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Alternative Neighbourhood Design

Re-Designing the Conventional Subdivision

By

Mark Spence

A Practicum
Submitted to the Faculty of Graduate Studies
In Partial Fulfillment of the Requirements
For the Degree of

Master of City Planning

Department of City Planning
Faculty of Architecture
University of Manitoba

THE UNIVERSITY OF MANITOBA

FACULTY OF GRADUATE STUDIES

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This practicum is dedicated to my Mom and Dad.

Abstract

The issue of urban sprawl is a main concern for cities across North America. Conventional neighbourhood subdivisions are the key building blocks that contribute to sprawl and have been criticized for their lack of affordability, convenience, efficiency, and public space. This research project presents an alternative approach to conventional neighbourhood planning and design. Recognizing that suburban growth is likely to continue, this project attempts to improve the residential subdivision rather than to limit its development. The alternative approach is based on the concept of sustainable development and is guided by a set of planning principles and design guidelines. This approach is demonstrated in the re-design of Royalwood, a conventional neighbourhood subdivision in Winnipeg. Following the re-design, a comparative analysis between the alternative concept and the conventional plan is undertaken, focusing on land use distribution and "urban efficiency". The analysis shows the alternative concept has advantages in housing diversity and affordability, local services, public spaces, and pedestrian conveniences, while having lower infrastructure and development costs. This project concludes with suggestions for future alternative development in Winnipeg, noting that the City government, residential developers, and local homebuilders are the key players for initiating progress. Recommendations are directed at the City of Winnipeg to create a more favorable setting for the possible implementation of future alternative development.

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Chapter 1: Introduction

The practice of conventional neighbourhood subdivision planning and design in North America has undergone an increasing amount of criticism in regards to its social, environmental, and fiscal performance. Citizens, municipal governments, urban planners, and designers have questioned the feasibility, validity, and livability of these modern residential developments. The type of development being referred to is typical in design and function and is commonly found in almost every urbanized area across the continent. The conventional neighbourhood subdivision can be identified by a list of characteristics. Maze-like street patterns, often without sidewalks, are interrupted by cul-du-sacs (Figure 1-1). Land use is often exclusively single family residential. Local conveniences are usually located in a strip mall on a major arterial outside of the neighbourhood, making reliance on the automobile essential. Critics argue that this kind of development is responsible for high costs to both the taxpayer and the environment due to inefficient land use, and is blamed for the loss of community because of its segregated, homogeneous, and isolated nature (Condon, 1996; Calthorpe, 1993; Roseland, 1992; Newman, 1991; Lozano, 1990; Real Estate Research Corporation, 1974).

Urban planners and designers are now, more than ever, confronted with the challenge to search for solutions to this dilemma. The continuation of conventional suburban development is inappropriate and detrimental. Searching for innovative planning and

design alternatives for residential areas should be given special attention. Both developers and municipal governments should be made aware of the potential benefits that an alternative development has over a conventional one, realizing that a paradigm shift in industry attitudes will only take place over a period of time. This project intends to offer one incremental step toward alternative residential subdivision planning and design.

The concept of sustainability, and sustainable urban development in particular, focuses on three main components- environmental (or ecological), economic (or fiscal), and social- and their interrelationships within an urban system. Unlike the conventional method of planning residential developments, sustainable urban design is based on planning that responds to contextual considerations. In essence, it is site planning that is tailored to appropriately "fit" its environs.

Figure 1-1: The typical North American neighbourhood subdivision. (Source: *Yard, Street, Park*, 1994:37.)

1.1 Project Objectives

The purpose of this project is to take the first step toward the development of an alternative neighbourhood subdivision. It will do so by examining the concept of sustainability as the guiding framework for development. Sustainability, or more accurately sustainable urban development, has been selected for its focus on environmental, economic, and social issues. Other methods were considered (such as the Neo-Traditional and Garden City concepts), however they did not adequately address all the problems associated with urban sprawl to the same extent. For example, Neo-Traditionalism is fast becoming a popular approach for alternative neighbourhood design. While it advocates that a better social atmosphere (i.e. pedestrian-friendly streets and more public places) can be achieved through design, it largely ignores other social issues like the affordability and accessibility of housing for a wide range of people and family types. Furthermore, the issues of urban ecology and economic concerns are rarely dealt with. The concept of sustainability focuses on the environmental, economic, and social components and recognizes that these three components are interrelated within the urban context.

While sustainability is the goal of this project, it should be understood that it is difficult to convince developers that wholesale changes should be made to conventional practices. If the paradigm shift is to occur, it will likely come in incremental stages over time. Therefore, the project proposes to provide sustainable

solutions within the framework of conventional patterns and marketing methods. This project intends to offer a planning and design approach that takes a first step away from the conventional method and toward a more sustainable one.

This research project undertakes a re-design of a conventional subdivision based on a prescribed alternative approach (discussed in chapter 3). There are three main goals for this approach:

1. To show an alternative method of planning and designing residential subdivisions based on the principles of sustainable urban development;
2. To show how a residential subdivision, planned and designed according to sustainable principles, may appear;
3. To show if a sustainable neighbourhood example can achieve or exceed the same level of fiscal "feasibility" as a conventional design.

1.2 Project Organization

The following is a brief layout of this project's organization and includes a synopsis of each chapter.

Chapter 1: Introduction. This chapter acknowledges that a problem exists in conventional subdivisions, and introduces the concept of sustainability as the

framework for a possible solution. The chapter states the project's goals and objectives, and the limitations of the project.

Chapter 2: Literature Review. This chapter identifies urban sprawl as a main concern in North American urban centres. Urban sprawl and its historical origins are discussed, and attention is given to land use issues associated with sprawl such as segregation and homogeneity. Sustainability is suggested as a basis for alternative urban development, recognizing that urban sprawl will continue to occur and that sustainability must be able to function within the current framework set by the development industry. The sustainability concept is defined and explained.

Chapter 3: Methodology. This chapter identifies the methods and techniques used to collect information and data for this research project. The chapter also outlines the principles used for the re-design.

Chapter 4: Alternative Concept. This chapter presents the alternative planning approach and site re-design. The chapter explains the site selection process and provides the rationale for its design. The form of the alternative concept is established by a set of design guidelines, which are applied to the selected site. A comparative analysis between the alternative concept and the conventional plan is then undertaken, examining land uses and "urban efficiency".

Chapter 5: Conclusion. The final chapter provides a reflective overview of the research project including its accomplishments, shortcomings, and general observations. A list of recommendations for the City of Winnipeg is provided regarding sustainable development considerations. This chapter concludes with a list of suggestions for further research on related topics.

1.3 Project Limitations

The focus of this project is the re-design of a conventional subdivision. The key stipulations for the site selection were:

1. A subdivision containing conventional features;
2. Access to information (and co-operation from the developer).

Royalwood, a 180-acre subdivision located in southeastern Winnipeg and developed by Ladco Company Ltd., is the site selected for this research project. During the research, development in Royalwood was ongoing (approximately half of Royalwood was developed as of November 1998). Therefore, subdivision plans were often consulted. This project is conducted under the assumption that urban sprawl is unlikely to subside in the near future. The alternative concept proposal should serve as a first step toward innovative neighbourhood subdivision planning to guide the way (or at least provoke dialogue) for future innovations. The re-design of Royalwood is an attempt to achieve a more sustainable neighbourhood than the existing conventional plan. The re-design does not incorporate an extensive list of

sustainable features, rather it responds to site ecology and contextual considerations as a basis for design while recognizing what is considered acceptable to the developer.

A main component of the research is the comparative analysis between the conventional and alternative schemes. Part of this comparison involves "urban efficiency" tests, which the developer uses to determine the fiscal "feasibility" of a subdivision. The two "urban efficiency" tests used by Ladco are the "frontage-to-service ratio" test and the "frontage per developable acre" test. These tests are discussed in section 3.1.7. Initially, a simple cost analysis of the alternative and conventional schemes was considered for the comparative analysis section. It, however, became apparent that a simple cost analysis would not be as informative as a full cost analysis, which is extensive and detailed. The developer conducts a full cost analysis only after a number of design alternatives have been considered. The full cost analysis includes all "hard services" such as infrastructure and utilities, and "soft services" that include developer's fees, lending interest rates, marketing costs, and inflation, and is also calculated by cash flows over the period of time that the developer is involved with a particular project. Considering the scope of this undertaking, this research project does not attempt a full cost analysis, rather it focuses only on the initial steps of the developer's evaluation process. Therefore, the "urban efficiency" tests are used in the comparative analysis.

Chapter 2: Literature Review

This chapter identifies urban sprawl as being one of the main problems in contemporary North American urban planning. The fundamental concerns associated with urban sprawl are discussed along with a brief history of sprawl in North America. The concept of sustainable development is then discussed as a framework with the potential to guide alternative subdivision design. A definition of sustainability is provided along with its components and includes examples of how some municipal governments are attempting to integrate urban sustainability into planning policy. A section on land use further addresses some of the main problems that face today's urban planners and designers. The land use section directs its focus towards the segregation and homogeneity that is becoming increasingly prevalent in our cities. A section on urban organization addresses these land use concerns.

2.1 Urban Sprawl

Prior to searching for solutions to our urban problems, it is important to first understand what those problems are. An examination into the history of the North American suburban evolution may contribute to the comprehension of those problems. This section identifies "urban sprawl" as being the main cause of many problems in the North American urban environment. Those sprawl-related problems are listed and discussed in section 2.1.1 and the history of urban sprawl is examined in section 2.1.2. Section 2.1.3 summarizes the discussion on urban sprawl.

2.1.1 The Problem with Urban Sprawl

> Sprawling subdivisions destroy the countryside. They result in uneconomic, inconvenient and ill-serviced communities, block the future, and offer nothing of lasting value that cannot be provided more adequately by orderly growth.
> **Central Saanich Capitol Region Planning Board 1957 (from Van Vliet, 1994:12)**

> Sprawlsville is flawed because it over-emphasizes the private, individualized world at the expense of our commons. It provides for private splendor in our houses and backyards and in our cars, but public squalor in our air and water, at the urban fringe as it falls under the subdivision's bulldozer, in the feeble attempts at community which characterize our suburbs, and in our public transport, which is allowed to run down and become vandalized.
> **Newman 1991 (from Roseland, 1992:25)**

These two quotes describe the impact that urban sprawl has on the quality of life within our cities and their surrounding regions. These two statements were taken four decades apart, suggesting that not much has changed in this trend of development.

The conventional neighbourhood subdivision has been widely criticized that it cannot adequately provide basic conveniences such as local employment, shopping, and community facilities (Calthorpe, 1993; Newman, 1991; Wentling & Bookout, 1988; Real Estate Research Corporation, 1974). Conventional subdivisions have become places of inconvenience, segregation, and isolation for its residents. They are also expensive, exclusive, inaccessible for many, and are ecologically destructive. These symptoms can be attributed to the current planning and design

practices for conventional subdivisions. This kind of urbanism (or more accurately "suburbanism") has been popularly regarded as "sprawl".

Urban sprawl is criticized in three main areas: environmentally, fiscally, and socially. Environmentally, urban sprawl results in increased auto dependency, which translates into higher fuel consumption and higher toxic exhaust emissions. Per capita, gasoline consumption is far higher in North America than anywhere else. Canadians produce 20 tons of carbon dioxide per person per year in our cities. In contrast, Amsterdam produces half that amount (Alcamo, 1990). It is thought that this is not attributed to larger car sizes or cheaper gas in North America, but rather to the compactness of the typical European city form (Newman & Kenworthy, 1989). Ecologically sensitive and agriculturally productive land is being consumed by urban sprawl at an alarming rate. Between 1960 and 1990, Kansas City and its suburban area increased 29% in population while its developed land area increased 110%. Both Chicago and Philadelphia gained 30% in suburban expansion while only growing 5% in population. Atlanta, Georgia is perhaps the best example of rapid expansion of urban sprawl. In 1990, Atlanta's suburban area stretched 65 miles from one end to the other. In 1997, that distance increased to 110 miles across (Anderson & Tregoning, 1998). In Canada, suburban growth encroaching into agricultural lands is especially problematic. Fifty percent of Canada's urban population lives in areas having the top 5% of the most productive farmland. Seventy-five percent of all urban growth in Canada occurred on these lands (Russwurm, 1977:47). One

example of rapid suburban growth in Canada is the City of Calgary, where 99% of its population growth to the year 2024 is expected to occur in new suburban areas (GoPlan, 1995:2-4).

Fiscally, planners and municipal governments have closely examined urban sprawl for its negative impacts. One conclusion from a study prepared for the U.S. Government summarized that "sprawl is the most expensive form of residential development in terms of economic costs, environmental costs, natural resource consumption, and many other types of personal costs." (Real Estate Research Corporation, 1974:7) It is expensive to build and maintain because of its inefficient use of land as it relies on an increased use of infrastructure to support it.

Socially, conventional neighbourhood subdivisions are incompatible with people's needs. Local shops and services are inconvenient, inadequate, or missing altogether, forcing people to drive out of the community for basic needs. There is also social exclusion of people from neighbourhoods due to insufficient choice of affordable housing and mobility- especially for singles, single parents and the elderly (Intensification Report, 1994; Land Economics, 1977). To better understand the phenomena of sprawl and to explain why conventional subdivisions are still being built in the same way despite acknowledging its harmful effects, it is beneficial to examine the origins of urban sprawl.

2.1.2 History of Urban Sprawl

The problems with the conventional neighbourhood subdivision are deep-rooted in its history. It is widely accepted that sprawl in North America did not take place on a grand scale until after the Second World War. However, it could be argued that the preference to physically spread out was entrenched in the minds of North Americans long before this. Following the Second World War, land, resources, and energy was abundant and cheap, which contributed to the building of the conventional urban form (Calthorpe, 1993; Wentling & Bookout, 1988). Communities grew fast and inefficiently and became dependent on extensive infrastructure systems. Cheap energy was a major catalyst for urban sprawl, which had an influence on the construction of larger homes. Low fuel costs also contributed to the dependency on the automobile in North America, as it increased separation of the home from the workplace (Roseland, 1992). Outlying land was made increasingly accessible by major highway networks facilitating the population to further disperse into low-density subdivisions. But the question remains: Why was there this urge or desire move away from North American urban centres?

Wentling & Bookout (1988) suggest that the roots of the North American psyche may play an important role in the low-density patterns that are now prevalent. The origins of this go back to the agrarian era where the lone farmhouse provided the idyllic form of tranquillity, open space, and self-sufficiency. The preference for the

single family detached dwelling is a response to the free-standing, independent farmhouse. Presently, similar studies and trends of consumer choice show that Canadians still consider the single family detached home to be the preferred dwelling type (Friedman & Cammalleri, 1992). There is also evidence that a "return-to-the-countryside" sentiment was very much a part of the visioning by utopians and idealists. Ebenezer Howard's "Garden City" concept embraced rural living while rejecting the socio-economic ills and disparities that faced the industrialized city at the turn of the century (Figure 2-1). The Garden City experiment focused on achieving the best qualities of the city (such as employment and recreational opportunities) combined with the best of what the countryside had to offer (such as clean air and open spaces). In the early 1900s, attempts were made to apply the Garden City concept to new developments located outside major industrial cities (Letchworth and Welwyn, outside of London, were the first of such developments). However, instead of designing a Garden City in full, most of these used only certain aspects of the Garden City. Many of these developments adopted its aesthetic philosophy (providing abundant landscaped parks, tree-lined streets, and spacious lots) without attempting to incorporate any socio-economic aspects that were also a part of the Garden City movement (Girling, 1994; Grant, 1991). The logic behind this was motivated by the profit factor. The builders of these developments were able to use the Garden City concept as a strong marketing tool while having no intentions of carrying out its other socio-economic objectives such as local

employment or providing an economic base (Watanabe, 1980). As a result, these projects turned out to be upscale suburbs rather than successful independent centres.

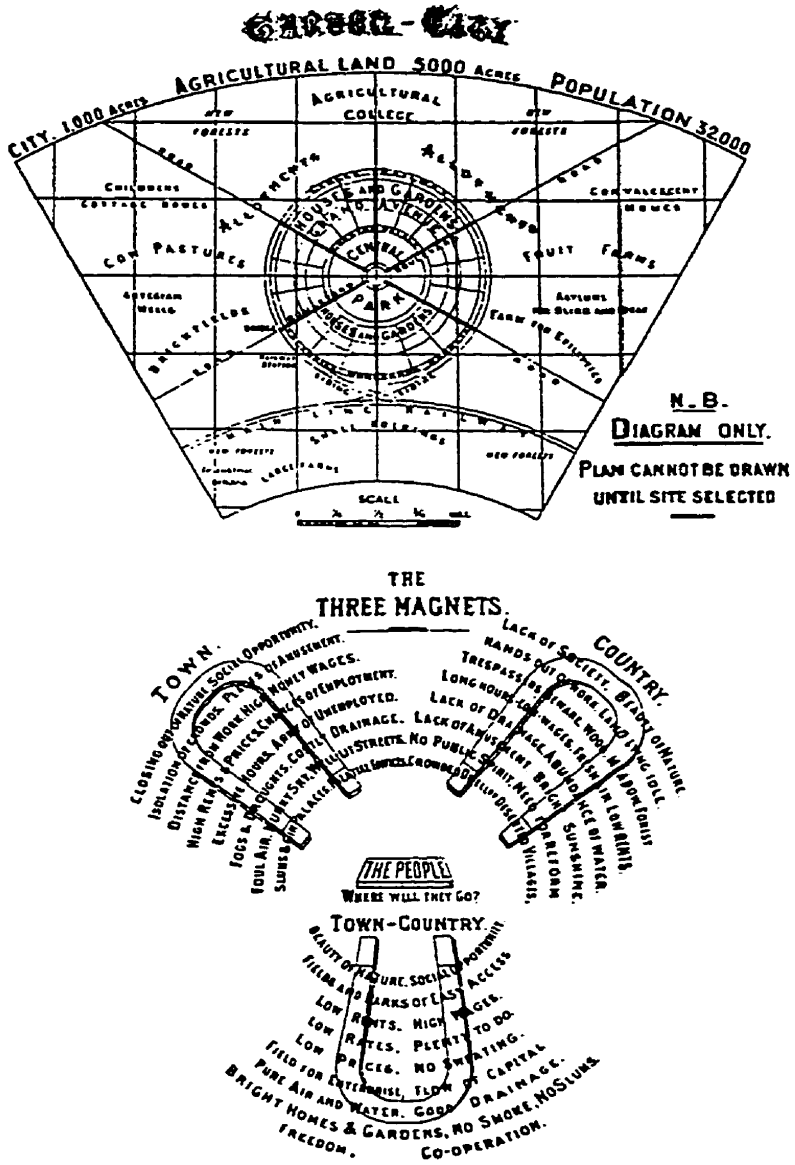


Figure 2-1: Ebenezer Howard's Garden City conceptual plan (top) and his "Three Magnet" theory (bottom) showing the advantages of a town and country atmosphere. (Source: *Yard, Street, Park*, 1994:10, 56.)

Advances in transportation technology gave rise to new ideas for the North American urban landscape. After it was realized how much of an impact the automobile would make in people's lives and on the North American landscape, architect Frank Lloyd Wright was inspired to offer his utopian vision of the future in the form of "Broadacre City" in 1934. Wright viewed innovations in transportation to be the catalyst for people to move out into the countryside at extremely low densities. Each dwelling unit would be situated on an acre plot where the occupants could grow their own food and be relatively self-sufficient (Figure 2-2). Although Broadacre City was never implemented, it provided a vision for decentralized land use patterns that are common today.

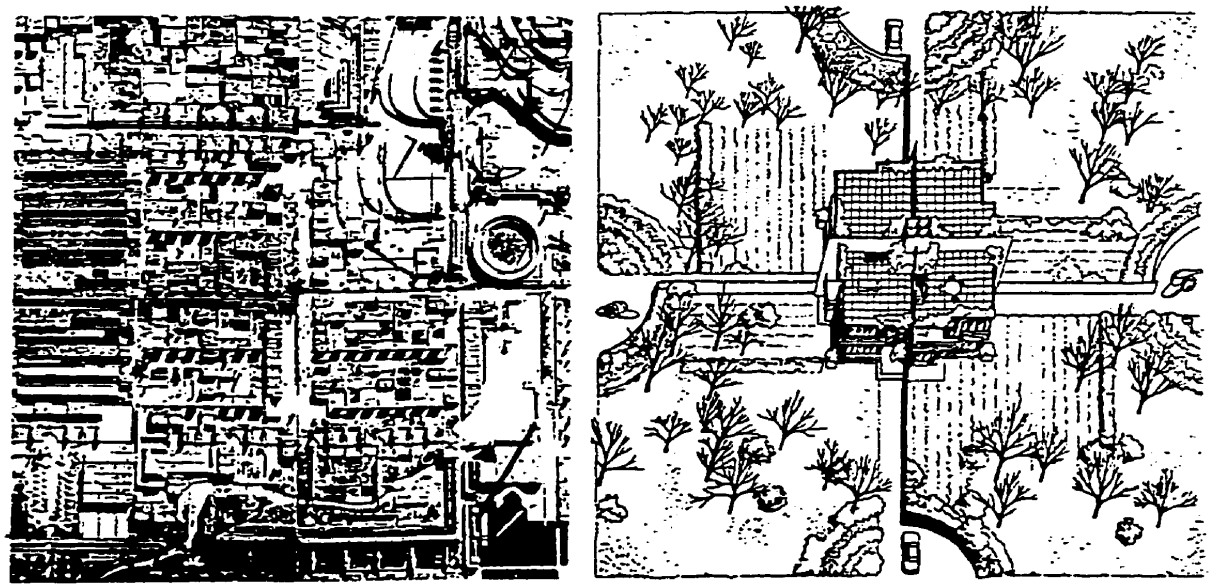


Figure 2-2: A model of Frank Lloyd Wright's Broadacre City (left) and a detailed drawing of a typical housing cluster and allotment (right). (Source: *Yard, Street, Park*, 1994:70, 72)

Following the Second World War, North America had witnessed a remarkable increase in population as young men returning from the war started families and took advantage of a renewed economy. There was an urgent need to house these new families which typically consisted of a married couple and two or three children. The Levittown projects were the first to respond to the growing demand to house the post war market. The first Levittown on Long Island, New York offered the "American Dream" of purchasing single family detached homes at very affordable prices. Its layout, use of land, and design would later come to symbolize the typical modern residential subdivision (Figure 2-3).

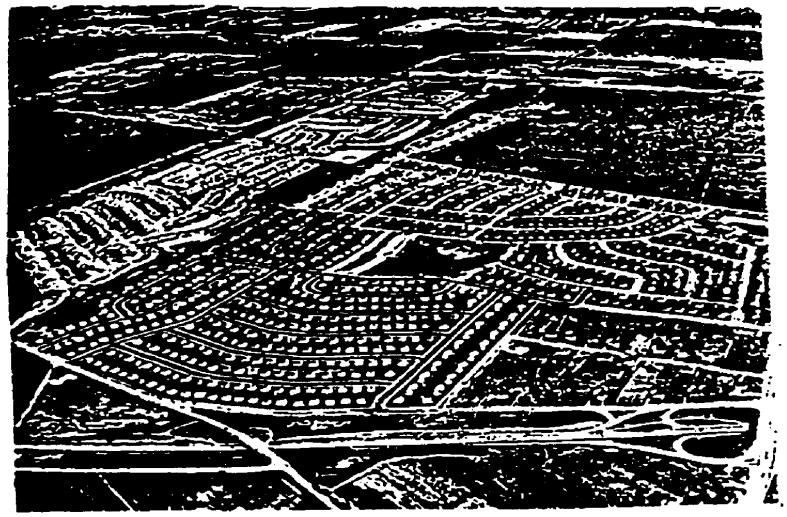


Figure 2-3: An aerial view of Levittown, N.Y. in its earlier stages of development. (Source: *Yard, Street, Park*, 1994:99.)

Canada's post-war suburbs, containing large tracts of parkland and half-acre lots, crudely reflected the Garden City and Broadacre City concepts. The conventional Canadian subdivision is strongly influenced by the development of Don Mills, Ontario. This project signaled the beginning of large-scale housing developments built by large corporations. The influences of Don Mills still exist in business practices as well as design features (seemingly aimless streets and collector road systems, low residential densities, segregated land uses). The result of the Don Mills project was the subsequent start of Canadian suburbia (Sewell, 1977).

Wentling & Bookout (1988) state that modern urban form can be attributed to the history of economies. Following the industrial-based economy in the earlier half of the century there surfaced a decentralized service-based economy. This had a dramatic effect on urban development patterns in two ways. First, there was a marked shift in new wealth. This resulted in the emergence of the quaternary sector (highly paid, skilled service-based professional jobs) and the tertiary sector (lower-paying, unskilled service jobs). Second, the emergence of this new economy furthered the gap between the social and economic classes. The direct response was a sharp increase in the demand of single family housing, more people were able to own their houses instead of rent, and the density level of residential developments dropped rapidly. Higher income earners physically distanced themselves from the lower income earners, migrating from within the city toward the outskirts. This type of migration is more common in North America than anywhere else. Sommer (1969)

contributes his perspective to North American segregation compared to British symbolism of classes. He states that while class in England determines who you are, in North America it determines where you live. There are always exceptions to this statement, but for the most part, physical segregation is more prevalent in North American society.

2.1.3 Urban Sprawl Summary

Since the post war era, however, much has changed in terms of family size, structure, and values. The average family size has decreased and there are more non-married and single-parent households. The once "typical" family of married couples with children and one income earner now represents only 17% of all Canadian families (CMHC, 1990). Current housing stock in conventional communities does not adequately accommodate these demographic trends, and yet they continue to be built similarly as they were following the Second World War. Calthorpe (1993:15) acknowledges this fundamental demographic shift as the primary source of mismatch between the resident and the community:

> We are using planning strategies that are forty years old and no longer relevant to today's culture. Our household make-up has changed dramatically, the workplace and workforce has been transformed, real wealth has shrunk, and serious environmental concerns have surfaced. But we are still building World War II suburbs as if families were large and had only one breadwinner.

A brief history of urban sprawl has identified the main catalysts for North Americans to migrate from urban centres to the exurban fringes. These main catalysts are:

1. The pursuit of the "American Dream" was a part of the North American psyche, and the single family home in the countryside was envisioned as a place of tranquillity, open space, and self-sufficiency. The Garden City and Broadacre City concepts reflected the strong return-to-the-country sentiment;
2. Innovations in transportation technology made far places accessible, making it easier for people to spread out farther than ever before. The Broadacre City concept was very conscious of this;
3. Land, energy, and construction costs were relatively inexpensive following the Second World War (partially due to large housing developments, such as Levittown and Don Mills, built by large corporations). This was significant because it provided affordable housing to the middle class whom comprised the majority of the population;
4. There was a change in the structure of economies with the emergence of the new quaternary sector, which made it possible to acquire more individual wealth. This subsequently increased the gap between classes, which resulted in the segregation and homogeneity of residential areas. Inner cities became ghettoized as wealthier populations moved to suburban areas.

The result of the urban-to-suburban movement had a profound effect on the basic design elements of the neighbourhood. Conventional residential developments are

characterized by a common list of conventional features (Anderson & Tregoning, 1998; Condon, 1996; Girling, 1994; Van Vliet, 1994; Calthorpe, 1993; Roseland, 1992; Lozano, 1990; Wentling & Bookout, 1988). These typical features of conventional neighbourhoods may include:

- Limited variety of housing types;
- Local commercial conveniences located outside of development (usually in a strip mall on arterial routes);
- Low residential densities;
- No particular adherence to site planning or local ecology;
- Planned as separate individual entities; minimal connections to adjoining neighbourhoods;
- Car-oriented design; little consideration for the pedestrian;
- Non-linear, winding street system;
- Very high proportion of private space compared to public space.

There is an obvious need to examine alternative models for urban development. The current problems that exist in urban centres across North America will persist if conventional development practices continue. This research project examines the concept and principles of sustainability as the basis for an alternative to conventional urban development.

2.2 Sustainability

To counter the problems of conventional communities, North American planners and municipal governments are increasingly examining the principles of sustainable development to guide urban growth (Calgary, Surrey, BC, and Davis, CA are a few examples). Although sustainable development is becoming more recognized and popular among planning and design professionals, there are very few examples of implementation. The sustainable development concept is relatively new and both the general public and developers are largely unaware of its potential. The terms "sustainable development" and "sustainability" will be defined and discussed here to gain understanding of the concept and its characteristics.

2.2.1 Defining Sustainable Development and Sustainability

The most recognized and accepted simple definition of sustainable development comes from the frequently quoted *Our Common Future* (1987) by the World Commission on Environment and Development (WCED). Formed by the United Nations, the WCED set out to examine and raise the awareness of the impacts that industrialization and development have had on the environment. The report called for a more sustainable approach toward development to decrease its globally harmful effects. The report defines sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". This document was especially significant to those who already supported the

sustainable development movement because it had given international and political credibility to a concept that many had embraced years before.

The term "sustainability" implies that the needs of a population and the flow of resources needed to support that population are to be brought into a dynamic balance. There is a common confusion with "sustainable development" and the terms "sustainable growth" and "sustainable use". Roseland (1992) suggests that these terms have been used interchangeably as if each meant the same thing. He refers to the International Union for Conservation of Nature (IUCN, 1991) to point out that "sustainable growth" is a contradiction of terms since nothing physically can grow indefinitely, while the term "sustainable use" is only applicable to renewable resources being used at a renewable rate. Some also mistakenly use the term "sustainable development" to simply mean either economic growth or environmental protection, when in fact it more accurately refers to economic development that stresses the importance of environmental quality and the conservation of natural assets (Pearce, 1991). Grant (1993) suggests that "sustainable development implies adaptation and improvement in a context where communities seek to protect natural process and landscape and to conserve resources for future generations" (from Van Vliet, 1994:25). While many people envision sustainable development as a means to "protect" the environment, Roseland (1992:7) states this requires economic and social change to reduce the need for environmental protection.

Sustainable development has an urban context. The concept of sustainable urban development urges us to restore our living environments to a healthy and ecologically sensitive state. This extends to creating new models of urban development in which our environment is cared for (Perks & Van Vliet, 1994:5). For Richardson (1989:14), sustainable urban development is "a process of change in the built environment that fosters economic development while conserving resources and promoting the health of the individual, the community, and the ecosystem (recognizing that the urban environment cannot be separated from the region of which it is a part)". From this, we can recognize that in the urban context, sustainable development includes the importance of the individual and the community. Therefore, sustainability also implies "improving the quality of human life while striving to live within the carrying capacity of the supporting ecosystem" (Perks & Van Vliet, 1994:5).

