee devastation has been reported. This time, the mass die-off was far worse. More than 37 million honeybees were found dead in Elmwood, Ontario, according to beekeeper Dave Schuit, who lost the bees from 600 hives in June. He and many others are pointing to insecticides called neonicotinoids, used in planting corn and some other crops. "Once the corn started to get planted [in Elmwood] our bees died by the millions," Schuit said. After a record-breaking loss of honeybees in the U.K., the European Union banned several pesticides in May, including neonicotinoid pesticides. [Source]

Trending topic: millions honeybees dead | **Click to see more on msnNOW Good**

Figure x – Sample of recent articles chronicling bee mortality increases since 2005. http://now.msn.com/millions-of-honeybees-found-dead-in-canada, Downloaded November 16, 2013

Table 1. Gross Wintering Losses by Province, 2012/2013

Province	Number of Colonies Wintered Fall 2012	Number of Dead or Unproductive Colonies Spring 2013	Percent Wintering Loss (%)
British Columbia	46,746	8,414	18.0
Alberta	282,000	67,116	23.8
Saskatchewan	125,000	33,750	27.0
Manitoba	84,000	38,976	46.4
Ontario	96,384	36,529	37.9
Quebec	50,000	12,000	24.0
New Brunswick	9,348	3,496	37.4
Nova Scotia	19,462	3,316	17.0
Prince Edward Island	6,413	1,788	27.9
CANADA	**719,353**	**205,385**	**28.6**

Figure x – Excerpt from CAPA bee mortality report 2013. http://capabees.org/content/uploads/2013/06/2013-CAPA-Statement-on-Colony-Losses-final.pdf, Downloaded January 26, 2014

Genetically modified crops (GM), in conjunction with a cohort of associated agricultural chemicals and fertilizers have increased land productivity, particularly where the land has become overtaxed and soil quality is poor and pests abundant. Farmers favour the use of transgenic seed because of the higher weed/pest resistance, increased yields, and economic benefits which help reduce traditional variability in yield and quality. Bee mortality however represents only one drawback being experienced as a byproduct of this evolving technology. GM crops and the companies that are pioneering the technology, seemingly distant and peripheral are actually very much at the centre of the struggle for social justice, food sovereignty, food affordability nutrition, health and resilience.

Percy Schmeiser, a farmer in Saskatchewan, Canada, contended that he did not knowingly plant transgenic round-up resistant seed, which he did not pay for, and that plants with GM traits found on his land were the result of seed that had blown over from a neighbor, who was a contract user of Monsanto's GM crop. These crops are immune to the effects of the herbicide Round-up. Round-up is a single application chemical which kills all plant material it immediately touches but is engineered to thereafter become inactive, making it an effective method to control weeds or other plant material that will compete with a cash crop for water and nutrients. Schmeiser's (and many other older farmer's) practice of saving and replanting canola seed that he had been cultivating over many decades was contrary to Monsanto's contractual control over their patented genetic material and they sought, and won, legal penalties against Schmeiser even though not only did he not use round-up on his crop (except for a 3 acre portion of his 100 acre field to test his discovery regarding the change in his plant material) and therefore did not

benefit from the new strain of seed, but it had contaminated the seed strain he had been cultivating, harvesting and replanting for years.[104]

Transgenic seeds are patented technology and therefore subject to complete control by the patent owner which forces farmers to destroy any remaining seed at harvest time and buy new seed in spring from the manufacturer. In the case between Monsanto vs. Percy Schmeiser, the concept of a plant as a higher organism, and therefore not patentable (using the precedent of the Harvard Mouse) was effectively defeated by the Supreme Court of Canada setting an ominous precedent for the ownership of food. The judgment was not unanimous, (a 5 to 4 vote) with the dissenting Justices agreeing that "a reasonable observer would conclude that "gene claims and the plant-cell claims should not be construed to grant exclusive rights over the plant and all of its offspring" and that, "Mr Schmeiser was entitled to conclude that since plants cannot be patented, they fall outside the scope of patent protection"".[105] This defeat, whether intended or not, has established legal precedent that removes any measure of protection against the potential pervasive effects of GM crops on bio-diversity (GM crops, as with other examples of invasive species, out-compete and supplant traditional varieties) and the ownership of whole species, and the ability to derive nourishment from it, will be privately owned.

With this type of control, a hopeful future for these crop species lies then solely with the patent holders moral and ethical discretion. Monsanto, the central figure with respect to GM crops, Round-up herbicide and growth hormones, has unfortunately repeatedly demonstrated questionable business and human ethics. Numerous complaints have come to light where Monsanto has approached farmers with similar contamination issues as Percy Schmeiser and threatened lawsuits unless they agree to pay a monetary penalty and sign a confidentiality agreement forbidding them from any disclosure of the existence of such an offer/settlement.[106]

Currently a battle is raging in the United States over the labeling of foods carrying genetically modified genes which have seen the food industry spend $70million dollars in lobbying efforts to keep labeling voluntary.[107] Monsanto currently holds patent control of roughly 95 percent of all soybeans and 80 percent of all corn grown in the United States.[108] With this monopoly, despite legal anti-trust challenges, they have consistently raised seed prices on corn and soybeans.[109] By logical extension, it can also be assumed that over time as GMO plants exert their invasive traits, and given the legal precedents, that 100 percent of these crops could eventually become controlled by Monsanto.

In Mexico, GM corn crops planted near or within the Mexican border prior to 1988 are demonstrating the triple effect of simultaneous bio-diversity destruction, cultural destruction and societal breakdown. Mexican farmers have a history spanning hundreds of years of selectively breeding, trading and growing a variety of corn crops. Great pride, passed down through

[104] (Clark, 2001)
[105] (Wirz, 2003)
[106] (Clark, 2001)
[107] (Parker, 2014)
[108] (Leonard, 2009)
[109] (Leonard, 2009)

generations, in the care and particular taste and features of various species of corn.[110] The act of sharing seeds, knowledge and ensuring variety is intertwined with their culture. Monsanto forcibly entered the Mexican seed market and has, as in the example of Percy Schmeiser, created a situation where GM corn crops are supplanting traditional varieties and the tradition of saving and trading seeds under threat of legal/monetary penalty. Compounding the problems is the fact that Mexican farmers derive far lower profits from their crops and therefore are not always able to purchase the full suite of accompanying products such as fertilizers and herbicides. The result is that, without the full system being employed, yields and quality are often found to be lower than the traditional crops. Once a Mexican farmer enters into contracts with Monsanto, because of their reputation for employing punitive measures, some Mexican farmers who find themselves on the verge of bankruptcy, have chosen to commit suicide instead of attempt to break ties and return to traditional methods. The problem is serious enough that the Mexican government has recently intervened and banned the use of GM corn crops in the country all together. This undoubtedly is not the beginning of the end in the struggle against corporate control of food, but it is an important example of its destructive potential and the need to establish a balance of choice and resilience against its effects.

[110] (Santini, 2006)

MONSANTO, PIONEER, PROHIBITED FROM MARKETING TRANSGENIC SEED

By Devon G. Peña | Seattle, WA | October 11, 2013

An October 10 press release with Mexico City byline announces the banning of genetically-engineered corn in Mexico. According to the group that issued the press release, La Coperacha, a federal judge has ordered Mexico's SAGARPA (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca, y Alimentación), which is Mexico's Secretary of Agriculture, and SEMARNAT (Secretaría de Medio Ambiente y Recursos Naturales), which is equivalent of the EPA, to immediately "suspend all activities involving the planting of transgenic corn in the country and end the granting of permission for experimental and pilot commercial plantings".

Figure x – Image excerpt from Food Democracy Now post October 11, 2013. http://www.fooddemocracynow.org/blog/2013/oct/11/breaking_mexico_judge_rules_that_GMOs_are_threat/, Downloaded December 8, 2013

World population growth projections indicate ….

3.8 Physical and Mental Health in the Built Environment

The purpose of preserving and proper stewardship of capital, in any form, is a means to an end. That end is usually a form of prosperity. In this case prosperity can be defined as vibrant health as the saying goes that if a man (or woman) does not have their heath, they have nothing.(**CITATION)

Where technology has made significant strides in prolonging life, preventing and curing various diseases, it has also provided side effects that threaten to undermine these health gains. One key example is that atherosclerosis is projected to become the number one disease burden in the world by 2020.[111]

The product of extensive study and research, the medical community is now recognizing the multi-disciplinary approach required to address the growing problem of preventable disease in the developed world. It requires involvement from all quarters of society in addition to the medical profession, including (but not limited to) areas such as architecture, urban planning, engineering, the legal profession, social sciences and government.[112]

Obesity is one of the most obvious examples of these diseases, a product of excess and never before seen chemical environments that mechanization and technology have wrought. Dr. Araya Sharma, Chair of Obesity Research and Management for the University of Alberta, notes that, “One thing we know for sure is that the answer to obesity is far more complex than simply telling people to eat less and move more. It’s much more complex in terms of the biological, societal, and mental health factors that drive obesity. We’re up against root causes that are very much related to evolutionary biology and the environment we’ve created – not just food but things like escalators, elevators and remote garage door openers, everything we’ve done to eliminate physical activity from our lives”.[113]

In addition to conventional medical research, other branches of science have uncovered the presence of a newly classified series of chemical compounds categorized as “obesogens” has come to light. Obesogens are industrial chemicals that come into contact with food or food organisms and exhibit the phenomena of rapid, unexplained weight gain in both animals and humans.

Among the originators of the concept of obesogens was Paula F. Baillie-Hamilton who, in her paper, “Chemical Toxins: A Hypothesis to Explain the Global Obesity Epidemic” noted that the historically significant rate at which the obesity epidemic was occurring was paralleling, “the exponential production and usage of synthetic organic and inorganic chemicals”.[114] Since some evidence existed, as noted for the pesticide dieldrin, for the link, she concluded that the increasing proliferation of synthetic chemicals in the environment could be a “significant causative factor in the current worldwide obesity epidemic”.[115]

[111] (Alberta Health, 2013, Pages 7&11)
[112] (Sharma)
[113] (Sharma)
[114] (Baillie-Hamilton, 2002)
[115] (Baillie-Hamilton, 2002)

Among various other researchers worldwide to confirm the hypothesis for various chemicals in animal test subjects, Dr. Bruce Blumberg and a team of researchers from the University of California Irvine observed statistics that very young children and infants were increasingly noted to be obese and that, "it is unlikely that infants are consuming more calories and exercising less than in the past, so *[ibid]* it is reasonable to hypothesize that the prenatal and/or early postnatal environment has recently changed".[116] Blumberg has proven the link between the chemical Triflumizole (a fungicide and known endocrine disruptor) and the reprogramming of fat cell behaviours in mice leading to abnormal obesity. Blumberg has also raised the concern, due to the genetic nature of the changes observed, that further study is required to determine if the changes are transgenerational, meaning the exposure may not affect just the individual but generations of offspring.[117]

With a mandate and funding from the European Commission, the Obelix project at the University of Amsterdam is one group charged with studying these endocrine disruptors. They are attempting to explain the link and quantify the effects of dioxins, polychlorinated biphenyls, brominated flame-retardants, organochlorine pesticides, phthalates and perfluorinated compounds on the human endocrine system starting in prenatal stages.[118] Research to date by several scientists in the United States, Canada and United Kingdom is pointing to an unexpected link between low levels, thousands of times below currently government and industry stated "safe exposure" levels, of the chemicals and obesity in lab animals.[119]

Figure x – X-ray image of a mouse injected with 1 part per million Diethylstilbestrol (DES), a synthetic estrogen. Image excerpt from research paper, "Developmental Exposure to Estrogenic Compounds and Obesity", National Institute of Environmental Health Sciences, California, January 2005.

[116] (Li, Pham, Janesick, & Blumberg, 2012)
[117] (Li, Pham, Janesick, & Blumberg, 2012)
[118] (The Obelix Project)
[119] (Mohun & Slinger, 2012)

Until science conclusively proves, or disproves, the range, thresholds and mechanisms by which chemicals may be responsible for human obesity and other health effects, it is clear that rebalancing the food system with more traditional methods of food harvesting, distribution and preservation associated with a local food system creates a resilience to their potential outcomes. Local urban food production provides opportunities to increase physical activity and minimize exposure to these chemicals which currently are almost unavoidable in commercial processing and storage of industrially produced food products. The organic quality of the food produced also provides the best opportunity for urban populations to consume the freshest, most nutrient dense, products which are a key to improving health and avoiding obesity.

