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Towards Sustainability: Redesigning Public Greenspace in an Existing Suburb in Winnipeg, Canada, Using Naturalization Techniques

BY

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MASTER OF LANDSCAPE ARCHITECTURE

Abstract

This practicum explores the principles and techniques of naturalization and their connection to the concept of sustainability. Naturalization techniques are applied in the redesign of public greenspace in an existing suburb in Winnipeg, Canada. The general issue of public perceptions of conventional versus naturalized greenspace are explored. Through previously conducted surveys, the opinions of residents of the study site are analyzed, and it is concluded that there is potential public support for a naturalization project. A naturalization plan has been designed for the study site, and an accompanying cost analysis has been calculated. Though installation and short-term maintenance costs for the project are high, maintenance costs over the long run are lower than those for a conventionally maintained landscape; the project will eventually pay for its installation costs through decreased management costs. Community participation is essential in the implementation of the plan, in that capital costs of installation can be reduced and hence recouped more quickly by the reduced maintenance regime. Community participation also contributes to the acceptance of naturalization as a viable alternative to conventional suburban landscaping. The study proves that naturalization can contribute towards a more sustainable suburban landscape, in ecological, economic and educational terms.

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Dedicated to David M. Shearer.

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1) Introduction

1.1) Sustainable Development

The concept of sustainable development has been discussed extensively since it was defined by the United Nations World Commission on Environment and Development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." (U.N.W.C.E.D., 1987: 43). To be sustainable, development cannot deplete resources to the point that there will be a scarcity or, worse, no resources left:

> "Sustainability implies that the use of energy and materials in an urban area be in balance with what the region can supply continuously through natural processes such as photosynthesis, biological decomposition and the biological processes that support life" (Calthorpe and Van der Ryn, 1986: ix).

A study of a typical Canadian residential subdivision reveals the necessity for a more sustainable approach to landscape design. Suburban greenspace is dependent upon high levels of maintenance and energy input—including continual mowing, watering, and chemical treatment. The energy and labour required to maintain such greenspace translate into high financial costs. In the current context of shrinking governmental budgets, such a landscape is fast becoming an unsustainable amenity—in economic as well as environmental terms. A potential solution to the problem lies in the employment of naturalization principles and techniques in retrofit design.

1.2) Definitions of Terms[1]

This study will focus on redesigning suburban public greenspace through naturalization, with the aim of creating more sustainable greenspace. It is intended that the conclusions and solutions reached be viewed as components of a larger, global effort to achieve greater sustainability.

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1 Please see the Glossary for a list of definitions of terms used in this study.

1.2.1) Sustainable Greenspace

Sustainable greenspace is defined, for the purposes of this study, as open space that has increased capacity over conventional open space to maintain and regenerate itself with minimized energy input, adverse effects on the larger environment, and economic cost, in which the cycle of nutrients is ideally closed and self-sufficient, given a constant supply of solar energy. (Hough, 1984; Van der Ryn and Calthorpe, 1986).

1.2.2) Naturalization

Naturalization is defined as an approach to landscape design and management that aims to introduce and encourage self-sustaining plant communities, through the use of both native and non-native plants. Naturalization also involves designing the landscape to fit human uses and needs as well as to achieve greater sustainability. This approach accepts, employs and celebrates natural communities and processes in design, rather than restricting or eliminating them (Howell, 1986: 13; Cairns, 1988: 66).

1.3) Sustainability and Naturalization

What ultimately sustains itself best in an ecosystem is that which is native or best suited to its environment (Bradshaw, 1986). Thus naturalization is a design approach that embodies the principles of sustainability; plant groupings are chosen that are best suited to regional and site conditions. Naturalization requires understanding and working with ecological inter-relationships—including those between humans and our surroundings—in design and management.

The typical suburban site is highly modified from its natural state—its topography, soils and biotic communities have been substantially altered. Consequently, along with native flora, non-native plant species may have self-sustaining attributes in such modified conditions. As will be discussed later, naturalization as defined in this study involves using plant communities, whether they are native or non-native, that are most appropriate for a particular site.

Naturalization can contribute to the achievement of sustainability in a number of ways. One is through what Michael Hough (1984) calls the principle of "Economy of Means:" maximum benefit is to be obtained from minimum effort, resources and energy.

The more efficient the process, the more assured the long-term viability of the system. Plant species that are selected to fit the site conditions, once they have become established, can thrive without excessive input of energy, water and resources. The nutrients they require are essentially contained within a closed, self-sustaining system, given a constant supply of solar energy. In a typical turfed greenspace, nutrients are removed in the form of mowed, raked or pruned organic matter and typically replaced by inorganic fertilizers brought from off the site. In contrast to this highly manipulated system, a naturalized greenspace has as its model the natural ecosystem:

> "From the fixation of carbon and nitrogen and the extraction of nutrients in soil through to the main distribution pathways of herbivores, predators and decomposers, the time that nutrients are retained within the [natural] system is maximized while losses are minimized." (Lefroy et al, 1993).

Economy of Means implies adopting more efficient, less costly practices of landscape management and consumption habits. To this end, naturalization lessens the need for human input of fertilizers, herbicides, and pesticides.

A naturalized open space design can yield economically sustainable results through fewer long-term maintenance needs. Various studies have demonstrated that, although the initial cost of implementing naturalization projects may be greater than those associated with conventional open space, reduced need for conventional maintenance and energy input make them more cost-efficient in the long run (Scott et al., 1986: 150, Granger, 1990: 108).

Naturalization allows for greater plant species diversity than do conventional landscapes, since it departs from static specimen planting and encourages ecological dynamics and succession. Diversity improves the ability of a community to persist through various stresses (Lefroy et al, 1993). While some plant species succumb to stress, others will thrive in their places. When conditions change over the long term, different species adapted to the new conditions will succeed species that have not been able to adapt. Such a community is inherently more sustainable than the typical suburban landscape consisting predominantly of specimen trees and turf, within which the demise of any of the plant components necessitates human intervention in order to perpetuate the intended form and character of the landscape. Naturalized spaces also provide more wildlife habitat than conventional turfed greenspace does (Hough, 1984).

Naturalization has merits that go beyond empirical sustainability. Ecological diversity, for example, can lead to related qualitative advantages; its associated visual and spatial variety can add to the aesthetic appeal of a built environment. Another positive aspect of naturalization is its educational value. It has been demonstrated that regular contact with nature or more "natural" landscapes is an important factor in the healthy development of children: "To develop a close association with the natural environment, children...require areas where they can experience aspects of the natural world as an integral and unquestioned part of their daily life and physical environment." (Jansson, 1984). Implementing a naturalization scheme for neighbourhood open space can also contribute to the well-being of a community. An atmosphere of shared purpose can result from resident participation in the installation and management of the naturalized landscape. Maintaining a naturalized environment lends itself to communal effort more than does mowing expanses of turf in conventional open space (Scott, 1986: 217).

Environmental education is an essential step towards a more sustainable society. The most effective way to raise environmental awareness is to provide immediate opportunities for people to observe natural processes in their own neighbourhood—opportunities afforded by naturalized spaces, but rarely by highly controlled conventional green space (Jansson, 1984; Baines, 1990). A naturalized landscape can also provide an alternative to the generic placelessness of many suburban environments. The plant forms and associations in a naturalized landscape, that are peculiar to the site or the region, can contribute to a neighbourhood's sense of identity and pride.

1.4) Objectives

The study will have the following objectives:

– to outline the principles and techniques of naturalization, based upon a review of literature and precedents;

- to determine what sorts of naturalization techniques would be appropriate for the proposed study site, Morley R. Kare Park, in the neighbourhood of Lakeside Meadows in Winnipeg, Manitoba;

– to find out the opinions of residents of the site regarding naturalization, through researching previously conducted resident surveys;

– to design a naturalization plan for the study site, that increases the sustainability of the site, fits community needs and desires, and complements the existing site amenities and facilities;

– to examine the costs of naturalization and, by comparing them with existing maintenance costs for the site, to determine whether there is a long-term economical advantage offered by naturalization.

2) The Suburban Context

Suburbia embodies the conventional North American landscape ideal of manicured lawns and specimen trees. In older, more urban neighbourhoods closer to the centres of Canadian cities, there is often more of a laissez-faire ethic in the treatment of greenspace that allows for naturalization to occur on its own. Perhaps because of the age of these older neighbourhoods, perhaps because of a gradual decrease in "vigilance," they contain occasional wild patches, where nature has reclaimed portions of yards, parks and empty lots. Suburbia, on the other hand, except where interrupted by houses, roads and parking lots, is a continuous green carpet laid over the natural landscape. In Winnipeg, much of the landscape that was eventually developed for suburban housing was first tilled into agricultural land. In this sense, many suburban tracts in prairie cities are twice removed from their original state.