2.2.2 Characteristics of Sustainability

Regardless of the continuing debate over specific definitions of sustainable development, there is a consensus that it must include three components- environmental, economic, and social- which are closely linked (IUCN, 1991; Richardson, 1989; WCED, 1987). These three components are identified in section 2.1.1 of this document as being the main areas of criticism for urban sprawl. The success of sustainable urban developments relies on the integration of these three components (Figure 2-4). The characteristics of the three components are considered in more detail.

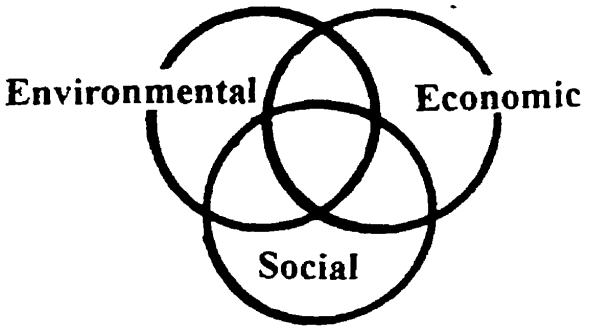


Figure 2-4: The relationship between the three components of sustainability.

Environmental: Sustainability may be misinterpreted as "greening" the area by returning the built environment back to a natural state. Such a transition could never be accomplished since it is impossible for people to live on the planet without altering the environment (MacNeill, 1991). Sustainability is rooted primarily in the ecology of natural systems, thus advocating that preservation and protection of the ecosystem is the primary consideration upon which planning decisions should be made.

Economic: To achieve social equity within the neighbourhood, affordable housing for different income groups and family types should be provided. A key to affordability is keeping development costs to a minimum. Increasing densities and maximizing land use efficiency can achieve this. In the late 1960s and early 1970s there was a strong push from municipal governments and planning associations to explore alternative subdivision designs to enhance the availability of affordable housing and to conserve energy consumption and land use. A series of studies were conducted in the United States, Canada, and Australia in the 1980s that focused on the affordability of planned communities having higher densities. These cost comparative studies between conventional neighbourhoods with lower densities and alternative designs having higher densities reported cost savings of $4,000 to $10,000 per housing unit for the alternative designs (Van Vliet, 1994:11). Although sustainable neighbourhoods are yet to be built in North America, there is evidence of interest for more economically sustainable measures of development in the form of

"infrastructure efficiency", which includes smaller lot sizes, reduced right-of-ways, and reduced setbacks (Marshall Macklin Monaghan Ltd., 1995).

Social: Equal accessibility by providing affordable housing is a key feature for the social component of urban sustainability. Therefore, the use of demographic data in community planning becomes essential to respond to the diverse nature of local populations. Housing, and the community in general, should be able to adapt to different life cycles and changes in lifestyles. A socially sustainable neighbourhood is one that is physically and culturally diverse and should also provide its residents with local employment opportunities if possible.

2.2.3 Examples of Sustainable Policy

Few Canadian municipal governments have adopted a sustainable urban development approach. Among those that are attempting it, there are close similarities in the definitions of the components of sustainability and their characteristics. These characteristics help clarify and guide the desired outcome of new community development. Guidelines for Metro Toronto and the City of Calgary are considered here to contribute to the understanding of the three components of sustainability. The Metropolitan Toronto Planning Department lists its *Components for the Livable Metropolis* (1991) as:

- *Environmental Integrity*: clean air, soil and water, and a variety of species and habitats are maintained through practices that ensure sustainability over a long term;
- *Economic Vitality*: a broadly based, competitive economy responsive to changing circumstances and able to attract new investments so that opportunities for employment and investment will be available in both the short and the long term;
- *Social Well-Being*: safety and health as well as equitable access to housing, regional, community, and neighbourhood services and recreational and cultural activities.

There is a close similarity between the Metro Toronto statement and that of Calgary's *Sustainable Suburbs Study* (1995) which advocates that communities need to be more responsible:

- *Environmentally*: communities are designed to minimize air, water, and soil pollution, reduce resource consumption and waste, and protect natural systems that support life;
- *Fiscally*: the cost of building, operating, and maintaining new communities and their supportive infrastructure and services are affordable, having regard to other spending priorities, and will not become a burden on future generations;

- *Socially*: communities are designed to be socially diverse, adaptable to changing lifestyles and to further the objective of providing all Calgarians with access to affordable housing, education, health care, essential goods, public amenities and services, and that their basic needs are met.

The Calgary document, later approved by City council, provides a chart comparing fiscal, social, and environmental characteristics between a less sustainable community (conventional) and a more sustainable one (Figure 2-5).

SOME CHARACTERISTICS OF A MORE SUSTAINABLE COMMUNITY

	A LESS SUSTAINABLE COMMUNITY	A MORE SUSTAINABLE COMMUNITY

FISCAL	- High development costs
	- High City infrastructure costs
	- High City maintenance costs
	- High City operating costs
		- Lower costs through:
		  - more compact urban form
		  - better utilization of services
		  - less infrastructure

SOCIAL	- Little sense of community, belonging or neighbourliness - Housing choice excludes certain household types and lifestyles - Design of public areas discourages walking and socializing - Few goods and services provided within community - Rigid separation of uses - Car essential	- Strong sense of belonging to a community; vibrant community life - Wide housing choice catering to many household types and lifestyles - Attractive public areas encourage walking and socializing - Most routine shopping needs met within community - Some mix of uses including employment - Need for car much reduced
ENVIRONMENTAL	- Inefficient use of land - High level of air pollution through auto dependency - Community design promotes lifestyles where excessive water, energy and resource consumption are largely unavoidable - No protection of environmentally sensitive areas	- More efficient use of land - Much reduced air pollution through reduced vehicle trips - Community design promotes lifestyles where consumption and waste can be reduced and conservation encouraged - Significant environmentally sensitive areas largely protected and integrated into the regional open space system

Figure 2-5: Characteristics for a more sustainable community according to the City of Calgary's Planning and Building Department. (Source: *Sustainable Suburbs Study*, 1995:17.)

2.2.4 Sustainability Summary

Achieving the objectives of sustainable development on a global scale is dependent upon the progress of implementing sustainability at the community or local level. The focus of this project, therefore, is at the neighbourhood level. There are a few points about sustainable development that need clarification. Sustainability is not attainable within today's perceived social, psychological, and material "needs". Sustainability, in its most literal definition, applies only to the use of renewable resources being used within rates of renewable capacity. Therefore, complete urban sustainability is impossible to achieve based on current global rates of renewable resource consumption (Rees, 1992). With this taken under consideration, the alternative concept presented in this project will strive to achieve a design concept guided by principles of sustainable development. Developers, municipal governments and the public are unlikely to accept the concept of sustainable development without first becoming familiar with it. This research project intends to introduce sustainable development as a first incremental step for alternative design. Such an approach on its own cannot solve contemporary urban problems, but the attempt may provoke thought towards changing current urban development practices.

2.3 Land Use: Addressing Segregation and Homogeneity

Before a viable solution for subdivision design can be attempted, it is first necessary to focus on an important issue. A critical task for the planner is to establish a coherent land use pattern for the neighbourhood. Land use planning organizes areas into functional segments typically as residential, commercial, recreational, industrial, and institutional. Segregation of land use means to physically distance different land use types from each other, thus making the function of each built area homogeneous (having the same function). The lack of strong land use guidelines (i.e. zoning) can give developers the freedom to build residential projects without restrictions. According to Lozano (1990) this is what we are currently experiencing in our subdivisions. He argues that ill-conceived land use practices in conventional developments have resulted in segregation and homogeneity.

Segregation and homogeneity create specialization. The more an entity becomes specialized, the less it is able to adapt to changing situations, such as a demographic shift in homebuyers or a drastic change in the local economy (Lozano, 1990; Odum, 1969; Boulding, 1968). Homogeneity is synonymous with physical and social monotony in urban areas, restricting residents in choice of housing types. Segregation and homogeneous land uses contribute to the degradation of the environmental and economic spheres as well. In a North American urban context, spatial separation has a strong link with segregation of land uses. Large areas of land

are used to accommodate isolated and specialized uses spread out across the regional landscape. This approach of development is expensive because it uses land inefficiently and requires the extended usage of infrastructure. Ecologically sensitive areas are disrupted to accommodate this kind of development.

If we acknowledge the need for change in the way we build our communities, and if we accept that the problem derives from poor land use practices, then it is our responsibility to seek a better approach. While design alone cannot achieve such an approach, it can provide an incremental step toward more innovative methods.

2.4 Keys to Urban Organization

Sustainable urban development presents a starting point in providing a set of guiding principles for community building. The next challenge is to respond to those principles by establishing a set of keys for community organization. Community organization in this sense refers to the physical pattern of development.

Following the Second World War, certain characteristics that made communities successful and livable were disappearing. Social diversity, a strong nucleus, and higher residential densities were key features of older neighbourhoods, but were largely ignored during the development of conventional communities (Lozano, 1990). These key features are utilized in this research project to develop the adopted

principles of urban organization. Each of these keys is explained in further detail below.

2.4.1 Diversity

Eugene Odum (1969:265) asks the question "is variety only the spice of life or is it the necessity for a long life of the total ecosystem comprising of man and nature?" By diversifying land use in subdivisions, choice is re-established in the social realm. Populations in North American urban areas consist of a variety of different cultures, ethnic backgrounds, and social structures. It should follow that a diverse environment would accommodate such a diversity of people. Diversity allows for flexibility and for a community to be better adapted to changing situations. This is not to say that the goal of social diversity should be enforced upon the residents, but measures should be taken to at least provide the opportunity for the citizen to make that choice. Establishing diverse neighbourhoods can be achieved by establishing a mix of different housing types (e.g. single family and multi-family) and land uses (e.g. residential, commercial, recreational).

2.4.2 Nucleus

Kenneth Boulding's book *Beyond Economics* (1968:74) identifies the first universal law of growth as the principle of nucleation or critical mass. This states that any structure should have a minimum size, that being its nucleus. Once the nucleus is

established, additions to the structure can be made. Additions around the nucleus usually consist of a different character and nature than that of its nucleus. This is because heterogeneous nucleation has the necessary complexity to start a sustained growth process. Towns and villages of colonial North America and in the later era of national expansion clearly showed the development of a strong nucleus. Only after critical mass was established did growth around it occur (Lozano, 1990). However, since the post war era, many communities have been built as single-functional subdivisions, mostly for the purpose of profit and engineering convenience. As a result, these subdivisions never turned into true communities. Neighbourhood vitality can be improved with the re-introduction of a central core or a neighbourhood node that becomes the focal area of community activity[1].

2.4.3 Density

The forces behind sprawl are varied and complex and have deep-rooted contexts. These powerful forces should not be ignored when designing an alternative subdivision. Imposing dramatic changes on the public would likely be met with very strong opposition. Change is more likely to occur if new ideas are gradually

[1] The developers of McKenzie Towne, a Neo-traditional community in Calgary, have built a neighbourhood node in its first phase of development. This node contains a "village green", apartments, a convenience store, and some offices. While this seems to defy good business logic, it may be a necessary marketing strategy for the developers to show they are committed to establishing a positive social atmosphere by creating a neighbourhood core early in their development.

introduced and proved successful. Acceptance may rely on the developers and their marketing abilities, and consumer preferences. There is evidence that consumer trends are shifting. Today's homebuyer considers lifestyle to be just as important as purchasing a home. Conveniences and increased leisure time are growing priorities, as the homebuyer is becoming increasingly willing to trade in extra private space for added convenience (to be closer to shopping, work, and recreation). Thus, there is a space-for-time tradeoff because of a growing willingness to accept higher densities in exchange for the advantages of community living (Bosselmann, 1998; Wentling & Bookout, 1988). A compact urban form is essential for the viability of local services when certain density thresholds are achieved (see 4.2.1.3). The use of various housing types utilizes different lot sizes and, in effect, can increase the residential density while providing choice to the consumer. Affordability would also increase due to lower development costs. Furthermore, a development could conceivably establish the same number of dwelling units on a site while conserving more land for open space and natural areas.

2.4.4 Urban Organization Summary

The three keys of urban organization- diversity, nucleus, and density- share an interdependent relationship. Heterogeneous land uses should exist within a neighbourhood and at its core. Diversity has a direct correlation with density as both combine to create choices in affordable housing. Viability of nucleation in the

community can only work when densities have reached acceptable thresholds that support services. Diversification, nucleation, and intensification provide a general structural guide for neighbourhood organization, which may compliment the sustainable framework quite effectively.

2.5 Literature Review Summary

The literature review examined urban sprawl, focusing on the problems that sprawl has caused and its history in North America. Urban sprawl was identified as a detriment to community development in the aspects of environmental, economic, and social issues. A history of urban sprawl in North America revealed it was mainly attributed to the pursuit of the "American Dream", advances in transportation technology, cheap and abundant energy and land, and a shift in economic structure. The urban sprawl section concludes with a list of characteristics commonly identified in typical conventional communities. This list is used for the site selection in this research project. Sustainable development, sustainability, and sustainable urban development were defined and discussed for a basis of an alternative approach to neighbourhood design. The concept of sustainability focuses on the integration of three components- environmental, economic, and social. These components compliment those aspects that are negatively affected in conventional developments. The principles of sustainable development guide the design in this research project. Land use issues were addressed. Segregation and homogeneity were identified as

two common characteristics that resulted from poor land use planning practices in conventional communities. Segregated and homogeneous developments are specialized entities. Specialization limits the ability to adapt or respond to changing situations, reduces housing choices and affordability, and creates monotony within a neighbourhood. The literature review also identified diversity, nucleus, and density as being the three keys for urban organization. Each of these was discussed individually, addressing concerns associated with conventional developments. Diversity, nucleus, and density comprise the organizing principles for the alternative design. The next chapter describes the project's methodology, the procedures, and the techniques used to collect information.

Chapter 3: Methodology

This research project undertakes the re-design of a conventional neighbourhood subdivision to produce an alternative concept. This chapter explains how the re-design and the subsequent comparative analysis between the conventional plan and the alternative concept were approached. The idea of the re-design is attributed to the *Edgemont II* study (Perks et. al., 1996), in which a re-design of a conventional residential community in Calgary was undertaken using the principles of sustainable development. The study compared land use distribution, housing types, and population profiles between the conventional and alternative schemes. Section 3.1 reviews the procedures taken for this research project and includes the techniques used for information gathering and synthesis.

3.1 Procedure and Techniques

This section explains the approach taken for the re-design and the comparative analysis between the conventional plan and the alternative concept. Each step of this project's alternative concept is listed in sub-sections. These sub-sections are titled "Identify Conventional Features", "The Site Selection", "The Developer's Rationale", "Establish Planning Principles", "Establish Design Responses", "The Re-Design", and "The Comparative Analysis". Information gathering techniques are included in each sub-section.

3.1.1 Identify Conventional Features

The list of typical conventional features presented in the urban sprawl summary (see section 2.1.3) is used in this research project to identify a suitable site for the re-design. That list is reinstated here.

- Limited variety of housing types;
- Local commercial conveniences located outside of development (usually in a strip mall on arterial routes);
- Low residential densities;
- No particular adherence to site planning or local ecology;
- Planned as separate individual entities; minimal connections to adjoining neighbourhoods;
- Car-oriented design; little consideration for the pedestrian;
- Non-linear, winding street system;
- Very high proportion of private space compared to public space.

3.1.2 Site Selection

Select a residential neighbourhood subdivision containing typical conventional features. The search for the conventional site was carried out by reviewing city maps and driving through various neighbourhoods. The developer of the selected subdivision was then contacted.

3.1.3 The Developer's Rationale

Determine the developer's rationale for planning and designing the conventional subdivision to gain insight into the City's approval process. This information was obtained by reviewing documents and written correspondence between the developer and various City departments such as Land Development, Parks and Recreation, Works and Operations, Streets and Transportation, Transit, and the Planning Department. Initial interviews were also set up with the site's developer. The discussion evolved around the main question "what was the reasoning behind Royalwood's design?"[2]

3.1.4 Establish Planning Principles

The alternative concept is based on the following set of planning principles: guiding, organizing, layout, and content. Each of these principles are explained in further detail.

3.1.4.1 Guiding Principles

The alternative concept reflects the principles of sustainability and sustainable urban development, focusing on the environmental, economic, and social components. These three components are incorporated into the decision-making of the re-design. The guiding principles of the re-design focus on:

[2] All interviews for this project were semi-structured. Discussion of various topics evolved from one or two main questions and pertinent information was used for this project.

- *Environmental Responsibility:* The alternative neighbourhood concept should achieve a synthesis between the built areas and its natural surroundings. Development practices should have minimal impact on local ecosystems. Conservation, enhancement, and protection of natural features and habitats are strongly encouraged;
- *Economical Efficiency:* The alternative neighbourhood concept should incorporate efficient form, design, and layout of land uses. The intent is to minimize the construction and maintenance of infrastructure and improve the delivery of services, resulting in lower development and housing costs;
- *Social Vitality:* The alternative neighbourhood concept should provide affordable housing choices to accommodate various individuals and families, provide its residents with public places and spaces for social interaction, and provide local conveniences and opportunities for employment.

3.1.4.2 Organizing Principles

The alternative concept adopts the following principles of urban organization (see section 2.4) to achieve a desired form that compliments the guiding principles:

- *Diversity:* The alternative neighbourhood concept should provide a variety of dwelling types. Diversity in the housing stock provides affordable choices to different family structures, sizes, and income levels. There should also be diversity in land uses. Reducing segregation and homogeneity of housing and

land use allows the neighbourhood to become more adaptable to changing situations;

- *Nucleus:* The alternative neighbourhood concept should provide a neighbourhood "node" or focal area to provide local services and/or activities (shops, daycare, and community facilities) for the convenience of its residents. This node should be centrally located within the neighbourhood to increase the accessibility of pedestrians and be connected with other amenities and activities (schools, open areas, and playgrounds);
- *Density:* The alternative neighbourhood concept should have an efficient, compact form to minimize development and housing costs (by using less infrastructure), to maintain thresholds of viability for local services such as retail and public transit (if applicable), and to preserve natural areas. Higher densities are achieved by using various housing types and lot sizes, and by reducing the width of public right-of-ways.

3.1.4.3 Layout Principles

The form and orientation of the alternative concept responds to physical and natural features within and surrounding the site. Development should only take place within areas that are considered to be non-productive or having little ecological value. The intent is that the neighbourhood's design responds to contextual considerations such as site characteristics (vegetation, wetlands, topography) and weather (wind and sun

angles). A site analysis based on Lynch (1962) was undertaken to gather pertinent data, which included:

- *Field investigations* of the site at different times of the year to observe and identify vegetation, wetlands, drainage, topography, and adjacent land uses. Observations were aided by photographs and field sketches. A study of the Seine River corridor was consulted for information on the site's quality of natural habitat and to obtain a complete inventory of plant and animal species for that area (see appendix A);
- *Key informant interviews* were conducted with the City's Superintendent of Technological Services to discuss the issues of drainage and the composition of soils in the Winnipeg area (this was necessary since soil tests are not required by the developer when building residential subdivisions). Questions included "was there a soil analysis for Royalwood?" and "what are the soil and drainage characteristics for Royalwood and for the Winnipeg region?";
- *Weather data* was utilized for studying local climatic conditions, including average winter temperatures, wind frequency and velocity, and sun angles;
- *Maps* were consulted to determine topography and adjacent land uses.

3.1.4.4 Content Principles

The content principles in the alternative concept reflect population and housing profiles of the city and the region. Demographic data should determine the mix of housing stock. Citywide and regional socio-economic data should establish housing types (i.e. single family dwellings, rowhouses, and apartments) and tenure (i.e. owned and rented dwellings)[3]. The ten census tracts surrounding the site (shown on the map in appendix C-2) are included in the regional profile. All demographic data is from Statistics Canada (1991). The profile categories include:

- Family size
- Family structure
- Household income
- Age distribution
- Housing by type
- Housing by tenure

3.1.5 Establish Design Responses

The alternative concept is based on a set of design responses (or guidelines). The responses are the result of the following approach, which is presented in section 4.2 of this document:

[3] The Toronto neighbourhood of St.Lawrence used a similar strategy for its housing mix. One of the neighbourhood's main goals was to create housing for all income groups, particularly for low and moderate incomes. To achieve this, the neighbourhood included different housing tenure and types according to local housing profiles (Hulchanski, 1984).

1. Identify the design topics to be considered. Each sub-section in section 4.2 represents a "Design Consideration" topic. These topics represent alternative features in the re-design. The topics include "Urban Organization", "Urban Ecology", "Drainage", "Climate", "Connections", "Housing Mix", "Pedestrian Access", and "Urban Efficiency";
2. State the objective(s) for each topic. An "Objective(s)" statement is made for each design consideration, which pronounces the desired vision for the alternative concept;
3. Identify the issues involved for each topic. The "Issues" statement recognizes the main points relating to each design consideration;
4. List any observations relevant to the topic. "Observations" are listed for each design consideration (when applicable) and may include site observations and/or documented data;
5. Discuss information relevant to the topic. The "Discussion" paragraph introduces and considers alternative approaches for each design consideration;
6. Establish design responses pertaining to each topic. The "Design Responses" are a set of design guidelines that are applied in the alternative concept. The design responses address a topic's objectives while acknowledging the contextual considerations of the site.

3.1.6 The Re-design Approach

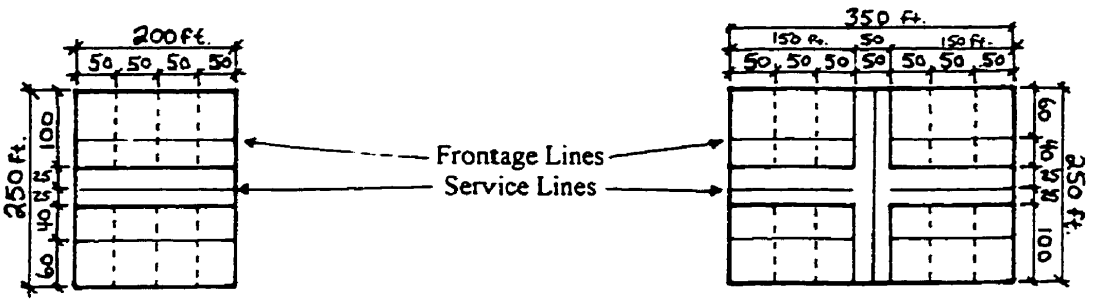
Undertake a re-design of the selected site using the stated planning principles and design responses. Assume that the re-design occurs at the pre-development stage (i.e. before 1992). In other words, the alternative concept is to be planned and designed according to the site conditions prior to present development, which had cleared the site of trees and has undergone extensive land grading. Determine the site's features and characteristics at the time of pre-development. This task was aided by the use of aerial photographs of the site (circa 1990) supplied by the City's Planning Department. These photographs show the location of significant tree stands that are no longer present. The alternative concept includes the requirements designated by the City (see section 4.3.1), which are often specified under a development agreement before the start of construction. These subdivision requirements include such things as park dedication, right-of-way regulations, arterial routes, retention ponds, and schools. The requirements were obtained through a review of the Land Development Department's *Development Agreement Parameters* (1989) and correspondence with the developer.

3.1.7 The Comparative Analysis

A comparative analysis between the conventional plan and the alternative concept was undertaken to display land use distribution and determine "urban efficiency". It is standard procedure for the developer to rely on two "urban efficiency" tests. They are the "frontage-to-services ratio" test and the "frontage per developable acre yield" test. Each test is explained here in more detail.[4]

The "frontage-to-services ratio" test is arrived at by first calculating the total length of saleable frontage (which is taken 40 feet from the edge of the street right-of-way (R.O.W.) and includes residential areas, commercial areas, and schools). The total length of salable frontage is then divided by the total length of services (or infrastructure, represented by the centreline of the R.O.W.). The resulting number value represents the "efficiency" ratio (Figure 3-1). Higher numbers are considered to represent a more "efficient" development. Using this method, the highest possible value is 2.0. This is achievable only by having a street or a number of parallel streets without intersections, and having saleable frontage extending along both sides of those streets for their entire length. Intersecting roads decrease the value, as lot sides are not considered to be saleable frontage. The developer's generally acceptable limit is 1.3 for a residential development. Although non-saleable areas such as parks can result in lower ratio values, they can increase property values because of their aesthetic qualities.

[4] Ladco's Manager of Land Development, Ken Oblik, provided information for the "urban efficiency" tests.



Total Frontage: 200 ft. x 2 = **400 ft.**
Total Services: **200 ft.**

400 ft. = 2.0 frontage-to-services ratio
200 ft.

Total Frontage: 150 ft. x 4 = **600 ft.**
Total Services: 250 ft. + 150 ft. + 150 ft. = **550 ft.**

600 ft. = 1.09 frontage-to-services ratio
550 ft.

Example dimensions: Lot sizes = 50 ft. width x 100 ft. length; Street R.O.W. width = 50 ft.

Figure 3-1: Examples of the "frontage-to-services ratio" tests. The highest level of "efficiency" is experienced when a street has saleable frontage along both sides of its entire length (left). The "efficiency" level drops sharply when intersections are added (right). (Drawing by Mark Spence.)

The "frontage per developable acre yield" test determines a general "efficiency" rate for a proposed subdivision design. The test divides the total saleable frontage by the total developable acreage within a site. The resulting number represents the saleable frontage in linear footage per acre. It is considered that higher numbers result in a more "efficient" development. Calculations of the two "urban efficiency" tests are applied to both conventional and alternative schemes in section 4.4.2.

Chapter 4: The Alternative Concept

This chapter is divided into four sections. The first section introduces the site selected for the re-design. The second section identifies the topics for alternative design considerations and establishes a list of design responses. The third section includes an illustration of the alternative concept and lists its features. The last section of this chapter is the comparative analysis between the conventional plan and the alternative concept.

4.1 The Conventional Site

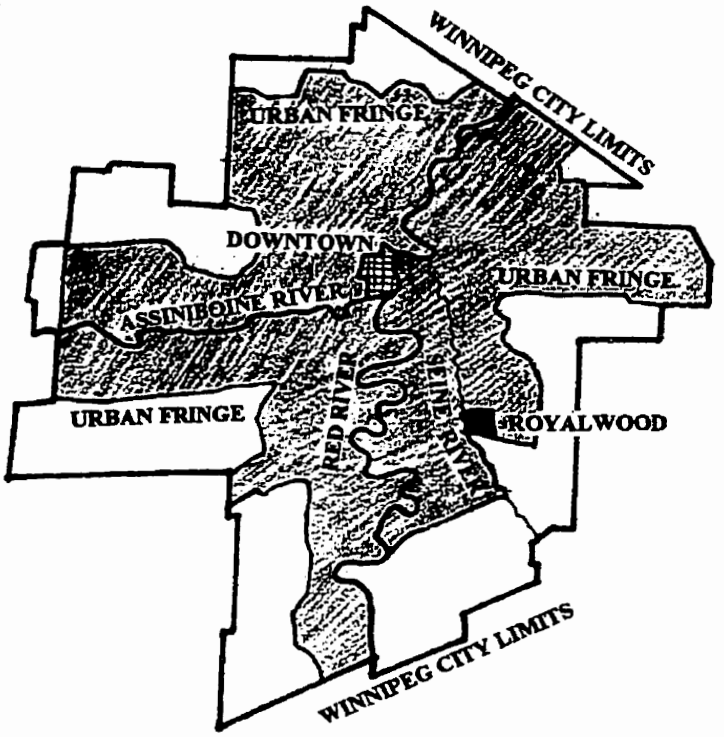
This section is divided into three sub-sections. The first identifies the site selected for the re-design and provides a descriptive list of features that either exist or are planned for the site. The second sub-section explains the reasons for the selection and includes a list of conventional features located within the site. The third sub-section reviews the developer's rationale for how the site was planned and designed.

4.1.1 Site Selection: Royalwood, Winnipeg

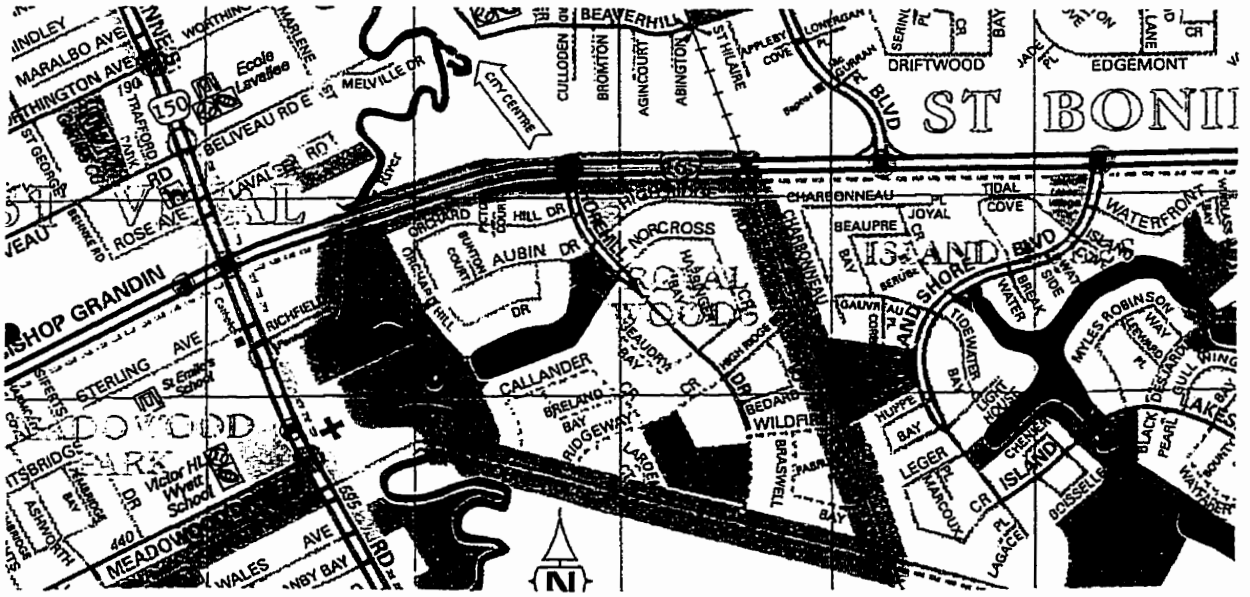
The site selected for the re-design is the neighbourhood subdivision of Royalwood, located on the urban fringe in southeast Winnipeg (Map 4-1). The 180-acre site is situated between Bishop Grandin Blvd. to the north (Figure 4-1), the CPR Emerson rail line to the east (Figure 4-2), John Bruce Rd. to the south (Figure 4-3), and the Seine River to the west (Figure 4-4). Map 4-2 displays the land uses surrounding Royalwood. Map 4-3 is a land use plan of Royalwood. The existing and proposed

features of Royalwood are listed here. (Note: Construction on the final phases of development was still ongoing. Autumn, 1998.)