Biophilia ….

Obesity rates are rising in Alberta. Albertan's average BMI is the third highest among Canadian provinces and as many as 100,000 Albertans are severely obese.[120] Obesity has strong links to other diseases most notably cardio-vascular disease which is a major cost to the health system as noted in a recent call to action by the government of Alberta's Health Minister and Chief Medical Officer of health.[121]

Diabetes is a

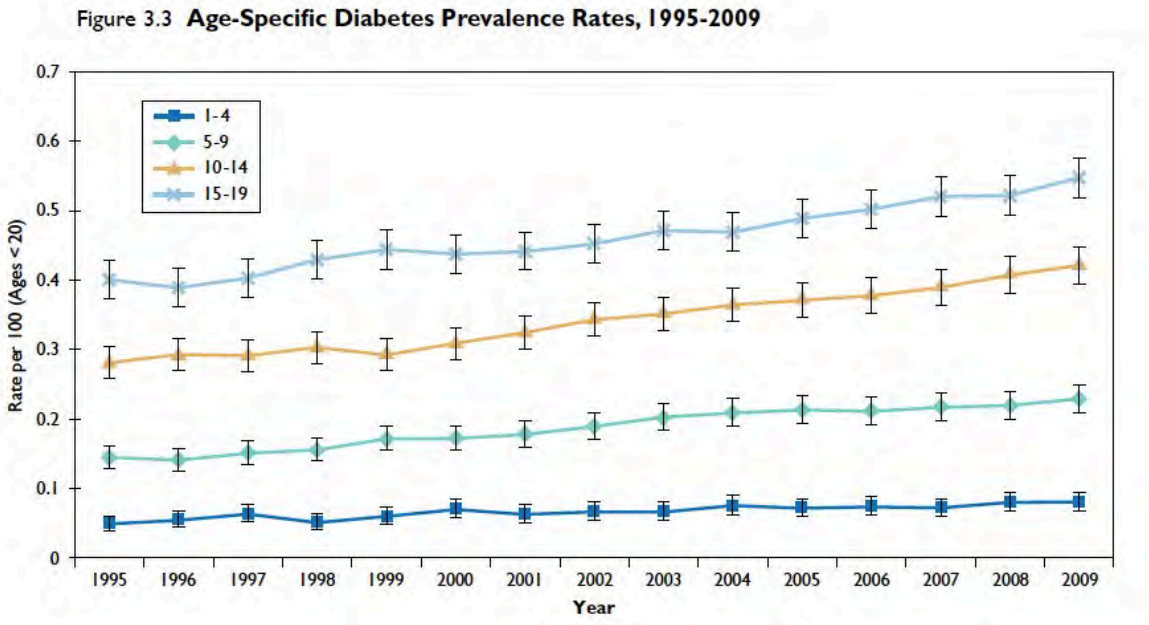

Figure x – Chart for Alberta, Canada, showing child and adolescent diabetes rate of incidence. (http://www.albertadiabetes.ca/AlbertaDiabetesAtlas2011.php, Downloaded November 2, 2013.)

[120] (Sharma)
[121] (Alberta Health, 2013)

Physical challenge incorporated into our daily lives, metaphorically like an exercise wheel in a hamster's cage, is necessary to renew vigor. (Insert ref's to Dr. Doyle-Bakers work – 100 calories when standing vs sitting – route to obesity)

Bone densities relationship to physical challenge and rise of bone related diseases

Activities such as growing food, harvesting, cleaning and marketing provide goals, objectives and economic reward that provides a holistic framework that marries with exercise, social and mental well being.

3.9 Natural Capital Valuation, Resilience and Bottom Up Change

Start out by talking about the potential for Collapse, Dark Age ahead etc.

Explain how everything is interlinked, Edmonton as a world citizen must participate in conservation and resilience to gain a level of self-sufficiency vs. total dependence.

The concept of triple bottom line accounting – Tie back to natural capital introduction and pull more from Hawken, Lovins Natural Capital Book, Upside of Down, Taleb, Resilience thinking.

Assessing a higher cost of natural capital consumed or destroyed permanently, vs. methods designed for sustainable natural capital consumption designed for recycling and reuse.

4.0 PRECEDENTS

4.1 Urban Food Typology

In order to discuss and articulate concepts related to urban food it is necessary to establish definitions and characteristics for different types of urban food growing configurations and elements of an urban food system.

Allotment Garden – A garden that, by way of title, lease or covenant, is assigned to one individual or a small group of individuals. In the United Kingdom, increasing urbanization in the 1800's triggered the need to transition poor rural residents to cities from their former way of life to that of the city. This created the idea of an allowance for allotments enshrined as a civil right with the Allotment Act of 1887. This was based on the idea that providing citizens with an opportunity to garden would prevent idleness and therefore curb general trouble-making. Later the Small Holdings and Allotment Act of 1907 and 1908 was strengthened with stricter guidelines to the extent that if six or more people demanded land for growing food, the town council in the municipality in which they resided would be obligated to grant their request.[122]

Figure x – Photo of British Allotment Garden and Gardener (Allotments: a very British passion - Telegraph, http://www.telegraph.co.uk/gardening/4699817/Allotments-a-very-British-passion.html Downloaded October 20, 2013.)

Apartment Garden - A garden, typically made up of containers of various sizes and styles that are kept by an Apartment dweller. Containers are usually kept on balconies or in the apartment interior. Where architectural style, guidelines and bylaws permit, window planter boxes are used to leverage and maximize growing space. One notable contemporary pioneer in this area is Mark Ridsdill Smith who resides in Newcastle upon Tyne in the United Kingdom. Through social media and the website www.verticalveg.org.uk Mark provides information on all season gardening using just his balcony and window planters to produce fresh vegetables.

[122] (Cockrall-King, 2012, p 114)

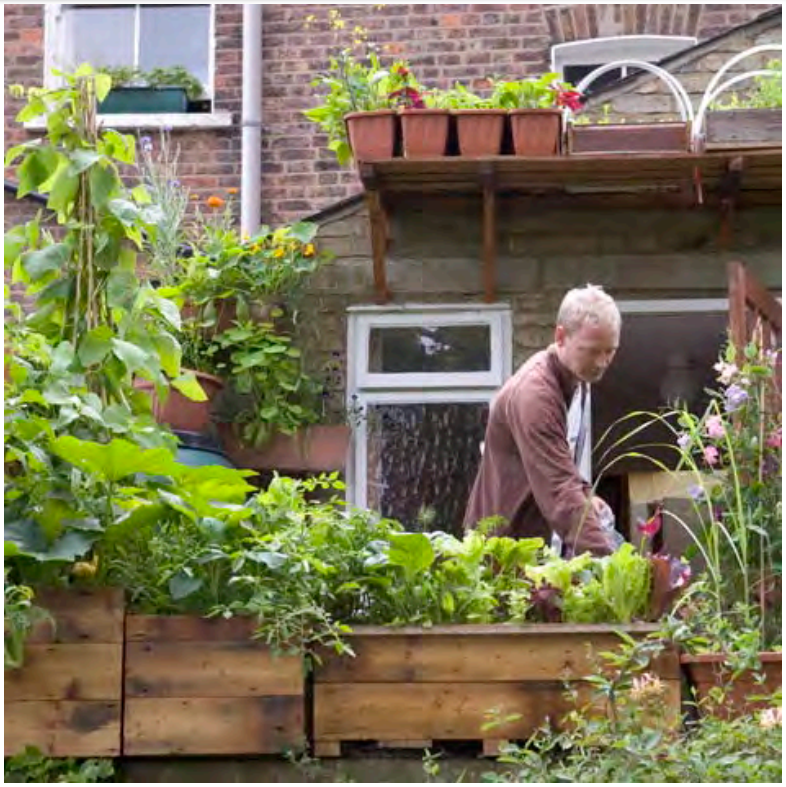

Figure x – Photo balcony planting (http://www.verticalveg.org.uk Downloaded October 20, 2013.)

Figure x – Photo window planting (http://www.verticalveg.org.uk Downloaded October 20, 2013.)

Community Garden – A Garden that is typically on public land (or land owned by a land trust for the specific purpose of community gardening) and is planted, tended and harvested by a community organization, group or club. Community gardens are open and not assigned to individuals.

Figure x – Photo volunteer planting group (http://sustainablefoodedmonton.org/city-of-edmonton-plant-a-row-grow-a-row/ Downloaded October 24, 2013.)

Figure x – Photo of Edmonton Waste Centre's community garden (http://sustainablefoodedmonton.org/city-of-edmonton-plant-a-row-grow-a-row/ Downloaded October 24, 2013.)

Community Kitchen – A kitchen and dining area associated with a Community Garden or Urban Farm. A Community kitchen's central purpose is to provide an opportunity for teaching preservation methods, as well as the basics of properly cooking and preparing whole foods. A secondary purpose is the associated dining area which provides a social gathering function for both casual association and structured functions including knowledge transfer around the planting, cultivating and harvesting.

Figure x – Photo of community kitchen example, Fusion Fellowship, Edmonton, Alberta, Canada. (http://www.fusionfellowship.ca/kitchen.html, Downloaded October 24, 2013.)

Edible Landscaping – General planting areas that are primarily for the purpose of natural/ornamental adornment of a site or building but of which the planting material used is typically from perennial plants such as fruit trees or berry bushes but may also original from annual plantings as well.

Figure x – Photo of lettuce, chard and tatsoi planted in a Victorian garden setting, St. Louis, Missouri, United States. (http:// http://www.gatewaygardener.com/vegetable-gardening/eat-your-landscape, Downloaded October 24, 2013.)

Figure x – Photo of plum tree. (http:// http://pics6.this-pic.com/key/burgundy%20plum%20tree, Downloaded November 1, 2013.)

Interim use Garden – Vacant lot that is typically temporarily leased to urban farmers for planting of a community or allotment garden. Many opportunities exist to make use of land that is transitioning from former to future uses and exploiting these opportunities is important to building opportunity for entrepreneurial farmers and maximizing available growing area and local food output/capacity.

Figure x – Example of vacant lot at 97th Street and 107th Avenue Edmonton, Alberta. (Photo by author, September 28, 2013.)

Figure x – Repurposing of underutilized parking lot on the North side of False Creek Expo lands by Solefood, Vancouver, British Columbia, Canada. (Photo from Vancouver Sun Article, May 10, 2012, http://www.vancouversun.com/story_print.html?id=6602315&sponsor=true, downloaded November 1, 2013.)

Market Hub – A central location for local urban farmers, and interested commercial operations, to bring their produce to market to the general public, supermarkets (typically non-chain supermarkets) and restaurants. Proximity of a Market hub to the target consumers as well as producers is the key to maintaining sustainability. Ideally located relatively close to a city centre and adequate trucking routes. The Ontario Food Terminal (OFT) in West Toronto is one of the only examples in Canada. Instituted in 1954 on a 16 hectare site, OFT includes a 10,000 square metre cold storage area to store produce transitionally.

Figure x – Photo of Ontario Food Terminal Board loading dock. (http://www.oftb.com/photo-gallery, Downloaded October 29, 2013.)

Figure x – Aerial Photo of Ontario Food Terminal Board, Toronto, Ontario, Canada. (http://www.oftb.com/photo-gallery, Downloaded October 29, 2013.)

Figure x – Photo of market at Ontario Food Terminal Board, Toronto, Ontario, Canada. (http://www.oftb.com/photo-gallery, Downloaded October 29, 2013.)

Processing Hub – Like the market hub, the processing hub is a central location for gathering, processing and storage of whole foods. This can be separate from the Market Hub or, ideally, combined with it. In the case of dealing with urban livestock (typically chickens) they must be appropriately slaughtered in a government certified facility observing health regulations in order to ensure public safety and in order to permit commercial sales. The processing hub ideally, as with the Community Kitchen, would provide an instructional function on proper methods for slaughter and storage. A processing hub function, if limited in scope, will typically be fulfilled on a contract basis by local businesses or commercial food processing facilities.