2.1) The Economics of the Conventional Landscape

The suburbs were originally intended to offer the modernity and convenience of city living set in the natural world of the country. Now, they are typically far-removed from nature, the "wild" element within them greatly diminished and simplified. Today's suburbs no longer represent the pastoral ideals of Howard, Perry, and Stein and Wright—the planners and designers of the late 19th and early 20th century who sought alternatives to urban congestion and deficiency of greenspace through their garden cities and suburbias. Open space in the suburbs has become standardized along with the rest of suburban built form—street patterns, housing, individual yard space—to facilitate rapid, inexpensive development of neighbourhoods. The close-clipped public open space of suburbia has become an unquestioned convention, accepted by developers, municipalities, homeowners and homebuyers as the least expensive option for providing public greenspace. Yet it has become apparent that, in fact, conventional greenspace *is* costly. The maintenance of such space is becoming harder to justify as municipal moneys grow scarce and as the ecological costs to the site and to the greater environment become more apparent.

Those who attempt to change landscape conventions, however, have to deal with the fact that there is a formidable economy centred around the installation and maintenance of conventional open space. Since the turn of the century, a huge landscaping and maintenance industry has arisen to supply the specimen shrubs, acres of sod, lawnmowers, pesticides and fertilizers that are necessary to maintain the conventional landscape. In lawn-care alone, a $25 billion-a-year industry has sprung up to service the estimated 25 million acres of lawn in the United States. Turfgrass has become so common that, by one estimate, it is the number one "crop" in the United States by area (Bormann et al., 1993: 62, 64, 87). Fertilizer producers, faced with a stagnated agricultural demand, have increasingly turned their attention towards lawn care. Although by weight only five to ten percent of fertilizer produced in the United States is used on lawns, that amount accounts for 25 percent of producers' profits (Bormann et al., 1993: 70). The size of the yard-care industry contributes to its success; economy of scale makes products affordable and accessible for most households. But the main reason behind the continued success of the industry is the lack of interest in—and understanding of—the concept of sustainable greenspace. Conventional greenspace requires continual mowing, fertilizing, weeding and pest removal; this battle against natural processes fuels a perpetual demand for products. In contrast to this, the goal of the naturalized landscape is to eventually reduce such maintenance needs, and product consumption, as much as possible.

2.2) Prevailing Attitudes Towards Greenspace

In 1870, an American named Frank J. Scott published a treatise on the burgeoning trend of "suburban home embellishment," entitled *The Art of Beautifying Suburban Home Grounds*. In it, he gave a description of the perfect lawn that foreshadowed what was to become the prevailing philosophy of suburban open space in the twentieth century: "A smooth, closely shaven surface of grass is by far the most essential element of beauty on the grounds of a suburban house." (Pollan, 1989: 41). In his 1894 book *The Wild Gardener*, William Robinson asked if there was not an alternative vision of beauty, that bore more of a resemblance to a natural landscape: "Who would not rather see the grass with countless flowers than a close surface without a blossom?" (Hoeppner, 1987: 72). It was Scott's vision, not Robinson's, that was to become the norm. Thus the most contentious issue raised by naturalization today is public perception—how people react to a departure from the norm.

Conventional wisdom holds that nature has little role to play in the city. The occasional appearance of "wildness" is looked upon as a lapse in maintenance—an eyesore to be cleaned up. A developer, designer or homeowner who tries to implement a naturalization plan in a typical suburb is likely to be met with skepticism from many of the neighbourhood's residents. University of Manitoba professor Charlie Thomsen drew such a response when he decided to transform his suburban yard in Winnipeg's Waverley Heights into a "'wild landscape'—a landscape that was more reflective of the region's character and more responsive to local climatic conditions." The reactions ranged from one hopeful neighbour leaving a lawn mower in Thomsen's front yard, to others referring to the yard as a "weed patch." The strongest blow occurred after the Thomsen family moved from the neighbourhood. The subsequent owner of the property replaced the natural shrubs and groundcover with standard bluegrass sod, and eventually removed the native trees as well, after their health had deteriorated in the absence of the naturalized site conditions (Thomsen, 1991: 37-38).

In the context of the status quo, it is difficult for suburbanites to envision an alternative landscape, let alone create one. William Perks of the University of Calgary has observed that there is typically a stand-off between the residential development industry and proponents of naturalization and other alternatives for open space design. The industry defends its developments by making the not unreasonable claim that it is merely providing what homebuyers want, and cannot risk providing what they possibly will *not* want. But the only frame of reference that the typical homeowner or buyer has is the conventionally designed landscapes found in every Canadian city; they have few images of the possible choices (Rollans, 1993). Clearly, if naturalization is to become a viable alternative, its virtues will have to be explained—along with the environmental and economic costs of the conventional landscape—through public education.

As well as the economic and environmental advantages of naturalization, its qualitative merits can be a selling point as well. Many of its proponents have cited its aesthetic potential for reinvigorating the often monotonous built landscape, by increasing the presence of nature in the city:

> "It is an attempt to make use of nature's intriguing life-forms, of its wildness, mystery and irrationality to counteract the physical rigidness of [sub-]urban form and its containing, highly controlled and organized life. Furthermore, it is an attempt to bring people again closer to the disappearing phenomena of the natural world" (Jansson, 1984: 31).

Two local examples illustrate the importance of informing and educating the public about naturalization programs. When the City of Winnipeg decided to decrease the frequency of mowing on a stretch of the Bishop Grandin Boulevard right-of-way, no attempt was made to inform the public that it was a cost-saving measure, and that a "wild" look was arguably more appropriate for such a large, isolated tract of land. The result was that the Parks and Recreation Department received hundreds of complaints from people who thought that it had simply not bothered to mow the corridor (Nielson, pers. comm., 1994).

In the other example, the City put into effect a small-scale naturalization project in an area near the main entrance to La Barrière Park, which is located just south of the city limits. A stand of bur oaks was under stress caused by regular mowing and compaction. The City decided to simply stop mowing the lawn, which consists of a standard mix of Kentucky bluegrass and creeping red fescue, in the entire area. But at the same time it installed interpretive signs explaining why mowing had been ceased—to save the oaks and to save money. The Parks and Recreation Department has not received a single complaint about the new maintenance policy. The difference in the magnitude of reaction is no doubt partly due to the fact that the Bishop Grandin site is seen by many more people than the La Barrière Park site, and also that Bishop Grandin Boulevard is within city limits and is thus perceived as a more "urban" site. Yet the difference between hundreds of calls and none at all is notable. City of Winnipeg naturalist Cheryl Nielson, who was involved with both projects, argues that this difference can be attributed mainly to the interpretive signage (pers. comm., 1994).

It is not just the general public that has to be well-informed about the concept of naturalization. If conventional techniques are used in the installation or management of a landscape that was intended to be naturalized, the project will likely fail. Successful projects have in common an informed management crew, whether it consists of volunteers or paid staff. In Massachusetts, a program was instituted in 1980's to encourage the growth of wildfowers on highway rights-of-way, in order to enhance the visual appeal of state highways and also to save on maintenance costs. The highway maintenance personnel were wary of the new strategy at first; they reportedly looked upon mowing "as a religious experience." But through retraining, they learned to use their mowers as a "creative tool," mowing selectively to reveal and enhance stands of wildflowers and grasses. Once the personnel were on-side, the project began to achieve successful results (Ahern and Smith, 1993: 165-166). The importance of informing as well as consulting with maintenance staff is stressed in a 1987 National Capital Commission report on naturalization in the Ottawa region:

> "A strong recommendation of this report, therefore, is that a series of seminars be initiated with mowing machine operators. If possible, these seminars should begin prior to the spring season and continue on into the summer to solicit their comments on the practicality of the alternatives and suggestions for others" (*Urban Veg.*, 1987: 16).

3) Naturalization: A Design Strategy

3.1) Conceptual Framework

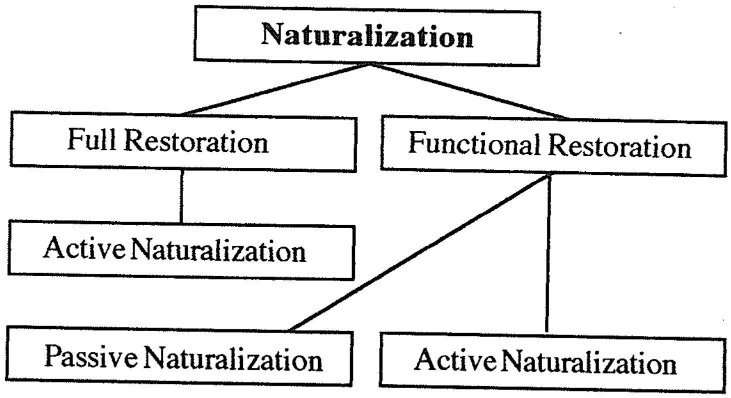

Figure 3.1: Approaches to Naturalization

The term "naturalization" is used to mean a variety of things (See Fig. 3.1). In a strictly ecological sense, it refers to what Cairns (1988: 66) calls "full restoration:" the attempt to restore a landscape to its pre-disturbed, natural state, as faithfully as possible. This approach places value in the original condition of a site, and implies that substantial human alterations to the landscape are "unnatural." Full restoration is valuable since, if a certain type of ecosystem is endangered, its survival will either depend upon the protection of remaining undeveloped patches or on attempts at full restoration of degraded sites. It is more achievable in some cases than others, as when the site in question has not undergone severe degradation and still retains much of its original make-up.