- Total number of housing units is 650. Almost exclusively single family detached homes. Lot sizes vary, averaging around 6000 sq. ft. There is a 3-acre site containing 26 multi-family dwellings at the Bishop Grandin entrance;
- A 3-acre commercial site is located adjacent to the multi-family site;
- There is greenspace along the entire length of the Seine River corridor. A paved cycling/walking path extends along this corridor;
- A 4-acre elementary school site is to be built adjacent to a park;
- A seven-acre storm water retention lake;
- The main arterial road R.O.W. width is 106 ft. (32m.), residential street R.O.W.s are 60 ft. (18m.). Also has cul-du-sacs, bays (or crescent streets) and roadside indentations (called "eyebrows");
- Landscaped buffer along Bishop Grandin.



Map 4-1: A context map of Winnipeg showing the location of the Royalwood site. (Redrawn from a City of Winnipeg map.)



Map 4-2: Regional map showing land use around Royalwood. (Source: Sherlock's city map of Winnipeg, 1996.)

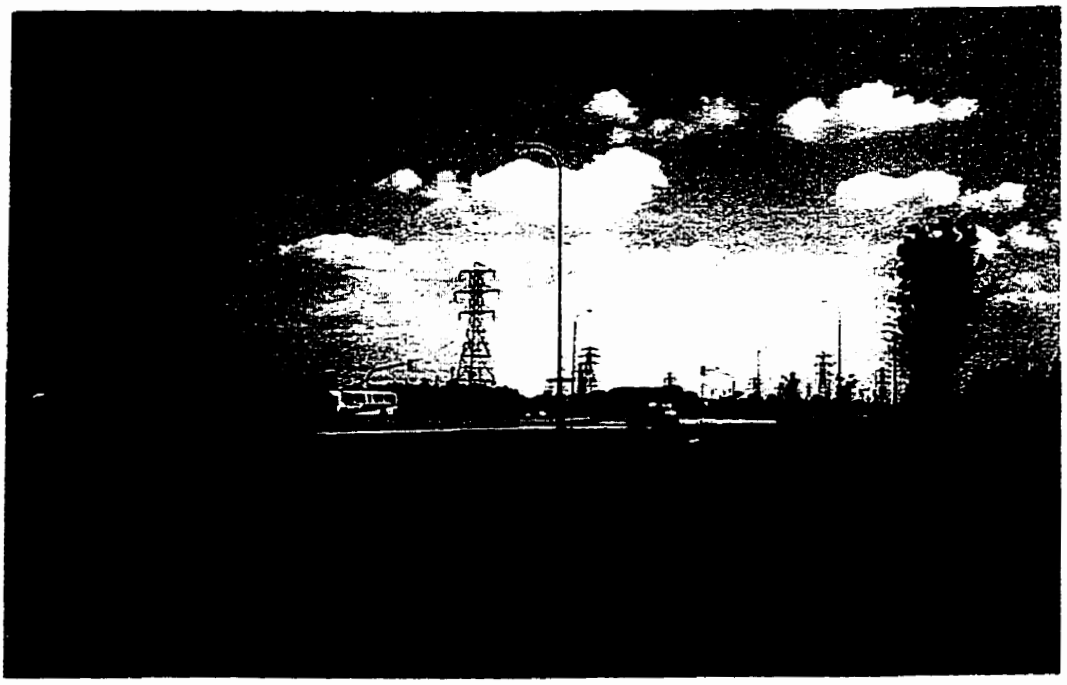


Figure 4-1: Looking north from Royalwood towards Bishop Grandin Blvd. Land use along this thoroughfare is restricted because the street R.O.W. includes a power line corridor. (Photo by Mark Spence.)

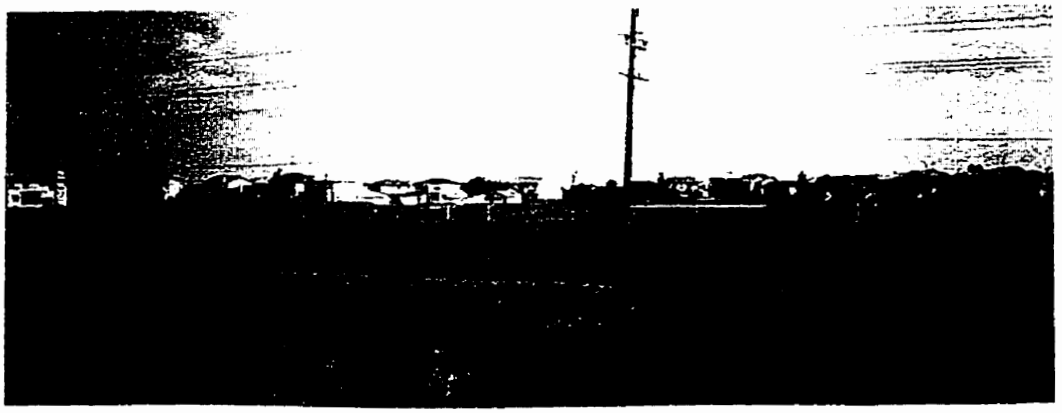
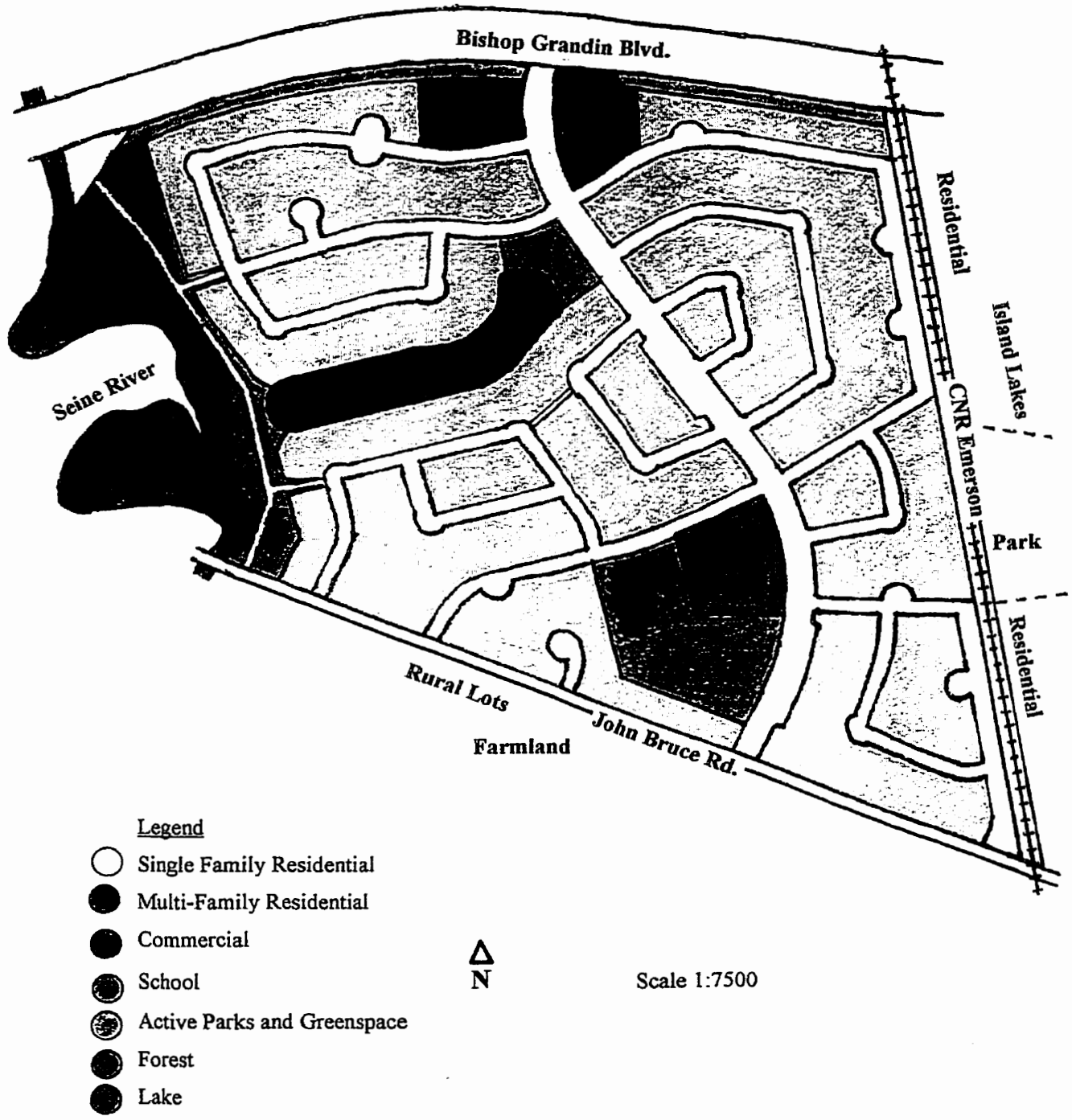


Figure 4-2: View from Royalwood looking east across the CPR Emerson railroad tracks towards the open play field in the neighbourhood of Island Lakes. (Photo by Mark Spence.)

Figure 4-3: Looking south from Royalwood. On the other side of John Bruce Rd. are rural lots and agricultural land that Ladco owns and plans to develop in the future. (Photo by Mark Spence.)

Figure 4-4: The Seine River borders Royalwood to the west. (Photo by Mark Spence.)

The Conventional Plan of Royalwood



Map 4-3: The conventional plan of Royalwood. (Source: Redrawn from a Ladco Co. Ltd. plan.)

4.1.2 Reasons for Site Selection

The site was chosen for two main reasons. First, Royalwood represents a typical conventional neighbourhood subdivision in Winnipeg. The following is a list of the conventional features of Royalwood, according to the criteria compiled in the literature review (section 2.1.3).

1. *Lack of diversity resulting in exclusion.* Upon completion of development, 96% of Royalwood's housing stock will comprise of single family units. The developer's initial target was to build homes for the $140,000-160,000 market range, which in effect excludes a large segment of Winnipeg's population from having the choice to live there.
2. *Designing without a neighbourhood focus.* The Royalwood plan does not provide a focal area where social functions and other opportunities for public interaction can occur. It is difficult to establish a sense of community without these features.
3. *Low residential density for urban neighbourhood.* Net density yield (number of units divided by residential acreage) for Royalwood is approximately 6 units per acre. Higher residential densities are needed to increase land use efficiency, which minimizes development costs, and to make local services (such as public transit and commercial activities) more viable. For example, the minimum density needed to support a small store is at least 12 dwelling units per acre (Lynch, 1962:147). Density thresholds are further explained in section 4.1.2.3.

4. *A disregard of natural features or contextual considerations.* The planning and design of Royalwood was done without considering site characteristics, such as local ecology. Prior to development, the site contained at least three woodland groves and a small seasonal wetland. These features provide habitat for both animal and plant species. However, development in Royalwood has destroyed most of these features rather than incorporating them into the design. Contextual considerations such as weather and climate factors were also neglected.
5. *Weak connections to adjacent neighbourhoods.* The plan does not establish any obvious links to features or places outside of its boundary. For example, the play field in neighbouring Island Lakes to the east presents a good opportunity to adjoin public space, such as a school, to Royalwood. This was attempted in earlier Royalwood design concepts, however, it was discouraged by the City's Parks and Recreation Department (a further explanation is provided in section 4.1.3).
6. *Lack of consideration for the pedestrian environment.* Royalwood's main road is the only street that has sidewalks. However, the main road has minimal residential frontage facing the street with a six-foot high fence extending along most of its sides, separating the sidewalk from the houses. This results in a sterile pedestrian environment. Residential streets do not have sidewalks, forcing people to walk on the streets and compromising their safety. The lack of sidewalks in the subdivision can be attributed to minimizing development costs.

There is a paved walking/cycling path that runs the length of the Seine River within the subdivision with two connecting pathways to residential areas.

7. *Confusing street system.* There is no obvious pattern in Royalwood's street system. The scattered orientation of the roadways plus the bays and cul-du-sacs give the subdivision a maze-like character which may be confusing, especially to the visiting motorist or pedestrian.
8. *Lack of public space.* The total amount of greenspace in Royalwood is approximately 22 acres or about 12% of the subdivision's total area. Landscaped or "active" parkland accounts for 14 acres of total greenspace. There is no apparent attempt in the plan to establish connections between these areas.

The second reason for selecting Royalwood as the site for this research project is due to the co-operation provided by the developer. Ladco Company Limited and its Manager of Land Development, Mr. Ken Oblik, have been cooperative in lending technical support by providing various maps and plans of the site and supplying various forms of data for the information-gathering process. Mr. Oblik also provided guidance for the "urban efficiency" tests used in the comparative analysis of this project.

4.1.3 The Rationale of Royalwood

This section explains the reasoning behind Ladco's decisions on the planning and design of Royalwood. The purpose here is to obtain an understanding of the approval process for subdivisions in Winnipeg.[5]

The Plan in General: Various City departments such as Parks and Recreation, Streets and Transportation, Works and Operations and others must first scrutinize all subdivision proposals and recommend changes. After each department has made their recommendations, the resulting design no longer resembles the original concept. The effect is that new subdivisions in Winnipeg have similar characteristics. The approval process of Royalwood is a good example of this. The original Royalwood concept contained an interconnecting park system that included a pedestrian network and linkages to adjacent areas. The Parks and Recreation Department discouraged the proposed park system, declaring that it would be too difficult to maintain. The original street system was altered to accommodate snow clearing more easily. The Provincial government also encouraged the developer to provide multi-family housing. Rather than getting involved in lengthy debate over the proposed amendments imposed by the City (and, in this case, the Province as well), developers are more likely to accept the recommendations since delays are costly.

[5] Information is from an interview with Mr. Oblik in October 1998.

Housing: Ladco's original intention was to establish a $140-160,000 price range for its housing market. However, when it came time to build, houses in the $180-200,000 price range were built and some are worth over $250,000. Ultimately, homebuyers have influenced the price range in Royalwood. Generally, the larger and more expensive homes are found west of the main road. The most expensive of these are found mainly along the lake and the Seine River. The least expensive homes are along the railroad tracks and backing onto Bishop Grandin Blvd. The original Royalwood plan did not include multi-family dwellings. Ladco purchased the Royalwood site from the Province of Manitoba. One of the stipulations in the purchasing agreement stated that multi-family housing was to be included on the site (but it did not specify the amount or type of multi-family housing). Ladco built twenty-six semi-detached bungalow condominium units (equaling 4% of the total 650 units). This particular housing type was chosen to establish a "fit" to the rest of the single family dwellings.

Commercial: The original plan of Royalwood did not include a commercial area. The developer later designated a 3-acre commercial site east of the main entrance because that particular area was not considered to be marketable as a residential area. The developer does not anticipate the commercial area to be developed due to the small number of units in the neighbourhood and the competing commercial area only one kilometer away in neighbouring Island Lakes.

School, Lake and Parks: The City required the developer to provide a four-acre school site. The original concept located the school centrally in the site with an adjacent playground adjoining the open play area in Island Lakes. The City required the inclusion of a stormwater retention lake (minimum of 5 acres in surface area). The developer constructed a 7.8-acre lake extending from the main road to the Seine River parkway. The intention for its positioning was to "set the tone" of the neighbourhood for people entering from Bishop Grandin. The area surrounding the lake is private property with the exception of the lake-ends. Typically, the City's Parks and Recreation Department require 10% of land within a subdivision to be dedicated as "active" or landscaped parkland. For the Royalwood site, the dedication is 8% of 173 acres, or 14 acres of dedicated parkland. The 173 acres was derived at by subtracting the seven acre flood zone area (which is non-developable) from the 180-acre total. The landscaped parkland includes a school park, a riverside parkway, a small lake-end park, and a landscaped buffer along Bishop Grandin Blvd.

Main Road: The access points of the main road were pre-determined. The City built the north access point at Bishop Grandin Blvd. prior to the planning of Royalwood. The developer purchased a lot south of John Bruce Road for future access to Ladco-owned properties south of the site. The main road is determined by the straightest route between these two access points using the minimum curve radius set by the City's traffic engineers. The positioning of the main road adheres to the standard set

by Winnipeg Transit, which states that all residential areas must be within 400 metres of the route.

4.2 Establishing Design Responses

This section explains the approach for establishing the set of design responses (or guidelines) used for the alternative concept. The design considerations presented here focus on particular aspects of neighbourhood planning and design and offer alternative ideas to conventional practices. These considerations appear in the order of how they were addressed in the re-design. Together, they comprise urban organization (which includes diversity, nucleus, and density), urban ecology, drainage, climate, connections, housing mix, pedestrian access, and urban efficiency.

4.2.1 Design Consideration: Urban Organization

Objectives: Plan the alternative concept according to the principles of urban organization as stated in section 3.1.4.2.

Issues: *Diversity, nucleus, and density.* It is important to first address the principles of urban organization because they directly influence other design considerations. For example, the desired levels of diversity and density in the re-design have a direct correlation with the housing mix. The principles of urban organization are identified here and are examined individually.

4.2.1.1 Diversity

Discussion: The key to a socially sustainable community is dependent upon the people that live there. One characteristic of a socially sustainable community is the ability to adapt to different conditions. Populations that are more diverse culturally, financially, and otherwise can offer neighbourhood stability while adding character to the local social fabric. Diversity of populations likely result in different lifestyles, values, and incomes, which in turn reflects on the need for a variety of housing types.

Design Response - Diversity:

- Accommodate a wide variety of socio-economic groups by supplying a range of affordable housing types.

4.2.1.2 Nucleus

Discussion: Conventional neighbourhoods typically lack a focal area. One requirement for a socially sustainable neighbourhood is providing public space where people can gather for local functions. A focal area should be included to add character to the neighbourhood. The focal area may consist of open public space such as a park, or public places such as a community centre, a meeting hall, daycare, or commercial facilities. The focal area should be accessible (within a short walking distance) to all neighbourhood residents.

Design Responses - Nucleus:

- Create a focal point within the site;
- The focal point placement should be centrally placed and within an acceptable walking distance (about 500 metres or a 5-minute walk) of all residential areas (Figure 4-5);
- The content of the focal point may be determined in the later stages of planning and development, but should include public spaces and places for social gatherings and activities, and commercial areas if considered feasible.

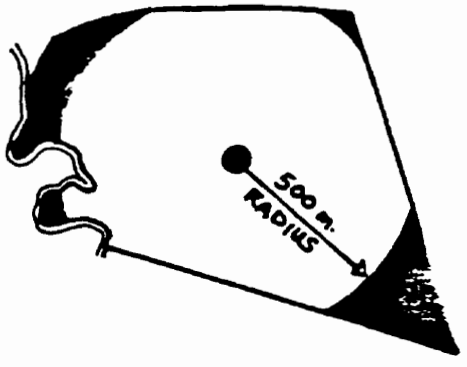


Figure 4-5: Proposed location for neighbourhood focal point and five-minute walking radius. (Drawing by Mark Spence.)

4.2.1.3 Density

Discussion: Increasing the density of a residential development can reduce infrastructure costs, increase the efficiency of service delivery, and preserve open space and natural areas. Higher densities are achieved by establishing a mix of housing types. Determining the suitability of density can depend on the character of surrounding neighbourhoods. Density thresholds determine the viability of services (i.e. public transit or commercial activities) within a development. The number and variety of services can increase with higher densities. Different places use different threshold standards. Lynch (1962:147) notes the following threshold examples that are commonly used in North American planning:

- The first threshold of 12 dwelling units per acre (d.u./ac.) is the minimum net density required to support a basic convenience store;
- The second threshold of 20 d.u./ac. is the minimum net density to support a few shops of various services;
- Net densities higher than 20 d.u./ac. can usually support multiple services, however single family dwellings are excluded from the housing mix.

The threshold theory, however, is subject to different situations. Other factors that determine viability should also be considered such as accessibility (i.e. driving/walking distance and location), types of services, and proximity of competing commercial centres.

Design Responses - Density:

- Utilize a compact urban form;
- Achieve higher density levels by introducing a variety of housing types;
- Achieve minimum threshold levels to support the viability of local services;
- Extend higher density housing along future transit routes (i.e. the main road);
- Locate higher density housing surrounding the neighbourhood focal point.

4.2.2 Design Consideration: Urban Ecology

Objectives: Integrate the site's urban and natural environments to achieve a synthesis or a balance. Preserve all areas that are considered ecologically sensitive and enhance the opportunity for local wildlife to flourish.

Issues: *Vegetation, wetlands, and open field.* Before the developer acquired the site, the land was used for agricultural activity. Areas that were once cultivated now contain limited ecological value. However, there is evidence that large tree groves and a small seasonal wetland had existed on the site before it was cleared for development.

Observations: The location of significant tree cover and the small wetland (prior to development) was plotted with the aid of aerial photographs (Figure 4-6). Identification of species mix in the riparian forest along the Seine River is recorded in, *An Assessment of Vegetation and Wildlife Habitat Quality for the Seine River*

Parkway (City of Winnipeg, 1995). A list of identified species is in appendix A. Site maps showing contour elevations provided location of the river flood zone. The small seasonal wetland was identified by field inspection.

- Riparian forest contains dense tree canopy and undergrowth including a wide variety of tree, shrub, and animal species;
- Remaining patch of forest in the field has similar characteristics to riparian forest;
- Indication of abundant wildlife in riparian zone along the river course;
- The Seine River swells during spring thaw and heavy rains, but does not overflow beyond its flood zone marked by the contour elevation of 230 m.;
- Small seasonal wetland located on south edge of tree stand is surrounded by cattails and bulrushes and is frequented by waterfowl.

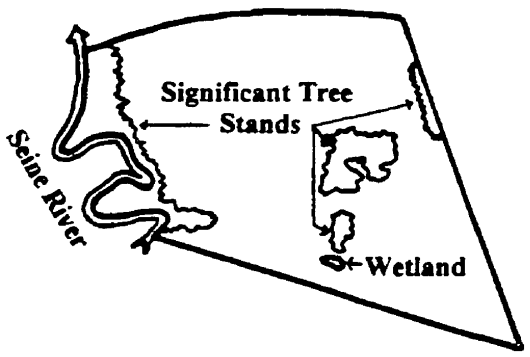


Figure 4-6: Royalwood site showing areas of vegetation and the wetland prior to development. (Redrawn from aerial photographs from the City of Winnipeg.)

Discussion: The various ecosystems (forests, wetlands) rely on complex species interaction. Species relationships within an ecosystem often exist in a fragile balance. For example, a large variety of plant and animal species is needed to

support a local food chain. The loss of a particular species can affect the whole system. Each species has particular requirements (i.e. food, water, cover, and territory) for survival. Habitat shape and size are especially important for supporting species types and populations within an area (Figure 4-7). Biodiversity is more prominent in larger and continuous forms of habitat than in smaller, non-cohesive patterns (Spirn, 1984).

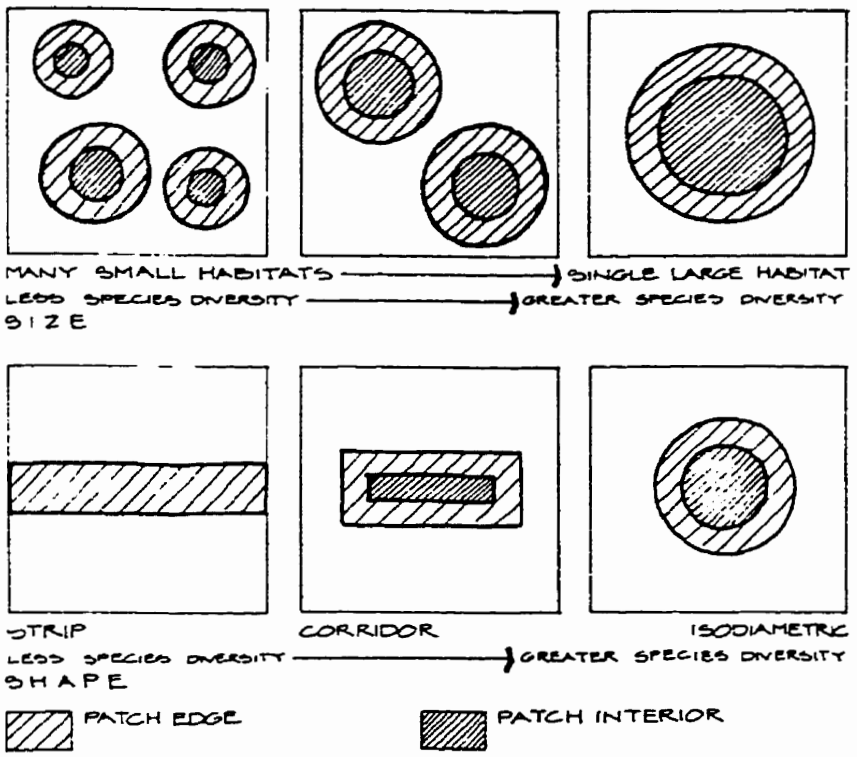


Figure 4-7: The principles of biodiversity for wildlife habitat. Species diversity is dependent on an area's shape and size. (Source: *The Granite Garden*, 1984:219.)

Woodlands and wetlands are natural mechanisms to help regulate stormwater runoff. The intricate root system of woodlands possesses a significant ability to absorb water while preventing erosion from surface runoff. Wetlands also increase an area's absorption capacity (Spirn, 1984). Preservation of ecological areas such as

woodlands, wetlands, and riparian zones goes beyond benefiting wildlife. Ecological preservation, conservation, and enhancement of natural areas can result in social and economic gains. Natural areas can add character to a neighbourhood and are attractive to potential homebuyers. Developers recognize the potential benefits of natural areas as amenities that can influence property values. Cities can realize the benefits of "ecological management of open spaces" (also called "closed" ecosystems by Spirn, 1984 (Figure 4-8)) as a measure for cost, labor, and energy savings on park maintenance (Spirn, 1984 and Sutherland, 1989). Therefore, land designated for development should only occur in areas having minimal ecological value or lands that have already been disrupted (such as land previously used for agriculture).

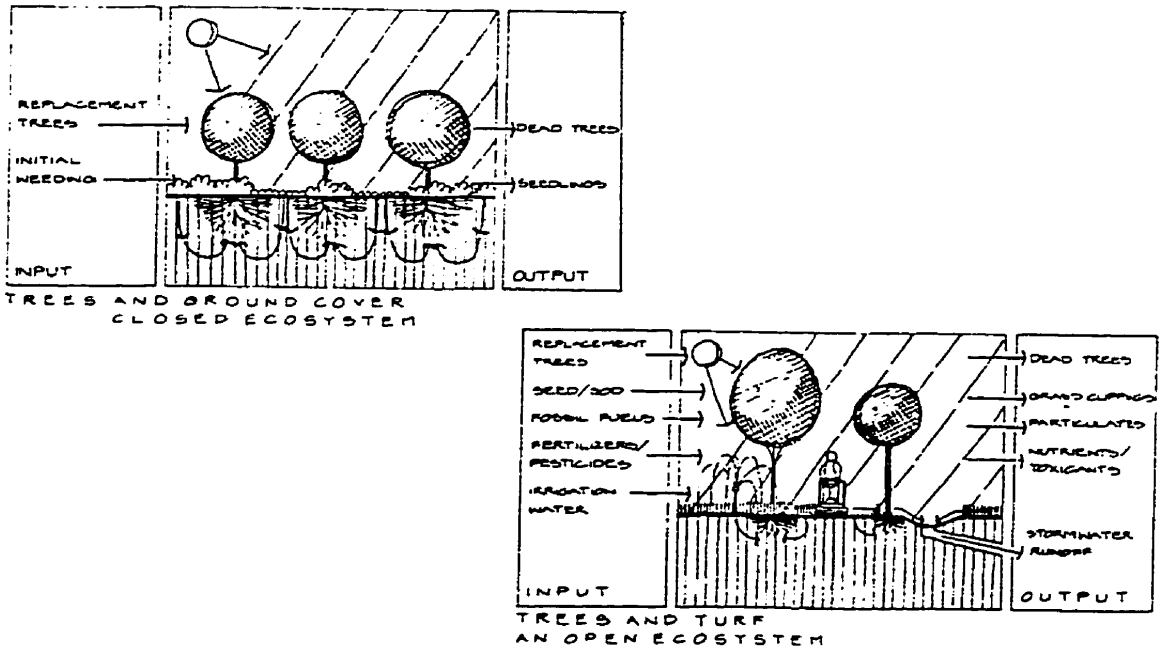


Figure 4-8: This illustration shows the benefits that a "closed" ecosystem has over an "open" ecosystem regarding inputs of energy and outputs of waste according to Spirn (1984). (Source: *The Granite Garden*, 1984:248-9.)

Design Responses:

- Designate ecologically sensitive areas for preservation and maintain these areas as "ecological management of open spaces";
- Identify and protect areas of aesthetic quality;
- Preserve and enhance woodlands and wetlands for their abilities to store stormwater runoff and provide wildlife habitat;
- Designate areas that are most suitable for development (such as former cropland);
- Establish buffers between ecological and built environments to avoid infringement upon sensitive areas.

4.2.3 Design Consideration: Drainage

Objectives: Provide necessary measures for efficient removal and storage of surface water and explore the option of retention pond "naturalization" (i.e. introduce indigenous plant species and maintain as an "ecological management of open space" area).

Issues: *Topography, gradient, and soils.* The quality of on-site drainage is largely dependent upon the site's topography and soil base. The site's flat surface combined with its clay-soil base has resulted in poor drainage.

Observations: Surface relief information was acquired from a topographic map and drainage quality was confirmed by field inspections.

- Predominantly flat surface without noticeable relief features;
- Slight grade sloping toward Seine River declining 1 metre over a distance of 1000 metres, or a 0.1% gradient (Figure 4-9);
- Increased drop in floodplain area (between the river course and the 230 m. contour line);
- Large pools are present after snow thaw and heavy rainfall.