Figure x – Photo of marketing by small scale family butcher operation, Sangudo Meats, Sangudo, Alberta, Canada. (http://www.blog.passionforpork.com/wp-content/uploads/2013/06/Edmonton-20130609-00633.jpg, Downloaded October 29, 2013.)

Roof-top Garden – A garden located on the rooftop of a building. Rooftops constitute a great deal of surface area in heavily Urbanized areas and as such constitute an, as yet, largely untapped resource for growing food. This also contributes to ensuring density as ground level farming can reduce the opportunity for dense business or residential space in the heart of a city. Examples of large-scale organizations include ones like Brooklyn Grange in New York, New York State, United States and Lufa farms greenhouses in Montreal, Quebec, Canada.

Figure x – Brooklyn Grange, New York, New York.
(http://www.brooklyngrangefarm.com/aboutthegrange/, downloaded October 23, 2013.)

Figure x – Lufa farms rooftop greenhouse, Montreal, Quebec. (http://www.montrealgazette.com/life/limit+rooftop+farm+project/7465349/story.html, downloaded October 23, 2013.)

Sub-urban landscape conversion – Method employed to subvert sub-urban lawn landscaping to grow vegetables or fruits. Benefits include reduced need for non-productive pesticide, fertilizer and water use while drawbacks include some additional maintenance.

Figure x – Example of sub-urban residential landscaped area planted with sweet potato plants instead of grass. (https://picasaweb.google.com/heathercflores/FoodNotLawnsOneNeighborhoodAtATime?feat=flashslideshow#5282851657845379970, downloaded October 25, 2013.)

Urban Farm – A garden, potentially including some limited livestock, of approximately six acres or greater. An Urban Farm usually only exists as a pre-existing island of land that has been

grandfathered and remains firmly established based on its historic use with urban development occurring around it over time. An urban farm may be part of learning or other public institution in order to retain is solidity over time. Examples include St. Werburghs City Farm, Bristol, England and Queens County Farm Museum, New York New York.

Figure x – Example of keeping livestock in an urban setting, St. Werburghs City Farm, Bristol, England. (Short film, Bristol and the Rainforest, http://www.icontactvideo.org, downloaded October 23, 2013.)

Figure x – Livestock with adjacent dwellings in the background, St. Werburghs City Farm, Bristol, England. (Short film, Bristol and the Rainforest, http://www.icontactvideo.org, downloaded October 23, 2013.)

Figure x – Site context for St. Werburghs City Farm, Bristol, England. (Google Earth, downloaded October 23, 2013.)

Urban Orchard – An orchard with fruit production within city limits. Apart from dedicated open plots of land, urban orchards provide an opportunity to recapture lost spaces such as boulevards or large setbacks and harness them to increase urban food production. One notable example includes the Urban Orchard Pilot Project which is being undertaken by four CityStudio students in Vancouver, British Columbia, Canada.

Step 3: The Design

We worked with the boulevard's adjacent homeowner, Village Vancouver, a permaculture designer, Engineering and the Parks department to come up with a design for the site that met the needs of all parties involved. We will be planting six dwarf fruit trees, 21 berry bushes, and five nitrogen fixing shrubs, as well as installing a mason bee home and two birdhouses to encourage biodiversity.

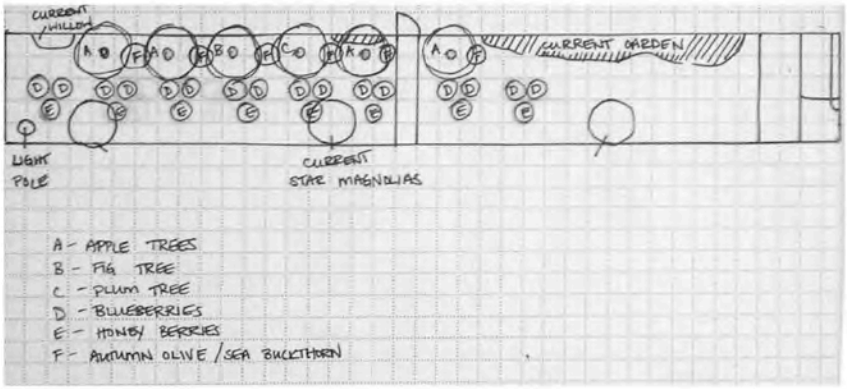

Figure x – Planning Step excerpt from CityStudio's final report on the Urban Orchard Pilot Project, Vancouver, British Columbia, Canada. (http://www.citystudiovancouver.com/wp-content/uploads/2013/01/UrbanOrchardFinalReport.pdf, downloaded November 2, 2013.)

Vertical Farming – Generically, the term refers to growing food in a fashion that maximizes growing material on a minimal footprint. This can be a farm that is constructed vertically using the floor plates of a new or renovated building two storeys or higher. The obvious advantages are the potential to provide greater growing area on a smaller land footprint, which is essential in densely, populated urban areas. Gilbert Ellis Bailey first coined the term vertical farming in 1915 in this book "Vertical Farming".[123] The concept has been recently popularized by Columbia Universities' professor Dr. Dickson Despommier in the book, "The Vertical Farm, Feeding the World in the 21st Century". On a smaller scale, the term can also be growing edible vegetation on a vertical surface such as racking or a green wall as is the case with vendors such as ivertical farm in Tampa Florida.

Figure x – Vertical farm structure example. Structure utilizes passive solar design, photovoltaic solar, wind and geothermal sustainable energy harvesting techniques. (http://www.odesign.com.au/Vertical-Farming.html, downloaded October 23, 2013.)

[123] (Wikipedia, 2013)

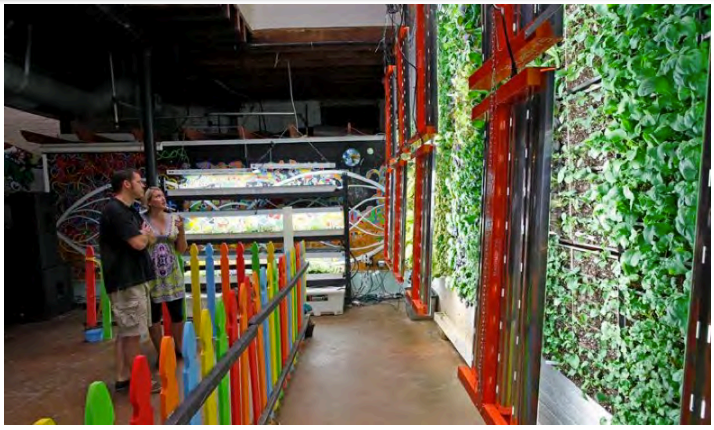

Figure x – Vertical grocery store example, ivertical farm, Tampa, Florida, United States. (http://www.iverticalfarm.com/photo-gallery.html, downloaded October 23, 2013.)

Figure x – Image excerpt from the9billion website, Plantagon Vertical Farm Project, Sweden. (http://www.the9billion.com/2012/02/22/construction-begins-for-plantagon-vertical-farm-in-sweden/, downloaded October 23, 2013.)

Victory Garden – An urban farm or garden created in wartime to augment food production to supplement food supply for both those on the home front and in the field. Victory gardens serve as a historical example of the potential for food scarcity in times of political or economic turmoil and the ability for urban gardens to act as a supplementary food supply when called upon.

Figure x – Example of World War II Victory Garden Poster, United States. (http:// http://www.retronaut.com/2012/09/batmans-victory-garden-c-1939-1945/, downloaded October 23, 2013.)

4.2 Vancouver's Urban Ecology and Food Revolution

Vancouver, the largest city West of the prairies, along with its neighboring communities span xx km2 with a population of xxx which adds up to a density of xx people / km^2 (xx people / $mile^2$).

Inspiration for the great kinship the people of British Columbia have with the environment likely stems from their landscape which gives them a strong sense of place. The remote, difficult to access and untouched stretches of mountainous terrain provide inherent barriers to easy development making deeper contemplation and monetary commitments necessary before attempting transformations on a large scale. The province's native cultures are also relatively strong ensuring that elements of traditional knowledge transfer remain intact which includes a strong connection with the land. Vancouver has also been noted as being one of the most livable cities in the world, being ranked first by Economist magazine for several consecutive

years.[124] This is the contextual environment within which Vancouver has set high goals for becoming the greenest city in the world by the year 2020. In order to reach this goal, an action plan formulated.

Stated on the inside cover the municipal report, “Greenest City 2020 Action plan” Vancouver lays claim to, “greenhouse gas emissions down to 5% below 1990 levels, even as our population has grown by over 27% and jobs have increased by over 18%”, “the greenest building code in North America”, and “shifting investment to walking, cycling and transit infrastructure instead of building new roads”.

The report identifies 10 goals necessary to become the world’s greenest city by 2020. Six of the ten goals relate directly to urban food including: Goal 1: Green Economy; Goal 3: Green Buildings; Goal 5: Zero Waste; Goal 6: Access to Nature; Goal 7: Lighter Footprint; Goal 10: Local Food.

Figure x – Image excerpt from Vancouver’s Greenest City 2020 Action Plan, page 4, Vancouver, British Columbia, Canada. (http://vancouver.ca/files/cov/Greenest-city-action-plan.pdf)

[124] **look up reference for vancouver being ranked #1 in the world – livable city

Goal 1: Green Economy. The action plan specifically indicates local food production, including beverages such as wine, as being identifiable as a "Green Job" which contributes to the green economy and green economy objectives.[125] Other green jobs identified in the plan include, "green roof technician", "drafter and architect" and, "policy analyst and researcher".[126]

Goal 3: Green Buildings. Vancouver's building bylaws require new buildings to be LEED® certified to a Gold rating which, to meet credit quantities, typically will require the inclusion of a green roof which is also encouraged.[127]

Goal 5: Zero Waste. "Food scraps, compostable paper, yard trimmings, and other organics make up about a third of Vancouver's waste stream" according to the action plan.[128] The plan raises the questions of what it will take to achieve zero waste and local food is identified as one key initiative required to do so.[129]

Goal 6: Access to nature. The action plan cites natural landscapes as, "shown to benefit our physical and emotional health by reducing blood pressure, cholesterol, and stress. These spaces also contribute to our sense of community by creating places for recreation activities, for children to play and for neighbours to meet and socialize".[130]

"Your local park, more than meets the eye", prefaces the report's spotlight on biodiversity, going on to point out, "these urban ecosystems also help to clean the air we breathe, absorb rainfall, filter toxins from storm water runoff, provide food for bees and other plant pollinators, regulate temperature and much more. From micro-organisms in the soil to large shade-providing trees, our urban ecosystems help protect the region's plants and animals and also help improve our health and enhance the quality of life that we all enjoy". [131]

Goal 7: Lighter footprint. With respect to lowering Vancouver's ecological footprint, the plan points out, "Vancouver residents use about three times more land and sea resources than our fair share. If everyone lived the way we do, we'd need more than three planets to sustain us". The plan identifies food as contributing 40% to this ecological footprint and endorses local food production as one method of mitigating this ecological impact.[132]

Goal 10: Local food. To encourage local food, the plan's target is to, "Increase city-wide and neighbourhood food assets by a minimum of 50% over 2010 levels". The plan recognizes the need to foster local food not only for its obvious ability to nourish without the need for extensive transport and distribution logistics, but also to protect, "food-producing lands and related biodiversity".[133] A key attribute identified in the report that a local food system needs to have in order to be successful is that, "the majority of residents live within a five-minute walk of a basket

[125] (City of Vancouver, 2012, p15)
[126] (City of Vancouver, 2012, p 24)
[127] (City of Vancouver, 2012, p 26)
[128] (City of Vancouver, 2012, p 37)
[129] (City of Vancouver, 2012, p 38)
[130] (City of Vancouver, 2012, p 41)
[131] (City of Vancouver, 2012, p 45)
[132] (City of Vancouver, 2012, p 48)
[133] (City of Vancouver, 2012, p 65)

of fresh produce. This is in contrast to a corner store that might only carry chips or other packaged food".