Full restoration, however, is often not the best naturalization approach. Most sites have been so drastically altered that it would be next to impossible to return them to their pre-development state. Lack of availability of native species, persistence of invasive non-native species, lack of complete knowledge of the pre-disturbed community and permanently altered abiotic elements such as soil and topography are some of the obstacles that can render full restoration difficult (Gorski, 1984: 39). As well, since it is often a slow and arduous task, the public that has a stake in the project can lose patience and confidence, which would pose a problem on a residential site (Cairns, 1988: 66).

Some proponents of full restoration assume that all human actions are unnatural phenomena. But if humans are viewed as *part of* nature, then sites modified by human settlement are no more unnatural than, for instance, a stretch of river that has been dammed by beavers. O.L. Gilbert (1989: 4 and 9) takes this opposite view on human settlement.

He holds that there is no innate value in either "natural" (i.e. untouched by humans) or urban environments; they are merely different. Gilbert argues that the bias of many ecologists against built-up environments has led to the dearth of research on the ecology of urban habitats.

Between the two points of view is an approach that could be termed "functional restoration," which places value in natural environments and recognizes the damage human activities can do to them, but at the same time accepts human alterations as inevitable. In this pragmatic approach to naturalization, the aim is that a site should function as an ecosystem with self-sustaining ability and diversity *similar* to its previous natural state: "...the presence or absence of a particular species is less important than the provision of functions and processes such as nutrient cycling, erosion control, or biomass production" (Howell, 1986: 13). The main criterion here is that the naturalized site has enough stability to require little management, whether that stability is attained with all native plants or with some non-native plants. Ideally, it should be as self-sustaining as a natural ecosystem (Cairns, 1988: 66).

In this approach, a range of degrees of "restoration"—the creation of pseudo-natural conditions—can be included under the category of naturalization. When exotic species are present on a site, the question of whether or not the site is successfully naturalized depends largely upon how aggressive the introduced plant species are, and how badly the native community is disrupted or simplified by their presence (Cohlmeyer, 1977: 64). Thus sites supporting monocultures of Canada thistle or purple loosestrife should not rightly be considered properly naturalized, because they lack diversity and hence long-term sustainability. But a grassland site that, because of human settlement, contains Kentucky bluegrass among an established community of native grasses and forbs can be considered successfully naturalized, as long as the community has the vigour to keep the bluegrass in check.

Functional restoration is arguably the best route towards economic sustainability. In full restoration, recreating the original soil conditions and topography, ridding the site of non-native species, and keeping the site completely exotic-free is labour intensive and expensive. Since the installation costs of naturalization can be higher than those for conventional landscapes to begin with, the functional approach to site preparation and non-native species makes more sense, since it involves lower capital costs than the full restoration approach. The more money saved in installation costs, the sooner those costs will be recouped through low maintenance requirements.

3.2) Design Considerations

3.2.1) Balancing Conventional and Naturalized Public Greenspace

It is not being suggested in this study that naturalization should be applied indiscriminately to every existing open space. There is obviously a need, for instance, for maintained turf in suburban public greenspace; its resilience makes it well-suited for various leisure activities ranging from picnics to outdoor sports.

Ideally, there should be a variety of landscapes—conventional, formal, natural, naturalized—that provide suburbanites with a range of choices. Part of designing with naturalization is aiming for greater diversity; this can be applied to landscape typology as well as to ecosystems. But to achieve this, it must be recognized that there is a large imbalance in suburbia—a preponderance of conventional, turfed greenspace. Naturalization is a design alternative that can introduce a more natural, sustainable type of open space into the mix.

Achieving variety in the suburban landscape need not only apply on a park-to-park level. Within each open space, the design of the landscape can be more than either naturalized *or* conventional. Naturalization can add character and variety to an individual landscape, contributing to a spectrum ranging from mowed turf at one end to fully naturalized areas at the other.

3.2.2) Design Guidelines

The intended final form of a conventional landscape is usually apparent as soon as the design has been implemented, and more often than not, its appearance is what most people expected. A naturalization site, however, is a more dynamic entity, and thus may look quite different depending on what stage it is at in its development. Add to this the fact that it is not what most people expect in a suburban context, and it is apparent that certain design decisions must be taken to ensure that, from the start, the project has the appearance of a worthwhile and purposeful undertaking. The following are several design guidelines intended to aid in these decisions, including those suggested by Hough and Barrett (1987: 101-102):

1. A naturalization plan in an existing residential greenspace must complement, rather than replace the facilities and amenities already on the site. Naturalization is

an unproven concept to many; therefore, it cannot be perceived as taking anything important away from the existing site if it is to be accepted by a community.

2. Where naturalized areas abut private residential property, the border between the two must be designed to meet the desires of the yard owners. One approach is to create a buffer strip of maintained turf. This ensures that homeowners who prefer the conventional landscape design of their own yards are bordered comfortably by more of the same (Urban Veg., 1987: 3). Another approach is to plant lines or strips of trees on the public side of the property line, to screen private yards from the public space.

3. Edges of naturalized areas must be well-maintained. Normally this involves regular mowing of turf adjacent to the edges of wild areas. This eliminates the perception of neglect by lending a purposeful look to the project, and reduces the potential for garbage collecting in the borders of wild areas (Hough and Barrett, 1987: 101). Maintained edges also set off naturalized areas as visually distinct from areas of mown turf—such as pathways and recreational fields— eliminating ambiguity as to which areas are for circulation and recreation, and which are not (Hough, Wong et al., 1989: 57). Consideration should also be given to the visual appeal of tree and shrub species at the edges of naturalized areas.

4. Since several years may pass before naturalized areas are fully established, elements of the design should create a purposeful, "complete" appearance for the site immediately following installation, to maintain the confidence and patience of the public. These may include planting of a few large standard trees with immediate spatial and visual impact, or planting forbs with attractive flowers or foliage in areas of high visibility, such as along pathways. (Ahern and Smith, 1993: 167).

5. Structural elements should be incorporated into the design. This can be accomplished through the use of pathways, benches or signage. Discernible structure will offset the "wilder" elements and will contribute to the project's appearance of purposefulness.

6. There should be a variety of plants and plant associations used depending on site conditions. Besides increasing the likelihood of the ecological success of the project, this also has positive aesthetic effects. Naturalized areas can win over the

public by offering a more visually and spatially diverse landscape than is typical of the suburbs. Variety of colours, shapes and textures, as well as the associated seasonal changes, can provide a dynamic that is less apparent in the more static conventional landscape (Hough and Barrett, 1987: 102).

Any naturalization project that is intended as public greenspace has to be designed to provide the easiest and fullest access to naturalized areas as is possible , in order for users to get the full benefit of closer contact with nature. In order to do this, existing regulations for conventional park use have to be re-evaluated. This is particularly true with respect to the retention pond at the centre of the study site. Existing City of Winnipeg regulations for residential retention ponds stipulate that there is to be no primary recreational contact with the water (swimming, for example), primarily because of safety concerns. Secondary contact, like boating, is permitted, but not encouraged. In designing a naturalization plan for the pond, such regulations that discourage people from being anywhere near the water will have to be re-examined.

3.2.3) Crime and Vandalism

Personal safety must be taken into account when designing public open space in a residential area. The theory of defensible space holds that crime and vandalism can be minimized, firstly, by a perception of territory that moves people to take responsibility for monitoring and caring for a public space, and, secondly, by the ability of users of a space to comfortably monitor their surroundings. If residents have a sense of collective ownership over an outdoor area, they will look out for potential trouble, and would-be troublemakers will decide that the risk of being caught is too high. People will feel safer in the area if they have sight-lines to exit points, and if they feel that the risk of danger is low (Newman, 1973).

The study site selected for this practicum has the advantage of being a community park surrounded by its neighbourhood. It is safe to assume that residents feel a stronger territorial claim over it than they would if the site was on the edge of the community, bordered a busy commercial thoroughfare, an industrial area, or some other land-use that attracted people from outside the neighbourhood. Resident participation in activities such as tree-plantings, as well as interest generated by an effective public education program, could only strengthen the feeling of community ownership of the park. Besides this sense of community ownership, the fact that the park does not attract crowds of people from many parts of the city means that, on the whole, it is probably a safer place than, for instance, the Forks National Park in downtown Winnipeg.

Since naturalization introduces a "wild" element into an otherwise closely-clipped landscape, it is important to maintain the edges of naturalization areas (as recommended in section 3.2.2) to avoid unkempt appearances. If areas are perceived as derelict, residents may avoid them and, unmonitored, they could become potential sites for trouble.

Naturalized areas, particularly wooded ones, are often more closed-in because of the presence of shrub canopies and groundcovers of various heights. Such areas may provide fewer sight-lines and hence may cause a sense of apprehension, particularly at night. Such wildness is permissible in, for instance, a provincial park in a non-urban area, where people visit with the understanding that they have left behind some of the amenities and security of the city. But in a suburban environment, there is a greater expectation that the landscape should be perceived as being safe. Good design will reach a successful compromise between the benefits of naturalization and safety concerns. The following guidelines for design and management are suggested by Hough and Barrett (1987: 106-108):

1. Circulation and activity areas should have clear physical and visual linkage to the outside of the public open space, and the interior of the space should be monitorable from points on its perimeter;

2. For the most part, dense plantings should be set back from paths;

3. Adequate night-lighting of circulation and activity areas should be provided, and areas not meant for regular use, such as the middle of a woodland area, should remain unlit to deter people from entering after dark;

4. In areas where clear sight-lines are deemed essential, naturalized areas should feature low plants or open plantings (see "Tree Plantations" in Section 4.4.1), to accommodate views.