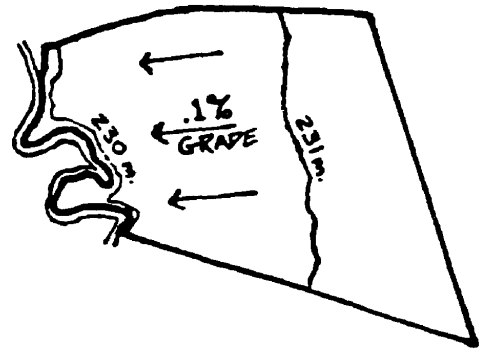


Figure 4-9: Topography and gradient of the Royalwood site. (Drawing by Mark Spence.)

Discussion: Soil tests are not required for residential developments in the City of Winnipeg. Developers are obligated to hire a consultant to conduct soil research only when planning industrial sites. There are no accurate city maps that depict specific soil types shown at a regional scale. George Sears is the City's Superintendent of Technological Services in the Public Works Department. According to Mr. Sears, clay-based soils are common for the entire Winnipeg region.

Winnipeg is situated on an ancient lakebed having a clay-base substructure that is semi-impervious to water. The site's soil composition, coupled with the level ground surface, has resulted in poor drainage. Most Winnipeg subdivisions provide retention lakes to control stormwater runoff. City engineers specify the surface areas and depths of these lakes. A more sustainable method of retaining stormwater runoff is to construct "naturalized" wetlands (Figure 4-10). This uses indigenous aquatic plant species in the stormwater drainage system. "Naturalization" can result in a number of benefits. It creates habitat for wildlife, serves as a natural filtration process (Figure 4-11), improves surface drainage more effectively, and serves as a neighbourhood amenity and local attraction. However, it should be noted that this method may not suit certain climates, soil conditions, or runoff levels. Although wetland naturalization is receiving increased acceptance in public policy (such as Calgary and many U.S. cities), implementation outside Europe is slow. Further study for the viability of this method in Winnipeg is needed. However, the City can take steps to establish a more natural setting for its current retention lakes. Providing a naturalized setting by introducing native plant species to the lake's edge has advantages over the conventional method of sodding. Decreased maintenance costs can be realized because the naturalization method is less labour intensive and requires little or no chemical pesticides or herbicides (see Figure 4-8).

Design Responses:

- Advocate the use of current capacity standards for stormwater retention lakes set by the City;
- Introduce native species of vegetation to surround retention lakes ("naturalization");
- Locate and position retention lakes to best utilize natural drainage and, if possible, link with other open or natural spaces;
- Encourage the preservation of existing woodlands and wetlands to increase local surface drainage.

Figure 4-10: Examples of constructed urban wetlands. (Sources: *Yard, Street, Park*, 1994:223 (left) and Mary-Ellen Tyler, 1994:171 (right)).

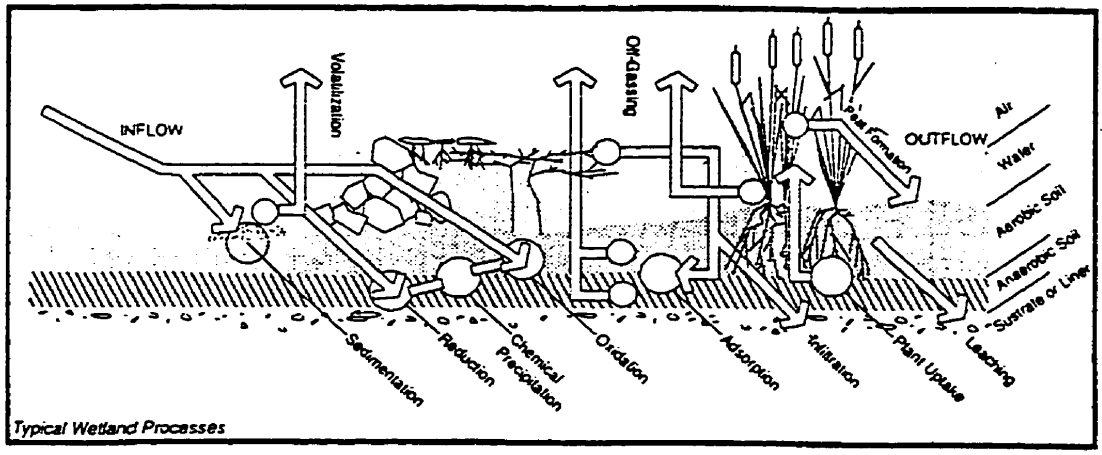


Figure 4-11: A cross-sectional diagram showing the working processes of a constructed wetland. (Source: *Sustainable Suburbs Study*, 1995:69.)

4.2.4 Design Consideration: Climate

Objective: Arrange urban layout to respond to positive and negative climatic considerations.

Issues: *Winter winds and sun angles.* We cannot control winter temperatures or snowfall, but we can create microenvironments to lessen their impact. Introducing certain design features into the neighbourhood can moderate severe windchill factors and blowing snow. It is, therefore, important to recognize the frequency and direction of cold winter winds. Sunlight exposure can be as uncomfortable as it can be pleasant. In winter, sunlight is in short supply and should be utilized as much as possible. In summer, shading should be provided to increase outdoor comfort. Methods of maximizing winter sun exposure while providing summer shade should be incorporated into the alternative concept.

Observations: The weather data is provided by Environment Canada (1998). Sun angle information is provided by *Canadian Eco-charts*, published by CMHC. Weather data and sun angle information are found in appendix B-1 and appendix B-5 respectively.

- Winnipeg's surface winds predominantly originate from the south except for January (the coldest month) when they blow from the northwest (Figure 4-12);
- Extreme wind speeds also typically originate from the northwest (up to 70 km/h);

- Average January wind speeds (18 km/h) combined with the daily mean temperature (-18°C) results in a windchill factor equaling -27°C. Extreme windchill example: -30°C temp. + 30 km/h wind = -60°C (see appendix B-3);
- Mid-day sun angles range from 63° at its highest point in June to 16° at its lowest point in December (Figure 4-13);
- Hours of daylight range from 8 hours in December (8:30 a.m. sunrise, 4:30 p.m. sunset) to 16 hours in June (5:30 a.m. sunrise, 9:30 p.m. sunset).

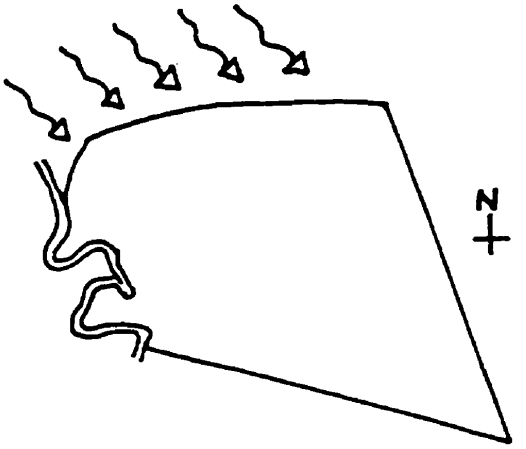


Figure 4-12: Predominant wind pattern for January in Winnipeg. (Source: Environment Canada, 1998. Drawing by Mark Spence.)

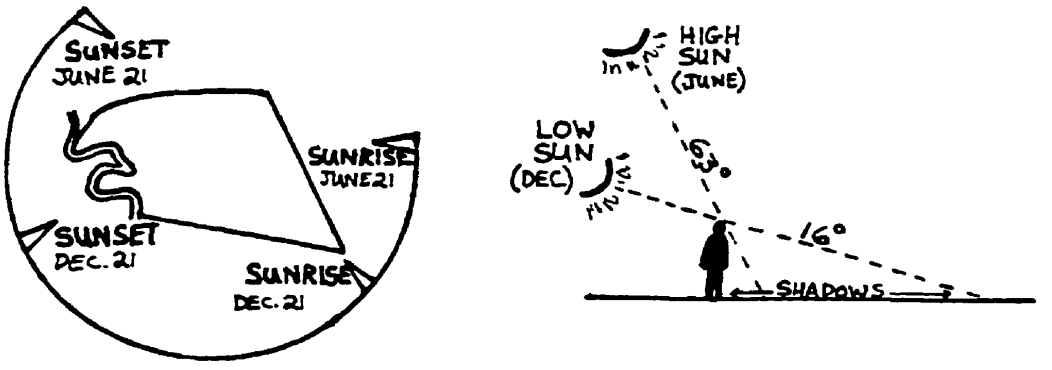


Figure 4-13: Minimum and maximum angles for daylight (left) and sunlight (right). (Source: *Canadian Eco-charts*. Drawing by Mark Spence.)

Discussion: Topography usually influences street orientation and the general layout of the neighbourhood. However, topography is not a consideration in the development of the Royalwood site. The general layout and street orientation for the proposed re-design should recognize and respond to two main factors: Cold winter winds originating primarily from the northwest, and winter and summer sun angles. Winnipeg is a city associated with weather extremes. Average seasonal temperatures range from 25°C (77°F) in the summer to -15°C (5°F) in the winter. However, these averages do not always reflect the realities of an extreme climate. Temperatures for this mid-continental location can easily reach extreme temperatures of +35°C (95°F) to -35°C (-31°F). It is impossible to adjust weather patterns to maintain comfort levels, but it is possible through design to influence and manipulate some weather factors at a micro-scale to become more compatible with outdoor activity. Classified as a "Winter City", Winnipeg is defined as a city having seasonal variations with prolonged periods of below freezing temperatures, precipitation in the form of snow, and restricted hours of daylight (Pressman, 1988). Freezing temperatures often combine with strong, gusting winter winds to create extremely high windchill factors and hazardous blowing snow conditions. In contrast, mid-day heat and exposure of high levels of solar radiation during the summer months can be unpleasant.

Design Responses:

- Establish shelterbelts[6] throughout the neighbourhood for protection from harsh winter winds, especially in those areas often used by the public;
- Use shelterbelts along pedestrian routes to provide shade in the summer and a windbreak in the winter (Figure 4-14);
- Construct a windbreak along northern edge of site;
- Use proper vegetation and methods to increase shelterbelt effectiveness;
- Street orientation should have a basic east-west orientation to utilize maximum sunlight exposure while blocking cold northern winds (Figure 4-15);
- Buildings should be set with heights and at distances where they do not deprive others of winter sun exposure.

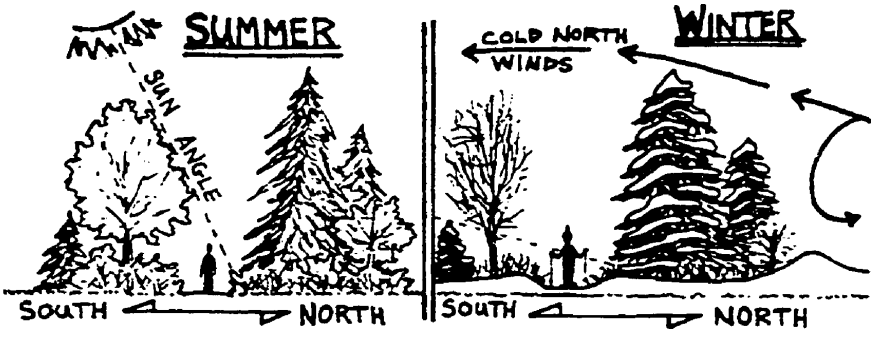


Figure 4-14: A cross-section of a shelterbelt and pathway in summer (left) and winter (right). (Drawings by Mark Spence.)

[6] Shelterbelts can reduce wind velocities up to 50% for distances ten to twenty times their height. To increase effectiveness, the belt should rise gradually on the windward side. A variety of vegetation works the best, especially when using evergreens for winter conditions (Lynch, 1962:54-5). See Appendix B-4 for wind dynamics.

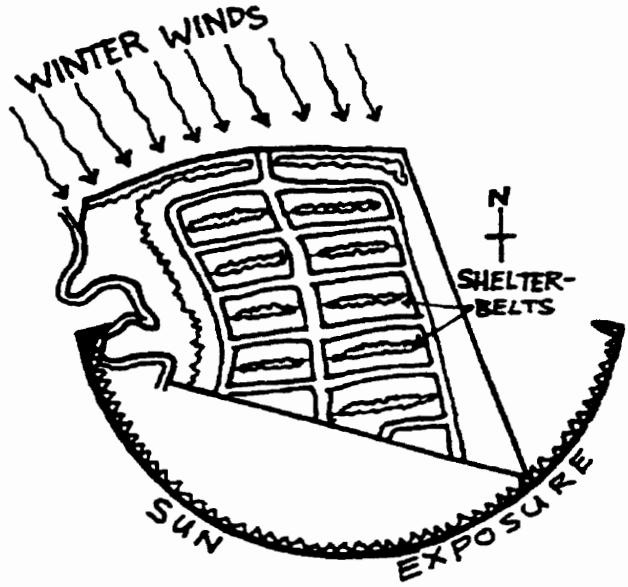


Figure 4-15: A general orientation of the neighbourhood layout responding to winter winds and sunlight exposure. (Drawing by Mark Spence.)

4.2.5 Design Consideration: Connections

Objective: Integrate land uses and public areas so they have physical and visual linkages to each other, thus providing easier pedestrian access while establishing neighbourhood character.

Issues: *Adjacent land uses and internal linkages.* The alternative concept should consider its surroundings. The neighbourhood should establish connections to outlying features as much as possible. Different land uses and features within the neighbourhood should be linked together in a rational order.

Observations: Maps were used to identify surrounding land uses (see Map 4-2).

- Large rural lots and a 300-acre field are located south of the site (the developer owns these lands and has designated them for future residential development); single family housing in Island Lakes subdivision to the east; Bishop Grandin Blvd., north of the site, is a major thoroughfare with power line towers, resulting in a very wide R.O.W.; the Seine River flood zone flanks the western edge of the site (see Figures 4-1, 4-2, 4-3, and 4-4);
- A large play field located across the rail tracks is the only possible access to Island Lakes from within the site;
- Main road access to the site, one on Bishop Grandin Blvd. and the other on John Bruce Rd., are pre-determined.

Discussion: Linkages should be established, both within and outside the neighbourhood, providing connections to different land uses, prominent landmarks, and public places (Figure 4-16). The neighbourhood should not be planned as a separate entity. Rather, its design should recognize and consider features and land uses beyond its boundaries. An effort should be made to connect the site with adjacent neighbourhoods wherever possible. Pathways with direct access to interesting features (natural or built) can help pedestrian orientation and encourage pedestrian activity (Calthorpe, 1993).

Design Responses:

- Establish physical and visual linkages between features and uses, both within and outside the neighbourhood;
- Provide walk/bike pathways as linkages to increase accessibility and encourage social interaction within the community.

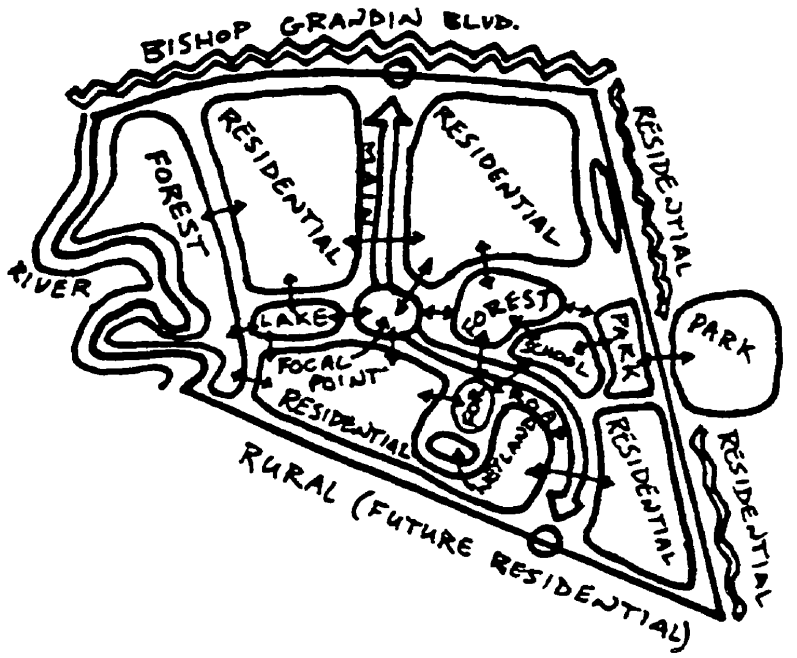


Figure 4-16: Conceptual layout and connections for Royalwood. (Drawing by Mark Spence.)

4.2.6 Design Consideration: Housing Mix

Objective: Provide a choice of affordable housing varieties to meet the needs of different lifestyles and lifecycles for individuals and families of various structure and size.

Issues: *Income distribution, family size and structure, age distribution, and housing type and tenure*. Demographics are statistical data of populations that include socio-economic information. Planners make decisions and predict future trends based on the study of demographics.

> Demography, the study of human populations, is the most powerful (and most underutilized) tool we have to understand the past and to foretell the future. Demographics affect every one of us as individuals. They also play a pivotal role in the economic and social life of our country. They explain which opportunities will be in demand, where job opportunities will occur, what school enrolments will be, when house values will rise or drop, what kinds of food people will buy, and what kind of cars they will drive.
> **Foot (1996:2)**

The recognition of different income levels should be considered to address housing affordability. An examination of household income distribution generally indicates housing affordability levels for low, medium, and high-income earners. As social values change over time, families also change in size and structure. These changes can deeply affect the demand for different housing types and sizes. A single parent with one child, for example, will have different household needs than a married

couple raising four children. Different lifecycle stages of the homebuyer can also determine the demand for different housing types. For example, young single professionals may be too busy to maintain a large home and yard and, therefore, may decide to purchase a condominium or rent an apartment. Although there are no set rules to lifestyle choices, generalizations are often made to predict buying trends. The age group of 65 years and older is an increasing segment of the North American population. This is especially true for Winnipeg. Therefore, attention should be directed toward the elderly for two main reasons. First, the elderly population may be more restricted in physical mobility due to their age. Second, the majority of elderly people are retired and no longer receive a steady source of income. For these two reasons, affordable low maintenance housing may become a more attractive and perhaps a necessary option to meet their special needs.

Observations: Certain statistical information was referenced to establish the proportional distribution of housing types for the alternative concept. The statistics are used to establish social equity for all socio-economic groups. A housing profile of Winnipeg was referred to for information on housing type and tenure. Data from ten census tracts surrounding the site provided a representation of local housing stock (see appendix C-2). This data only considers the housing types that were deemed suitable for the location (i.e. high-rise apartments are not an option). Data in this study was compiled from *Profile of Census Tracts in Winnipeg* (Statistics Canada, 1991). Figures are listed in appendix C.

- Incidence of impoverished households (income below $15,000) is 17%;
- Combined middle and upper income groups account for 60% of all households;
- The "traditional" family consisting of two parents with children now accounts for only 58% of all families;
- Single parent families account for 15% of all Winnipeg families (85% female parents; 15% male parents);
- Single person households account for 11% of all private dwellings;
- The elderly (65+) age group accounts for 13% of the total population;
- Tenure in Winnipeg: 60% ownership, 40% rental.

Correlation of Observations: The data suggests that there are at least two relationships between housing types and other variables. These relationships roughly occur on a 60% - 40% distribution frequency. The first noted relationship is between housing type and housing tenure. Single-family detached dwellings account for 60% of Winnipeg's housing stock, while ownership of all dwelling units in Winnipeg also occurs at 60%. This suggests that most occupants of single family dwellings own their homes while occupants of other dwelling types (apartments, rowhouses, duplexes) are more likely to rent. A second possible relationship is between housing type and income. Households that earn an income of $30,000 or more account for 60% of all Winnipeg households while 40% earn less than $30,000. This correlation suggests that a household income of at least $30,000 is required to afford a single-family home.

Discussion: Affordability is the central issue in conventional neighbourhoods. Specific market groups are often targeted for home purchase in new developments. Usually, new residential subdivisions are built to accommodate predominantly higher income families, resulting in the exclusion of large segments of the population. The developer favours this kind of project for its potential rate of return on investment. However, the needs of the majority are neglected when communities are planned in this manner. A city has an obligation to adequately provide basic needs in an equitable manner for all its citizens. The neighbourhood should provide housing that could adequately adapt to changing socio-economic conditions. A diverse housing mix allows a neighbourhood to accommodate various income groups and family types.

Design Responses:

The following are general guidelines for the housing mix and distribution for the alternative concept. Figure 4-17 illustrates the different housing types.

Single Family Detached:

- 60% to 70% of total housing stock should consist of single family dwellings;
- Two different lot sizes should be provided to increase choice: a) medium lot detached (standard size- 15m. x 30m. or approx. 5000 sq. ft.); and b) large lot detached (standard size- 18m. x 36m. or approx. 7200 sq. ft.);
- Net density yield[7]: 6-9 dwelling units per acre.

[7] Dividing the number of units by the residential acreage derives the net density yield.

Single Family Semi-Detached:

- 10% to 15% of total housing stock should consist of semi-detached dwellings;
- Standard lot size: 12m. x 24m. or approx. 3200 sq. ft.;
- Net density yield: 14 dwelling units per acre.

Single Family Attached (Rowhouses):

- 10% to 15% of total housing stock should consist of rowhouses;
- Standard lot size: 9m. x 24m. or approx. 2400 sq. ft.;
- Net density yield: 18 dwelling units per acre.

Multi-Family Residential (Garden Apartments):

- 15% to 20% of total housing stock should consist of apartment dwellings;
- Garden apartments typically consist of two or three stories (usually 16-24 units per building);
- Mixed-use buildings consisting of street level commercial and upstairs residential should be an option (located in or adjacent to the focal area);
- Net density yield: 30-50 dwelling units per acre.

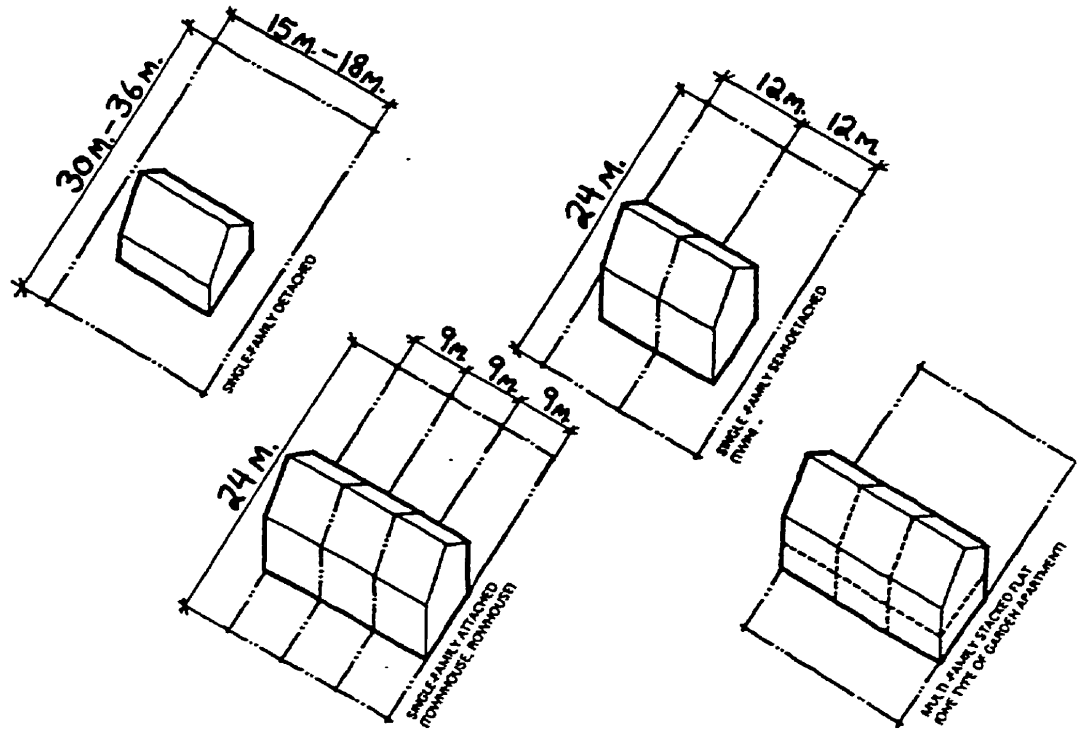


Figure 4-17: Proposed housing types for the alternative Royalwood plan (drawings are not to scale). (Source: *Progressive Architecture*, June, 1991:55.)

4.2.7 Design Consideration: Pedestrian Access

Objective: Provide safe, clear, and convenient access routes for pedestrians.

Issues: *Walking and cycling pathways.* Conventional communities are often planned without much consideration for the pedestrian. Rather, the focus of planning and designing residential communities has shifted toward the automobile.

Discussion: Neighbourhoods should be designed to accommodate the needs of the pedestrian. Sidewalks or cycle paths are rarely provided in conventional developments, forcing the pedestrian to share the roadway with automobiles. Clear

pedestrian routes should be provided, connecting neighbourhood features in a safe manner. Bicycle trails should also be present within the neighbourhood to offer an alternative method of transportation.

Design Responses:

- Provide exclusive pedestrian routes within the neighbourhood to connect public places and spaces, recreation areas, schools, and the neighbourhood's focal area;
- Design pedestrian routes within shelterbelts (see Figure 4-14) to maximize pedestrian comfort in both summer and winter;
- Provide bike trails that extend to neighbourhoods and main roadways adjacent to the site.

4.2.8 Design Consideration: Urban Efficiency

Objective: Provide an "efficient" layout and urban form that requires minimal infrastructure implementation.

Issues: *Density, saleable frontage, and street system.* Affordability has a direct relationship with the "efficiency" of a development. Housing prices are influenced by the development (infrastructure) costs. Higher densities result in lower development costs, which in turn result in more affordable housing. "Urban efficiency" tests are common and reliable indicators for determining the initial "feasibility" of a development (see section 3.1.7). The results of the tests can

influence the choice of housing markets targeted. The tests consider the amount of saleable frontage and infrastructure within a development. The configuration of the street system is an important factor for "efficiency" because it represents a development's infrastructure.

Discussion: The "services-to-frontage ratio" and the "saleable frontage per developable acre" are two "urban efficiency" tests used by developers to determine the "feasibility" of a development. According to both tests, a residential development is more likely to be "efficient" when the saleable frontage is maximized. The alternative concept should recognize two important considerations for increasing the amount of saleable frontage in a residential development. First, higher density housing is needed to increase the frontage-to-services ratio. Second, an "efficient" street system is needed. The most "efficient" system from a developer's perspective would consist of long, straight roads, minimal side streets and intersections, and having saleable frontage extend down the length of both sides of the street. Straight road grid patterns are easier to construct and provide the most efficient manner of service delivery (Lynch, 1962). Lot plotting is more manageable, as fewer irregular-shaped lots are likely to result. The straight grid system has been criticized for being monotonous and not responsive to topography or other conditions. Although topographic features are not a factor within the site, the grid should respect other features such as wooded areas.

Design Response:

- Incorporate higher density housing into the alternative concept;
- Design a street system with minimal curves and intersections, while respecting site features;
- Maximize saleable frontage on both sides of streets (where it is practical to do so).

4.3 The Re-Design

This section presents the re-design concept for this research project. First, a review of City requirements for the site is provided in sub-section 4.3.1. These requirements are combined with the design responses established in section 4.2 to produce the alternative concept. The concept is presented in sub-section 4.3.2 (Map 4-4). Sub-section 4.3.3 describes the features of the alternative concept.

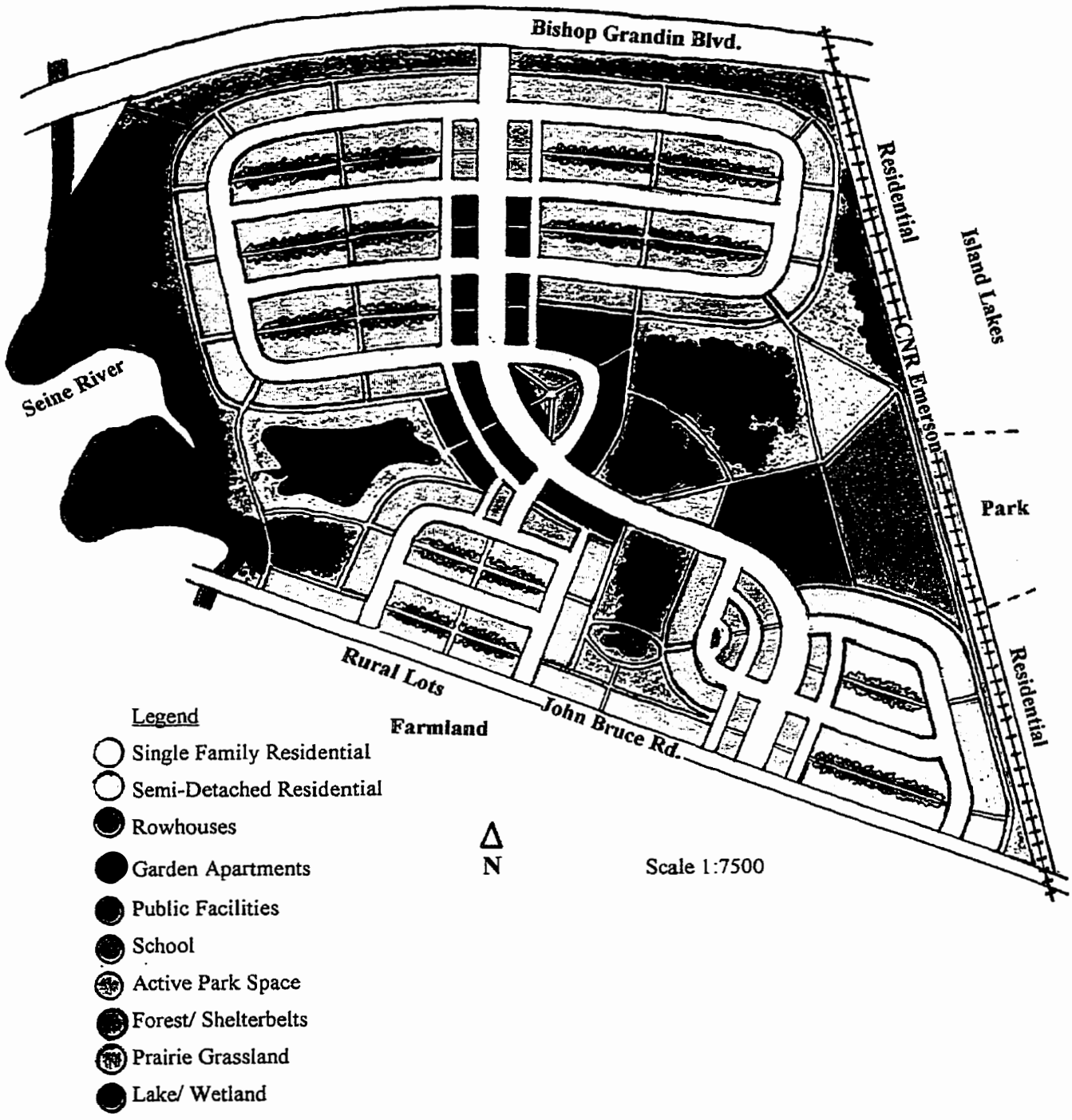
4.3.1 Subdivision Requirements

Various City of Winnipeg departments and divisions such as Parks and Recreation, Works and Operations, and Streets and Transportation prescribe certain provisions for subdivision plans. The City has outlined a series of requirements for the Royalwood site, which are listed here to help direct the re-design process. Site requirement information was obtained from *Development Agreement Parameters* (City of Winnipeg, 1989) and from copies of City correspondence to the developer.