Several strategies are also identified as needing to be undertaken to underpin and stimulate a local food system including: Development of a coordinated municipal food strategy, Support for the creation of processing, storage, distribution and waste management infrastructure including associated jobs geared specifically for local food, information hub, network to facilitate equal access to local food and local food advocacy which works at regional, municipal, provincial and national levels.[134]

Food asset growth

FOOD ASSET	CURRENT	2020 GOAL	PER CENT INCREASE
Community Kitchen	69	100	45%
Farmers Market	4	22	450%
Community Produce Stand	3	15	400%
Community Food Composting Facilities	0	5	500%
Community Garden Plots	3,260	5,000	53%
Urban Orchards	3	10	330%
Urban Farms	1	5	400%
Food Hub	0	1	100%
Total	3,340	5,158	54.4%

Figure x – Urban food metric objectives from Vancouver's Greenest City 2020 Action Plan, page 66, Vancouver, British Columbia, Canada. (http://vancouver.ca/files/cov/Greenest-city-action-plan.pdf)

One key community proponent for urban food in Vancouver is Michael Levenston, originator of the City Farmer's website which went live on October 15, 1994. Born and raised in Toronto, he has the unique perspective of wanting to be both an ardent farmer while not being forced to give up the convenience, efficiencies and stimulation of urban life.[135] In 1981 Levenston convinced the city to turn over a 230 square metre (2,500 square feet) piece of land to him for the purposes of establishing a small demonstration urban farm which he has subsequently been tasked by the city to use to educate city residents about composting household wastes.[136] Levenston feels that urban agriculture is part trend, part necessity and will always be a matter of personal choice but notes that sufficient space in the urban landscape has to be provided in

[134] (City of Vancouver, 2012, p 67)
[135] (Cockrall-King, 2012, p 163)
[136] (Cockrall-King, 2012, p 165)

order that it be sufficiently productive to be worthwhile, therefore density must be balanced or properly planned to allow for it.[137]

- Skyharvest

- Rules for Backyard chickens

4.3 Toronto's Urban Ecology and Food Movement

Toronto, with historical monikers such as "Hogtown" and "Cabbagetown", has a food growing heritage, not unlike Edmonton, upon which new traditions can be built and extended from.[138] Since the mid nineteenth century however, Toronto has evolved into the sprawling metropolis of the Greater Toronto Area (known as the GTA) spanning xx km2 with a population of xxx which adds up to a density of xx people / km^2 (xx people / $mile^2$). The GTA can be characterized as being the most highly urbanized region in Canada and therefore can provide important lessons about where Edmonton is heading as its population continues it's rapid growth.

[137] (Cockrall-King, 2012, p 167)
[138] (Cockrall-King, 2012,p 199)

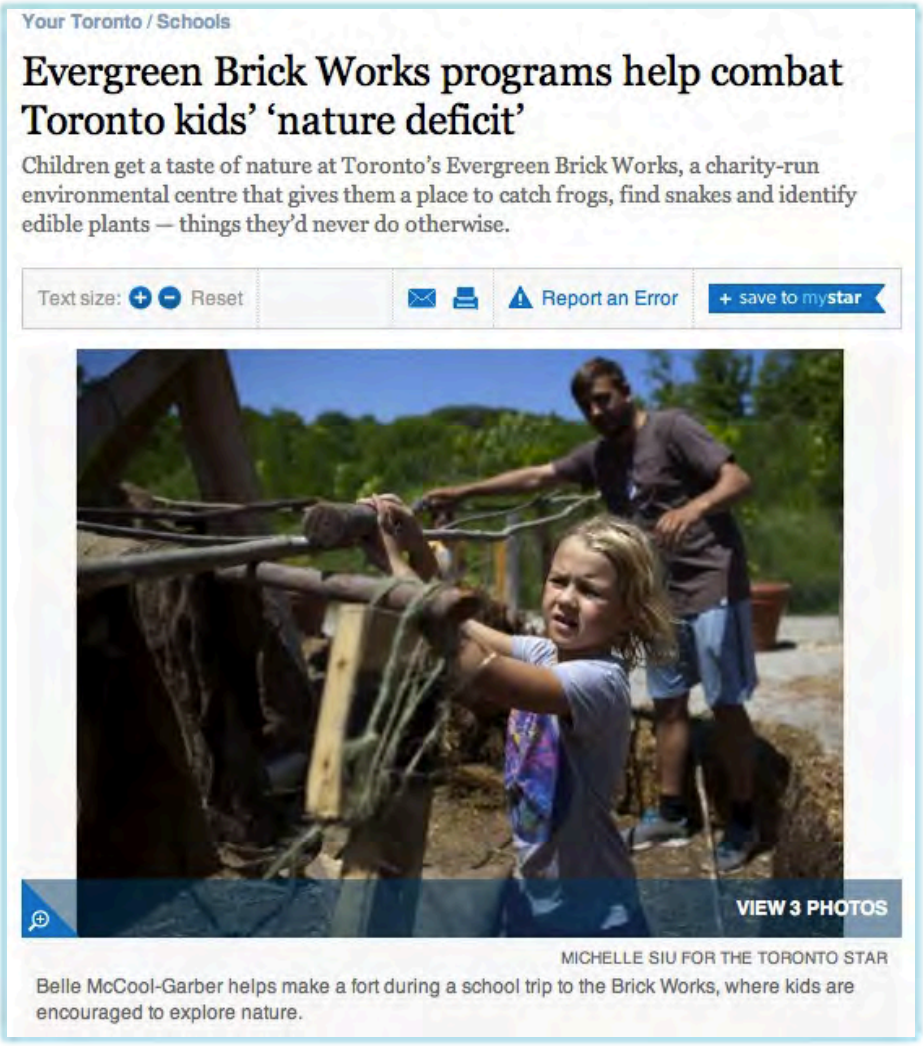

Figure x – Image excerpt from Toronto Star website, Toronto, Ontario, Canada. (http://www.thestar.com/yourtoronto/education/2012/08/07/evergreen_brick_works_programs_help_combat_toronto_kids_nature_deficit.html)

Although Toronto is endowed with numerous natural areas such as High Park gardens and St. James park gardens, a handful of Torontonians have come to realize that perpetuating agrarian heritage and knowledge surrounding the growing of food and its effect on health is in jeopardy and requires active stimulus to ensure vitality. The Evergreen Brickworks in the shadow of Toronto's downtown core is an oasis of nature in the city which provides an opportunity for urban dwellers, particularly youth, to experience aspects of nature and human ecology that would otherwise not exist amongst the impermeable concrete streets and in the shadows of skyscrapers.

Evergreen Brickworks was borne of this desire to set a new example of urban ecology. A brownfield site, the conversion of this former industrial property to a centre of ecological education itself is a model of renewal and exemplar for the possibility for positive change. The 16 ha site of an old brick factory, which at one point sat above a deep open pit clay mine, has

since been partially backfilled and now home to an expansive pond which provides an ecologically important wetland environment supporting biodiversity in relatively close proximity to the downtown core of the city.[139] As both an amenity where things are growing and grown, it is also a location where people can be involved in various forms of engaging physical activity, such as skating in winter and planting in summer.

Figure x – Image excerpt of Evergreen Brickworks site from International Union of Architects website, photo by Du Toit Architects Ltd.. (http://sbd2050.org/project/evergreen-brick-works-3/

[139] (Rushowy, 2012)

Figure x – Image excerpt from International Union of Architects website, photo by Du Toit Architects Ltd.. (http://photos4.meetupstatic.com/photos/event/f/2/a/600_319803882.jpeg)

Figure x – Image excerpt from International Union of Architects website, photo by Du Toit Architects Ltd.. (http://www.where.ca/wp-content/uploads/2012/10/Screen-shot-2012-10-03-at-11.47.jpg)

Sixteen buildings on the site, totaling 16,537m2 in area, have been given heritage status having been built between the 1880's and 1960's.[140] Establishing a centre for ecological education is one method to address the growing problem of nature deficit noted most acutely among youth. Nature deficit is defined as the loss of knowledge and feeling of familiarity humans have with natural surroundings and is the product of being born and raised in an environment almost exclusively limited to concrete and steel with only the sporadic appearance of a tree or patch of manicured grass to provide a hint of the patterns and environment of the natural world. Generations are now being born in Toronto, and other large cities, that have no first hand visual, touch, smell or emotional association or appreciation for the origins of whole food and destinations for waste.[141] Without these connections, clinical sensibilities about living evolve which lead to insensitivity about the impact of personal choices on the ecology of the city and

[140] (Torza, 2011)
[141] (Rushowy, 2012)

impact on the environment in general. Through its site, organizers and programs, Evergreen Brickworks seeks to change this. Children learn about edible flowers, catch frogs and see a deer bed down.[142] Evergreen's garden market provides information about the importance of local plant species, natural pest management and the dangers of invasive species through their garden market and urban gardening workshops.[143] These experiences light the fires of wonder, kinship, the desire to know, and germinates a new conscience which becomes the basis for more ecologically centered habits to moderate the effects of consumptive centered habits.

Although nature deficit is present among the younger generation, a great number of Torontonians, particularly immigrants who remain true to cultural fresh food traditions which desire a diversity of produce not necessarily available commercially, undertake growing their own food in backyards.[144] The city currently sees 40% of its citizens growing some form of garden at home and there are 226 community gardens in the city and the city itself operates 12 allotment gardens that provide 1,674 plots for families or individuals to grow food.[145]

With only 51 percent of residents within one kilometer of a grocery store, Toronto exhibits the phenomena of having food deserts, places where whole food (fresh fruits, vegetables, meat) is not available.[146] Given this reality, the organization FoodShare, which originated in Toronto but has started initiatives like the nation-wide Big Crunch campaign which, "works to build a resilient food system" as noted by author Jennifer Cockrall-King in her book, Food and the City.[147] FoodShare, was formed in 1985 to more holistically address community food security issues manifested in the increasing demands placed on the food bank system.[148] In Ontario, food bank usage since 2008 has shown an overall increase of 19.6% with 35% of people accessing the system being children (this increase includes a -7.1% improvement in 2012-13).[149]

FoodShare works to address this issue using activism, advocacy and community outreach programs and is an example of bottom up change not requiring any government involvement except for non-profit tax status and coordination activities. These programs are numerous (25 in total) but notably include: Big Crunch, a simultaneous bite of fresh apples by children coast to coast; Field to Table Schools program, where nutrition, food growing ecology and cooking knowledge becomes part of the school curriculum; Good Food Box, a non-profit source of local fresh fruit and vegetables; Mobile good food market which, as the name implies, is a vegetable and fruit supermarket on wheels, servicing neighborhoods that have demonstrated fresh food access gaps.[150] One of the important amenities used to serve various programs is its 63 square metre (682 square foot) urban garden and compost facility.[151] This amenity, located in downtown Toronto at the Centre for Addiction and Mental Health (CAMH), is key to the program's success

[142] (Rushowy, 2012)
[143] (Evergreen Brick Works, 2014)
[144] (Cockrall-King, 2012,p 201)
[145] (Cockrall-King, 2012,p 199)
[146] (Cockrall-King, 2012,p 202)
[147] (Cockrall-King, 2012, p 202)
[148] (Cockrall-King, 2012, p 202)
[149] (Food Banks Canada, 2013, p 22)
[150] (FoodShare, 2014)
[151] (Cockrall-King, 2012, p201)

and serves as an excellent example of the holistic benefits urban agriculture can have in the community.

One of the first food banks in Canada, The Stop provides another example of both positive change and the growing need for fresh food access and education to combat hunger and poor nutrition which, although pulling back from record highs of 412,998 people per month, remains higher than demographics recorded in 2008 during the recession of 374,230 people per month with children making up the largest identifiable group at 131,734 individuals per month.[152] The Stop has two locations in the city providing frontline services to the surrounding communities such as, “drop-in, food bank, perinatal program, community action program, bake ovens and markets, community advocacy, sustainable food systems education and urban agriculture”.[153] The Stop offers programs and acts as an educational resource for schools in a similar fashion to Foodshare.