5. Aspects of the site that are potentially appealing to vandals—such as interpretive signage and new plantings—should be checked regularly to ensure that any vandalism is quickly repaired. Vandalized areas and objects attract further vandalism.

Part of the appeal of naturalization is that it can instill a level of variety, spontaneity and uniqueness into the often very predictable suburban environment. The challenge is to successfully incorporate these elements into the existing landscape, without creating an environment in which few people feel safe, and without tidying up naturalized areas to the point that they differ little from the traditional landscape. It should be stated here that no design can create a completely risk-free public greenspace, since designers cannot eliminate the undesirable elements of human behaviour. Common sense must be exercised by users of a space in order to avoid potentially dangerous situations (Hough and Barrett, 1987: 107).

3.2.4) Wildlife

There is the perception that wildlife in residential areas is an undesirable thing. Animals like rodents and raccoons are acceptable in a "wild" environment like a provincial or wilderness park, but are viewed as pests when they are found near people's homes. The public education that must accompany any naturalization program should include learning about the associated fauna. Wildlife admittedly can have detrimental effects; plantings, for instance—whether in a conventional or naturalized landscape—can be damaged by rodent browsing. But the negative attitudes towards wildlife stemming from the perceived necessity for control over nature can and should be discussed within the context of educating people about naturalization. The fact that much "desirable" wildlife is attracted by naturalized areas is already well-known. In southwestern Ontario, for instance, studies undertaken at Carleton University have shown that replacing mown turf with meadow and woodland results in a dramatic increase in songbird species diversity over introduced species, like European starling and house sparrow, that normally dominate species-poor urban areas (*Urban Veg.*, 1987: 20).

4) Naturalization: Implementation and Management

As opposed to the standardized and industrialized methods for installing conventional greenspace, naturalization techniques are inherently specific to the region and site at hand. They will differ according to climate, region, and microclimatic site conditions. Therefore it is difficult to come up with standardized procedures, since from case to case, there are variations in each stage of the process. Nevertheless, a naturalization strategy for the study site can be derived from examining precedents, as long as regional and site differences are taken into account. In this section, naturalization will be discussed in the context of three general "landscape types:" Open, Woodland, and Wetland Areas. As will be seen, naturalization techniques differ depending on which landscape type is the desired result of the project.

Under the umbrella of functional restoration, there are two categories of naturalization: passive and active. In passive naturalization, no intentional planting or seeding is done; flora on a site are allowed to grow through fortuitous seeding and self-propagation. As was previously discussed, passive naturalization is being practiced in La Barrière Park.[2] With this approach, it is possible to generate a meadow of grasses and forbs from standard bluegrass turf, if a high proportion of native species is not an immediate goal. It is the cheapest naturalization technique, since "installation" typically requires little more than discontinuing mowing or reducing mowing frequency; its success, however, varies according to site conditions and depends upon what the desired results are.

Active naturalization involves ground preparation and planting or seeding of appropriate species. It produces results in less time than does passive naturalization—an important consideration, since the people who use the site are typically anxious to see rapid results. Active naturalization areas are more costly to install than passive areas.

4.1) Natural Context: the Ecology of the Aspen Parkland

The vast majority of the area that was once occupied by aspen parkland has been developed into agriculture and urban areas during the last 150 years. The aspen parkland was a transition zone between the great plains of central North America and the coniferous forest of the Pre-Cambrian Shield. The southern boundary of this area runs from the north-western corner of Minnesota north-westward through southern Manitoba and central

2 Hough, Peruma et al. (1982: 26) refer to this approach as "natural regeneration," in the context of woodland naturalization.

Saskatchewan and Alberta. It is bounded on the north by the edge of the spruce and jack pine boreal forests of the northern prairie provinces (Bird, 1961).

Aspen parkland contains two major plant communities—aspen forest and prairie—which are interspersed with each other in a state of tension. A number of factors determine whether the forest advances on the grassland, or vice versa. Historically, the prairie encroached into forested areas when the woody plants were killed off by drought conditions, wildfire, or browsing and trampling by large herbivores. In wetter periods, wildfire was less common, and the forest often advanced on the prairie. These conditions were greatly altered by European settlement, when fires were checked and prairie was converted to agricultural use. Generally speaking, where aspen parkland still exists in southern Manitoba, grassland tends to dominate in drier locations, while aspen forest occurs in depressions and on north and east-facing slopes, where there is more available moisture (Bird, 1961).

Forests in aspen parkland are dominated by stands of trembling aspen. Communities of shrubs and forbs are found around their edges, where the transition into grassland occurs. In the southeast portion of the aspen parkland, including southern Manitoba, aspen-oak forest occurs on well-drained sites, with bur oak as a climax tree species (Cohlmeyer, 1977: 9). On floodplains and in river valleys, riparian forest communities occur, which include Manitoba maple, green ash, American elm, and bur oak, as well as riparian shrub and herb species (Bird, 1961). Grasslands in aspen parkland can be classified in three main types: fescue prairie, mixed prairie and tall grass prairie. Although all three were found at one time within Manitoba, the most common type of grassland remaining within the Red River Valley is tall grass prairie (Cohlmeyer, 1977: 28-31). Representative plant species of the forests and grasslands of the aspen parkland are included in Tables 1.1 and 1.2 in Appendix 1.

4.2) Open Areas

4.2.1) Types of Open Communities

The best-known open plant community in suburban greenspace is the turfgrass lawn. Whatever the extent of the naturalization project, some lawn is usually necessary, for a variety of uses ranging from sports fields and passive recreational sites to mown margins bordering roads, private yards or planting beds. But there are other possibilities for open communities, where openness is necessary but mown turf is not. Such conditions exist where openness may be needed to maintain important sight lines, to ensure that parts of the site are perceived as safe and comfortable, or to provide spatial and aesthetic contrast to areas with denser vegetation.

Prairie restoration expert Doug Collicutt (pers. comm., 1994) identifies two types of open communities. "Prairie" is defined as original or authentic grassland that supports vegetation which is native to the site or region, while "grassland" is defined as a generic term referring to any open area supporting grasses, native and/or non-native. He defines "restoration" as the attempt to establish prairie, or native vegetation in general, on a site where it has been wiped out (what Cairns refers to as "full restoration"). The definitions of these terms will be used in this study, with the exception that "meadow" will be used instead of "grassland," as the generic term referring to any open area supporting grasses, native and/or non-native, that is mowed less frequently than a typical suburban lawn[3].

On the study site, full restoration would be the necessary route towards creating a piece of the prairie, since the natural site conditions have been all but erased. This involves active naturalization through ground preparation, seeding or planting and regular maintenance until the prairie is established. Full prairie restoration is clearly in keeping with a sustainable approach to land stewardship, in that it is an attempt to re-establish parts of an endangered native landscape. However, it is a difficult task to recreate prairie in a suburban greenspace, since the natural soil profile and topography usually have been obliterated by the complete regrading of the site and the addition of topsoil. A logical compromise is the functional restoration approach, in which the realities of the modified site conditions are taken into account in producing a self-sustaining meadow with less effort and cost.

Another reason why functional restoration is useful is that native prairie may not satisfy the aesthetic or practical conditions that are desired in a particular area of the site. Diekelmann, Howell and Harrington (1986: 242-248) have demonstrated that restoration techniques can be employed to establish a "simplified prairie" plot, for the average private yard:

> "...an approach to residential landscaping which uses native prairie species in combinations that both emulate at least some of the functions and dynamics of natural prairies and satisfy aesthetic and functional concerns."

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3 The term "meadow" has more than one meaning; its most general definition is "land in or predominantly in grass' (Merriam-Webster, 1993), but it can also refer to grassy areas occurring in regions of high rainfall, or to open areas in predominantly wooded regions (Hoepfner, 1987: 64).

On a site large enough to accommodate several large areas of open communities (as well as some mown turf), the majority of the site could be slated for passive and active naturalization into meadow, while full prairie restoration could be attempted in one "showcase" prairie plot. The extra effort would be justified by the educational opportunities afforded by an area of restored native prairie. In time such an area could also serve as a seed source for naturalizing other local areas. Whether or not producing a prairie is the goal, it is worthwhile examining prairie restoration and management techniques for potential applications to less rigourous types of open community naturalization.