- Private approaches (driveways) onto Bishop Grandin Blvd. or on the main road are restricted;
- Lot depths along Bishop Grandin Blvd. are to be at least 41 metres;
- A main road running north-south through the neighbourhood is to be accessed from Bishop Grandin Blvd. and John Bruce Rd., having a minimum curve radius of 220 metres separated by tangent sections lengths no less than 100 metres;
- A stormwater retention lake is to be included having a minimum surface area of 5 acres;
- John Bruce Rd. is to terminate at the Seine River and the railroad crossing;
- Winnipeg Transit requires a maximum distance of 400 metres from residential areas to bus routes;
- A 4-acre school site is to be provided;
- 8% (or approximately 14 acres) of net developable acreage is to be dedicated to "active" or landscaped parkland.

These subdivision requirements, together with the design responses from section 4.2, are applied to the alternative concept, which is displayed in sub-section 4.3.2 on the following page.

4.3.2 The Alternative Concept of Royalwood



Map 4-4: The alternative concept of Royalwood. (Source: Drawn by the author.)

4.3.3 Features and Rationale of the Alternative Concept

This section presents the features of the alternative concept. These respond to the characteristics identified in the conventional plan listed in section 4.1.3. The features explained in this section are housing diversity, neighbourhood focal area, residential density, natural and contextual considerations, connections, pedestrian access, street layout, and public and private space.

Housing Diversity: The single family home accounts for 60% of total dwelling units in Winnipeg and approximately 70% in the region surrounding the site. The housing profile in the alternative concept generally reflects Winnipeg's housing mix, while recognizing the site's regional context. The housing mix for the alternative concept (based on a total of 650 units) is as follows:

- 420 single family units or 65% of total housing stock;
- 100 garden apartment units or 15% of total housing stock;
- 66 semi-detached units or 10% of total housing stock;
- 64 rowhouse units or 10% of total housing stock.

The more expensive single family dwellings are likely to be located along the lake, the river, and adjacent to natural areas. It is also likely that the cost of single family dwellings will decrease when situated closer to multi-family units.[8] The more affordable dwellings, including semi-detached, rowhouse, and garden apartment

[8] This has been experienced in the conventional plan.

units are located around the neighbourhood focal area and along the main road to be more accessible to transit routes and local services.

Neighbourhood Focal Area: A focal area is included in the alternative concept to provide neighbourhood residents with local conveniences. The focal area contains a "village green" and public facilities such as daycare, and a meeting hall. Commercial activity can be accommodated within the facility if it is considered viable. This location makes it accessible to all neighbourhood pedestrians (within a five-minute walk of most households).

Residential Density: The overall net density yield of the alternative concept (9.1 d.u./ac.) is higher than that of the conventional plan (6.3 d.u./ac.). Higher density housing, located along the main road and surrounding the focal area, consists of semi-detached, rowhousing, and apartment units, which combine for a net density yield of 20.2. According to Lynch (1962:147), this density level is considered sufficient to support a few small shops (depending on the density over a certain area).

Natural and Contextual Considerations: The alternative concept has a general east-west orientation for streets, residential areas, pathways, and shelterbelts. The alignment responds to the climatic context, reducing winter winds from the north and maximizing sunlight exposure from the south. Areas identified as having ecological value were preserved. These areas include all woodlands and a small seasonal

wetland. The developed areas are designed to achieve a synthesis between the urban and natural environments. The alternative concept uses an "ecological management to open space" approach to lower maintenance costs and energy input (see section 4.2.2). This approach includes the management of wetlands, woodlands, and restored prairie grassland. These areas are not included in the 8% park dedication required by the Parks and Recreation Department (see section 4.3.1) and, therefore, would not be maintained by the City. Rather, the developer would be responsible for maintaining these areas.

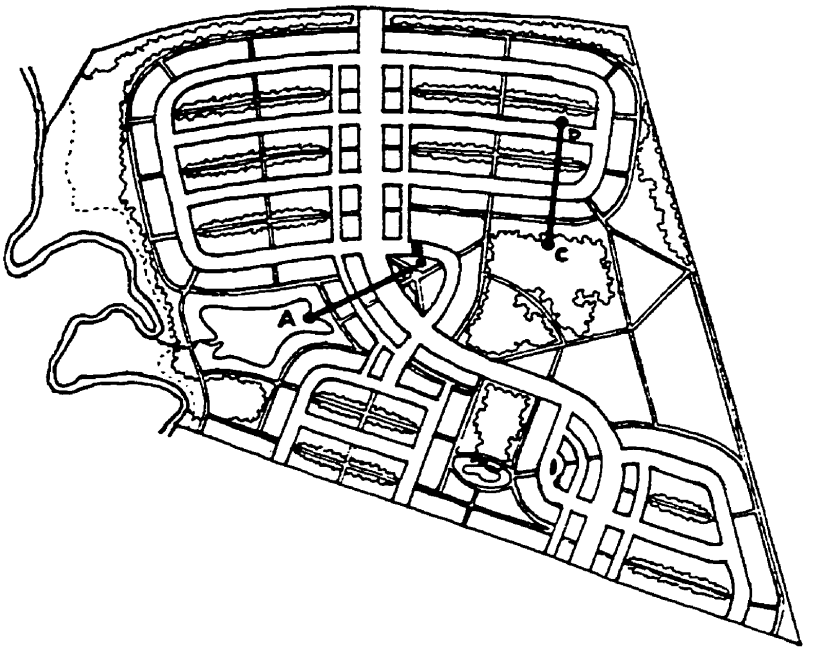
Connections: Physical and visual linkages are established within the site and the local area connecting public places and open spaces as much as possible. This helps facilitate pedestrian movement by linking residential areas to other neighbourhood features such as the focal area, school, lake, parks, and other greenspace. Connections are also made to the adjacent neighbourhood of Island Lakes to the east and to the future residential development south of the site.

Pedestrian Access: The pedestrian pathway system is a prominent feature in the alternative concept, linking the neighbourhood together. Some pathways extend between residential properties, away from the dangers of automobile traffic, and within shelterbelts providing protection from the elements. There is a total of 25,240 ft. (or 7.6 km.) of pathways/sidewalks in the alternative concept compared to 8,160 ft. (or 2.5 km.) in the conventional plan.

Street Layout: The main road connects the pre-determined access points at Bishop Grandin Blvd. and John Bruce Rd., running the straightest route possible while avoiding natural areas. Rowhouses and semi-detached units face onto the main road to achieve a more social atmosphere. Future public transit (bus) service is designated to the main road and focal loop. The residential roads are fairly direct without excessive curving or intersections, maximizing saleable frontage wherever possible. All single family dwellings are automobile accessible from the street, while multi-family dwellings are accessible by rear lanes and parking lots. Section 4.4.1.4 provides the lengths of streets and alleys for both the alternative concept and the conventional plan.

Public and Private Space: The total area of public space (including schools, parks, and "naturalized" areas) in the alternative concept is 68 acres compared to approximately 71 acres of private residential space (a ratio of 1 acre of public space for every 1 acre of residential space). In contrast, the total area of public space in the conventional plan is 25 acres while the private residential space is 104 acres (a ratio of 1 acre of public space for every 4 acres of residential space).

Two cross-sections are provided to further explain the alternative concept. Map 4-5 shows the location of section A-B, which illustrates the neighbourhood focal area, the main road, rowhouses, back alleys, and the retention lake (Figure 4-18). Section C-D illustrates a single-family residential area including the street, the shelterbelt and walkway, and a portion of the "naturalized" area (Figure 4-19).



Scale 1:12,500

Map 4-5: The alternative concept with the locations of cross-sections A-B and C-D illustrated in Figure 4-18 and Figure 4-19 respectively. (Drawing by Mark Spence.)

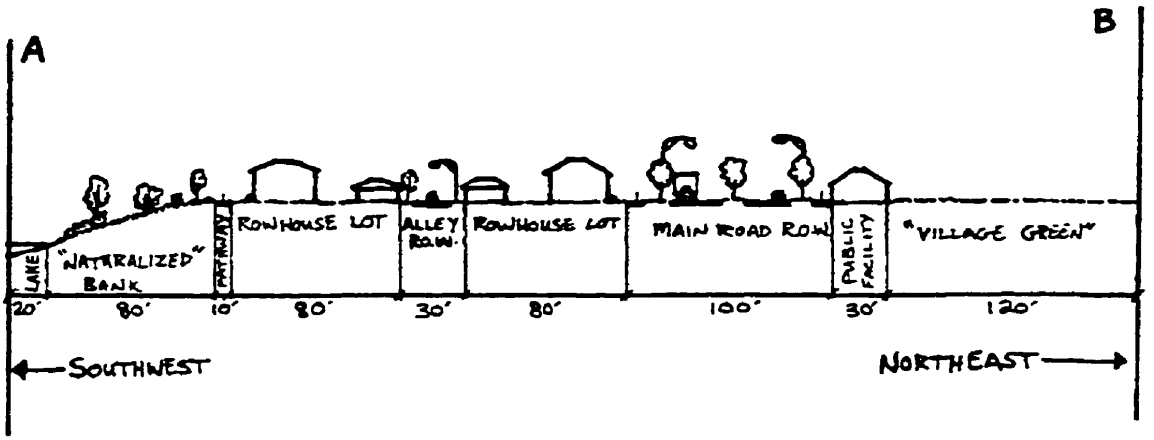


Figure 4-18: Cross-section A-B from Map 4-5. (Drawing by Mark Spence.)

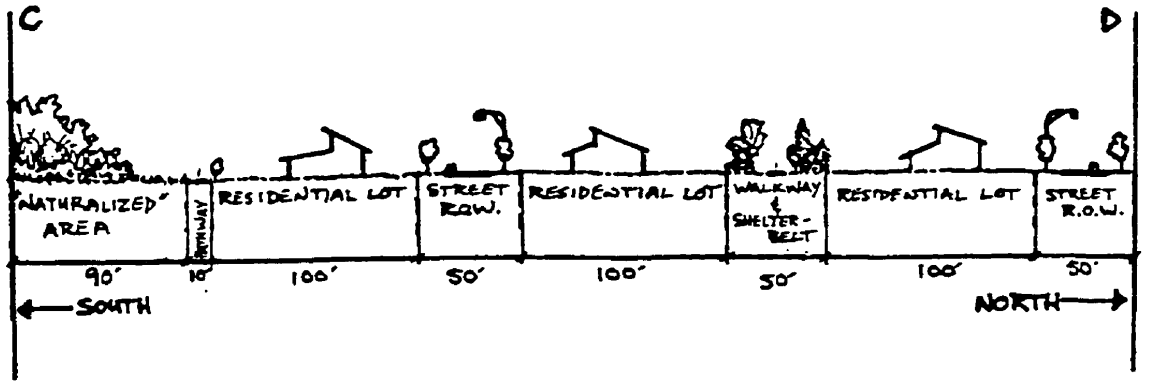


Figure 4-19: Cross-section C-D from Map 4-5. (Drawing by Mark Spence.)

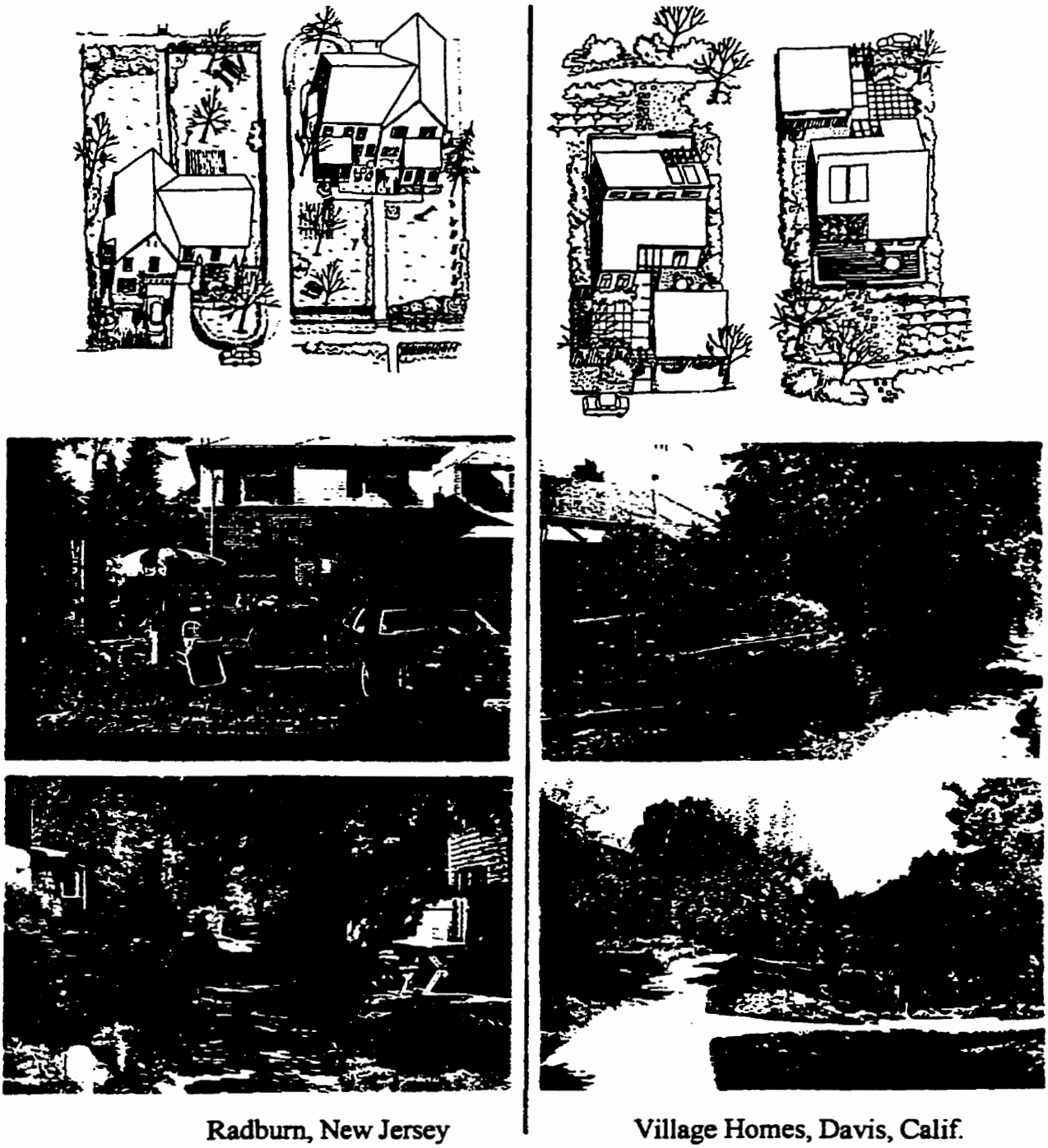


Figure 4-20: The alternative concept has similar characteristics, in terms of dedicated pathway space and street access, to the older Radburn plan, ca.1930 (on the left) and the more recent sustainable development of Village Homes in Davis, California, ca. 1980 (on the right). (Source: All images taken from *Yard, Street, Park*, 1994:55,62,63,155,157.)

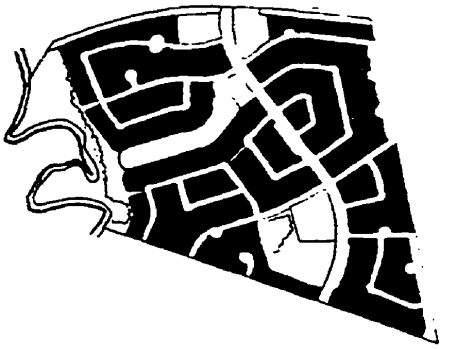
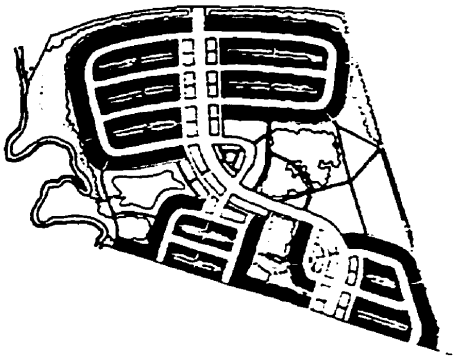
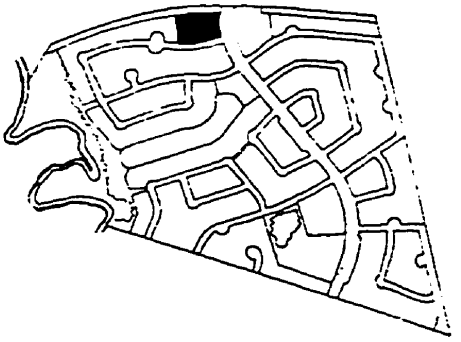
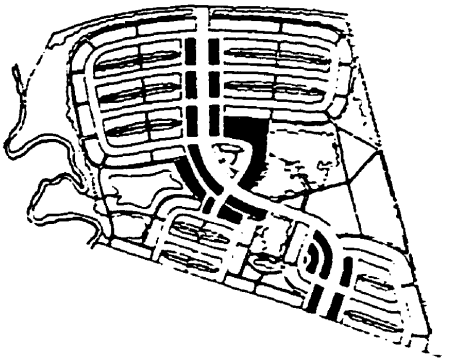
4.4 The Comparative Analysis

This section compares the conventional plan with the alternative concept using two methods. First, a land use analysis is undertaken to show the main differences regarding land use distribution and proportion. The second comparison is economically based. Two "urban efficiency" tests, which the developer uses in the initial stages of subdivision planning, are used to compare "efficiency" levels between the two schemes. It is important to utilize the same tests that developers use for determining a design's "feasibility".

4.4.1 Land Use Analysis

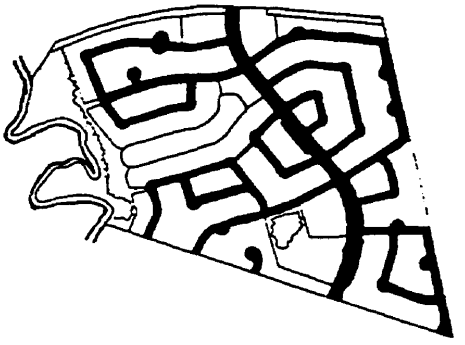
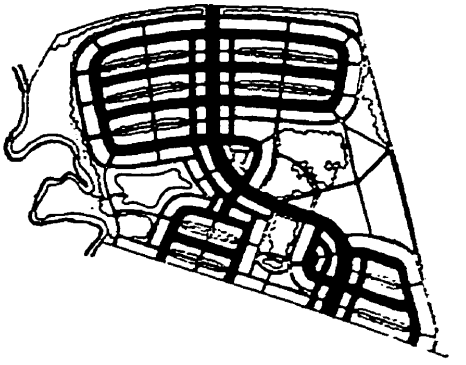
The land use analysis displays both schemes side-by-side to illustrate each aspect of their composition. Some cost comparisons are included where applicable. The land use features are presented in the order of size, starting from the largest land use feature in the conventional plan to the smallest feature. The features include housing, right-of-ways, greenspace, lakes and wetlands, schools, commercial, and pedestrian circulation. (Note: All plans presented in this section are scaled at approximately 1:25,000.)

4.4.1.1 Housing

Conventional Plan	Alternative Concept
	
Single Family Dwellings • Number of units: 624 • Total area: 101 acres • Net density yield: 6.18 d.u./ac. • % of total housing stock: 96%	Single Family Dwellings • Number of units: 420 (210 large lot & 210 medium lot) • Total area: 60 acres • Net density yield: 7 d.u./ac. • % of total housing stock: 65%
	
Multi-Family Dwellings • Number of units: 26 • Total area: 2.7 acres • Net density yield: 9.6 d.u./ac. • % of total housing stock: 4%	Multi-Family Dwellings • Number of units: 230 • Total area: 11.4 acres • Net density yield: 20.2 d.u./ac. • % of total housing stock: 35%

Comparative Analysis of Housing: The alternative concept was designed to the equivalent number of housing units as in the conventional plan (650 units). Single family homes are predominant in the conventional plan, accounting for 96% of all units. The alternative concept designates 65% of its total housing stock to single family homes. Two different lot sizes are provided (large lots, averaging 7,200 square feet with 60-foot frontage; and medium lots, averaging 5,000 square feet with 50-foot frontage) to provide choice. The total space allotted for single family homes is 40% less in the alternative concept than in the conventional plan, allowing more space for other uses. For the purpose of this study, multi-family housing refers to any dwelling unit other than single family detached. The twenty-six units designated as multi-family on a 3-acre site in the conventional plan are condominiums in the form of single family semi-detached dwellings, accounting for 4% of total units. The alternative concept has 66 semi-detached units accounting for 10% of total housing stock on 4.8 acres at a density of 13.5 d.u./ac. There are also 64 rowhouses or 10% of the total housing stock accounting for 3.6 acres at a density of 18 d.u./ac., and 100 garden apartment units, which represents 15% of total housing stock on 3 acres at a density of 33.3 d.u./ac. The housing profile in the alternative concept resembles the demographic profiles of Winnipeg much closer than that of the conventional plan.

4.4.1.2 Right-of-Ways

Conventional Plan	Alternative Concept
	
• Length of main road: 3,250 ft. • Length of residential roads: 19,305 ft. • Length of John Bruce Rd: 3,150 ft. • Total length of R.O.W.s: 25,705 ft.	• Length of main road: 3,530 ft. • Length of residential roads: 15,080 ft. • Length of John Bruce Rd.: 3,150 ft. • Length of alleyways: 4,025 ft. • Total length of R.O.W.s: 25,785 ft.
• Area of main road R.O.W.: 7.8 ac. • Area of residential road R.O.Ws: 27.6 ac. • Area of John Bruce Rd.: 4.8 ac. • Total area of R.O.W.s: 40.2 ac.	• Area of main road R.O.W.: 8.1 ac. • Area of residential road R.O.W.s: 17.3 ac. • Area of John Bruce Rd.: 4.8 ac. • Area of alleyways: 2.8 ac. • Total area of R.O.W.s: 33 ac.

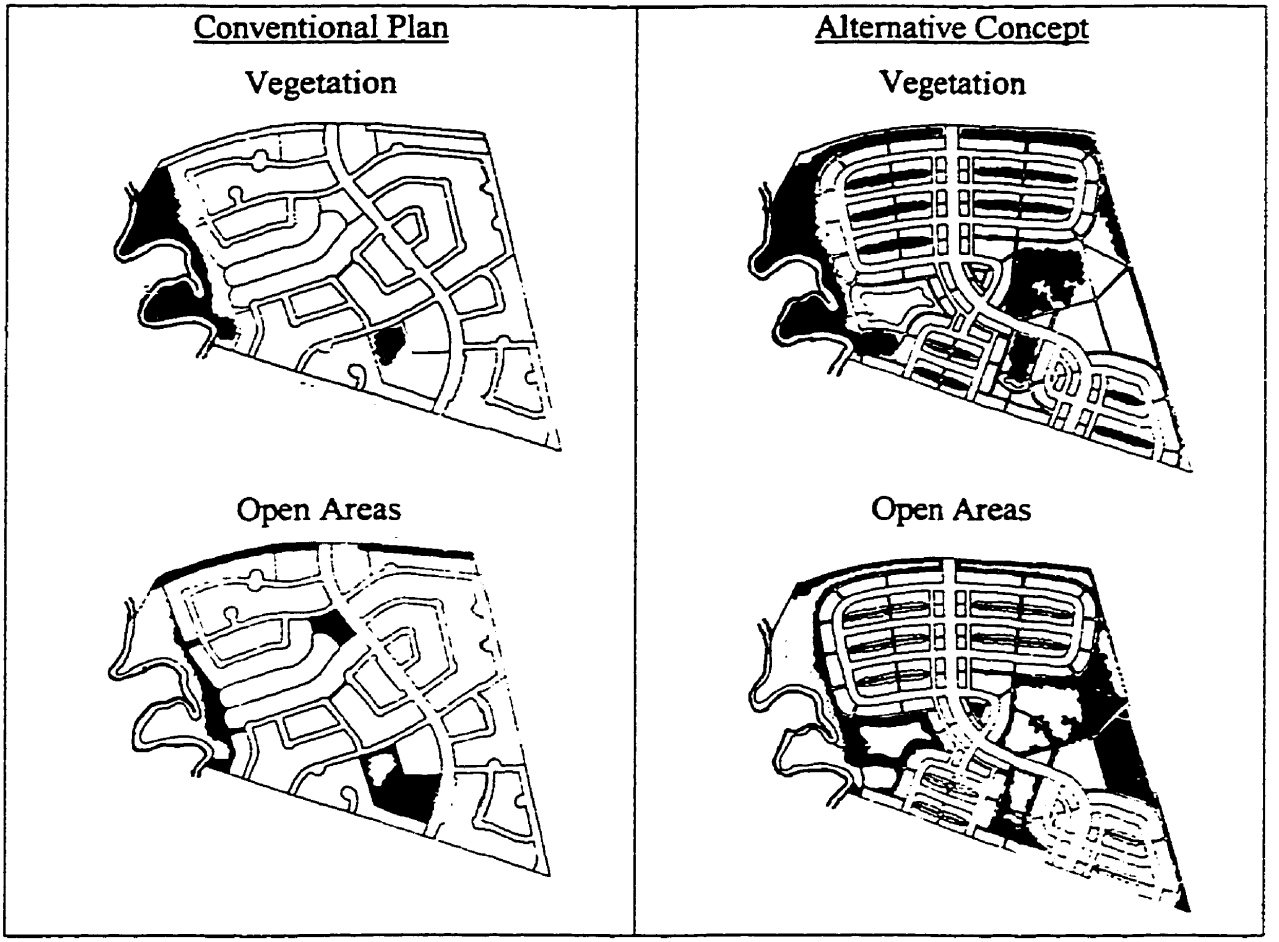
Comparative Analysis of Right-of-Ways: The conventional plan has set the width of its main road R.O.W. at 32 metres (approx. 106 ft.) and the residential R.O.W. width at 18 metres (60 ft.). The R.O.W.s for the alternative concept are set at 30 metres (100 ft.) for the main road, 15 metres (50 ft.) for residential roads and 9 metres (30 ft.) for alleyways. The alternative standards are similar to those dimensions used in older neighbourhoods in Winnipeg. For example, residential roads in older parts of the city have a typical R.O.W. width of 50 feet, which contained a paved road

surface of 24 feet in width. The conventional plan also sets the residential street width at 24 feet, but uses 10 feet more in R.O.W. width. Both schemes generally have the same total length of R.O.W.s, measured at over 25,700 feet. However, the area dedicated to the R.O.W. in the alternative concept is about 7 acres less than that of the conventional plan due to the narrower width standards and the use of alleyways. In addition to the benefits of saving space, the R.O.W.s in the alternative concept can also be less expensive, while providing access to the same number of units. A simple cost comparison on R.O.W.s can demonstrate this. The average cost of a main road in Winnipeg is $379 per foot and $253 per linear foot for a residential road.[9] Therefore, the approximate cost for streets in the conventional plan totals $6,115,915 ($4,884,165 for residential roads and $1,231,750 for the main road). The approximate R.O.W. cost for the alternative concept would be $3,815,240 for residential roads, $1,337,870 for the main road, and includes $293,825 for alleyways[10], for a total cost of $5,446,935. Based on this simple calculation, the alternative concept has a cost advantage of nearly $670,000.

[9] These figures are provided by Ladco and are based on the following specifications: Main road = 6" water main, 10" sanitary sewer, water and sanitary connections to houses, 200mm-thick concrete road, 2 sidewalks, boulevard grading and sodding. Residential road = 6" water mains, 10" sanitary sewer, water and sanitary connections to houses, 150mm-thick concrete road, boulevard grading.

[10] Alleyways are calculated at $73 per foot and are based on 6"-thick concrete with a gravel base at 15 feet wide.

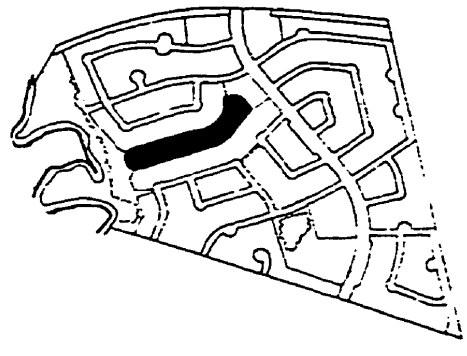
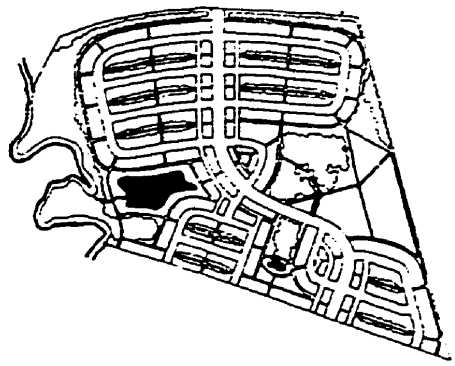
4.4.1.3 Greenspace



Comparative Analysis of Greenspace: The term "greenspace" here refers to both landscaped or "active" parkland as well as "naturalized" areas, which include woodlands, wetlands, and grasslands. The City's Parks and Recreation Department require an "active" parkland dedication of 8% (or 14 acres) from the 173 acres of developable land within the site. The developer is obligated to maintain any greenspace beyond the 8% requirement. The "active" or landscaped parkland in the conventional plan consists of the riverside parkway, the park adjacent to the school, a

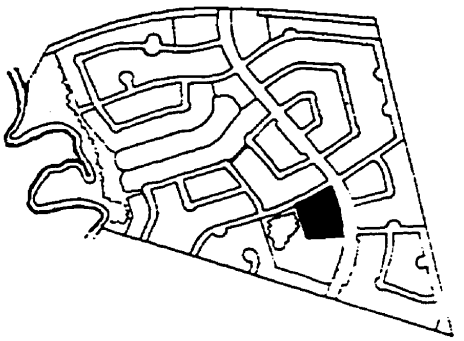
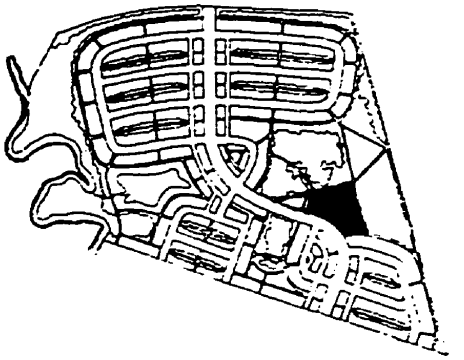
lake-end park, and the buffer along Bishop Grandin Blvd. Seven acres of riparian forest along the river is not included in the 8% dedication. The total area of greenspace in the conventional plan is approximately 21 acres or 12% of the site's total area. In contrast, the total greenspace in the alternative concept is 67.7 acres or 38% of the site's total area. This includes 45.9 acres of restored grasslands and woodlands (including the riparian forest), and 13.9 acres of shelterbelts, which total nearly 60 acres of "ecologically managed open space" (see section 4.2.2). A 6.6-acre park located adjacent to the school and a 1.3-acre "village green" located in the focal area, combine for nearly 8 acres of "active" parkland. Although the alternative concept provides over three times more greenspace than the conventional plan, the alternative would theoretically cost the City less in park maintenance. This is because the City's Parks and Recreation Department would only be required to service the alternative concept's "active" parkland, which totals less than 8 acres.