In addition, The Stop has evolved to become a strong centre for advocacy with former executive director Nick Saul (1998) and Andrea Curtis authoring a book chronicling the early days of The Stop and how they strove to change the model where, “a hamper full of canned salt, sugar and fat” and, “wilted and packaged foods were *[sic]* industry castoffs-mislabeled products and misguided experiments that no one wanted to buy” were food bank users only chance to stave off hunger for one more day.[154] This was the genesis for the concept of the Community Food Centre (CFC) model as well as the associated organization Community Food Centres Canada. A CFC is intended to “provide emergency access to high-quality food in a dignified setting that doesn’t compromise their self-worth” and where, “kids get their hands dirty in the garden and kitchen in ways that expand their taste buds and help them to make healthier food choices”.[155]

Figure x – Image excerpt from Community Food Centres Canada, community food centre concept (http://www.cfccanada.ca/images/CFC%20-%20for%20website.jpg)

[152] (King & Fotheringham)
[153] (The Stop Community Food Centre)
[154] (Canadian Food Centres Canada)
[155] (The Stop community food centre)

These Toronto organizations recognize the need to provide not only emergency food, but a healthy diet, particularly to the youngest, to avoid the despair and never ending cycle of poverty that becomes a blight on society.

The keeping of some form of livestock helps round out the dietary variety of food produced in an urban setting. Chickens that provide eggs and, at a mature stage of their lives meat, are a popular method to satisfy protein demand in an urban farming setting. Although illegal, Toronto has an ongoing heritage of keeping urban chickens. An anonymous Toronto urban chicken farmer stated that they can get as many as 18 eggs per week out of three chickens which can be an ample supply of fresh protein for a small family.[156] Residents face a fine of $300 if they are caught harbouring chickens in their backyard but continue to organize and fight to have the bylaw revised.[157]

***TYPICAL CONCLUSION - Add verbage tying back to establishing a healthy, sustainable dense and livable urban form that provides heightened nutritionto the poorest residents …*

4.4 SPIN Farming

Small plot intensive farming (SPIN Farming) was developed by farmers Wally Satzewich and Gail Vandersteen of Saskatoon, Saskatchewan, Canada in association with Roxanne Christensen of Philadelphia, Pennsylvania of the United States in 2006.[158] While simultaneously farming 20 acres of vegetables outside of Saskatoon and a few back-yard plots of vegetables in the city, Wally and Gail realized that the city plots, being intensively planned and planted, were actually more profitable than the rural. They attributed this to factors such as unpredictable environmental conditions on the open prairie such as wind, hail, insects, rodents and deer, as well as transportation and employee costs vs. multiple harvests in the city owing to early planting possible due to the urban heat island micro-climate among other things.[159] They sold the land in the countryside and began expanding their city holdings through purchase or rental of unused backyard gardens which Wally points out provides a much more controlled environment allowing tighter management practices to be applied than could have been with their 20 acre planting which ensure profitability.[160]

It is a business system developed on selling higher quality produce at higher prices which is a different market than food produced by the industrial food chain. Satzewich points out in the pamphlet, “Touching the Soil”, that despite an approach that appears to defy the accepted paradigm that large mass production methods lead to the greatest yields and efficiencies, “While the land base and expenses for a sub-acre farm are a fraction of the costs for a conventional multi-acre farm, the bottom lines are similar. And *[sic]* counter intuitive thought It seems, a sub-acre farmer can expect to make the same living as a large-scale farmer, but with

[156] (Jutras, 2012)
[157] (Jutras, 2012)
[158] (SPIN Farming)
[159] (SPIN Farming)
[160] (SPIN Farming)

less stress and overhead, and with more certainty of success from year to year".[161] The movement boasts over six hundred SPIN farmers operating in various countries around the world.[162] Roxanne Christensen found similar results in her Somerton Tanks farm enterprise in Philadelphia and became a co-creator of the SPIN method bringing her marketing expertise to the team.[163]

◄ An open house at Somerton Tanks Farm. The farm is located on property owned by the Philadelphia Water Department and adjacent to checkered water tanks. With less than one acre of land to farm on, this parcel grossed over $67,000 in 2006.

Figure x – Image excerpt from Touching the soil, you're your job and go farm in the city handout, SPIN Farming website. (http://www.spinfarming.com/common/pdfs/SPIN_Touch_the_Soil_article.pdf)

► Vandersteen harvesting in a rented backyard. This late-spring photo shows how advanced the crops are early in the season. Micro climates in urban areas are generally warmer than in outlying rural areas. This is a real market advantage as Vandersteen and Satzewich have crops weeks before growers from the country have produce.

Figure x – Image excerpt from Touching the soil, you're your job and go farm in the city handout, SPIN Farming website. (http://www.spinfarming.com/common/pdfs/SPIN_Touch_the_Soil_article.pdf)

[161] (Touch the Soil)
[162] (Cockrall-King, 2012, p 189)
[163] (SPIN Farming)

Curtis Stone of Green City Acres in Kelowna, British Columbia, Canada is one example of a successful SPIN farmer. With a start-up investment of $7,000 from which he derived gross earnings of $20,000 in his first six months on an approximately ½ acre of urban land.[164] The SPIN farming website, frequently asked question section, indicates that SPIN farmers will typically gross $50,000 per year per ½ acre of urban land.[165] His market typically included individuals, farmers markets and local restaurants seeking high quality fresh produce. Although his produce in some cases cost three times more than an industrial supply source, his customers found out that by receiving produce such as lettuce the same day it was picked, it would last up to two weeks in a cooler and had more volume and body so that each head actually would go further providing quality on the plate and reducing the up front cost.[166] Accepting testimonials on the SPIN farming website as only select and filtered, marketing material, Curtis Stone represents a tangible example of the success possible by re-deploying empty urban lots in the service of growing food while experiencing the freedom of an entrepreneurial endeavor. It is the profit motive which Stone feels can provide a, "lasting catalyst for change", but what he is most enthusiastic about is that he can combine making a living with his overriding goal, "to show that a sustainable living outside the conventional grocery and industrial food system is possible in a city" and that as a trailblazer he, "needs to succeed in order to inspire other people to follow his lead".[167]

Figure x – Image excerpt from Green City Acres (Curtis Stone) website, Kelowna, British Columbia, Canada, sample of vegetable products available. (http://www.greencityacres.com/get-out-produce/our-csa/)

[164] (Cockrall-King, 2012, p 188)
[165] (SPIN Farming)
[166] (Cockrall-King, 2012, p 187)
[167] (Cockrall-King, 2012, p 188)

SPIN farming in particular benefits from any unproductive or otherwise vacant portions of land that exist in all cities. Whether it is large back yards that residents no longer use, empty strips of commercial land awaiting development, power line or utility right of ways with deep services, they all provide the opportunity for profit, healthy and sustainably grown food and employment.

The crops that are typically grown include leafy green vegetables in various varieties, radishes, tomatoes, potatoes, carrots, celery. In colder climates, all of the above can also be grown in greenhouses.

From experience, Wally Satzewich found that the short growing season in Canadian latitudes made his modestly sized rural property insufficiently large to gain the efficiencies necessary to make a comfortable living, forcing him to adopt the adage, "go big or go home".[168] With only nominal sums required to purchase hand implements, optionally a rototiller and a small truck, little or no cost for land, more consistent climate and extended growing season owing to urban heat island effect, he found that farming in the city could be consistently more lucrative while fulfilling his aptitudes and desire to make a living from the land.

As traditional rural farming currently requires hundreds of thousands of dollars, (and in larger scale operations millions) of capital invested into land, machinery, seed, fertilizer, pesticides, herbicides, crop insurance and fuel, making it well beyond the reach of the average individual or family to simply take up the vocation from scratch. Combined with large-scale competition from industrial farms in Southern climates, this also makes perpetuating traditions of generational farming a daunting and unappealing prospect for the vast majority of farming families today. – find a ref for this. Urban farming, SPIN farming in particular, does away with most of these constraints, operates in a niche market and leaves the individual free to determine what level of scale-up they want to adopt. The SPIN method has been adopted and exported to Ireland, United Kingdom and Australia.[169] In Curtis Stone's case, wanting to be a true exemplar of sustainability, he believes in a "pedal-powered urban farming business" most dramatically demonstrated by his commitment to pulling a four-hundred pound rototiller from plot to plot on his bike.[170]

***TYPICAL CONCLUSION - Add verbage tying back to establishing a healthy, sustainable dense and livable urban form that provides heightened nutritionto the poorest residents …*

4.5 Lufa Farms Montreal

Lufa farms represents a private commercial model that takes advantage of the underutilized resource of urban roof-tops to establish hydroponic greenhouses. Their principal objectives were to develop a green business that would conserve water, be energy efficient, avoid the use of commercial pesticides and compost urban food wastes while directly harvesting and delivering high quality, nutritious, produce to its customers thereby minimizing additional energy traditionally used for refrigeration, storage and transport employed in a traditional system.[171]

[168] (Cockrall-King, 2012, p 190)
[169] (Cockrall-King, 2012, p 180)
[170] (Cockrall-King, 2012, p 189)
[171] (Lufa Farms)

Early on in the conception of the business model, they had to make a choice between traditional methods of soil-based growing or hydroponics. Although, “hydroponics can be environmentally benign” it is felt that since some level of man made, nitrogen-fixing fertilizer such as muriate of potash and super phosphate, which are by definition not organic inputs, hydroponics cannot currently be considered organic.[172] As such Lufa openly concedes that they cannot be considered truly organic (growing without the assistance of any modern synthesized materials) but by recycling 100% of their water and minimizing their artificial inputs to the greatest extent possible, they are striving to achieve a similar level of sustainability and purity in their process and product as what a certifiably organic crop would be.[173]

With their first installation on the roof on an older building at 1400 Antonio Barbeau in Montreal, Quebec, Canada, they seek to produce vegetables for customers within a 24 km (15 mile) radius of their business.

The greenhouse is 2,880 m^2 (31,000 ft^2 or 0.71 acre) in size and being located on the top of an occupied, environmentally conditioned (heated in winter) building the greenhouse takes advantage of both the temperature moderating effects provided by the urban heat island effect of the city as well as roof heat rejection from the building. In winter the greenhouses are supplemented with heating equipment that is natural gas fired, but energy use and costs are kept to a minimum by the aforementioned benefits afforded by the location as well as an automated semi-transparent curtain system deployed at night, when the heating demand is the greatest, to provide additional insulation.[174]

In 2013 they also constructed a 3,995 m^2 (43,000 ft^2 or 0.99 acre) greenhouse, 30% larger than the Montreal facility, on top of a new warehouse.[175]

They produce 453 kg (1,000 lbs.) of food per day feeding 3000 subscribers on a weekly basis.[176] This works out to 638 kg / acre production per day (1,407 lb./acre/day). The investment to set up the original location cost $2,000,000.[177] Although still in their infancy as a company, their operation in a Northern latitude and continued existence and profitability serves as both an example and template for urban food growing opportunities

Lufa Farms was listed as a finalist in global accounting and business management company Ernst & Young’s (EY Canada) Quebec entrepreneur of the year awards. Ernst & Young point out that, “The future of job creation is set to come not from big corporations or government, but from entrepreneurs who represent 66% of job creation within the OECD and 85% within the EU”.[178] The finalists were selected based on criteria which included, “their vision, leadership,

[172] (Jannasch, 2008)
[173] (Lufa Farms)
[174] (Lufa Farms)
[175] (Lufa Farms, 2013)
[176] (Immen, 2013)
[177] (Immen, 2013)
[178] (Ernst & Young, 2013)

financial success and social responsibility".[179] Like SPIN farming, Lufa Farms is therefore an example of grass roots level change and innovation that can come from an urban food model.

4.6 CUBA – Agriponicos

The agricultural system in Cuba provides many lessons for the value of pre-planning resilience (or anti-fragility) in urban areas. When the country's political ties and economic trade collapsed with the Soviet Union after the fall of the Berlin wall in 1989, Cuba's systemic dependence on imported oil became its Achilles heel in terms of crippling its ability to produce food using conventional large scale, monocrop methods. With a 70% drop in fertilizer and pesticide imports and a 50% drop in oil imports, the ability to provide the inputs for large farms was drastically reduced almost overnight.[180] Cubans endured significant hardships and were forced to reinvent their system for the growing, harvesting and distribution of food.