4.2.2) Ground Preparation

i) Prairie

In order to generate a prairie grassland from a sodded site, some degree of ground preparation is required: as much of the existing turf grasses should be eliminated as is possible, so that they will not compete with the prairie plantings. Various methods have been suggested for this. Schramm (1990: 172-174) argues that substantial ground preparation is necessary, and outlines the following procedure: after the site is plowed in the fall so that perennial grass and forb roots will be killed by winter freezing, it should be harrowed in early spring. After allowing remnant grasses and weeds to come up from the seed bank, shallow harrowing should be repeated about two weeks later to remove the emergent plants. Another interval should be allowed so more seeds can germinate, before more harrowing is done. It is important to work just the surface of the soil; deep cultivation only brings more weed seeds to the surface. This process can be repeated into early summer, when enough of the unwanted seed bank near the surface has been eliminated to render the soil essentially sterile, and seeding with prairie species can begin.

Schramm also outlines a method that includes site treatment with Roundup, a broad-spectrum herbicide.[4] Two or more weeks after the initial harrowing of the site, the

4 There is no unanimity on the use of pesticides in naturalization projects. Although some people maintain that pesticides should generally be avoided (either for environmental or public relations reasons), many others argue that they are often necessary in restoration projects, where no other method for controlling weeds is nearly as effective. Some of the more recently introduced herbicides on the market are less potentially harmful to the greater environment than others—Roundup, for example, is said to break down completely within seven days of application and leave no residue. But there are still concerns about potential health hazards of pesticides and adverse effects on the environment associated with the manufacture of pesticides. The effects of many commercially available products are still not fully known; hearings conducted in 1990 in the United States Senate revealed that 32 out of 34 major lawn care pesticides have not been fully assessed for their long-term effects on human health and the

emergent weeds are treated with Roundup, two or preferably three times. After the treatment, further cultivating or harrowing of the ground should be avoided, to prevent more weeds coming up from the seed bank. At least six days after the last treatment, the site can be seeded.

Other restorationists argue that the ground should be disturbed as little as possible. The existing sod should either be killed with herbicide or burned, without having been cultivated or harrowed, and then seeded. Leaving the site relatively undisturbed can minimize weed problems, since the soil on many sites contains a weed seed bank, and since many weeds are encouraged by soil disturbance (Armstrong, 1990: 33). Another advantage to leaving the soil undisturbed is that it allows any mycorrhyzae within the soil a better chance of surviving. Although cool season turf grasses like Kentucky bluegrass do not rely heavily on mycorrhyzal activity, they play an important role in native, warm-season grass communities (Collicutt, pers. comm., 1994).

Transparent plastic sheeting has been used in some projects through a process called solarization (Bainbridge, 1990: 96-98). The clear sheeting, when placed over a cultivated site in the summer months, causes the soil and plant material to heat to a temperature that kills most undesired plants but that spares beneficial soil organisms like earthworms and mycorrhizae. It is especially effective in suppressing unwanted cool-season grasses. Soil solarization can take as little as four weeks to eliminate all undesirable plant species. However, there are disadvantages; since the clear sheeting is uncovered, erosion can be caused by rapid precipitation runoff onto adjacent sites. As well, the exposed sheeting, and the sandbags or other heavy objects needed to secure the sheeting in the absence of mulch, may have a negative visual impact in a residential area.

It is reasonable to assume that, on a site like the study site, soil should not be added during the ground preparation stage. The addition of topsoil often brings more weed seeds, which exacerbates the problems caused by the weed seed bank in the soil already on the site (Nolan and Smith, 1992: 4). Nutrient rich soil creates ideal conditions for weedy species to flourish. If species diversity is a long-term goal, it is better to plant a prairie into relatively nutrient-poor soils. It has been demonstrated in one study that species diversity and soil quality are inversely proportional; rich soils tend to be dominated by one or a few species, while poor soils seem to provide more available niches and can thus support a wider variety of prairie plants (Piper and Gernes, 1989: 14). The entire site chosen for this

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environment (Bormann et al., 1993: 103-104). Obviously, care has to be taken if pesticides are used in a project to which the label of "sustainability" is applied.

study is covered with a layer of topsoil that was installed, as is standard, to provide a good growing medium for the turfgrass sod.[5] Adding soil would be unnecessary, since the existing topsoil is already nutrient-rich. In some situations, where the soils are very clayey, amending the soil structure by adding sand and/or straw may be appropriate (Collicutt, pers. comm., 1994).

ii) Meadows

No site preparation is required for passive naturalization of turfed areas into meadows; regular mowing is either discontinued or limited to a few cuts per season, except around the edges for the sake of appearances. Passive naturalization of turfed urban sites has been attempted in several Canadian municipalities, including Winnipeg, Edmonton and Ottawa.

Active naturalization on sites where turf species are allowed to remain has been suggested in some sources (*Urban Veg.*, 1987: 32), although there is little documentation of any results. In this approach, called "overseeding," native or non-native grass and forb species are seeded into the existing sod, with the intent of increasing species diversity by creating a mixed grassland of non-native and native species (*Urban Veg.*, 1987: 32). In some projects, seeding or planting plugs right into the existing sod with no ground preparation has been tried with success; after a few years, the native species have become established and co-exist with the lawn grass species (Armstrong, 1990: 33). Other projects have shown that some ground preparation is useful in helping the seeds become established in the dense sod of the turf species. One method is to mechanically break up the surface of the existing sod, to ensure that the new seeds have contact with the soil (Diekelmann and Schuster, 1982: 148). Another is to burn the existing sod before seeding, to provide some patches of bare ground in which the seeds can germinate. A potentially effective ground preparation method for seeding into existing turf would be to alter the mowing regime in order to change the growth habit of the turf species, in order to make conditions more favourable for seed germination. This method is discussed in Section 4.2.4.

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5 This information was supplied by the City of Winnipeg Parks and Recreation Department. As will be later discussed, no soil samples were taken from the study site.

4.2.3) Planting Procedures and Species

i) Prairie

The most common method for planting a prairie is to use native seed, which is planted most commonly with a seed-drill. If the planting area is very small, such as within a residential yard, seeds can be broadcast by hand. Planting seedlings of plants and transplanting native prairie sod have both been done with some success, but the former entails higher material costs and is more labour intensive, and the latter requires the presence of a prairie nearby, that can be used as a source for plants or seeds and that can withstand the disturbance (Deikelmann and Schuster. 1982: 145). With a seed-drill, seeds are planted in a series of rows, at a shallow depth, typically less than 1 cm beneath the surface. Although the rows may be visible for the first few years after planting, the ensuing vegetation will eventually fill in and obscure them. Making several passes with the seed drill at different angles can minimize the row effect (Collicutt, pers. comm., 1994).

Typically, both grass and forb species are seeded (either separately or together), with the specific ratio and species make-up dependent on the site and region. Seeding density is calculated and measured out in weight of seeds per unit area, although the varying size and weight of seed from species to species must be considered in the calculations. Various seeding densities have been used on different projects, but generally, the figure is usually between 15 and 55 kg/ha, or 13 and 48 lb/ acre (Betz, 1984: 181). John Morgan, of the Prairie Habitats nursery in Argyle, Manitoba, recommends 27.5 kg of grass seed and 4.4 kg of forb seed per hectare (*PrairieHabitats*, 1994: 11). Very small, lightweight seeds can be mixed with a heavy medium like bran or cracked wheat, so that they will be carried through the seed drill (Bragg and Sutherland, 1989: 82). Usually, the seed mix is prepared so that the resulting prairie will be dominated by grasses. Schramm (1990: 171) suggests that forbs should be seeded in high concentrations in some areas, to create stands of forbs scattered through the grass-dominated prairie site; he argues that this mimics a natural prairie phenomenon, in which forb species are often found in clumps.

The species of grasses and forbs seeded should obviously fit the particular microclimatic conditions of the site; a range of different communities are possible within southern Manitoba's tall-grass prairie alone, depending on, among other factors, soil type, moisture levels, aspect, slope and levels of disturbance (Cohlmeyer, 1977: 31-35). Table 1.1 in Appendix 1 includes representative grass and forb species for three general sets of tall grass prairie conditions.

In obtaining seed for native prairie restoration, it is important to find a source that is relatively near the site to be planted. Many of the species appropriate for prairie plantings in southern Manitoba have a huge range, occurring as far south in the continent as Texas. Consequently, there is significant variation between ecotypes within the same species. In a study done in Minnesota on prairie grasses from various states in the U.S., it was shown that, among varieties of big bluestem, there was a difference of approximately 50 days between the times at which samples from North Dakota and Kansas reached similar phenological stages (Olson, 1986: 222). Prairie species planted in southern Manitoba that are accustomed to different microclimatic and light conditions may not produce a successful prairie.

ii) Meadows

Manual seeding on small sites and drill-seeding on large sites is probably the best approach for turf areas in which overseeding is to be used to create a generic meadow, as it is in establishing a prairie. The main difference between overseeding existing turf to produce grassland on one hand, and attempting a full prairie restoration on the other, is the extent to which the existing vegetation is removed to accommodate the seeded species (as well as the extent of the subsequent management regime). As well, non-native species can be seeded in overseeding if they are appropriate for the intended use of the meadow. It can be useful to prepare the site with herbicide treatment or burning, even if the end product is merely a generic meadow composed of both seeded native grasses and forbs and non-native turf and/or weedy species.