4.4.1.4 Lake / Wetlands

Conventional Plan	Alternative Concept
	
• Stormwater retention lake: 7.8 acres • Wetlands: none	• Stormwater retention lake: 5 acres • Wetlands: one, approx. 1 acre

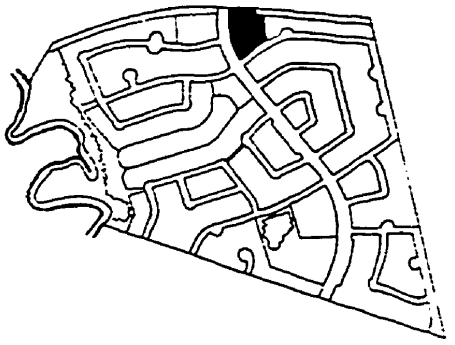
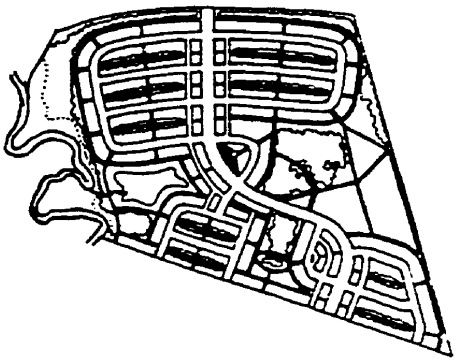
Comparative Analysis of Lakes/Wetlands: The conventional plan provides a 7.8-acre stormwater retention lake, but does not preserve the small seasonal wetland in the south central region of the site. Most of the area surrounding the lake consists of private lots. The lake in the alternative concept adheres to the required minimum area of 5 acres. The wetland and the area surrounding the retention lake are "ecological management" areas, requiring minimal maintenance or intervention.

4.4.1.5 Schools

Conventional Plan	Alternative Concept
	
• Total area: 4 acres	• Total area: 4 acres

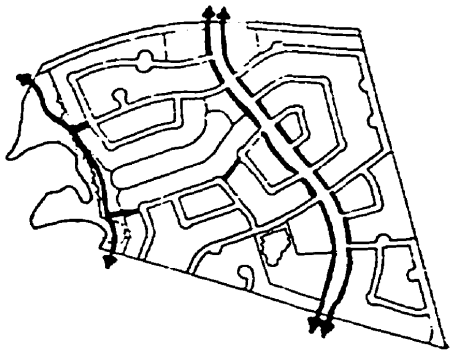
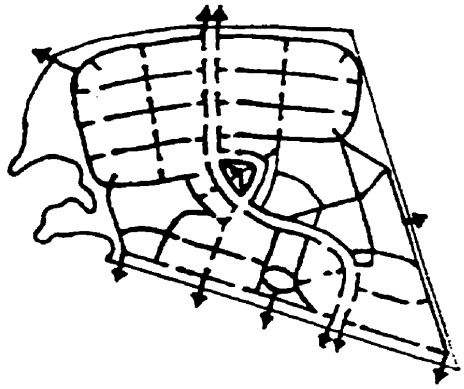
Comparative Analysis of Schools: A school site of 4 acres is present in both schemes, as required by the City. Both schemes situate the school on the main road and are roughly located in the same position within the site. Each has "active" park space adjacent to the school site, however the alternative concept connects the park with the play field in neighbouring Island Lakes.

4.4.1.6 Commercial

Conventional Plan	Alternative Concept
	
• Commercial area: 3 acres	• Neighbourhood facility: 0.7 acres

Comparative Analysis of Commercial and Neighbourhood Facilities: The conventional plan locates its commercial area at the main entrance of Bishop Grandin Blvd. to attract motorists as well as neighbourhood residents. The commercial area is yet to be built. The developer does not expect that commercial activity can be successful in the Royalwood site due to the proximity of the competing commercial area located in neighbouring Island Lakes. The focal area in the alternative concept contains "neighbourhood facilities" that can accommodate commercial activity. Flexible zoning is also an option to include mixed-use buildings for home businesses or home employment.

4.4.1.7 Pedestrian Circulation

Conventional Plan	Alternative Concept
	
• Total walkway length: 8,160 ft.	• Total walkway length: 25,240 ft.

Comparative Analysis of Pedestrian Circulation: The pathway system in the conventional plan is restricted. Sidewalks line the main road and a paved pathway extends along the edge of the Seine River forest. There are two connector pathways leading to the river pathway from residential areas and one pathway connecting two streets. An extensive pathway network is designed for the alternative concept. With the exception of the main road, the pathway system does not extend along the streets. Rather, the interconnected pedestrian system has pathways between residential properties, under the cover of shelterbelts. Obviously, the expenses of the proposed pathway system in the alternative concept are more than that of the conventional plan. According to the developer, the cost for asphalt walkways are about $17 per foot. There is approximately 1,660 feet of pathways in the conventional plan compared to 18,180 feet of pathways in the alternative concept. The cost of these pathways amount to $28,220 for conventional and $309,000 for alternative. These

figures do not include the sidewalks along the main road since they are included in the cost of the R.O.W. Also, there is a high expense associated with the shelterbelts along the pathways, which the developer would be obligated to maintain.

4.4.2 "Urban Efficiency" Analysis

Developers have different methods to test the "feasibility" of their development concepts. Ladco Company Limited applies two tests to their residential subdivision designs. These are referred to as the "frontage-to-services ratio" and the "frontage per developable acre" tests. If the results do not maintain a certain level of acceptability, the subdivision design is altered until a more favored result is achieved. These two tests are used here to demonstrate the "efficiency" of the alternative concept compared to that of the conventional plan.

4.4.2.1 Frontage-to-Services Ratio

Ladco uses the "frontage-to-services ratio" test as a quick and reliable method of determining a project's "feasibility" in the early stages of subdivision design rather than undertaking a full cost analysis, which is only undertaken in the later stages of planning. A subdivision design is considered "efficient" when the test result achieves a certain number. The formula divides the total linear footage of saleable frontage in the development by the total linear footage of services (or infrastructure). The resulting number is the frontage-to-services ratio (see section 3.1.7). The developer's minimum acceptable ratio number is approximately 1.3. The

comparative calculations for the "frontage-to-services ratio" test are presented below. The developer provided data for the conventional plan.

Conventional Plan		Alternative Concept	
Saleable Frontage (ft.)		Saleable Frontage (ft.)	
Residential	32,010	Residential	29,070
Commercial	720	Public Facilities	330
School	790	School	560
Local Improvement Recoveries for John Bruce Rd.	3,150	Local Improvement Recoveries for John Bruce Rd.	3,150
Total Frontage	36,670	Total Frontage	33,110
Services (ft.)		Services (ft.)	
Main Road	3,250	Main Road	3,530
Residential Roads	19,305	Residential Roads	15,740
Local Improvements John Bruce Rd.	3,150	Local Improvements John Bruce Rd.	3,150
Total Services	25,705	Total Services	22,420
Frontage-to-Service Ratio		Frontage-to-Services Ratio	
$\frac{36,670}{25,705} = 1.43$		$\frac{33,110}{22,420} = 1.48$	

The results of the test show both plans having acceptable "efficiency" levels according to the standards set by the developer. The alternative concept has a slightly higher ratio than the conventional plan. This is attributed to the saleable frontage (in the form of rowhouses and semi-detached units) included along most of the main road in the alternative concept. In contrast, the conventional plan has very little residential frontage along its main road.

4.4.2.2 Saleable Frontage per Developable Acre Yield

The second test used by Ladco is the "saleable frontage per developable acre yield" test. This test gauges a development's profitability potential and is widely accepted by developers and municipal planners. The test divides the total saleable frontage of a development by the number of acres that can be developed on that site (see section 3.1.7). The total area of the site is 180 acres. The total developable area of the site is 173 acres (seven acres is within the flood zone indicated by the 230-metre elevation contour line). The developer's acceptable limit for this test is usually set at 200 feet of saleable frontage per developable acre. The following are the calculations and results of the "saleable frontage per developable acre yield" test for the conventional and alternative schemes. The developer provided the figures for the conventional plan.

Conventional Plan	Alternative Concept
Total saleable frontage: 36,670 ft. Total developable acreage: 173 ac. $\frac{36,670}{173 \text{ ac.}} = 212$ ft./acre	Total saleable frontage: 33,110 ft. Total developable acreage: 173 ac. $\frac{33,110}{173 \text{ ac.}} = 194$ ft./acre

The results of the test show the conventional plan having a higher yield of frontage per acre than the alternative concept. The yield of 194 in the alternative concept is below the developer's acceptable limit. The 240 units of higher density housing types in the alternative concept have resulted in lower residential frontage numbers.

4.4.3 Comparative Analysis Summary

The comparative analysis examined the differences between the conventional and the alternative schemes, focusing on land use in the first section and "urban efficiency" in the second section. Housing, right-of-ways, greenspace, lakes and wetlands, schools, commercial, and pedestrian circulation were examined. Both schemes have 650 housing units. The conventional plan consists of 96% single family homes. The alternative concept has a more diverse housing mix that includes single family detached (65%), garden apartment units (15%), semi-detached units (10%), and rowhouses (10%). A diversity of dwelling types is able to provide more choices of affordable housing for different family types, sizes, and income levels. Right-of-ways (R.O.W.) in the two schemes were examined. The total area of R.O.W.s in the conventional plan was more than the alternative concept, even though the total length of R.O.W. in both schemes was almost identical. This is attributed to narrower R.O.W. widths and the use of alleyways in the alternative concept. A simple cost comparison of roadways has shown that the alternative concept can be less expensive than the conventional plan by as much as $670,000 while servicing the same number of housing units. Greenspace was also examined. The conventional plan has a total of approximately 21 acres of greenspace (12% of the total area), including 14 acres of "active" parkland that requires maintenance by the City. The alternative concept has approximately 68 acres of greenspace (38% of the total area), including 8 acres of "active" parkland. The remaining greenspace is designated as a "closed" ecosystem, requiring minimum intervention from the developer. The land use

analysis also examined lakes and wetlands. Both schemes use the lakes as "connectors" from the river to the residential areas. The lake in the conventional plan has private lots backing on to nearly all of its sides, limiting public access, while there is complete public access to the lake in the alternative concept. Unlike the conventional plan, the alternative concept also preserves a small seasonal wetland. Both schemes have located the required 4-acre school site along the main road. However, the alternative concept connects its school site with a park to the play field in Island Lakes. Commercial areas were also studied. The conventional plan has a 3-acre site at its main entrance. However, the developer considers it unlikely that it will be developed. The alternative concept does not include a "commercial" area. Instead, "public facilities" are designated for the neighbourhood's focal area. This area contains daycare and other community services for local residents and can provide space for commercial activity. Pedestrian circulation was the last feature examined in the land use analysis. The only sidewalks in the conventional plan are along the main road and a paved pathway extends along the edge of the Seine River corridor. The alternative concept includes a pedestrian network with pathways interconnecting between the back lots of the residential areas. These pathways would cost approximately $300,000 more than the pathways in the conventional plan. However, savings from the reduced R.O.W.s (approximately $670,000) would offset the extra expenses for the pathways. As a result, residents would have safer pedestrian access and a better social setting (which are marketable qualities), while having lower development costs.

Two "urban efficiency" tests were undertaken in the comparative analysis to determine the "feasibility" of both schemes. According to the developer's standards, the "frontage-to-services ratio" test considers both schemes to be "efficient". The alternative concept achieved a slightly higher ratio than the conventional plan. Based strictly on a frontage-to-service ratio, the alternative concept presents a better return on the developer's investment. The second test was the "saleable frontage per acre yield". The developer's acceptable limit is 200 feet of frontage per acre. The conventional plan yielded 212 ft./ac. while the alternative concept yielded 194 ft./ac. Although the alternative concept did not achieve the developer's acceptable yield level, an exception can be made here. This test favors the single family dwelling subdivision, giving the alternative concept a disadvantage because it uses different housing types with higher densities, which decreases the total frontage in a development.

Chapter 5: Conclusion

This chapter has two main sections. First, a reflective overview summarizes the research project's accomplishments, shortcomings, and general observations. The second section provides a list of recommendations for the City of Winnipeg concerning the development of sustainable communities. Recommendations are also suggested for further study of topics related to this research project.

5.1 Reflective Overview

Sub-section 5.1.1 provides a summary of the project's accomplishments. Sub-section 5.1.2 acknowledges and reflects upon some of the project's inadequacies. A number of general observations are discussed in sub-section 5.1.3 pertaining to issues addressed in the project.

5.1.1 Accomplishments

This research has presented a planning and design approach that takes a first step toward an alternative method of neighbourhood development and away from conventional methods that contribute to urban sprawl. While the alternative concept is based on principles of sustainable development, it does not strive to include a wide range of sustainable measures. It represents a compromise between sustainable design and designing within the limitations set by developer, government, and consumer acceptance.

Each of the stated goals of this research project was addressed. These were:

- To show an alternative method of planning and designing residential subdivisions based on the principles of sustainable urban development;
- To show how a residential subdivision, planned and designed according to sustainable principles, may appear;
- To show if a sustainable neighbourhood example can achieve or exceed the same level of fiscal "feasibility" as a conventional design.

The planning and design approach for the alternative concept is described in section 3.1. Section 4.3.2 displays an illustration of the concept, which is the result of stated planning principles from section 3.1.4, synthesized with the design responses established in section 4.2. "Urban efficiency" tests were applied to the alternative concept to determine "feasibility" and compared to the conventional plan. This demonstrates to developers that alternative designs are capable of yielding "efficiency" levels comparable to conventional designs.

The research project identified the features that are commonly associated with conventional neighbourhoods (see section 2.3.1). The alternative concept has recognized and addressed each of the following features in the re-design:

Conventional Feature: Limited variety of housing types.

Alternative Response: The alternative concept has utilized different dwelling types to provide a choice of affordable housing for a variety of income levels, and family structures.

Conventional Feature: Local commercial conveniences located outside of development (usually in a strip mall on arterial routes).

Alternative Response: The alternative concept has recognized the importance of the "nucleus" as a key component of urban organization. A focal area was established in the re-design to provide neighbourhood residents with basic community and commercial services, recognizing that the existence of a nearby strip mall on Bishop Grandin Blvd. will limit the economic viability of the nucleus.

Conventional Feature: Low residential densities.

Alternative Response: The alternative concept established higher residential densities to maintain thresholds of service viability (such as public transit and commercial services), and to reduce development costs while increasing the level of "urban efficiency".

Conventional Feature: No particular adherence to site planning or local ecology.

Alternative Response: The alternative concept has recognized contextual features such as climate, topography, and vegetation, and has emphasized the preservation of ecologically sensitive areas within the site.

Conventional Feature: Planned as separate individual entities; minimal connections to adjoining neighbourhoods.

Alternative Response: The alternative concept was designed to connect with adjacent areas and features as much as possible. Linkages were also established between different land uses and features within the site.

Conventional Feature: Car-oriented design; little consideration for the pedestrian.

Alternative Response: The alternative concept has included an extensive pedestrian pathway system, removed from the streetscape and enclosed within shelterbelts to increase pedestrian safety and comfort.

Conventional Feature: Non-linear, winding street system.

Alternative Response: The alternative concept has utilized a relatively straight, simple street grid system for efficient service delivery and to decrease confusion of orientation.

Conventional Feature: Very high proportion of private space compared to public space.

Alternative Response: The alternative concept was designed to provide ample public space in relation to private space. The concept provides one acre of greenspace (including all parks, open areas, and woodlands) for every acre of residential space.

In addition to the stated goals, this research project intends to benefit the City, developers, homebuilders, planners and urban designers, and the consumer by:

- Encouraging further interest and research into sustainable urban development and other alternative approaches;
- Provoking thought toward the reconsideration of values such as social equity, affordability, accessibility, ecology, local conveniences, and pedestrian considerations;
- Encouraging an increased awareness for subdivision planning, realizing that it is not a matter of simply maximizing lot yield within a site.

5.1.2 Shortcomings

Although this research project has attempted to present a step toward more sustainable neighbourhood development, the alternative has focused primarily on the "approach" to planning and design. While concentrating on certain aspects of a project, it is inevitable that other important issues relating to the subject will receive

less attention or be left out entirely. The following acknowledges at least three issues for further research.

The first issue is how the alternative concept is able to effectively address urban sprawl. The alternative concept was designed to match the same number of dwelling units (650) as the conventional plan. The main reason for this was to demonstrate land use efficiency when utilizing different housing types. Although the alternative concept has achieved higher residential densities than the conventional plan, the total number of units per acre for the entire site remains the same. In other words, the same number of dwelling units exists on the same amount of land in both schemes. Therefore, this particular method is more effective for demonstrating land use efficiency within a site, and less effective for addressing urban sprawl. The research project could have been more effective if the alternative concept was planned without the targeted number of dwelling units. The re-design could have then included the maximum amount of dwelling units based on the stated planning principles and design guidelines.

The second issue that should have been addressed in more detail is public transit, since it is considered an integral part of sustainable urban development for three main reasons: environmental, economic, and social. Sustainable communities are typically comprised of various housing types, which accommodate a variety of residents having different economic situations. The lower income residents may rely

on public transportation for trips to work, shopping, school, etc. Higher transit ridership results in fewer cars on the road, which alleviates traffic congestion and reduces exhaust emissions. Higher densities support public transportation by increasing the total number of potential riders residing within close proximity to transit routes. The alternative concept acknowledged this by providing higher density housing along the main road and surrounding the neighbourhood focal area (designated as the proposed transit route). However, more attention could have been directed toward the actual bus routes that pass by the site, and future transit links with adjacent areas. Route #75 runs east along Bishop Grandin Blvd. to the University of Manitoba, while route #55 runs north along St. Anne's Rd. to downtown. Both routes present good transportation opportunities for students and workers living within the site. Figure 5-1 illustrates possible examples of how the site could be serviced by existing transit routes.

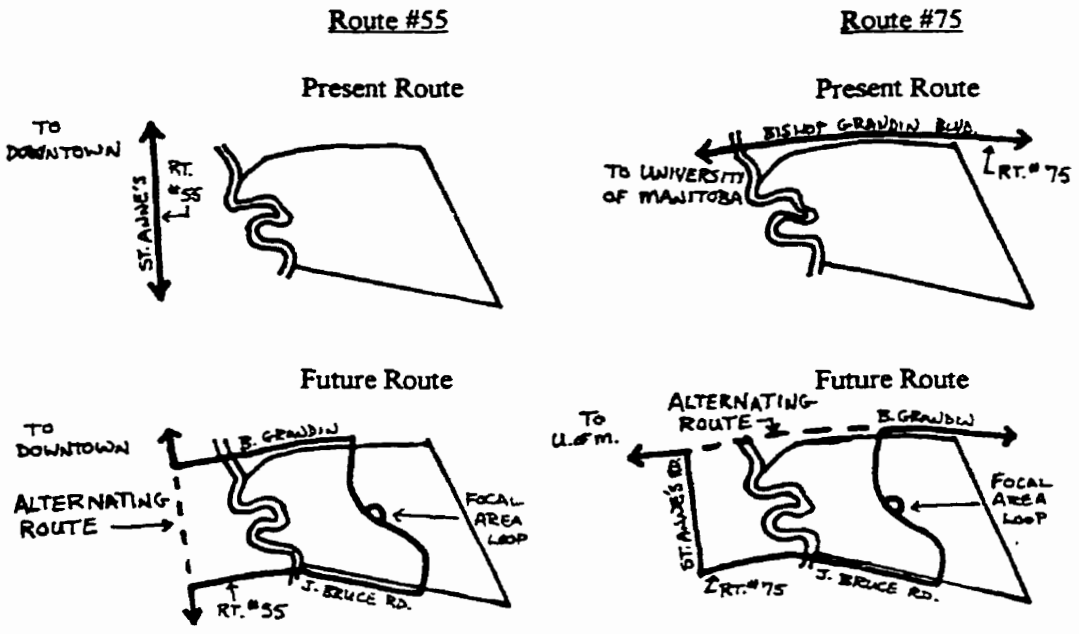


Figure 5-1: Possible bus routes in the alternative concept shown at different phases of development. (Drawings by Mark Spence.)

A third issue that should have been further addressed in this research project involves local employment. Sustainable communities should provide job opportunities within the neighbourhood. The alternative concept limited facilities in the focal area to accommodate local commercial functions. Different innovations for local employment opportunities should be explored. For example, the possibility of including home-based businesses within the neighbourhood could be a viable option if zoning codes were altered to allow for mixed residential/commercial use. This issue is included among the recommendations in this chapter.

5.1.3 General Observations

It could be argued that the urban sprawl phenomenon is the result of the most successful marketing campaign in the history of urbanization. People buying into the "American Dream" entitles them to own a single family home and yard away from the problems of the city. Large developments like Levittown and Don Mills made the "Dream" affordable for the middle class family. Despite its noted flaws, urban sprawl is actively supported and remains a popular choice for homebuyers because it has been the dominant building trend over the past five decades. People are generally more comfortable with the things that are most familiar to them. Proposal to alter this trend may meet considerable resistance. The perception may exist that if we no longer pursue the "American Dream", then it follows that we must change our social value structure as well. The marketability of sustainable development is unlikely to have the same impact as the marketing of suburbia, which offered the opportunity to buy into something that only the social elite could once afford. Marketing sustainable development might be harder to sell because people may perceive it as something that takes away rather than contributes to their lifestyles. In other words, instead of offering "more", like suburbia does (i.e. more private space, larger house and yard, personal transportation), sustainable development may be perceived as something that offers "less" (i.e. reduction of house and yard size, replace the car with public transit). It should be emphasized that what we perceive as desirable in suburbia now, may be detrimental to future generations. If alternative communities are being proposed, then the evaluation of those communities should be

based upon different values as well. Although the fiscal bottom line is still important (and is arguably the deciding factor for development proposals going forward), a development's worth and success should also be judged on those features that make a neighbourhood desirable and livable. This research project used an economic evaluation system to determine if the alternative concept could be considered fiscally "feasible" according to the developer's standards. Although this was an important exercise, the "urban efficiency" tests are strictly economic. Amenities (such as trees, water, open spaces, and pathways) and public services (such as daycare, teen drop-in centres, schools, libraries, and community activities) are all relevant factors for the homebuyer. Providing such features can enhance the marketability of the development. The neighbourhood should be viewed as a place of socializing, shopping, recreation, and employment, rather than simply being a place to live.

Prior to embarking upon this research project, it was assumed that conventional development was continuing in the City of Winnipeg due to the will of the developer, while the City's role was to ensure that zoning codes were being enforced. After researching the situation more closely, a different cause for the continuation of conventional development was revealed. Apparently, Winnipeg developers are willing to attempt alternative development projects instead of continuously reproducing the conventional (Ladco's initial concept for Royalwood is one example of this). When a developer submits a subdivision proposal, it is subjected to a series of amendments by various City Departments and ultimately resembles a

conventional design. Rather than dispute the amendments (which can be costly and cause delay), developers usually accept the amendments and proceed with the project.

There is a second identifiable agent that contributes to conventional development. Mr. Ed Dolhun is a planner and engineer with the City of Winnipeg who has submitted alternative subdivision proposals for development in the past. One such proposal was Canterbury Park, which was roughly based on the Radburn model and contained similar features to the alternative concept (i.e. homes face inward to inner parkway with sidewalks). While certain City Departments (primarily Parks and Recreation, Streets and Transportation, and Works and Operations) have discouraged alternative subdivision proposals, the homebuilders were usually even more opposed because they were reluctant to stray from routine industry practices. Even though the developers were willing to take a chance on alternative projects, homebuilders were not willing to provide homes for those projects.[11] If homebuilders contribute to the continuation of conventional development due to certain concerns, then those concerns should be addressed. According to Mr. Dolhun, homebuilders are worried about the uncertain marketability of alternative developments. Winnipeg homebuilders are comfortable building for conventional developments because homes always sell in these markets. Alternative schemes are unlikely to be developed unless homebuilders are convinced that the consumer is willing to buy

[11] Information was obtained in a telephone interview with Mr. Dolhun on February 4, 1999.

into such a development. Of course, the problem is how something can be proven if it does not exist? Developers and homebuilders are calculated risk-takers, and are unlikely to accept experimental projects unless incentives are provided to guarantee their investment to produce alternative project examples. A government-funded program (perhaps all three levels of government) would probably be needed to guarantee that all costs would be recuperated. However, it has been stated that the City government is part of the problem because departments such as Parks and Recreation, and Streets and Transportation tend to discourage alternative development concepts. It is most likely that government involvement is required to establish favorable conditions for alternative development implementation. The following section includes a list of recommendations for government involvement in the development process.

5.2 Recommendations

This section contains recommendations for the City of Winnipeg and its various administrative departments regarding the implementation of sustainable neighbourhoods. This section also includes suggestions for further research of sustainable development issues for the City of Winnipeg.

A city has the responsibility to all its citizens to adequately provide basic needs in an equitable manner. If sustainable communities were to be developed in Winnipeg, then government-level assistance would likely be needed to aid the effort. There is

evidence that developers from the private sector have tried to instigate innovations in subdivision design, but were eventually discouraged by the City. The City should take a more proactive role in encouraging innovative community development, and recognize that it might be in their best interest to at least examine alternative neighbourhood designs. The concept of sustainable urban development is still relatively new to North America. The City should research this concept and perform a study on its viability (such as Calgary's *Sustainable Suburbs Study* (1995)). If the conclusions are positive, recommendations should be made for changes in current subdivision standards and an outline plan should be made for possible implementation. The City should also consider the possibility of implementing a "sustainable neighbourhood prototype" (this could be a multi-level government project in co-operation with other interested parties such as the Canadian Mortgage and Housing Corporation, Canadian Institute of Planners, and the Urban Development Institute). This prototype could serve as a "living" educational tool for the City, developers, homebuilders, and the public. The prototype could be studied for its fiscal effectiveness, while demonstrating to the public that lifestyles are not greatly altered. Government incentives, in the form of development fee waivers, guarantees on investment, and reduced land costs, should be available to developers and homebuilders to build sustainable prototypes, while homebuyers should be offered tax credits. The Royalwood site could have offered an excellent opportunity to build a sustainable prototype, since the Provincial Government owned the site prior to Ladco.

The following is a list of recommendations intended to provide a more favorable setting for implementing alternative developments in general and sustainable communities in particular:

- Alternative subdivisions should be an option for the City to review. The City's Planning Division should alter certain codes, standards, and guidelines of subdivision development that impede the opportunity for alternative innovations to occur;
- Establish flexible zoning for the possibility of locating small businesses within the neighbourhood. Opportunities for home occupation should be provided;
- Establish a site specific range of density for residential developments (i.e. #of dwelling units per acre) to maximize land use efficiency and to curb sprawl;
- Sustainable developments should be constructed on urban infill sites wherever possible, utilizing existing infrastructure to minimize costs;
- A site analysis should be included as an important part of the subdivision planning process. The subdivision design should respond to contextual features such as climate, surrounding uses, and natural features (i.e. vegetation, topography, and drainage);
- Neighbourhood focal areas (or "nodes") should be established centrally within neighbourhoods to provide convenient access for residents to basic commercial services and community activities. Higher-density housing should be planned

near or adjacent to neighbourhood focal areas and transit routes to increase viability;

- Subdivision planning should respect surrounding land uses and linkages. Neighbourhoods should be planned as interconnected areas rather than separate entities. The City should provide conceptual plans that show neighbourhoods in relation to their regional contexts. Figure 5-2 presents an example of a regional concept plan for the Royalwood area;

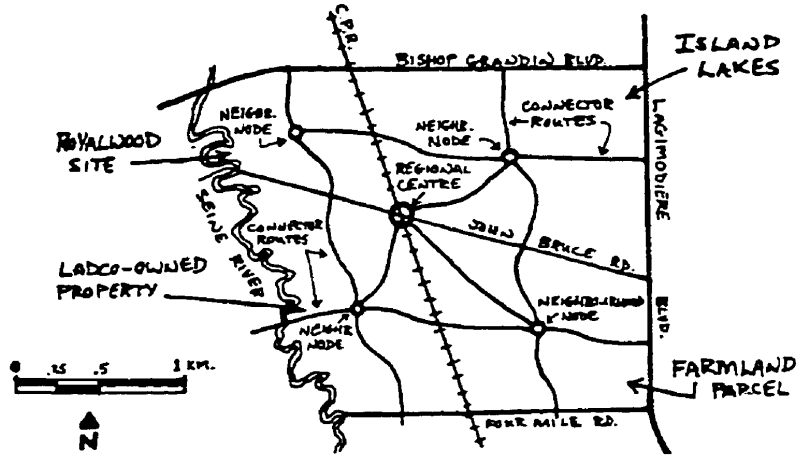


Figure 5-2: A conceptual sketch of the region containing the Royalwood site based on an alternative approach. (Drawing by Mark Spence.)