The government directed the curriculum and research of entire Universities in Cuba to be re-oriented towards agroecological research and a strong emphasis was placed on development of local food production to decentralize and minimize the need for transport of fresh food.[181] As a result, cereal production increased 83%, vegetable production quadrupled between 1994 and 1999 and a 60% increase in bean production and 100% increase in citrus fruits resulted meaning that Cuban's had 2,580 calories per capita available for consumption per day which was close to the minimums recommended by the World Health Organization, despite being the second poorest country in the Americas.[182]

It is the unique approach developed by the Cuban scientists to several traditional problems of pest control, disease control and fertilization that present working examples of alternatives to traditional farming methods and inputs. By using a variety of biological (as opposed to chemical) agents such as soil bacterium (Bacillus thuringiensis) predatory ants, parasitic flies and "Biofertilizers" in the form of composted animal wastes, as well as Rhizobium bacterium and Azotobacter which fertilizes crops and assists the fixing of nitrogen necessary to plant health of many non-legume crops, Cuban agriculture has achieved independence from modern commercial inputs and their negative effects.[183] To bolster soil fertility, intercropping and crop rotation, as opposed to monocropping, is used to ensure the soil is able to recover some of its fertility in between growth and harvest cycles.[184]

Cuba also developed an alternative to the corner supermarket, the Organoponico. They are a combination of both an urban farm with a connected "retail kiosk" attached to eliminate middle men associated with a traditional North American buying system, delivering fresh produce

[179] (Ernst & Young, 2013)
[180] (Zepeda, 2003)
[181] (Zepeda, 2003)
[182] (Zepeda, 2003)
[183] (Cuba's Agricultural Revolution:A Return to Oxen and Organics)
[184] (Desarrollo Alternativo A.C. Desal)

directly to consumers in a decentralized fashion, in close proximity to where they live fulfilling the mandate of the reduction or elimination of the energy demand for transport.[185]

Author Jennifer Cockrall-King visited Cuba in both 2007 and 2010 and carefully recorded her first hand accounts of the experience as other documentation about Cuba and its food revolution is notably scant citing an article by Bill McKibben, “The Cuba Diet: What Will You Be Eating When the Revolution Comes?” in Harper’s magazine in 2005 as being one of the few mainstream media outlet reports accounts of the trying circumstance the Cuban people found themselves in.[186] She noted that despite the revolution in production, rationing was still necessary and the system was difficult and labour intensive and yet the Cuban people she met were generally felt a keen sense of purpose to its continuation and expansion.[187]

Cuba also developed an alternative to the corner supermarket, the Organoponico. They are a combination of both an urban farm with a connected “retail kiosk” attached to eliminate middle men associated with a traditional North American buying system, delivering fresh produce directly to consumers in a decentralized fashion, in close proximity to where they live fulfilling the mandate of the reduction or elimination of the energy demand for transport.[188] Organoponico’s also contribute to the city’s ecology by becoming decentralized repositories for food and other biological wastes which reduce the amount of waste that requires trucking to a disposal facility, as well as providing islands of permeable landscape which directly harnesses fresh water in the form rainfall to grow food while simultaneously reducing the volume, and therefore capacity, of storm water that municipal systems need to handle.

Author Jennifer Cockrall-King visited Cuba in both 2007 and 2010 and recorded her first hand accounts of the experience as other documentation about Cuba and its food revolution is notably scant citing an article by Bill McKibben, “The Cuba Diet: What Will You Be Eating When the Revolution Comes?” in Harper’s magazine in 2005 as being one of the few mainstream media outlet reports accounts of the trying circumstance the Cuban people found themselves in.[189] She noted that despite the revolution in production, rationing was still necessary and the system was difficult and labour intensive and yet the Cuban people she met were generally felt a keen sense of purpose to its continuation and expansion.[190]

[185] (Cockrall-King, 2012)
[186] (Cockrall-King, 2012, p 183)
[187] (Cockrall-King, 2012, p 305) (City of Vancouver, 2012)
[188] (Cockrall-King, 2012)
[189] (Cockrall-King, 2012, p 183)
[190] (Cockrall-King, 2012, p 305)

***TYPICAL CONCLUSION - Add verbage tying back to establishing a healthy, sustainable dense and livable urban form that provides heightened nutritionto the poorest residents …*

5.0 APPLICATION

5.1 Evolution in Urban Planning – Multi-disciplinary Approach

As natural systems become ever more taxed and world population increases Architectural and Urban designers and planners will be called upon to increase their scope of practice and expertise in order that these problems be managed and addressed as our cities and buildings are designed and built to ever increasingly be more efficient and address an expanding suite of problems posed by density.

The relationship of food and patterns of human ecology has a direct relationship to how cities grow making the need for cities to increasingly find ways to become denser but at the same time habitable, enjoyable, healthy and resilient. How to achieve these goals all while generating a lower ecological footprint regionally, as well as globally, must gain greater emphasis in urban design discourse.

Architecture, Urban Planning and Landscape Architecture have all historically associated and collaborated to solve built environment issues. New linkages to professional Agronomists, Apiculturists, Bio scientists, Chemists, Climatology, Ecologists, Economists, Energy Producers, Epidemiologists, Health Sciences, Kinesiologists, Psychologists, Meteorologists, Physicists and Politicians (to name only a few) must be forged in order to realize synergies and incorporate them in the execution of design solutions. Problems such as the quality and cost of food available to citizens, the obesity epidemic, nature deficit, youth development, entrepreneurial opportunities (through re-purposing of underutilized urban land), preservation of natural areas, preservation of prime farmland, and resilience to food supply shocks all have solutions and a multiplicity of relationships to urban planning and the built environment. Without engagement of other disciplines, design evolution takes place in a vacuum of otherwise apparent knowledge, meaning targeted, adaptive and well-tailored solutions of substance will be unlikely to be achieved.

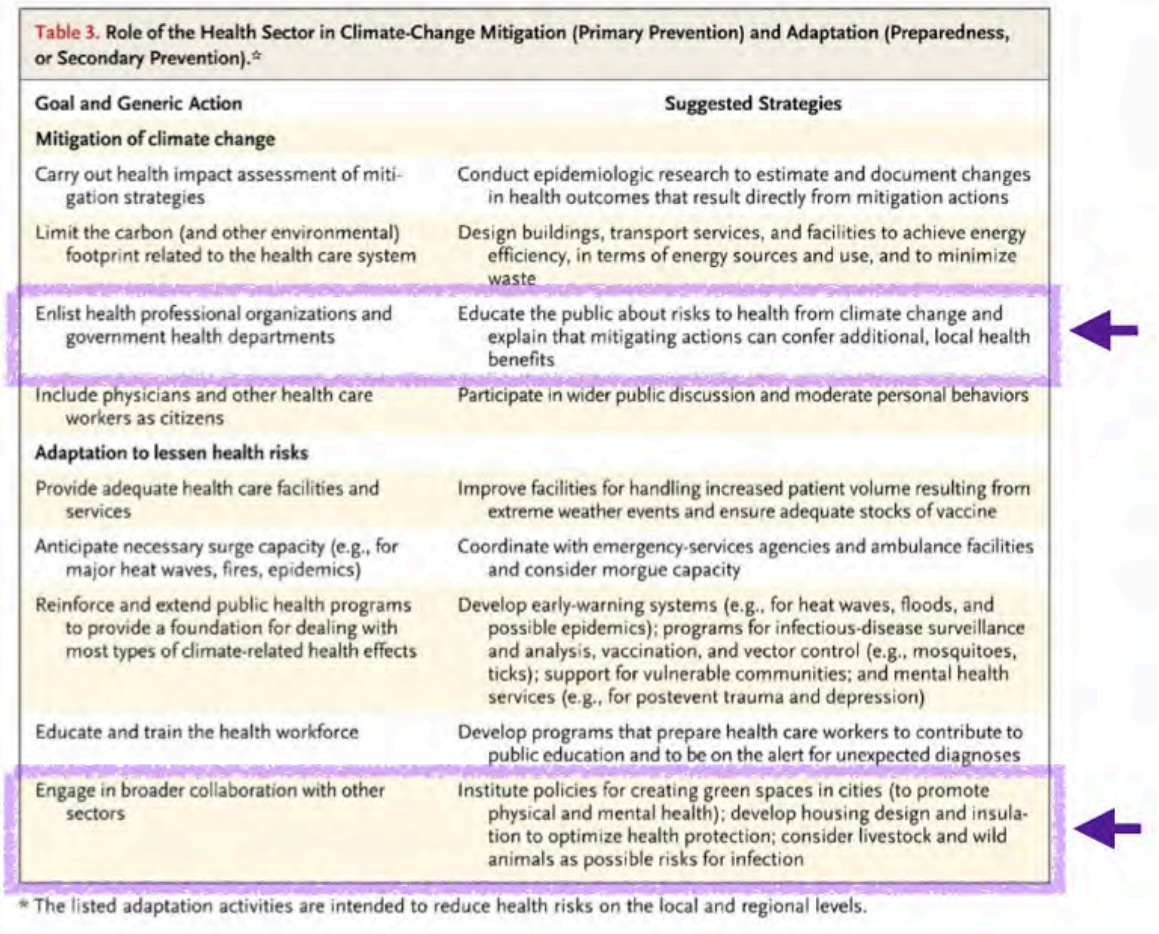

Table 3. Role of the Health Sector in Climate-Change Mitigation (Primary Prevention) and Adaptation (Preparedness, or Secondary Prevention).*

Goal and Generic Action	Suggested Strategies
Mitigation of climate change	
Carry out health impact assessment of mitigation strategies	Conduct epidemiologic research to estimate and document changes in health outcomes that result directly from mitigation actions
Limit the carbon (and other environmental) footprint related to the health care system	Design buildings, transport services, and facilities to achieve energy efficiency, in terms of energy sources and use, and to minimize waste
Enlist health professional organizations and government health departments	Educate the public about risks to health from climate change and explain that mitigating actions can confer additional, local health benefits
Include physicians and other health care workers as citizens	Participate in wider public discussion and moderate personal behaviors
Adaptation to lessen health risks	
Provide adequate health care facilities and services	Improve facilities for handling increased patient volume resulting from extreme weather events and ensure adequate stocks of vaccine
Anticipate necessary surge capacity (e.g., for major heat waves, fires, epidemics)	Coordinate with emergency-services agencies and ambulance facilities and consider morgue capacity
Reinforce and extend public health programs to provide a foundation for dealing with most types of climate-related health effects	Develop early-warning systems (e.g., for heat waves, floods, and possible epidemics); programs for infectious-disease surveillance and analysis, vaccination, and vector control (e.g., mosquitoes, ticks); support for vulnerable communities; and mental health services (e.g., for postevent trauma and depression)
Educate and train the health workforce	Develop programs that prepare health care workers to contribute to public education and to be on the alert for unexpected diagnoses
Engage in broader collaboration with other sectors	Institute policies for creating green spaces in cities (to promote physical and mental health); develop housing design and insulation to optimize health protection; consider livestock and wild animals as possible risks for infection

* The listed adaptation activities are intended to reduce health risks on the local and regional levels.

Figure x – Examples of calls for multi-disciplinary action, New England Journal of Medicine, Globalization, Climate Change and Human Health, role of the health sector. (http://www.nejm.org/doi/pdf/10.1056/NEJMra1109341, Downloaded November 2, 2013, edited with highlighting by author.)