In LaBarrière Park, the City of Winnipeg is experimenting with a decreased mowing regime on an acreage of open land that currently supports a vegetative cover of turf grasses and various old field species. The entire site was treated with Roundup in the spring, before a native seed mix was planted with a seed drill and tractor. The reason behind the ground preparation was not to permanently eradicate the existing vegetative cover, but to temporarily remove it to enable the seeded species to germinate without competition (Langridge, pers. comm., 1994). As will be explained in detail in section 4.3.6, if the existing species are predominantly cool-season grasses, they will out-compete the planted natives in the spring unless they are controlled. What makes this project a meadow naturalization, and not a prairie restoration, is the fact that the objective is merely to produce a meadow that is reasonably self-sustaining and visually acceptable.

Native grass species are useful in overseeding because of the variety of species available that will suit various site needs. Big bluestem is an appropriate species if the desired product is a meadow of tall grasses; blue grama, on the other hand, grows to a maximum height of only twenty centimetres. It can be useful in turf areas where no active recreation occurs, but where there is occasional traffic. Generally, shorter grasses and forbs may be more appropriate for meadow overseeding, especially if the meadow areas border high traffic areas or sports fields. Shorter vegetation is easier to walk through if it is necessary, and since there is not as much foliage, it may hold up better visually than tall grasses would if they were trampled. Non-native grasses other than the regular turf species are also potentially useful in meadow naturalization. Buffalo grass, for instance, is a short warm season grass (native to western Manitoba and the western prairie provinces), which will withstand some compaction and is also drought-tolerant, which makes it ideal for low-use, low-maintenance areas (Borland, 1986: 4.04). Species that are appropriate for meadow naturalization are included in Table 1.1 in Appendix 1. Since the existing turf grasses are not to be completely eliminated, a lower seeding density could be used in overseeding meadows, to reduce costs.

If the existing sod in a turf area is to be left intact, The grass and forb species chosen for seeding should only include species that are known to establish themselves and persist in areas of dense ground cover, whether they are native or non-native. Plantings in the City of Edmonton have demonstrated that forbs such as black-eyed susan, birdsfoot trefoil and yarrow have potential for this type of application (Nolan and Smith, 1990: 39-40). Seeding species that are not known for successfully competing with Kentucky bluegrass will likely result in failure.

Many of the species found in commercially available wildflower mixtures fall into the latter category. Even with bare soil to germinate in, many of the plants in these mixtures will not persist after the first season or two. These mixtures are designed for short term visual appeal, and are for the most part inappropriate for areas intended to have low-maintenance needs over the long-term (*Urban Veg.*, 1987: 32). Another problem with these mixtures is that they often contain more annuals and biennials than perennials.

Since, as previously mentioned, there is little literature available on overseeding turf areas to produce meadows, it is difficult to predict whether overseeding will yield results that warrant the cost of seed, as opposed to allowing turf areas to develop into meadows without seeding. In this project, both overseeded and unseeded meadows will be included, with the intention that the long-term results will indicate whether one or both of the approaches should be used for meadows in the Winnipeg region.

4.2.4) Management

i) Prairie

Regular, controlled burning is generally considered to be the most effective way to manage a native prairie, and to arrest the progress of successional woody species. A study done at on a site in southwestern Minnesota, which was severely degraded and contained much non-native vegetation, showed that annual burning increases the diversity, cover and vigour of native prairie species, and keeps invasive non-native species of cool-season grasses and broadleaf weeds in check (Becker, 1989: 163-169). Most restorationists hold that burning has to be done frequently: roughly once every two years for at least ten years, until the prairie has established itself (Schramm, 1990: 170).

Although burning has been tried at various times during the warm months on various projects, the most effective time to burn seems to be in early spring. Cool-season grasses like Kentucky bluegrass and smooth brome show bursts of growth in the spring and fall, while warm-season grasses produce the most growth during the hot part of the summer. Warm-season grasses remain largely dormant weeks after cool-season grasses have sprouted up in the spring, and return to dormancy when the cool fall weather arrives. Spring burning removes the cover of emergent cool-season grasses and litter, and allows light and heat to penetrate to the soil, encouraging growth in the warm-season plants at a time when they would otherwise be out-competed (Hulbert, 1986: 138; Borland, 1988: 4.04). The heat of the fire also increases micro-organism activity in the soil earlier in the season.

Mowing has been used as a substitute for fire if for some reason burns are not feasible. However, some studies have indicated that mowing can result in incomplete litter removal and subsequently inhibit photosynthetic productivity in prairie plants (Schramm, 1990: 170). One study showed that, on a seven year old planting of warm-season prairie grasses where both spring burning and spring mowing were done, both techniques resulted in an increase in production in the warm-season grasses, and a decrease in production in cool-season grasses. The burning, however, resulted in higher and lower production respectively than did the mowing (Diboll, 1986: 204).

Although regular burning on a restored prairie seems to be the best way to keep weedy species in check, it is difficult to predict how big a problem weeds will be on a given site, since each site is different. If there is a problem with a particularly aggressive species like Canada thistle, some spot herbicide treatment may be required.

ii) Meadows

A range of management strategies are possible for meadows, from a decrease in mowing areas of turf to controlled burning. The chief goal behind burning a prairie is to reproduce native prairie as faithfully as possible, which includes eliminating or decreasing the presence of non-native plants. Since a meadow can include non-native species, burning need not be considered as the only management tool. The main objectives behind meadow management are to prevent the dominance of aggressive weedy species, to maintain a reasonably presentable appearance that is not mistaken for neglect, and, unless passive naturalization into scrub or woodland is intended, to check advancement of successional woody species.

That being said, controlled burning is beneficial to any open plant community, whether prairie or meadow. It can serve a valuable function in terms of safety; a well-executed burn can reduce the amount of organic litter in a meadow, which reduces the chances of wildfire. If mowing is decreased in an existing turf area, some of the resultant growth will eventually fall over, and cover and kill the vegetation beneath it. A fire will clear out this debris and leave bare ground where the dead vegetation was, which opens up niches for other species to colonize. Thus fire creates conditions which encourage higher species diversity (Collicutt, pers. comm., 1994).

Persuading the public that the benefits of controlled burns outweigh the drawbacks is probably the most significant problem associated with burning grassland in a residential area. It is common to hear complaints from residents near burn sites about smoke. As well, in highly visible areas, a recently burned area in the spring will likely elicit more of a negative public reaction than if the area were merely mowed. The perception that controlled burning is dangerous is one that could be dealt with through public education; burning techniques are advanced to the point that a burn can be done with only a few metres separating the burning area from adjacent lands (Collicutt, pers. comm., 1994). Nevertheless, in light of public perception, an acceptable maintenance approach for meadows might be to use infrequent mowing as the usual method. Burning could be an option to be used occasionally, in order to remove dead plant litter and create more spaces for new plants to seed. Burns could be conducted perhaps once every few years, with ample warning and explanation to residents. Another option on a large site would be to burn a small portion of the meadow area each year, on a rotating basis, so that all the meadow areas are burned at one time or another.

Mowing an area of turf that is to become meadow should be done in the spring, to allow any native grasses that have been seeded or that have colonized the site sufficient light to encourage growth. After that the site should be mowed one or more times during the rest of the growing season. The grass can be left unmowed at the end of autumn, to provide visual interest during the winter and to provide cover of wildlife (Nolan and Smith, 1992). Letting grasses and forbs to go to seed in the fall also allows for a seed source for future plants.

Although there is not much documentation of the results of reduced mowing on Kentucky bluegrass sites, a number of things can be expected. Lawn turf species have been cultivated to respond to regular, low mowing. Bluegrass has been known to go to seed at as low a height as four or five inches when mowing is stopped. Since it is "trained" to be regularly cut off, most of its growth is concentrated laterally in the form of tillers, which produce the characteristic dense sod mat. Although some sites in Winnipeg have produced reasonably presentable stands of bluegrass 12 to 18 inches high (Langridge, pers. comm., 1994), this tendency for turf grasses to grow laterally can result in sparse, straggly vertical growth if mowing is suspended. This results in an unkempt appearance. A solution may be to decrease the frequency of mowing gradually while raising the mowing blades for each cut, so that the turf grass is trained to grow vertically. Under this strategy, an area of turf such as Morley R. Kare Park (the site chosen for this study), which is mowed roughly twelve times in a growing season, might be mowed six times during the first year, three the following, and twice in subsequent seasons. The exact rate of decrease would have to be determined ad hoc, as the reaction of the grass is assessed. Encouraging turf grass to grow vertically would likely result in a less dense sod mat, which would promote higher species diversity by increasing the chances of other grass and forb species to establish themselves (Collicutt, pers. comm., 1994).

Some degree of weed control is usually necessary when mowing is curtailed. The extent to which this is necessary is determined by particular site conditions, including the proximity of weed sources and the weeds and weed seed bank that already exist on the site. The number of "weeds" that are undesirable in a meadow, however, is fewer than it is in a prairie restoration. Quack grass and smooth brome, two weed species commonly found in lawns, can actually be beneficial in a meadow, since they have an attractive appearance when allowed to grow to full height. Shorter, broadleaf weeds, like plantain and dandelion, are for the most part kept in check once surrounding grasses grow tall enough to shade them out (Nolan and Smith, 1992: 33-42). The most problematic weed is Canada thistle, which if left unchecked can choke out almost all other species. However, if it is treated properly before it has a chance to spread, one herbicidal treatment can usually remove it for good, unless there is a seed source very nearby (Langridge, pers. comm., 1994). A meadow site, then, will require occasional weed control; but this can probably be accomplished with spot herbicide treatment, as opposed to the conventional blanket treatment currently applied to the study site.