- Develop site specific standards for greenspace/open space. Location of parks, greenspace, and open space should be influenced by site characteristics. The City should re-think its policy of limiting the developer to the current requirement of 10% "active" parkland dedication, which contributes to the destruction of parkland and natural habitats;
- The City should explore the option of an "ecological management of open spaces" approach for areas requiring minimal maintenance (including areas surrounding stormwater retention lakes). There are lower labour and

maintenance costs associated with this approach, as well as a reduction in pollutants and waste;

- The City should pre-designate places having ecological value as being strictly "off limits" for development and be incorporated into the local greenspace network;
- There should be an emphasis on good pedestrian circulation from the initial stages of neighbourhood planning. Opportunities should be maximized for pedestrian transportation (i.e. walking/cycling pathways) both in the site and regionally;
- Public transit plays a key role in supporting sustainable communities. Transit routes should be planned in the initial stages of neighbourhood design to access the neighbourhood focal areas proposed. Residential densities along transit routes should be high enough to sustain good transit service;
- Planning alternative developments requires better integration and co-ordination from many interests and agents. Initial stages of conceptual planning and design should involve the input from design teams consisting of planners, urban designers, architects, landscape architects, developers, homebuilders, engineers, and various City Departments. Public input is equally important to guide alternative projects and help determine what is acceptable to the consumer. Design charettes should be utilized to aid the process.

This research project has examined the concept of sustainability as an alternative approach to neighbourhood planning and design. Due to time constraints and other limitations, some issues were not adequately addressed in detail and require additional investigation. The following is a list of suggestions for further study relating to sustainable urban development in Winnipeg:

- An investigation (of either the City or the private sector) to expose the mechanisms, barriers, and reasoning that prevent or discourage the development of alternative concepts in Winnipeg;
- A further investigation of residential densities, service thresholds and their relationship to "viability" in Winnipeg;
- An examination toward possible partnerships to fund the construction of a sustainable neighbourhood prototype in Winnipeg;
- A survey of local developers and homebuilders to determine and gauge their interest toward the construction of a sustainable development in Winnipeg;
- A survey of consumer attitudes and preferences toward a sustainable development concept in Winnipeg.

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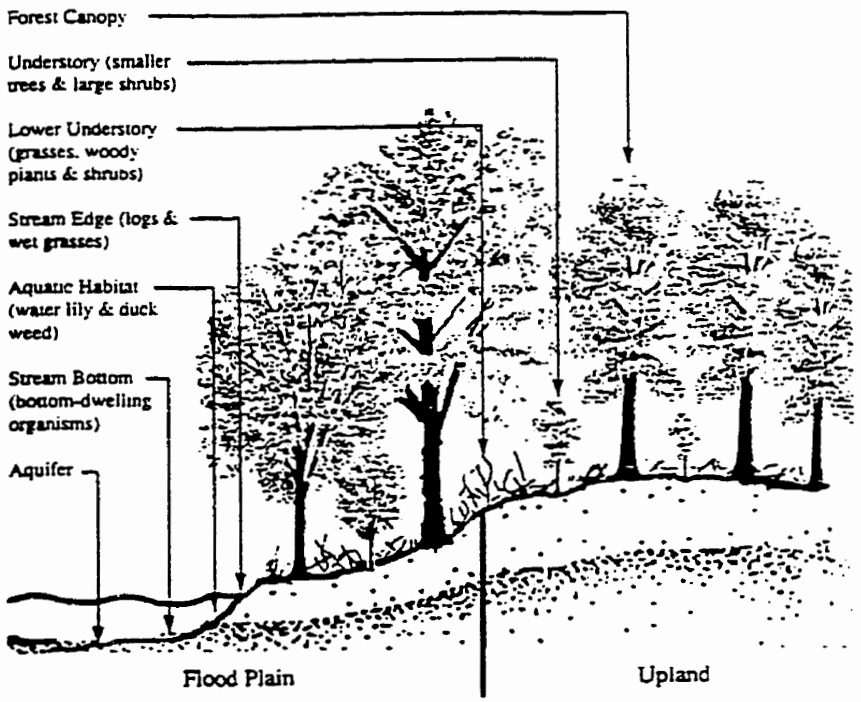
Appendices

Appendix A: Ecology of the Royalwood Site

This section identifies the ecologically significant areas within the study site and focuses on the quality of habitat. An inventory of different types of flora and fauna common to the area is provided here. All recorded data was taken from the City of Winnipeg's *An Assessment of Vegetation and Wildlife Habitat for the Seine River Parkway* (1995). Further field inspections identified the forested areas within the Royalwood site as being similar in composition with that of the forest along the river corridor.



A diagram of typical vegetation structure along a stream corridor. (Source: *An Assessment of Vegetation and Wildlife Habitat Quality for the Seine River Parkway*, the City of Winnipeg, 1995, p. 4.)

The following list is an inventory of the plant and animal species that were observed in *An Assessment of Vegetation and Wildlife Habitat Quality for the Seine River Parkway* (1995) found on pages 38-48.

Plant Observations
Native Sedges, Grasses & Rushes

Common Name	*Family*	*Genus*	*Species*
American Elm	Ulmaceae	Ulmus	americana L.
Sedge	Cyperaceae	Carex Spp.	
Slender Wheat Grass	Gramineae	Agropyron	trachycaulum (Link) Malte
Tickle Grass		Agrostis	scabra Willd.
(Rough Hair Grass)			
Big Bluestem		Andropogon	gerardi Vitman
Slough Grass		Beckmania	syzigachne (Steud.) Fern.
Northern Reed Grass		Calamagrostis	inexpansa A. Gray
Nodding Wild Rye		Elymus	canadensis L.
(Canada Wild Rye)			
Mat Muhly		Muhlenbergia	richardsonis (Trin) Rydb.
Witch Grass		Panicum	capillare L.
Switch Grass		Panicum	virgatum L.
Reed Canary Grass		Phalaris	arundinacea
Alkali Chord Grass		Spartina	gracilis Trin.
Prairie Chord Grass		Spartina	pectinata Link.
Prairie Dropseed		Sporobolus	heterolepsis A. Gray
Rush	Juncaceae	Juncus Spp.	

Plant Observations
Native Shrubs & Trees

Common Name	*Family*	*Genus*	*Species*
Manitoba Maple	Aceraceae (Maple)	Acer	negundo L. var. interius (Britt) Sarg.
American Hazelnut	Betulaceae (Birch)	Corylus	americana Walt.
Beaked Hazelnut		Corylus	cornuta
Twining Honeysuckle	Caprifoliaceae (Honeysuckle)	Lonicera	diocia L. var glaucescens (Rybd.) Butt.
Western Snowberry		Symphoricarpos	occidentalis Hook.
High Bush-Cranberry		Viburnum	opulus L. var. americanum (Mill) Ait.
Downy Arrowwood		Viburnum	rafinesquianum Schultes
Climbing Bittersweet	Celastraceae (Staff-tree)	Celastrus	scandens L.
Red Osier Dogwood	Cornaceae (Dogwood)	Cornus	alba L.
Wolf Willow/Silverberry	Elaeagnaceae (Oleaster)	Elaegnus	commutata Bernh.
Bur Oak	Fagaceae (Beech)	Quercus	macrocarpa Michx.
Green Ash	Oleaceae (Olive)	Fraxinus	pennsylvanica Marsh. var. austinnii Fern
Saskatoon Berry	Rosaceae (Rose)	Amelanchier	alnifolia Nutt.
Round Leaved Hawthorn		Crataegus	rotundifolia Moench.
Wild Plum		Prunus	americana Marsh.
Canada Plum		Prunus	nigra Ait.
Choke Cherry		Prunus	virginiana L. var. melanocarpa (A. Nels)Sarg.
Prickley Rose		Rosa	acicularis Lindl.
Wood's Rose		Rosa	woodsii Lindl.
Rose species		Rosa	sp.
Red Raspberry		Rubus	idaeus L. var. aculeatissimus Regel & Tiling
Narrow Leaved Meadowsweet		Spirea	alba Du Roi
Balsam Poplar	Salicacea (Willow)	Populus	balsamifera L.
Cottonwood		Populus	deltoides Marsh.
Trembling Aspen		Populus	tremuloides Michx.
Pussy Willow/ Diamond Willow		Salix	discolor Muhl.
Peach-Leaved Willow		Salix	amygdaloides Anderss.
Wild Black Currant	Saxifragaceae (Saxifrage)	Ribes	americanum Mill.
Northern Gooseberry		Ribes	oxyacanthoides L. var. oxyacanthoides

Plant Observations • Native Forb Species

Common Name	*Family*	*Genus*	*Species*
Ostrich Fern	Polypodiaceae (Fern)	Matteuccia	struthiopteris (L.) Tod.
Common Cattail	Typhaceae(Cattail)	Typha	latifolia
Narrow-Leaved Cattail		Typha	angustifolia
Narrow Leaved Water Plantain	Alismaceae (Water Plantain)	Alisma	gramineum
Poison Ivy	Anacardiaceae	Rhus	radicans
Indian Hemp	Apocynaceae	Apocynum	cannabinum
Sweet Flag	Aracea (Arum)	Acorus	calamus L.
Wild Sarsparilla	Araliaceae (Ginseng)	Aralia	nudicaulis
Dwarf Milkweed	Asclepiadaceae	Asclepias	ovalifolia
Common Milkweed		Asclepias	syriaca
Harebell	Campanulaceae	Campanula	rotundifolia
Common Yarrow	Compositae	Achillea	millefolium
Giant Ragweed		Ambrosia	trifida L.
Ragweed		Ambrosia	psilostachya
Prairie Sage		Artemisia	ludoviciana
Aster Species		Aster	sp.
Many Flowered Aster		Aster	ericoides
Smooth Aster		Aster	laevis
Lindley's Aster		Aster	ciliolatus Lindl.
White Upland Aster		Aster	ptarmicoides
Floodman's Thistle		Cirsium	floodmanii
Gumweed		Grindelia	squarrosa
Rhombic Leaved Sunflower		Helianthus	laetiflorus
Narrow-Leaved Sunflower		Helianthus	maximalianii Schrad.
Canada Hawkweed		Hieracium	canadanse
Blue Lettuce		Lactuca	tatarica
Meadow Blazingstar		Liatris	ligulistyllus
Arrow-leaved Colt's Foot		Petasites	sagittatus
Canada Goldenrod		Solidago	canadensis
Stiff Goldenrod		Solidago	rigida
Cocklebur		Xanthium	strumarium L.
Wild Morning-Glory (Bindweed)	Convolvulaceae	Convolvulus	sepium L.
Wild Cucumber	Cucurbitaceae (Gourd)	Echinocystis	lobata (Michx.) T. & G.
Common Horsetail	Equisetaceae (Horsetail)	Equisetum	arvense L.

Common Name	*Family*	*Genus*	*Species*
Purple Milk-vetch	Leguminosae (Pea)	Astragalus	danicus Retz.
Canadian Milk-vetch		Astragalus	canadensis L.
Wild Licorice		Hedysarum	lepidota (Nutt.) Pursh.
Wild Peavine		Lathyrus	venosus Muhl.
Hog peanut		Amphicarpa	bracteata (L). Fern.
American Milk-vetch		Astragalus	fridgidus (L).Gray.
Lesser Duckweed	Lemnaceae (Duckweed)	Lemna	minor L.
Prairie Onion	Liliaceae (Lily)	Allium	textile Nels. & Macbre.
Wood Lily/ Prairie Lily		Lilium	philadelphicum L.
Wild Lily of the Valley		Maianthemum	canadense Desf. var. interius Fern.
Common Solomon's Seal		Polygonatum	canaliculatum (Muhl.) Pursh
False Solomon's Seal		Smilacina	stellata (L.) Desf.
Carrion Flower		Smilax	herbacea L. var. lasioneura (Hook) D.C.
Trillium (Noding Wakerobin)		Trillium	cernuum L. var.macranthum Eam. & Weig.
Moonseed	Menispermum (Moonseed)	Menispermum	canadense L.
Indian Pipe	Monotropaceae (Indian Pipe)	Monotropa	uniflora L.
Yellow Pond-Lily	Nymphaeaceae (Water-lily)	Nuphar	variegatum Engelm.
Yellow Evening-Primrose	Onagraceae (Evening Primrose)	Oenothera	biennis L. var.canescens Torr.& Gray var.hirsutissima
Large Yellow Lady's Slipper	Orchidaceae (Orchis)	Cypripedium	calceolus var. pubescens (Willd.) Correll
Yellow Wood-Sorrel	Oxalidaceae (Wood-sorrel)	Oxalis	stricta L.
Downy Plox	Polemoniaceae (Plox)	Plox	pilosa L.
Swamp Smartweed	Polygonaceae (Buckwheat)	Polygonum	coccineum Muhl.
Water Smartweed		Polygonum	amphibium L.
Western Dock		Rumex	occidentallis S. Wats
Fringed Loosestrife	Primulaceae (Primrose)	Lysimachia	ciliata L.
Whorled Loosestrife		Lysimachia	quadrifolia L.
Red Baneberry	Ranunculaceae (Crowfoot)	Actaea	rurbra (Ait.) Willd.

Common Name	*Family*	*Genus*	*Species*
Tall Meadow-Rue		Thalictrum	dasycarpum Fisch. & Lall.
Veiny Meadow-Rue		Thalictrum	venulosum Trel.
Smooth Wild Strawberry	Rosaceae (Rose)	Fragaria	virginiana Dcne.
Silverweed		Potentilla	anserina L.
Yellow Avens		Geum	apleppicum Jacq.
Northern Bedstraw	Rubiaceae	Galium	palustre L.
Sweet Scented Bedstraw		Galium	triflorum Michx.
Pale Comandra	Santalaceae	Comandra	var. angustifolia (DC.) Torr.
Blue Monkey Flower	Scrophulariaceae (Figwort)	Mimulus	ringens L.
Common Mullen		Verbascum	thapsus L.
Bittersweet/climbimg Nightshade	Solanaceae (Potatoe)	Solanum	dulcamara L.
Water Hemlock	Umbelliferae (Parsley)	Cicuta	maculata L. var. angustifolia
Cow Parsnip		Heracleum	lanatum Michx
Smooth Sweet Cicely		Osmorhiza	aristata (Thunb.) Mak & Yabe
Black Snakeroot		Sanicula	marilandica L.
Golden Alexander		Zizia	aurea (L.) Koch
Stinging Nettle	Urticaceae (Nettle)	Utrica	dioica L. var. procera (Muhl.)
Wood Nettle		Laportea	canadensis (L.) Gaud.
Early Blue Violet	Violaceae (Violet)	Vioia	adunca J.E. Smith.
Crowfoot Violet		Viola	pedatifida
Downy Yellow Violet		Viola	pubescens Ait.
Western Canada Violet		Viola	selkirkii Pursh
Wild Grape	Vitaceae (Grape)	Vitis	riparia Michx.
White Baneberry		Actaea	rubra forma neglecta (Gilman) Robins
Canada Anemone		Anemone	canadensis L.
Wood Anemone		Anemone	nemorosa L. var. bifolia (Farwell) Biov.
Thimbleweed		Anemone	cylindrica A. Gray
Smooth Leaved Buttercup		Ranunculus	abortivus L.
Seaside Buttercup		Ranunculus	cymbalaria Pursh
Wild Columbine		Aquilegia	canadensis L.
Marsh (Swamp) Buttercup		Ranunculus	septentrionalis Poir.
Spiked-Water Milfoil	Haloragaceae	Myrophyllum	spicatum L.
Blue Flag	Iridaceae (Iris)	Iris	versicolor L.
Common Blue-Eyed Grass		Sisyrinchium	montanum Greene.
Obedient Plant (American Dragonhead)	Labiatae (Mint)	Dracocephalum	parviflorum Nutt.
Giant Hyssop		Agastache	foeniculum (Pursh) Kize
Field (Wild) Mint		Mentha	arvensis L. var. villosa (Benth.) S.R. Stewart

Plant Observations
Non-Native Forbes

Common Name	*Family*	*Genus*	*Species*
Duckweed	Lemnaceae	Lemna	Sp.
Bluebur	Boraginaceae	Lappula	echinata Gilib.
Nodding Stickseed		Lappula	deflexa (Whal.)
Maltese Cross	Caryophyllaceae(Pink)	Lychnis	chalcedonica
Lamb's Quaters	Chenopodiacea (Goosefoot)	Chenopodium	album L.
Common Burdock	Compositae	Arctium	lappa L.
Common Wormwood		Artemisia	vulgaris L.
Ox-eye Daisy		Chrysanthemum	leucanthemum L.
Canada Thistle		Cirisium	arvense L.
Scentless Chamomile		Matricaria	maritima L.
Common Plantain		Plantago	major L.
Perennial Sow Thistle		Sonchus	arvensis L.
Common Dandelion		Taraxacum	officinale Weber
Goat's Beard		Tragopogon	pratensis L.
Horseradish	Cruciferae(Mustard)	Amoracia	rusticana P. Gaertner, B. Meyer & Scherb.
Pennycres(Stinkweed)		Thlaspi	arvense L.
Water Milfoil	Haloragaceae	Myriophyllum	alterniflorum Dc.
Yellow Flag	Iridaceae(Iris)	Iris	pseudacorus
Black Medick	Leguminosae	Medicago	lupulina L.
Alfalfa		Medicago	sativa L.
White Sweet Clover		Melilotus	alba Medic.
Yellow Sweet Clover		Melilotus	indica L. All.
Red Clover		Trifolium	pratense L.
White Clover		Trifolium	repens L.
Garden Asparagus	Liliaceae	Asparagus	officinallis L.
Purple Lossestrife	Lythraveae	Lythrum	salicaria
Common Plantain	Plantaginaceae	Plantago	major L.

Plant Observations
Non-Native Shrubs & Trees

Common Name	*Family*	*Genus*	*Species*
Ladies (Yellow) Bedstraw	Rubiaceae (Madder)	Galium	verum L.
Tartarian Honeysuckle	Caprifoliaceae	Lonicera	tatarica L.
Russian Olive	Elaeagnaceae	Elaeagnus	angustifolia L.
Common Caragana/	Leguminosae	Cragana	arborescens Lam.
Siberian Peatree			
Lilac	Oleaceae	Syringa	vulgaris L.
Siberian Elm	Ulmaceae		

Plant Observations
Non-Native Sedges, Grasses & Rushes

Common Name	*Family*	*Genus*	*Species*
Couch/Quack Grass	Gramineae	Agropyron	repens
Smooth Brome Grass		Bromus	inermis
Barnyard Grass		Echinochloa	crusgalli
Timothy		Phleum	pratense
Cananda Blue Grass		Poa	compressa
Kentucky Blue Grass		Poa	pratensis
Green Foxtail		Setaria	viridis

Mammal Observations

Common Name	*Genus*	*Species*
Gray Squirrel	Sciurus	carolensis
Red Squirrel	Tamiasciurus	hudsonicus
Least Weasel	Mustela	nivalis
Long-tailed Weasel	Mustela	frenata longicauda
Mink	Mustela	vison lacustris
Skunk	Mephites	orephitis
Raccon	Procyon	lotor hirtus
Cottontail Rabbit	Sylvilagus	floridanus similis
Red Fox	Vulpes	vulpes regalis
Fraklin Ground Squirrel	Spermophilus	franklinii
Black Bear	Ursus	canadensis canadensis
Coyote	Canis	zibethicus albus
Snowshoe Hare	Lepus	americanus phaeontus
White-tailed Jack Rabbit	Lepus	townsedii campanius
White-footed Dear Mouse	Peromyscus	maniculatus bairdii
Field Mouse	Microtus	pensylvanicus drummondii
Gapper's red-backed Vole	Clethronomys	gapperi loringi
Short-tailed Shrew	Blanaria	brevicauda manitobensis
House Mouse	Mus	musculus
White-tailed Deer	Odocileus	virginianus

Fish Observations

Common Name	*Genus*	*Species*
Northern Pike	Hiodon	tergisus
Carp	Esox	lucius
White Sucker	Catostomus	commersoni
Black Bullhead	Ictalurus	melas
Rock Bass	Ambloplites	rupestris

Bird Observations

Common Name	*Genus*	*Species*
Pied-billed Grebe	Podilymbus	podiceps
Great Blue Heron	Ardea	herodias
Blk.-crowned Night-Heron	Nycticorax	nycticorax
Canada Goose	Branta	canadensis
Wood Duck	Aix	sponsa
Mallard	Anas	platyrhynchos
Blue-winged Teal	Anas	discors
Bufflehead	Bucephala	albeola
Hooded Merganser	Lophodytes	cucullatus
Cooper's Hawk	Accipiter	cooperii
American Kestrel	Falco	sparverius
Merlin	Falco	columbarius
Killdeer	Charadrius	vociferus
Spotted Sandpiper	Actitis	macularia
Franklin's Gull	Larus	pipixcan
Herring Gull	Larus	argentatus
Mourning Dove	Zenaida	macroura
Black-billed Cuckoo	Coccyzus	erythropthalmus
Eastern Screech-Owl	Otus	asio
Snowy Owl	Nyctea	scansiaca
Long-eared Owl	Asio	otus
Common Nighthawk	Chordeiles	minor
Whip-poor-will	Caprimulgus	vociferous
Ruby-thr. Hummingbird	Archilochus	colubris
Belted Kingfisher	Ceryle	alcyon
Red-headed Woodpecker	Melanerpes	erythrocephalus
Red-bellied Woodpecker	Melanerpes	carolinus
Yellow-bellied Sapsucker	Sphyrapicus	varius
Downy Woodpecker	Picoides	pubescens
Hairy Woodpecker	Picoides	villosus
Northern Flicker	Colaptes	auratus
Eastern Phoebe	Sayornis	phoebe
Great Crested Flycatcher	Myiarchus	crinitus
Western Kingbird	Tyrannus	verticalis

Common Name	*Genus*	*Species*
White-breasted Nuthatch	Sitta	carolinensis
Brown Creeper	Certhia	americana
Carolina Wren	Thryothorus	ludovicianus
House Wren	Troglodytes	aedon
Golden-crowned Kinglet	Regulus	satrapa
Veery	Catharus	fuscescens
Swainson's Thrush	Catharus	ustulatus
Hermit Thrush	Catharus	guttatus
American Robin	Turus	migratorius
Gray Catbird	Dumetella	carolinensis
Brown Thrasher	Toxostoma	rufum
Sprague's Pipit	Anthus	spragueii
Bohemian Waxwing	Bombycilla	garrulus
Cedar Waxwing	Bombycilla	cedrorum
Loggerhead Shrike	Lanius	ludovicianus
European Starling	Sturnus	vulgaris
Red-eyed Vireo	Vireo	olivaceus
Tennessee Warbler	Vermivora	peregrina
Orange-crowned Warbler	Vermivora	celata
Nashville Warbler	Vermivora	ruficadilla
Yellow Warbler	Dendroica	petechia
Chestnut-sided Warbler	Dendroica	pensylvanica
Magnolia Warbler	Dendroica	magnoilia
Yellow-rumped Warbler	Dendroica	coronata
Palm Warbler	Dendroica	palmarum
Bay-breasted Warbler	Dendroica	castanea
Blackpoll Warbler	Dendroica	strata
Black-and-White Warbler	Mniolta	varia
American Redstart	Setophaga	ruticilla
Ovenbird	Seiurus	aurocapillus
Northern Waterthrush	Seiurus	noveboracensis
Common Yellowthroat	Geothlypsis	trichas
Canada Warbler	Wilsonia	canadensis
Scarlet Tanager	Piranga	olivacea
Rose-breasted Grosbeak	Pheucticus	ludovicianus
Indigo Bunting	Passerina	cyanea
American Tree Sparrow	Spizella	arburea

Common Name	*Genus*	*Species*
Lincoln's Sparrow	Melospiza	lincolnii
White-throated Sparrow	Zonotrichia	albicollis
White-crowned Sparrow	Zonotrichia	leucophrys
Harris' Sparrow	Zonotrichia	querula
Dark-eyed Junco	Junco	hyemalis
Red-winged Blackbird	Agelaius	phoeniceus
Brewer's Blackbird	Euphagus	cyanocephalus
Common Grackle	Quiscalus	quiscula
Northern Oriole	Icterus	galbula
Pine Grosbeak	Pinicola	enucleator
Purple Finch	Carpodacus	purpureus
House Finch	Carpodacus	mexicanus
Red Crossbill	Loxia	curvirostra
White-winged Crossbill	Loxia	leucoptera
Common Redpoll	Carduelis	flammea
Hoary Redpoll	Carduelis	hornemanni
Pine Siskin	Cardeulis	pinus
American Goldfinch	Cardeulis	tristis
Evening Grosbeak	Coccothraustes	vespertinus
House Sparrow	Passer	domesticus
Chipping Sparrow	Spizella	passerina
Clay-colored Sparrow	Spizella	pallida
Savannah Sparrow	Passerculus	sandwichensis
Fox Sparrow	Passerella	iliaca
Song Sparrow	Melospiza	melodia
Eastern Kingbird	Tyranus	tyranus
Barn Swallow	Hirundo	rustica
Blue Jay	Cyanocitta	cristata
American Crow	Corvus	brachyrhynchos
Black-capped Chickadee	Parus	atricapillus
Red-breasted Nuthatch	Sitta	canadensis

Appendix B: Winnipeg Weather Statistics

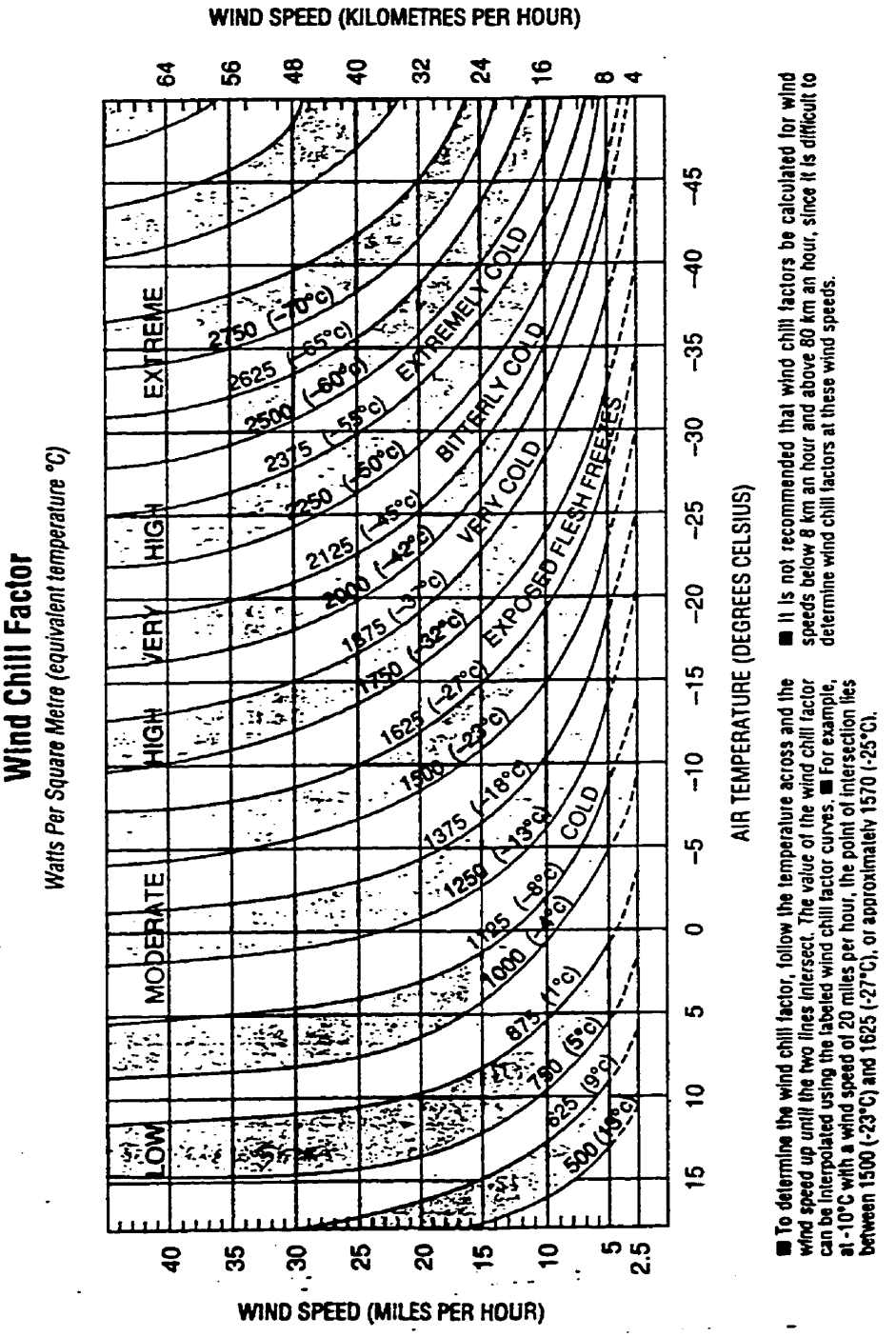
The following information is a collection of Winnipeg's weather including temperature, wind speed and direction, and sun angles. This information was used for the weather and climate analysis for this project. The chart below is from the *Canadian Climate Normals 1961-1990*, Environment Canada, 1998.