Architects have traditionally been team leaders and accumulators of an eclectic set of skills, and given this range they are uniquely suited to be one of the prime authors of societal change. Speaking to what the role of (young) architects in society today should be, by comparison to Imhotep who was considered the first architect, incoming RAIC president Wayne DeAngelis noted in a recent issue of Award magazine that the Pharaoh's son, "was many things, a polymath, chancellor to the Pharaoh, first engineer, first physician, chancellor of the King of Egypt, first in line after the King of Upper Egypt, administrator of the Great Palace, hereditary nobleman, High Priest of Heliopolis, builder, chief carpenter, chief sculptor, Maker of Vases in Chief and a revered poet and philosopher" and, "involving himself in a great number of other services for his community".[191] The challenges facing communities, cities, provinces and countries today need leaders with the requisite knowledge or at least the knowledge of how to bring together the seemingly un-related to develop greater benefit and avoid peril. In an era where governments struggle with debt, the need for this type of approach is particularly acute to

[191] (De Angelis, 2014, p 7)

ensure that infrastructure dollars are fully leveraged and invested to the best use of society as whole.

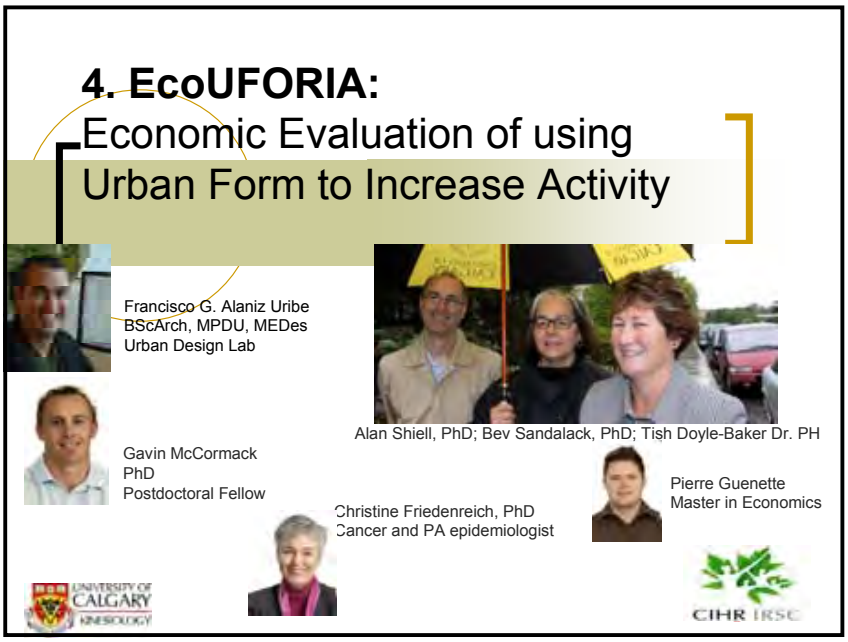

Figure x – Image excerpt from 2010 Physical Activity Forum powerpoint presentation by Dr. P.K. Doyle-Baker , Does the Built Environment Influence Health?, example of multi-disciplinary study of urban design issues. (obtained by author from Dr. P.K. Doyle-Baker, reproduced with permission)

With respect to Edmonton and western Canada, problems of sprawl, poverty, depletion of natural resources such as water, energy and soil remain on a somewhat distant horizon with the likelihood of imminent negative consequence seemingly unlikely. Ancient Mesopotamia, now barren, was once known as the Fertile Crescent and was a vigorous, seemingly unstoppable life force generating the first mathematics, engineering and robust agricultural production. They however fell victim to complacency as put by Jane Jacobs, “the stagnated moribundity of formerly unassailable and vigorous cultures is caused not by assault from outside but by assault from within, that is by internal rot”.[192] Cultural decay started with the seemingly unassociated eradication of the Arab marshland watersheds and Mediterranean forests, filled in and cut down to increase available farmland and satisfy “industry’s relentless demands for wood fuel”[193] which resonates, with the state of society and energy development in Alberta today. As history bears lessons that, if not heeded, have repeatedly proven to repeat themselves, it is incumbent upon professionals, including Architects and Urban designers as enlightened thinkers, to look beyond traditional boundaries of practice to play a role in ensuring these issues are addressed within their scope of influence - that being the built environment.

[192] (Jacobs, Dark Age Ahead, 2005, p 14)
[193] (Jacobs, Dark Age Ahead, 2005, p 15)

Given the large scope of the problems being experienced in other parts of the world such as the droughts in California, of which effects can be felt in Western Canada, it is clear that Edmonton has a role to play to continue to increase its' sustainability by reducing demands on the environment locally and globally through incremental change. Ground up innovation and adoption will take many years or decades which, if targeted correctly, can make Edmonton anti-fragile and able to resist, cope and perhaps even profit from the effects of an unpredictable high impact event, (or events) Nicholas Nassim Taleb would characterize as a "Black Swans".[194] Reshaped infrastructure and cultural connections with the ecology of food have an impact on health, economic stability and food supply making Urban Agriculture one vehicle through which this type of resilience can be achieved.

In an effort to further explore this new territory, The City of Edmonton initiated "Fresh, Edmonton's Food & Urban Agriculture Strategy".[195] The initiative, guided by a 15 member cross disciplinary Advisory Committee of business people, restaurant owners, non-profit groups, agricultural specialists, university faculty, and city planners, was spawned by the growing recognition by Edmonton's municipal government of food's relationship with community development and the role it can play in furthering sustainability, economic development and urban liveability.[196] Most succinctly put in the report, "Municipalities can also capitalize on opportunities by taking an integrated planning approach that brings together different systems (including infrastructure, food and agriculture, energy, and buildings) performing different but complementary functions".[197] Although seemingly a disparate consideration, urban food should be of the conversation when issues of health, community development, economic opportunity, urban liveability and built environment design are contemplated.

One passage from the Fresh report summarizes notionally why Edmonton is ready for a more deliberate embrace of Urban Agriculture, "Edmonton is fortunate to sit at the intersection of many important and dynamic opportunities in today's world. We have a strong economy with sound forecasts for growth. We are at the centre of a region that is competing in some of the world's leading industries, including agriculture. We have access to ample water and fertile land that surrounds us. And we can boast of a population that combines a pioneer spirit with unstoppable innovation".

[194] (Taleb, The Black Swan, The Impact of the Highly Improbable, 2010, p 39)
[195] (The City of Edmonton, 2012)
[196] (The City of Edmonton, 2012, p iv)
[197] (The City of Edmonton, 2012, p 2,7)

Figure 2: *Peri-urban to Inner Urban Core Transect*

	PERI-URBAN	URBAN RESIDENTIAL	INNER URBAN	INNER URBAN CORE
	Peri-urban	Urban		
FOOD PRODUCTION	• Larger tracts of farmland • Market Gardens • Hobby Farms • Small livestock • Bees and Hens	• Backyard Gardens • Edible landscaping in parks and public right of way • Community gardens and orchards • Possibly bees and hens (pilot)	• Community gardens • Rooftop gardens • Private (condo) food gardens • Edible landscaping in parks and public right of way	• Rooftop gardens • Private (condo) food gardens • Edible landscaping in parks and public right of way
PROCESSING	• On farm processing and preserving	• Neighbourhood Food Hub / satellites	• Food Hub (community food centre)	• Food Hub (community food centre)
STORAGE & DISTRIBUTION	• Aggregation center • On-farm cooler and dry storage	• Cellars	• Community root cellars • Fresh box delivery	• Community root cellars • Fresh box delivery
BUYING & SELLING	• Farm gate sales • Rural farmers' markets	• Farmers' markets • Grocery stores	• Farmers' markets • Grocery stores • Food programs	• Farmers' markets • Food programs
EATING & CELEBRATION	• On farm tastings • Home consumption	• Home consumption • Restaurants	• Food trucks, Restaurants, Patios • Cooking programs • Community kitchens	• Street festivals, Food trucks, Restaurants, Patios • Community kitchens
WASTE & RECOVERY	• On farm waste management • Reduced packaging at farm gate	• Residential composting • Restaurant food waste pick • Reduced packaging	• Condo / home composting • Reduced packaging • Office composting	• Reduced packaging • Office composting program
EDUCATION & GOVERNANCE	• Training and incubation farms for new farmers • Extension services • Provincial crop and farm research • University programs • Opportunities for new immigrants • Farmer training	• Training for urban gardeners • School programs • University programs • Urban gardener training • Food preparation • Nutritional advice	• Training for urban gardeners • School programs • University programs • Urban gardener training • Food preparation • Nutritional advice	• Training for high tech urban gardeners • Urban gardener training • Food preparation • Nutritional advice

Figure x – Image excerpt from Fresh, Edmonton's Food & Agriculture Strategy, components of an urban agriculture system. (http://www.edmonton.ca/city_government/documents/FRESH_October_2012.pdf)

During public consultation, repeated key themes citizens identified were: Space available for urban agriculture needs to be increased; Access to local food needs to be improved; Prime agricultural land needs to be protected; Local food needs to be celebrated; Food and community cohesion have a strong link; City growth must be balanced; Economic opportunities for urban

agriculture need to be increased; More education and promotion of local food is needed; Infrastructure for food growing and related businesses needs to be increased; Information exchange needs to be enhanced; The Municipal Government should take a leading role to ensure all of the above happen.[198]

Based on the public consultation and deliberation by the advisory committee, nine strategic directions for Edmonton's Urban Agriculture were established: (1) Establish the Edmonton food council; (2) Provide food skill education and information; (3) Expand urban agriculture; (4) Develop local food infrastructure capacity; (5) Grow local food supply and demand; (6) Enliven the public realm through a diversity of food activities; (7) Treat food waste as a resource; (8) Support urban farmers and ecological approaches to farming; (9) Integrate land use for agriculture.[199]

According to Hani Quan, Edmonton's principal planner for the Food and Urban Agriculture Project there is not an immediate need for urban food production, however, "We have acknowledged that cities are the built form of choice going into the future, but I don't think we have answered critical and basic questions about how cities align with the need for food that sustains us".[200] He also feels that, "it is best to try a complete range of activities that can fit into a number of diverse socio-economic and geo-physical situations" in order to judge the benefit and merit of such activities going forward.[201]

5.2 Planning Study and Policy Development

Edmonton has committed to many positive initiatives over its' history, such as enshrining and carefully protecting the natural preserve that is the river valley, a waste management centre that extracts biomass from the garbage stream to feed an industrial scale composter operation, and the Rundle Park landfill conversion to name just a few. In doing so the city and its citizens have demonstrated a strong willingness to be progressive leaders in managing its' ecology.

Edmonton is also a city of vision and recognizes the value of long term planning. This is evident in the emphasis given to the importance that green space can play in creating liveable, dense, city core which is exemplified in municipal plans for areas such as The Quarters, the Downtown Development plan and the Edmonton Centre (Blatchford Field downtown airport) redevelopment. The Edmonton Centre plan in particular proposes the "Agrihood", an introduction of urban agriculture as a strategy to create actively engaging urban green space to further sustainability goals, connect urban dwellers to nature, support a healthier outdoor lifestyle all the while reinforcing historic preservation and "memorable placemaking" in the public realm.[202]

[198] (The City of Edmonton, 2012, p 13)
[199] (The City of Edmonton, 2012, p 65)
[200] (Quan, 2013)
[201] (Quan, 2013)
[202] (The City of Edmonton, 2011)

Figure x – Image excerpt from Bylaw 15800, Page 53, The Armature Project, The Quarters Downtown Community Revitalization Levy Bylaw , Edmonton, Alberta, Canada. (http://www.www.edmonton.ca/city_government/documents/Quarters_Downtown_CRL_Area_Plan_15800.pdf)

Figure x – Image excerpt from City Centre Redevelopment October public consultation presentation, Edmonton, Alberta, Canada. (http://www.edmonton.ca/city_government/projects_redevelopment/city-centre-airport-review-public-consultation.aspx)

Green space fosters a connection to nature, a key element of liveability, but to build some level of self sufficiency and establish a connection to food and our food growing heritage and ecology represents an as yet under-explored aspect of the "greening" of Edmonton's urban design.

FRESH also noted that urban agriculture does not need to be a primary land use, meaning that any green space that is subsidiary to the prime land occupancy can, and should, be supported as a means of growing food.[203]

As with other public services such as schools and emergency services, cities need to shape city planning to encourage evenly distributed community and retail food opportunities throughout, but particularly in the core of the city.