If a turfed site is left unmowed and unburned—that is, left to passive naturalization, succession into a woody plant community will eventually occur. In Edmonton, various "leftover" spaces near parks and on roadsides have been left to naturalize. On one site that had been left uncut for a number of years, native shrub species eventually began to replace the grass (Nolan and Smith, 1992: 33-42). Passive naturalization projects in Ottawa on

National Capital Commission land have demonstrated three stages of succession. In the first stage (one to three years), the turf grasses are the dominant species; in the second (three to five years), seedlings of native, exotic and weedy grass and forb species become established, and begin to replace the original grass; and in the third stage (five to 20 years), shrub and tree species gradually establish and begin to increase their cover. These woody species eventually replace the second-stage grass and forb species after about twenty years (*Urban Veg.*, 1987: 28).

The drawback to passive naturalization is its unpredictability. In southern Manitoba, the establishment of a shrub and tree canopy would take longer than in the NCC projects, due to the drier, harsher climate; and if the area in question is particularly dry, woody species may never establish to any extent. Depending on nearby seed sources, such an area could either evolve into a predominantly native plant community, or it could be dominated for years by undesirable weeds like Canada thistle and purple loosestrife. Thus, even if an area is left unmowed or unburned to regenerate on its own, occasional weed control is required. Desirable species could be spared from weeding; if woody succession occurs in an area where it does not interfere with existing site usage or sightlines, it could be allowed to continue by mowing and/or weeding around it, with occasional pruning or thinning as required.

4.3) Woodland Areas

4.3.1) Types of Woodland Naturalization

Hough, Peruma et al. (1982: 25-26) outline three approaches to woodland restoration: "natural regeneration," and two active approaches, "managed succession" and "plantation." Natural regeneration, or passive naturalization, is in most situations too slow an approach when the goal is to create woodland. Managed succession, an approach pioneered in Britain and the Netherlands, involves strategic plantings of various woody species that accelerate succession from meadow to forest. The eventual goal of managed succession is to mimic the ecological, visual and spatial character of a woodland with several canopy levels. Pioneer species are planted to help establish soil, canopy and microclimate conditions for subsequent species on the site. Intermediate and climax species are planted either at the same time as the pioneer species, or later, after the first plantings have become established.

The plantation approach involves planting only tree species and not sub-canopy or border shrub species. This approach can be appropriate on sites immediately next to housing, where residents are uneasy about having dense, "wild" areas too close to their yards, or where open sight lines through plantings are desired (Nolan and Smith, 1992: 58-65). It can also be implemented, using pioneer species, as the first step in a project where managed succession is the long-term goal, but further plantings of non-pioneer species are currently not feasible because of budget or time constraints. The Ontario Ministry of Natural Resources has used the plantation approach successfully in reforesting with softwoods, including pine, spruce and fir, and some shade-tolerant hardwoods, including oak, maple and walnut (Hough and Barrett, 1987: 102).

Shrubs as well as tree species can be planted using the plantation approach. Shrub plantations can create a spatial effect that is more closed-in at chest or eye level than a tree plantation, but with an open sky overhead, instead of a canopy. As with trees, shrub plantation can also be the first step where managed succession is a long-term goal. Natural succession from prairie to aspen forest typically begins with the invasion of pioneer shrub species like wolf-willow, snowberry and chokecherry. These species tend to inhibit the growth of grasses to the point that other woody species, like hazel and eventually aspen, become established (Cohlmeyer, 1977: 17-18). Shrub plantations can set the stage for eventual succession into sub-climax and climax forest; a shrub plantation simply approximates an earlier successional stage. With the random establishment of larger shrubs and trees, a shrub plantation can develop into a forested area with a more open canopy and a dense understorey. This could provide contrast to forested areas where trees were initially planted. Such contrast creates variety both visually and with respect to wildlife habitat. Shrub plantations can be compared with natural thickets or scrub areas, in which the vegetation is dense and consists mainly of shrub species.

4.3.2) Ground Preparation

It is important to ensure that woodland plantings will not be out-competed for moisture by aggressive grasses and herbs. If the planting site has an existing cover of turf grass, it usually has to be eliminated, or at least its growth has to be curtailed. Since whips or saplings are normally used in naturalization, grass, if left unmown, can severely inhibit their growth or even kill them. Long grass also provides excellent habitat for rodents, which girdle and often kill young plant stems through browsing (Hough, Wong et al., 1989: 16).

Generally, when woody seedlings or whips are to be planted, existing grass and other vegetation is cultivated, either with or without having first been treated with herbicide. Cultivation can be done manually on small sites, but on larger sites a roto-tiller, tractor, or some other type of mechanical cultivator is normally used to save on labour costs. If cultivation is to be the method used for weed control after initial tilling and planting, it will be required on a regular (usually monthly) basis through the first growing season, and at least once in each subsequent season, until the woody plantings develop a shade canopy that will inhibit weed growth (Maxsom, 1984: 6).

There are alternatives to regular cultivation (and/ or herbicide use) after the initial tilling under of the site. On small sites—100 square feet and smaller—newspaper can be used to quell vegetation growth. The ground is covered with several layers of newspaper held down with mulch for an entire growing season, and then recultivated and planted the following year. This approach has the advantage that the newspaper eventually biodegrades and thus does not have to be removed (Dorney, 1984: 30). However, applying and maintaining the paper cover is labour-intensive, and thus the method is not feasible for large sites. Soil-solarization is an alternative that requires less labour to install than paper, and holds together better in heavy rain and winds. The major disadvantages are the unsightly appearance of the area covered with plastic, and the fact that it eventually has to be removed.

Perforated opaque plastic sheeting produces similar results in terms of suppressing unwanted vegetation, but has other advantages as well. After tilling and planting, the sheeting is placed over the site, and then held in place with a layer of mulch, which looks better than the uncovered transparent sheeting. The real advantage of opaque plastic sheeting, as will be discussed in Section 4.3.5, is its effectiveness in controlling weeds during the post-planting establishment period.

On turfed sites, woodland naturalization can be attempted without first removing or cultivating the grass. Since existing grass is effective at keeping out weeds, this approach has some merit. However, certain criteria have to be met in order for woody plants to exhibit healthy growth within grass. Specimens planted into the turf have to be large enough—or be frequently monitored—to ensure that they are able to compete with the grasses for water and nutrients and to withstand rodent browsing. Or, alternatively, there must be an adjacent patch of existing woody plants, such as a stand of trembling aspen, that tend to spread vegetatively into open sites (Nolan and Smith, 1992: 64). Another alternative is to install bark mulch or wood chips over existing vegetation, which can inhibit its growth and, with regular irrigation, can help retain adequate moisture for the woody plantings.

On some sites slated for naturalization, soils have been badly degraded, often by industrial activity. In these instances it has been common to either fertilize the soil, or add topsoil from another site. When Toronto's Ecology Park was being constructed, the soil was discovered to be nutrient poor from years of intense urban use. Because of this, topsoil was brought in and added to the site before planting was begun (Gordon, *Ecology Park*, 1990: 205). However, as is the case with prairie plantings, adding nutrients in the form of topsoil or fertilizer creates ideal conditions for weedy species that can out-compete woody plantings before any canopy is established. The advantage of planting into nutrient-poor soil is that the initial lack of nutrients will help curb weed growth. Later, when the established woody plantings have ameliorated the soil by fixing nitrogen, producing leaf litter and stimulating soil micro-organism activity, a shade canopy will have developed so that ground conditions will be more suited to woodland species than to weeds (Howell, 1986: 15). The soil in the study site already has high nutrient levels, so, as was the case with open communities, no additional nutrients are needed at the ground preparation stage.

4.3.3) Planting Procedures

Generally, bare-root seedlings or whips are used. This is due to the fact that large numbers of plants are usually required. Seedlings and whips are less expensive than container stock, and require less labour to transport and install. Also, in large plantings where each individual plant may not always get the maintenance attention it needs, seedlings and whips generally have a better survival rate than larger stock, although there is variation between species (Emery, 1986: 138).