WINNIPEG INT'L A, Manitoba
49°54-N 97°14-W/O
239m
1938 to/à 1990

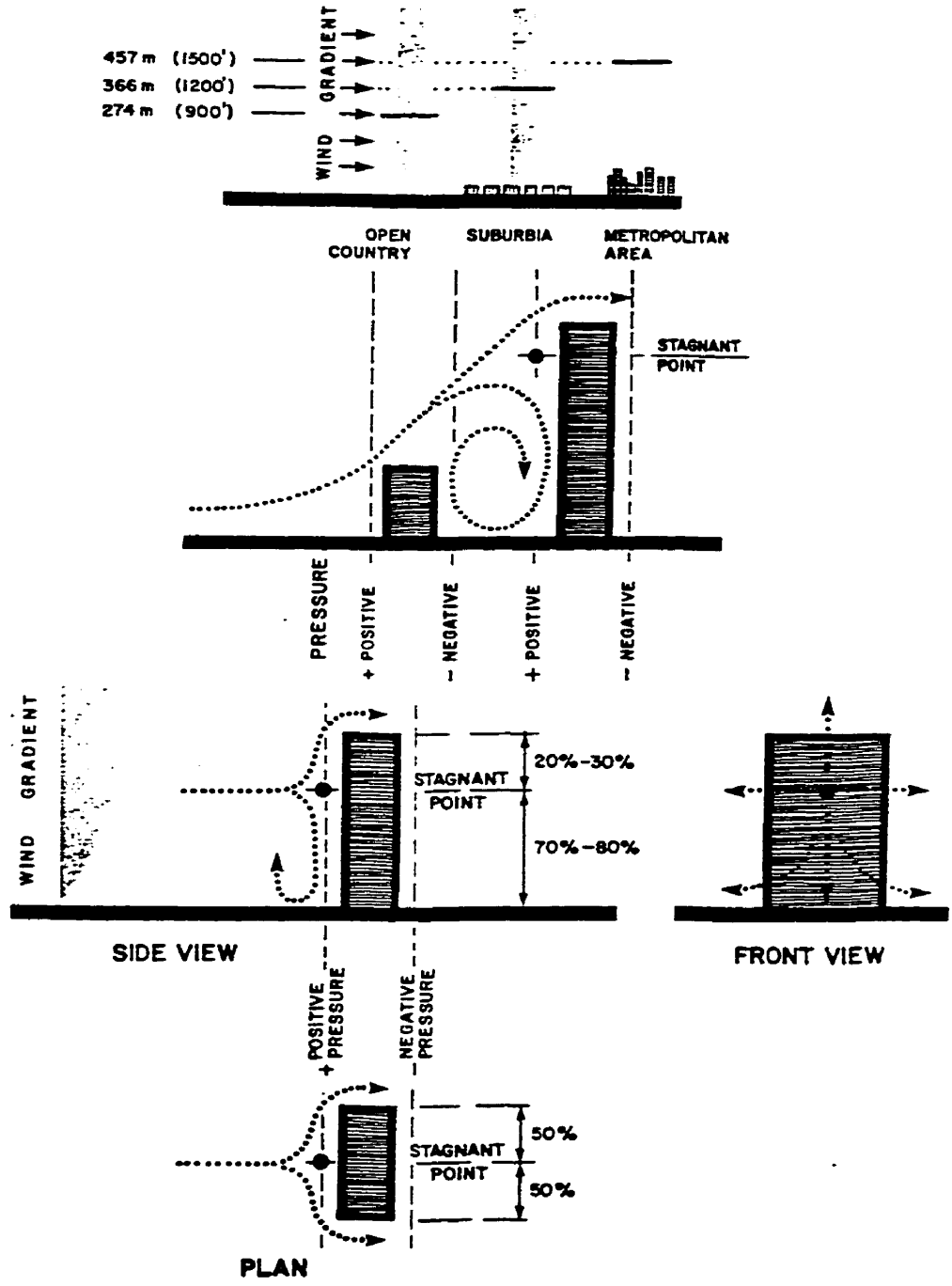
	Jan janv	Feb févr	Mar mars	Apr avr	May mai	Jun juin	Jul juill	Aug août	Sep sept	Oct oct	Nov nov	Dec déc	Year année
Temperature													
Daily Maximum (°C)	-13.2	-9.7	-1.8	9.8	18.6	23.4	26.1	24.9	18.6	11.3	-0.4	-9.9	8.1
Daily Minimum (°C)	-23.6	-20.6	-12.4	-2.3	4.5	10.4	13.4	11.7	6.1	0.1	-9.2	-19.4	-3.4
Daily Mean (°C)	-18.3	-15.1	-7.0	3.8	11.6	16.9	19.8	18.3	12.4	5.7	-4.7	-14.6	2.4
Extreme Maximum (°C)	7.8	11.7	23.3	34.3	37.0	37.2	37.8	40.6	38.8	29.4	23.9	11.7	
Date	942/23	958/25	946/27	980/21	980/22	988/11	940/22+	949/07	983/02	961/06	975/05	939/06	
Extreme Minimum (°C)	-42.2	-45.0	-37.8	-26.3	-11.1	-3.3	1.1	0.6	-7.2	-17.2	-34.0	-37.8	
Date	966/24+	966/18	962/01	979/02	958/01	964/03	972/03	965/28	965/26	941/30	985/30	973/31+	
Degree-Days													
Above 18 °C	0.0	0.0	0.0	0.7	13.0	36 8	73.1	56.4	9.2	0.3	0.0	0.0	189
Below 18 °C	1129.1	936.2	778.5	428.6	212.0	69.0	18.5	45.7	178.6	380.9	683.3	1013.7	5874
Above 5 °C	0.0	0.0	1 8	54.1	214.0	357.8	457.6	413.6	224.0	74.9	4.3	0.0	1802
Below 0 °C	571.2	428.8	237.1	30.4	0.8	0.0	0.0	0.0	0.1	10.7	168.3	456.1	1904
Precipitation													
Rainfall (mm)	0.3	0.4	5.9	26 4	57.8	83.8	72.0	75.3	50.9	24.6	5.3	1.6	404.4
Snowfall (cm)	22.6	17.1	19.2	9.4	2.0	0.0	0.0	0.0	0.4	4.9	19.0	20.1	114.8
Precipitation (mm)	19.3	14.8	23.1	35.9	59.8	83.8	72.0	75.3	51.3	29.5	21.2	18.6	504.4
Extreme Daily Rainfall (mm)	3.8	7.6	30.0	36.0	60.2	69.8	69.1	83.8	65.0	74.4	17.0	21.8	
Date	944/20	958/23	945/25	986/30	978/25	984/21	942/29	962/11	941/03	949/10	948/02	982/02	
Extreme Daily Snowfall (cm)	23.0	23.6	35.6	21.3	21.1	0.3	0.0	0.0	5.8	24.6	27.7	21.6	
Date	989/07	955/20	966/04	964/13	967/01	969/12	990/31+	990/31+	984/24	971/30	958/17	948/15	
Extreme Daily Pcpn. (mm)	22.5	23.6	35.6	44.1	60.2	69.8	69.1	83.8	65.0	74.4	27.7	21.8	
Date	989/07	955/20	966/04	986/30	978/25	984/21	942/29	962/11	941/03	949/10	958/17	982/02	
Month-end Snow Cover (cm)	24	23	9	0	0	0	0	0	0	1	8	15	

Days With													
Maximum Temperature > 0°C	2	3	13	27	31	30	31	31	30	30	15	3	246
Measurable Rainfall	•	•	2	5	9	12	11	11	11	7	2	•	73
Measurable Snowfall	13	9	7	4	•	•	0	0	•	2	9	12	56
Measurable Precipitation	12	8	9	8	10	12	11	11	11	9	9	11	119
Freezing Precipitation	2	2	2	•	•	0	0	0	0	•	3	3	13
Fog	2	2	3	•	•	•	•	1	1	2	2	2	17
Thunderstorms	•	0	•	•	3	6	8	6	3	•	•	•	28
Sunshine (Hrs)	119.7	139.9	177.7	232.4	276.8	290.6	321.7	285.9	189.3	149.8	94.9	98.6	2377.3
Station Pressure (kPa)	98.87	98.95	98.78	98.64	98.48	98.29	98.45	98.48	98.55	98.53	98.66	98.79	98.62
Moisture													
Vapour pressure (kPa)	0.16	0.20	0.33	0.54	0.82	1.25	1.57	1.43	1.01	0.67	0.38	0.20	0.71
Rel. Humidity - 0600L (%)	80	81	83	81	77	80	85	87	86	84	84	81	
Rel. Humidity - 1500L (%)	75	75	72	54	45	50	52	50	53	56	72	77	
Wind													
Speed (km/h)	18	17	18	20	19	17	15	15	18	19	18	17	18
Most Frequent Direction	NW	S	S	N	S	S	S	S	S	S	S	S	S
Extreme Hourly Speed (km/h)	70	80	81	80	72	80	89	74	71	77	76	71	
Direction	NW	W	NW	NW	NW	S	SE	E	N	NW	W	S	
Extreme Gust Speed (km/h)	106	129	113	106	109	127	127	122	98	102	124	89	
Direction	S	NW	N	N	NW	W	S	NW	S	N	W	NW	

Wind and its affects have played a large role in the design considerations of the alternative plan. The chart below determines the wind chill factor, which is based on temperature combined with wind speed.



The wind chill factor chart. (Source: *The Canadian Global Almanac, 1995.*)



The dynamics of air movement. (Source: *Design for Northern Climates*, Matus, 1988, p. 168.)

The sun's position in the sky accounts for the number of possible hours of daylight for any given area. This is important if the planner of a subdivision is concerned with the allowance of sunshine or shading. The chart below shows the monthly angles to determine the position of the sun over Winnipeg (from *Canadian Ecocharts*, CMHC, p. 15).

WINNIPEG, MANITOBA
Latitude - 49° 54' N Longitude - 97° 14' W Time Zone - 6

DATA VARIABLES			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MEAN DAILY SOLAR RADIATION (MJm^{-2})			5.25	9.05	14.06	17.74	20.90	22 74	22.99	19.00	13.32	8.15	4.64	3.82
SELECTED ANGLES FOR MAXIMUM RADIATION		Az°	180	180	180	180	135	135	135	135	180	180	180	180
		Tilt°	90	60	60	30	30	30	30	30	30	30	60	90
POSITION OF THE SUN	9 am	Az°	129.29	123.73	118.85	113.13	107.11	103 08	104 66	111.96	121.82	130.10	134.50	133.79
		Alt°	4.97	12.57	22.44	33.12	39 91	41 51	38.58	32 62	24.74	16 13	7.98	3 53
	12 pm	Az°	169.93	168.02	168.20	169.07	168.02	164 44	163.44	167 33	172.76	176 17	176.29	173.53
		Alt°	19.68	28.90	39.82	51.61	59.90	62.87	59.71	51.88	40.50	29.26	20.06	16.41
	3 pm	Az°	213.66	216.95	223.69	232.97	240.04	241.52	237.38	231.78	227.47	223 69	219.19	215 10
		Alt°	13.74	22.61	31.75	40.89	47.47	50.73	48 94	41.48	30.31	19.24	11.15	9 21
SHADOWS (m)		9 am	11.50	4.48	2.42	1.53	1.20	1 13	1.25	1.56	2.17	3.46	7.13	16.21
		12 pm	2.80	1.81	1.20	0.79	0.58	0 51	0.58	0.79	1.17	1.78	2.74	3.40
		3 pm	4.09	2.40	1.62	1.15	0.92	0.82	0.87	1 13	1.71	2.87	5.07	6.17
SUNRISE SUNSET (hrs)		am	8:15	7:27	6:28	5:23	5:35	5:20	5:44	6:28	7:14	8:00	7:51	8:24
		pm	5:05	5:57	6:43	7:31	9:15	9 41	9.26	8:35	7:29	6:26	4:38	4:29

Appendix C: Demographics

The demographic profile of the region surrounding Royalwood, and of Winnipeg, played a large role in deciding the housing stock. The following is a profile summary of the City's demographics based on the Winnipeg Census Division's *Census 1991* (1996).

WINNIPEG CENSUS DIVISION

Population Change 1986 - 1991

Year	Winnipeg
1986	594,555
1991	615,190
% Change 1986 - 1991	3.5%

Population By Age Group, 1991

	Winnipeg	%
Total population	615,190	100.0%
0 - 4 years	43,665	7.1%
5 - 9 years	40,215	6.5%
10 - 14 years	38,255	6.2%
15 - 19 years	41,635	6.8%
20 - 24 years	49,490	8.0%
25 - 29 years	56,880	9.2%
30 - 34 years	55,385	9.0%
35 - 39 years	50,100	8.1%
40 - 44 years	45,085	7.3%
45 - 49 years	34,065	5.5%
50 - 54 years	27,485	4.5%
55 - 59 years	26,085	4.2%
60 - 64 years	25,670	4.2%
65 - 74 years	46,320	7.5%
75 years and over	34,840	5.7%

Total Number of Households by Tenure

	Winnipeg	%
Number of occupied private dwellings	240,675	100.0%
Owned	145,760	60.6%
Rented	94,915	39.4%

Average and Median Family & Household Incomes

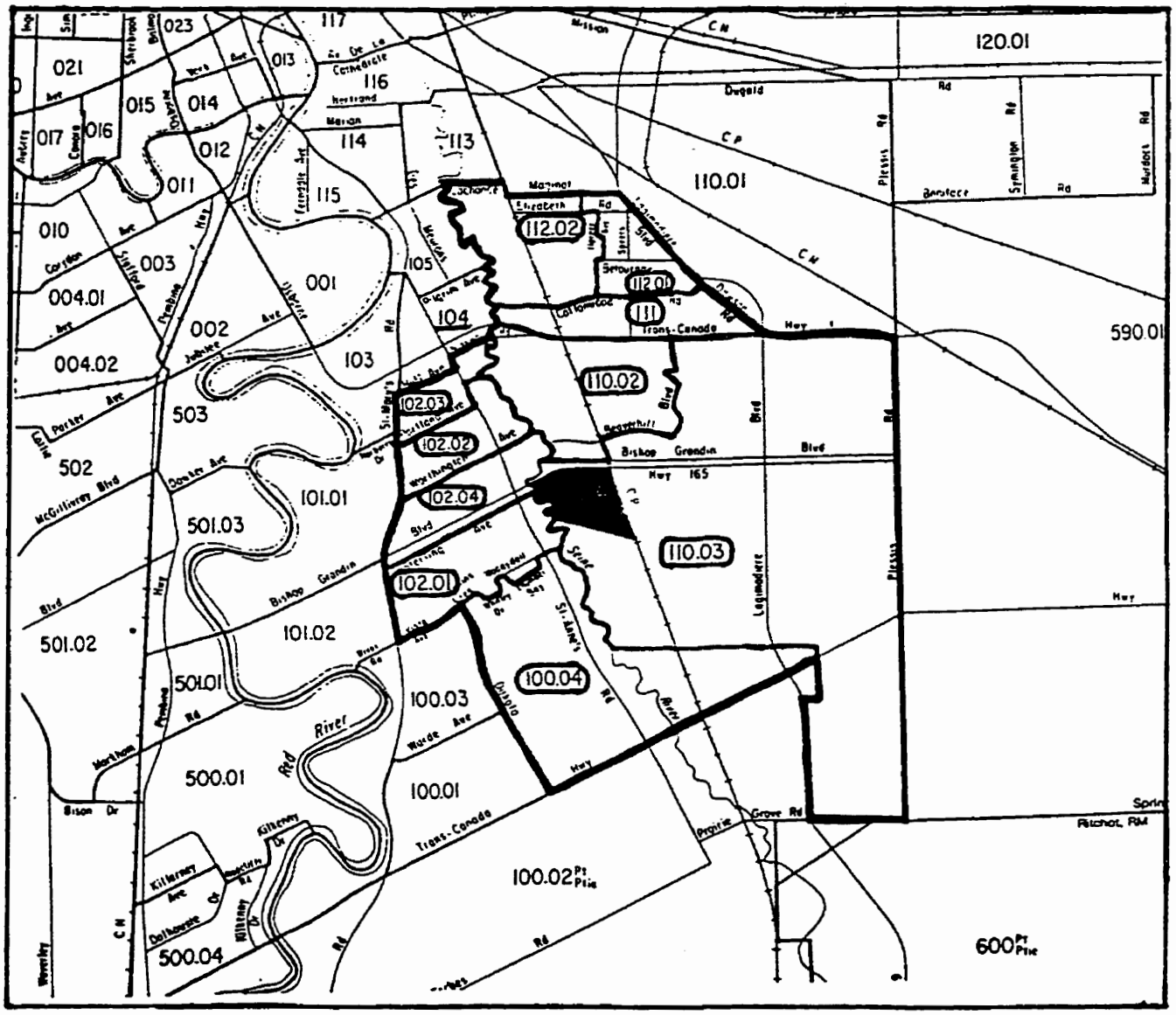
	Winnipeg
Family income - All census families	162,235
Average family income $	$49,261
Median family income $	$43,775
Household income - All private households	240,690
Average household income $	$42,169
Median household income $	$36,035

Incidence of Poverty by Type

	Winnipeg
All economic families	165,270
Low income economic families	28,820
Incidence of low income	17.4%
All unattached individuals	90,580
Low income unattached individuals	39,245
Incidence of low income	43.3%

Total Number of Census Families by Type

	Winnipeg	%
Total number of census families	162,250	100.0%
Total husband-wife families	137,250	84.6%
Total without sons and daughters at home	57,770	42.1%
Total with sons and daughters at home	79,480	57.9%
Total lone-parent families	25,000	15.4%
Male parent	3,840	15.4%
Female parent	21,160	84.6%
Average number of persons per family	3.0	



A regional map of southeast Winnipeg showing the ten census tracts that surround Royalwood and are included in the analysis of this study. (Source: *Statistics Canada Profiles*, 1991.)

The following charts are a compilation of demographic information for Winnipeg and the ten census tracts around Royalwood. This information is from *Statistics Canada Profiles* (1991) and was used in the demographic analysis stage of this project.

Characteristics	Winnipeg 100.04	Winnipeg 102.01	Winnipeg 102.02	Winnipeg 102.03	Winnipeg 102.04
Dwelling and Household Characteristics					
Total number of occupied private dwellings	2,280	1,800	1,715	1,525	2,300
by tenure					
Owned	1,945	1,405	835	630	445
Rented	335	395	880	895	1,855
Band housing (3)	–	–	–	–	–
by structural type of dwelling					
Single-detached house	1,820	1,200	915	590	305
Semi-detached house	60	190	5	–	15
Row house	15	245	20	125	365
Apartment, detached duplex	–	–	–	–	–
Apartment building, five or more storeys	–	90	455	150	950
Apartment building, less than five storeys	380	65	325	650	665
Other single attached house	–	5	–	–	–
Movable dwelling (4)	5	15	–	–	–
Total number of private households	2,280	1,805	1,720	1,520	2,295
by size of household					
1 person	350	230	560	580	895
2 persons	835	465	625	520	750
3 persons	435	350	240	245	335
4 – 5 persons	625	705	265	175	295
6 or more persons	40	55	25	10	25
by number of census families					
Non-family household	420	280	685	665	1,060
1 census family	1,850	1,515	1,025	850	1,240
2 or more census families	10	10	5	5	5
Number of persons in private households	6,220	5,535	3,825	3,125	4,795
Average number of persons per household	2.7	3.1	2.2	2.1	2.1
Census Family Characteristics					
Total number of census families in private households	1,875	1,530	1,040	860	1,240
by size of census family					
2 persons	830	465	560	480	650
3 persons	425	355	225	220	295
4 persons	470	510	185	125	220
5 or more persons	155	195	70	40	75
by family structure and presence of never-married sons and daughters					
Total husband-wife families (5)	1,740	1,245	885	660	850
Total families of now-married couples	1,610	1,175	775	560	645
Total without sons and daughters at home	660	305	395	305	300
Total with sons and daughters at home	945	870	380	255	350
1	365	235	150	120	130
2	440	455	160	105	150
3 or more	140	180	65	30	65
Total families of common-law couples	130	65	105	100	200
Total without sons and daughters at home	85	30	65	65	135
Total with sons and daughters at home	40	35	40	35	70
1	20	15	25	20	45
2	15	10	15	15	20
3 or more	5	10	5	5	–
Total lone-parent families	130	290	150	200	390
Male parent	25	30	30	20	45
1	20	15	15	15	35
2	5	10	5	5	10
3 or more	5	10	–	5	5
Female parent	105	260	130	180	345
1	60	115	80	100	185
2	35	85	45	75	115
3 or more	15	50	10	10	50

Characteristics	Winnipeg 110.02	Winnipeg 110.03	Winnipeg 111	Winnipeg 112.01	Winnipeg I. 112.02	Winnipeg, C
Dwelling and Household Characteristics						
Total number of occupied private dwellings	1,815	2,245	1,680	1,270	1,915	241,165
by tenure						
Owned	1,460	1,750	1,410	925	1,320	146,200
Rented	350	495	270	345	590	94,970
Band housing (3)	–	–	–	–	–	–
by structural type of dwelling						
Single-detached house	1,310	1,775	1,395	900	1,110	142,740
Semi-detached house	185	10	75	80	350	10,085
Row house	125	–	–	55	55	8,840
Apartment, detached duplex	5	–	–	40	–	4,935
Apartment building, five or more storeys	–	–	205	–	–	33,675
Apartment building, less than five storeys	190	460	–	190	395	40,105
Other single attached house	–	–	–	–	–	510
Movable dwelling (4)	–	–	–	–	–	275
Total number of private households	1,810	2,245	1,680	1,270	1,910	241,170
by size of household						
1 person	195	290	260	190	410	67,280
2 persons	525	625	585	445	645	75,910
3 persons	375	405	330	270	370	39,000
4 – 5 persons	655	845	470	335	445	52,520
6 or more persons	65	80	45	35	40	6,455
by number of census families						
Non-family household	250	375	300	250	500	80,670
1 census family	1,550	1,840	1,365	1,010	1,400	158,380
2 or more census families	15	25	10	10	15	2,115
Number of persons in private households	5,545	6,880	4,695	3,520	4,980	603,325
Average number of persons per household	3.1	3.1	2.8	2.8	2.6	2.5
Census Family Characteristics						
Total number of census families in private households	1,575	1,900	1,385	1,030	1,425	162,690
by size of census family						
2 persons	515	610	595	430	645	72,490
3 persons	380	415	300	260	355	36,795
4 persons	465	620	325	235	295	36,665
5 or more persons	215	265	165	105	135	16,740
by family structure and presence of never-married sons and daughters						
Total husband-wife families (5)	1,390	1,785	1,270	870	1,200	137,660
Total families of now-married couples	1,325	1,670	1,220	810	1,095	124,445
Total without sons and daughters at home	375	470	505	310	460	49,720
Total with sons and daughters at home	950	1,200	715	500	630	74,720
1	315	350	255	185	245	26,675
2	430	600	305	225	265	32,850
3 or more	205	255	155	90	125	15,195
Total families of common-law couples	60	110	45	65	100	13,215
Total without sons and daughters at home	35	80	20	35	50	8,180
Total with sons and daughters at home	30	30	25	30	50	5,030
1	15	20	10	15	35	2,655
2	10	5	5	–	10	1,590
3 or more	5	10	5	10	5	785
Total lone-parent families	190	115	120	155	235	25,030
Male parent	25	20	30	25	40	3,850
1	15	10	20	15	20	2,385
2	10	5	10	5	15	1,085
3 or more	5	5	5	–	–	385
Female parent	160	95	90	130	195	21,180
1	90	50	50	65	115	12,200
2	50	35	30	50	60	6,385
3 or more	20	10	10	10	25	2,595

Characteristics	Winnipeg 100.04	Winnipeg 102.01	Winnipeg 102.02	Winnipeg 102.03	Winnipeg 102.04
1990 INCOME CHARACTERISTICS (concluded)					
Total income by sex					
Males 15 years and over with income	2,200	1,775	1,445	1,130	1,510
Under $1,000 (43)	50	85	20	25	50
$ 1,000 – $ 2,999	40	50	80	45	85
3,000 – 4,999	80	65	60	50	45
5,000 – 6,999	40	70	20	35	70
7,000 – 9,999	65	85	80	65	95
10,000 – 14,999	180	95	155	155	165
15,000 – 19,999	230	110	140	145	170
20,000 – 24,999	190	130	170	200	240
25,000 – 29,999	260	140	160	90	145
30,000 – 39,999	460	455	315	180	270
40,000 – 49,999	340	260	160	70	120
50,000 and over	265	235	70	60	60
Average income (44) $	30,433	29,277	24,587	22,805	22,851
Median income (44) $	29,706	30,746	24,218	20,612	21,099
Standard error of average income $	797	888	790	904	914
Females 15 years and over with income ..	2,245	1,920	1,500	1,350	2,000
Under $1,000 (43)	70	170	20	70	55
$ 1,000 – $ 2,999	95	95	130	20	110
3,000 – 4,999	150	115	70	80	105
5,000 – 6,999	125	125	65	95	190
7,000 – 9,999	225	180	200	135	305
10,000 – 14,999	210	300	310	335	390
15,000 – 19,999	335	180	320	175	255
20,000 – 24,999	310	160	160	160	240
25,000 – 29,999	215	215	75	130	165
30,000 – 39,999	345	215	80	80	135
40,000 – 49,999	130	135	45	45	35
50,000 and over	30	25	20	15	15
Average income (44) $	19,644	17,831	15,691	16,881	15,208
Median income (44) $	18,901	14,739	14,011	12,944	12,390
Standard error of average income $	556	633	565	876	490
Family income – All census families	1,870	1,530	1,040	860	1,240
Under $10,000	60	50	60	75	155
$10,000 – $19,999	105	150	110	120	255
20,000 – 29,999	210	130	130	150	220
30,000 – 39,999	275	160	260	175	210
40,000 – 49,999	295	285	205	140	145
50,000 – 59,999	335	285	90	75	95
60,000 – 69,999	210	165	95	40	95
70,000 and over	380	300	80	80	65
Average income $	51,284	50,314	39,788	37,746	32,977
Median income $	49,813	49,524	37,847	35,539	29,067
Standard error of average income $	1,141	1,300	1,259	1,614	1,337
Incidence of low income (45)					
All economic families	1,920	1,530	1,070	920	1,310
Low income economic families	195	240	195	210	510
Incidence of low income (46) %	10.0	15.7	18.3	22.7	38.8
All unattached individuals	430	375	790	630	1,145
Low income unattached individuals	70	155	340	225	550
Incidence of low income (46) %	16.5	41.0	43.0	35.8	48.0
Total population in private households	6,210	5,525	3,815	3,115	4,790
Persons in low income family units	610	900	850	760	2,030
Incidence of low income (46) %	9.8	16.3	22.3	24.4	42.3
Household income – All private households .	2,280	1,800	1,720	1,525	2,295
Under $10,000	90	105	205	160	390
$10,000 – $14,999	80	105	150	205	330
15,000 – 19,999	125	80	200	135	240
20,000 – 29,999	310	180	230	345	435
30,000 – 39,999	315	195	325	255	365
40,000 – 49,999	385	280	235	190	205
50,000 – 59,999	340	305	145	85	140
60,000 – 69,999	210	180	130	50	85
70,000 and over	440	320	80	80	85
Average income $	48,499	47,853	34,099	31,708	28,086
Median income $	46,531	46,016	31,879	28,207	24,018
Standard error of average income $	1,058	1,244	1,047	1,210	886

Characteristics	Winnipeg 110.02	Winnipeg 110.03	Winnipeg 111	Winnipeg 112.01	Winnipeg 112.02	Winnipeg, C
1980 INCOME CHARACTERISTICS (concluded)						
Total income by sex						
Males 15 years and over with income	2,100	2,475	1,845	1,375	1,825	222,915
Under $1,000 (43)	70	70	60	25	10	6,170
$ 1,000 – $ 2,999	85	75	45	70	70	9,025
3,000 – 4,999	40	85	55	40	55	8,365
5,000 – 6,999	70	60	55	40	50	8,850
7,000 – 9,999	130	70	65	55	90	14,170
10,000 – 14,999	185	100	160	125	210	24,085
15,000 – 19,999	115	145	110	200	250	21,245
20,000 – 24,999	105	180	155	160	110	22,340
25,000 – 29,999	135	165	185	110	215	21,570
30,000 – 39,999	325	470	425	245	405	38,590
40,000 – 49,999	325	380	310	170	190	22,365
50,000 and over	495	660	220	140	160	26,130
Average income (44) $	35,756	39,049	30,503	27,034	27,104	28,154
Median income (44) $	32,927	35,825	30,718	23,508	26,547	24,177
Standard error of average income $	1,444	1,324	963	1,025	802	140
Females 15 years and over with income ..	2,080	2,465	1,850	1,280	1,890	232,030
Under $1,000 (43)	70	115	90	65	65	10,135
$ 1,000 – $ 2,999	145	190	115	100	85	14,425
3,000 – 4,999	120	180	155	105	140	14,495
5,000 – 6,999	130	65	95	105	65	15,225
7,000 – 9,999	220	205	205	125	245	27,235
10,000 – 14,999	245	250	290	160	420	42,650
15,000 – 19,999	275	375	310	175	290	30,215
20,000 – 24,999	245	230	215	150	240	24,490
25,000 – 29,999	190	190	135	125	150	17,840
30,000 – 39,999	215	360	130	135	120	20,035
40,000 – 49,999	120	175	85	15	60	9,240
50,000 and over	115	120	25	15	15	6,040
Average income (44) $	20,454	21,026	16,585	15,720	16,058	17,247
Median income (44) $	16,920	17,963	14,880	13,917	13,936	13,743
Standard error of average income $	961	723	602	666	507	68
Family income – All census families	1,575	1,900	1,385	1,025	1,430	162,670
Under $10,000	25	25	20	50	45	8,885
$10,000 – $19,999	55	70	55	65	100	16,395
20,000 – 29,999	105	105	90	145	195	21,350
30,000 – 39,999	185	135	215	195	275	24,965
40,000 – 49,999	165	180	275	155	260	24,655
50,000 – 59,999	175	300	210	125	190	21,325
60,000 – 69,999	250	265	180	100	155	14,755
70,000 and over	610	810	340	190	200	30,325
Average income $	67,811	70,841	55,166	47,907	46,238	49,301
Median income $	62,610	63,758	52,245	44,596	43,627	43,807
Standard error of average income $	2,043	2,050	1,415	1,700	1,226	217
Incidence of low income (45)						
All economic families	1,585	1,910	1,380	1,055	1,460	165,700
Low income economic families	95	90	90	170	170	28,825
Incidence of low income (46) %	6.0	4.6	6.4	16.1	11.7	17.4
All unattached individuals	295	420	370	285	565	90,645
Low income unattached individuals	70	100	115	105	235	39,250
Incidence of low income (46) %	23.7	24.6	31.1	36.1	41.1	43.3
Total population in private households	5,525	6,880	4,695	3,515	4,975	601,780
Persons in low income family units	355	380	385	640	725	127,225
Incidence of low income (46) %	6.4	5.2	8.2	18.2	14.6	21.1
Household income – All private households .	1,810	2,245	1,680	1,270	1,915	241,165
Under $10,000	30	55	30	80	105	23,145
$10,000 – $14,999	35	30	85	45	145	20,955
15,000 – 19,999	65	85	90	115	85	18,545
20,000 – 29,999	180	170	180	165	350	36,545
30,000 – 39,999	205	200	190	220	335	34,590
40,000 – 49,999	210	255	295	170	270	31,045
50,000 – 59,999	210	335	230	160	195	24,885
60,000 – 69,999	280	260	200	100	185	16,815
70,000 and over	635	840	380	210	235	34,640
Average income $	64,858	65,722	51,492	44,859	41,584	42,208
Median income $	59,841	59,495	48,967	40,430	37,977	36,007
Standard error of average income $	2,077	1,874	1,351	1,549	1,127	163