Strengthen MDP with recommendations included in FRESH

Develop a Food Charter and Council

Subsidize and encourage food growing, whole food preparation and preservation education and outreach NGO's (Like Vancouver's tax incentive program from which SOLEfood inner city farm sprung forth from)

[203] (The City of Edmonton, 2012, p 8)

5.3 Who, Where, When, How and Why

When addressing any issue or problem, fundamental questions need to be answered. The question of ***WHAT*** can be understood to of course be the establishment of a deliberate Urban Agriculture plan developed in concert with the City of Edmonton and the Edmonton Food Council.

Answering the question of ***WHO***, it is all Edmontonians that can embrace and integrate Urban Agriculture into their surroundings and as a subsidiary use to primary land use. This could be municipal planners including fruit trees into boulevard planting schemes, apartment dwellers with balcony or window boxes, suburbanites with backyard (or front-yard) gardens and restaurants with roof-top gardens. One of the greatest attributes of urban agriculture however is its ability to teach, empower and create economic independence. As such poorer communities can derive some of the greatest benefit from Urban Agriculture interventions and incentivization.

WHERE urban agriculture is best suited to be located could be said to be both complex and simple. The simple answer is, everywhere. The typology of urban food installations provides a full range of ways in which growing food can take place: from balconies to window boxes, urban orchards to trees on boulevards, backyards to empty lots or utility right of ways. Complexity enters when the questions of due process, ownership, stakeholder engagement and implementation are answered.

Although urban planners look at cities as wholes themselves, what is generally missing in the discourse of urban planning and architecture is the conception of each new building, each urban development or redevelopment in a world context and in the context of what ecological capital expenditure it represents and in doing so categorically understanding whether it represents fragility or anti-fragility. This can be reckoned not just in the material selection, recycled or recyclable, but in its perpetual effect in terms of energy consumption, contribution to urban heat island effects, consumption/preservation of fresh water, creation of elements of natural habitat (green roofs) or ability to remain reusable in terms of program flexibility and durability of structure and systems. These are lenses that are infrequently or never applied for a variety of reasons including the client's wishes. The designers of public spaces, buildings and developments have a greater sense of the importance of even small beneficial changes as participating in a cumulative total - contributions towards positive change that in and of themselves are not the answer but as an aggregate and a direction define a path for others to follow.

WHERE needs to be everywhere, however as increasing density is the consensus solution to long-term sustainability for both civilization and cities, it is the urban core which needs the greatest attention to ensure liveability. Achieving greater density without creating greater energy use intensity and further distance between urban dwellers and nature remain however chronically unresolved challenges that remains at the forefront of achieving liveable and sustainable cities.

A prime target for establishing urban agriculture, especially in the heart of dense urban environments such as Brooklyn New York, has proven to be re-purposing of older buildings in or near the city cores to increase accessibility by pedestrian or cycling modes of transport. Location of urban agriculture in this setting, augmented by ample public transit is a key siting or zoning consideration.

Examples of structural or infrastructure repurposing which have shown to be successful are numerous, but are most contemporarily demonstrated in the case of SPIN farming, Evergreen Brickworks in Toronto, Lufa Farms in Montreal and Brooklyn Grange in New York city. SPIN farming as a method relies on utilizing the under-utilized.

One example of such an exploration is the living bridge. It is the re-use of an abandoned space that is not suitable for any other purpose. As a bridge it is, ironically perhaps, a link spanning vehicular traffic which traditionally severs pedestrian and neighbourhood connections. Bereft of its former use as a railway bed, it has been converted to public space, linking people and public space with greenery including some vegetable and fruit bearing plants. It serves as a perfect example of repurposing for a use that is restorative and adds to the liveability of occupants of the downtown core, Chinatown and the McCauley district.

Figure x – Image of the Living Bridge summer 2013, excerpt from Living Bridge website, Edmonton, Alberta, Canada, Photo by Jerry Aulenbach. (http://livingbridgeedmonton.com/)

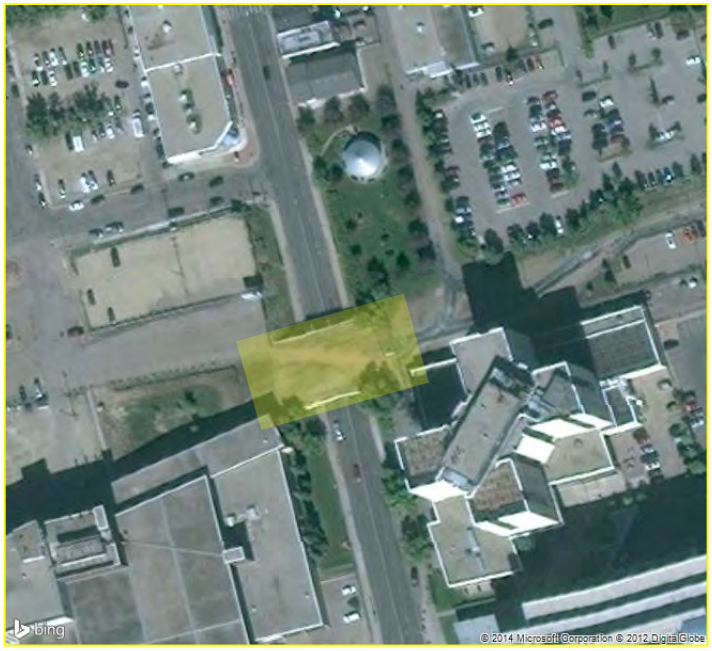

Figure x – Aerial photograph of Living Bridge site with Mary Burlie park to the upper right (Northeast), abandoned Remand Centre to the bottom right (Southeast), site for the new Royal Alberta Museum to the bottom left (Southwest), and Chinatown directly to the North. (Image excerpt from Bing Maps, http://www.bing.com/maps/, March 2014)

As noted in the "Fresh" report, Edmonton has a unique opportunity placed before it in terms of nexus that exists between a robust economy, exceptional growth and development and a great deal of energy and interest expressed by citizens that see the potential for this type of initiative to allow citizens to individually and collectively have a positive effect on their community. Edmonton is also experiencing major increases in primary school enrolments which are expected to nearly double by the year 2022[204] meaning that a whole new generation of young people can be influenced by and benefit from growing up in this type of healthy, holistic and hopeful environment which will do much for ensuring its' long term sustainability. The question of ***WHEN*** is therefore now.

There are of course a variety of methods ***HOW***, Edmontonians can establish a more deliberate and structured integration of urban agriculture.

One key initiative that could be administered by the Edmonton Food Council would be the creation of a website where vacant urban gardens or other available land can be posted and standardized contracts established to facilitate quick and simplified assurance of fairness and regulation adherence by all parties.

[204] (Alberta Education, 2012, p 2)

Encouraging evenly distributed community and retail food opportunities throughout particularly poorer neighbourhoods (more affluent neighbourhoods are typically already well served and are readily accessed by vehicular modes of transportation) especially in the core of the city.

Improvements to current city bylaws will be necessary to permit primary and secondary land uses to support Urban Agriculture. The City of Boston is currently engaged in similar initiatives to those proposed in FRESH. …. <list, show, use Boston's new urban ag bylaws as template>

In new suburbs, land is set aside and zoned for public uses such as schools, protective services and health centres. Just as is done in new developments in suburban communities, land within the urban core could be zoned with urban agriculture as a primary use. In concert with zoning that encourages fresh food retail to be set-up in urban areas identified as fresh food deserts, this can provide a strong stimulus for ensuring a vibrant local food network is established.

When contemplating the question of ***WHY***, the focus can be narrowed to three key concerns that exist in the Edmonton region today: Improve the Health of its citizens; Reach the next generation and ensure knowledge transfer; Build Anti-fragility and Resistance to current and future problems.

Urban agriculture improves health through improved food quality, the physical activity that the action of growing propagates and the mental and physical biophilic benefits of connecting to nature and natural settings and processes. Food grown by hand, in smaller localized batches, in a truly organic fashion is free of pesticides, industrial chemicals and hormones and delivered fresh, at the peak of its nutritional efficacy, without the requirements of high levels of energy input for harvest, refrigeration, warehousing and transport.

By breaking down some element of the division of labour traditional to an industrial system, an eclectic range of knowledge is spread wider and farther over a greater number of people, (preferably all people) instead of being concentrated in the hands of a few provides greater assurance that knowledge is passed down from one generation to the next. Having the knowledge to retain the power to grow, process and prepare food to feed oneself creates a sense of empowerment and independence important to ensure individual and community resilience. It also creates a greater sense of touch with the environment and ability to make democratic and informed decisions about societal directions that support food growing for future generations.

When health and knowledge and knowledge transfer are addressed, resiliency is largely the result. Rounding out resiliency (or anti-fragility) is the economic benefit that can be derived from urban food production. With the loss of Class 1 and 2 soils by the expanding girth of the city, the potential for food interruptions resulting from problems in distant food producing sources (ie: vegetables take a large jump in cost due to a drought or earthquake in California) local food production stands to benefit and keep monetary exchange local and to the benefit of the city as a whole.

5.4 Regional Adaptation and Winter City Considerations

As with all urban design initiatives, regional adaptation, to local environmental conditions, culture, regulation and traditions are necessary to ensure success. Developing urban agriculture in a way that helps reinforce the unique sense of place that Edmonton is, a key element of urban planning and place making.

A portion of the Edmonton Food Council's mandate could be to ensure Northern Alberta's food growing heritage is commemorated. A connection to the strong growing heritage embodied in businesses such as Hole's Greenhouses and the Hole family's contributions to enshrining growing knowledge in books, Prairie garden centre's corn maze and

Given Edmonton's cold climate, the greenhouse may become the dominant feature, which can be manipulated to create unique forms, mimicking the success and identity already created by buildings like the Muttart Conservatory and the Enjoy Centre.

5.5 Changes in Aesthetic Sensibilities

Biological forms are typically messy, intricate and as such can be unappealing when contrasted with manicured, man-made objects and environments. As gardening and agriculture can tend to be an unruly endeavour, some middle ground must be found in terms of keeping the order of the city while introducing the disorder of organic growth. From a design perspective, the built environment must be conceived with the mindset of yielding to natural processes, not overcoming them.

<insert image of urban garden from Toronto arch kids growing>

Urban and building forms must more often be inclusive of insect, aquatic, avian, animal and plant life to support biodiversity, which is the underpinning of human biological existence. The decline and recovery of bees is a key example of the danger that our notions of aesthetic and natural conquest pose to our own survival. Edmonton does generally well in these areas but expanded awareness of the importance of the maintenance and greater integration of these features is necessary to maintain vigilance and avoid fragility from creeping in.

As Stan Rowe posits, "The "culture" for which cities are acclaimed is itself a kind of virtual reality, providing various compensations for separation from the natural world. Artifice is used to plug the holes in urban lives with facsimiles of important experiences thoughtlessly blown away. The arts serve as humanistic buoys to keep spirits afloat after natural life preservers have been discarded. Jean-Jacques Rousseau's sour comment that "big cities need plays and corrupt people need novels" can be more positively phrased: "Artists provide food of variable quality for starving souls in cities"".[205]

The age of planned obsolescence must draw to a close. Debate about questions of style must be lensed with the embodied beauty of sustainability. Something that is.

[205] (Rowe, 2006, p 88)

5.6 Technology Application

Charles Lindbergh once commented that, “In wilderness I sense the miracle of life, and behind it our scientific accomplishments fade to trivia.” [206]

The drive for new technological advances must continue but simultaneously adopt the understanding that in terms of sustaining human existence nature achieves with little effort what will require quantum leaps in our knowledge to match, much less exceed.

One example of how technology can fail us can be seen in medicine. What often is easily misunderstood with respect to technology is not its ability to solve a problem, it more often lies in the simple truth that technological solutions often cannot be economically deployed on a sufficiently large scale or repetitive scale, owing to economics, energy or material availability, to effect real change. Nature is typically always more prolific and therefore problems posed to humankind by nature sometimes cannot be overcome simply because the price is too great. In light of this, a strategy of working with nature, instead of contrary to it, would almost always seem to be a recommended course of action.

Concept of infinite recycling, closed industrial loops – cradle to cradle, Ray Anderson and Paul Hawken….

[206] (Lindbergh)

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