Trembling aspen has been established by planting root crowns dug from aspen clones or bluffs in the wild, according to City of Winnipeg Forester Mike Allen (pers. comm., 1994). Individual plants are cut off from the edge of a clone at the roots, which are then pruned along with the above-ground portion of the plants, and the remaining root crown is put in moist peat to root and sprout before planting on the site . Although this technique has been successful, its main drawbacks are the fact that natural aspen stock has to be depleted, and that a longer period of time is needed to develop tree-size plants as compared with planting seedlings.

i) The Managed Succession Approach

In managed succession, a decision has to be made as to whether plantings will be phased over time, or done all at once. Phased planting allows intermediate and climax tree and shrub species, as well as shade-loving groundcovers, to be planted into the shade of canopy of the established pioneer crop which was planted earlier. If the first planting consists entirely of pioneer species, the canopy will close faster than if intermediate or climax species are in the initial mix (Emery, 1986: 198). The drawback to phased planting is that a second phase adds to labour costs, since planting trees among the pioneer crop can be more difficult, particularly if substantial thinning is required.[6] As well, two more years of irrigation—on top of the two years needed for the initial plantings—are needed in order to establish the second phase plantings. These added costs make one-phase planting economically more feasible . Planting a majority of pioneer species, as well as some species that will put on rapid initial growth but will tolerate shade later, can minimize the adverse effects of slow growth and canopy development in the remaining sub-climax and climax plantings.

Aesthetically, planting patterns are arguably more of a concern in woodland naturalization than they are in a grassland or meadow, because of the visual and spatial impact that trees and shrubs create. There are precedents for arranging woody plantings both in a random, naturalistic manner, and in grids or other patterns. Some have recommended the naturalistic approach, since the overall aim is to mimic nature (Diekelmann and Schuster, 1982: 155-156). However, random planting makes subsequent installation of the plastic weed barrier more difficult, and also complicates further plantings if a second planting phase is intended. Planting on a grid or some other simple pattern makes these tasks easier (Maxsom, 1984: 6). The formal arrangement of new plantings can contribute to the purposeful appearance of the site as it establishes itself (Zoerb, 1993: 32). The appearance of rows or patterns of plantings will be obscured in time by the growth of other tree, shrub, grass and herb species, and possibly by intentional thinning of the original plantings.

Pioneer seedlings can be planted at or below the density ultimately desired for the woodland, so that there is room for sub-climax and climax species to eventually grow without necessitating thinning. This assumes, however, that most of the pioneer plantings will survive, which is often not the case. The shade canopy also takes longer to close than if a higher density of initial plantings is used (Howell, 1986: 15-16). The three most successful plots in the NCC naturalization project featured seedlings planted at 1.0 and 1.5 metres on centre[7], with the majority being pioneer species. The pioneer seedlings had very high survival rates, although the non-pioneer seedlings planted at the same time showed lower survival rates. Roughly four years after the initial plantings, canopies had developed to the point that secondary plantings of sub-climax and climax species showed consistently

6 The need for thinning, however, can lead to positive results, if it is treated as a volunteer event, in the same vein as a tree-planting. Thinning can also provide a cheap source of firewood or mulch for other naturalization sites (Zoerb, 1993: 34).

7 The 1.5 m initial spacing yielded essentially the same successful results as did the 1.0 m spacing; therefore 1.5 m spacing will be used in this project.

high survival and growth rates (Hough, Wong et al., 1989: 26-32). Thus planting pioneer species at a higher density creates optimum growing conditions for non-pioneer species sooner. This holds true whether the latter are planted at the same time or in a second phase.

Shrub species in the borders between woodland and managed turf are useful in producing a natural appearance around the edges of forested areas, and they serve an important functional role as well. Planting shrub borders provides shade that inhibits weed growth, and also serves to physically protect the tree plantings from disturbance. Shrub species that will sucker or spread vegetatively are recommended for use in this situation, since they will fill in more quickly than other species (Dorney, 1984: 15).

The borders of woodland areas have a high species diversity, since they represent an ecotone between forest and grassland or meadow. They can be planted with flowering shrubs, as well as shrubs that have good fall and winter colour or texture, and they can also attract desired songbirds to the area. Thus effective woodland border planting has aesthetic and educational merit as well as a functional value. The turf edges around these woodland borders do not always have to be maintained right up to the shrub plantings. In some areas where it is appropriate, a margin of unmown grass can be left to allow shrub species to spread vegetatively outwards, so that natural spreading of the woodland plot is encouraged (Nolan and Smith, 1992: 64).

A woodland naturalization should include consideration of the plants found in the herb stratum. The "herb stratum" refers here to the herbaceous and woody plant species that are found beneath the shrub stratum on the floor of the aspen forest. The plant species that are found here are for the most part suited to the shade, litter, soil and nutrient conditions of the forest floor rather than to the prairie. (The herb stratum in border communities usually consists mostly of grassland species as well as some woodland plants that are light-tolerant.) In some naturalization projects, herbaceous plants have been planted along with shrub and tree seedlings, either at the same time or after a shade canopy had developed. Although these herb stratum species form a necessary part of the aspen forest community as do larger woody species, planting them in numbers approaching those in natural conditions is labour intensive and costly, due to the fact that so many plants need to be planted so close together to cover a large area. They can also be damaged if any maintenance has to be carried out within the forested area, whether it is regular cultivation to control weeds, or the removal of plastic weed barrier and respreading of mulch on the forest floor.

The easiest way to produce a herb stratum in a woodland naturalization is to allow groundcover species to naturally colonize the site. Although they are an important part of the ecology of the forest, their establishment or lack thereof is not as visibly noticeable as the establishment of tree and shrub plantings. From this point of view, it can be argued that planting resources should be put towards the larger plantings. After the forest is established, groundcover species will eventually appear on the forest floor, when seeds are born to the site by wind or animals. Herbaceous species eventually became established in the NCC plots in Ottawa, though none were planted (Hough, Wong et al., 1989: 28). The length of time needed for this to occur is largely dependent upon how far away from the site seed sources are.

Planting of herb stratum plants could be undertaken by volunteer school groups who are interested in taking part in a naturalization project. The small plant sizes would make it possible for young children to plant individual specimens without much difficulty. Herb stratum species could be planted in selected areas within the forest plantings—perhaps near the periphery just behind the shrub border plantings—so that with time they would spread into the rest of the forest area. If a plastic weed barrier has been installed to inhibit weed growth, herb stratum species would have to be planted after its removal. A representative list of aspen parkland herb stratum species is given in Table 1.2 in Appendix 2.

ii) The Plantation Approach

Where the plantation approach is deemed appropriate, the above planting procedures are simplified. With tree plantings, if sight-lines through the plantation are desired, the shrubby woodland border can be omitted, although in its absence, ground treatment to quell weed growth will be more important. If there is no eventual intention to plant or encourage understorey growth, a tree plantation area can be planted without removing the existing grass, but the limitations to the growth of woody plantings in tall grass (outlined in section 2.2.3 *i)*) must be addressed.

4.3.4) Species

Species used in woodland naturalization will differ depending on the site's region and microclimatic site conditions. If the managed succession approach is to be followed, species lists should include both pioneer and intermediate or climax species, representing the tree and shrub strata. Some of the species used in the more successful NCC test plots in Ottawa can grow in the Winnipeg region, and might be viable in a naturalization scheme. There have also been successful naturalization projects of varying scopes undertaken in Winnipeg, that can provide information on how certain local species perform.

Even though native plants are becoming more widely available commercially, large numbers of native woody specimens have often been difficult to obtain at an affordable cost. To save money, municipalities might want to consider developing their own native plant nurseries if they are considering launching regular naturalization projects.[8] One potential source for large numbers of native woody plants is the Prairie Farm Rehabilitation Administration, which supplies stock to owners of large acreages and to governments for reforestation projects, often for the cost of shipping the plant material only (P.F.R.A.).

Although the natural vegetation of the study site would either have been prairie or aspen forest, planting species that are not found in the aspen forest may be appropriate for a number of reasons. It is often easier to plant cultivars of natives or non-native species that have a similar appearance and will grow in similar conditions to less readily available and more costly native species such as trembling aspen. Hybrid poplars—cultivars of native species of *Populus*—were used with success as a nurse crop in the NCC projects (Hough, Wong et al., 1989: 26-32). There are other non-aspen parkland species besides hybrid poplar that can be useful for woodland naturalization . In sufficiently moist conditions, Manitoba maple—for the most part a riverbottom forest tree species—can be effective as a pioneer species because its rapid growth, but will also tolerate shade more readily after establishment than will native or hybrid poplars. White spruce is normally only found on the northern fringes of the aspen parkland and not as far south as southern Manitoba (Bird, 1961: 27). Yet it is a useful addition to forest naturalization because it provides cover for birds as well as visual interest, especially during the winter months. Scots pine is an attractive European cultivar that is useful because it is winter hardy and will do well in well-drained, dry sites (P.F.R.A.). A list of woody species suitable for naturalization is given in Table 1.2 in Appendix 2. The list includes a representative sampling of the species found in the aspen parkland, as well as useful non-native species.

4.3.5) Management

Regular watering during the first growing season is crucial for the survival of woodland plantings. Young whips and seedlings are very susceptible to drought and need moisture to ensure adequate development of root systems (Hough, Wong et al., 1989: 2).

8 Jim Thomas, of Hilderman, Witty, Crosby and Hanna and Associates, has this suggestion, based on his firm's experience with a naturalization project under the Kildonan Bridge in Winnipeg. Bare-root trembling aspen stock was specified for the project, but it proved difficult to get a hold of. When some of the bare-root plantings on the site failed, they had to be replaced with container-grown stock supplied by a commercial nursery.

As well, barriers such as snow fencing may have to be erected around planted areas for at least the first growing season, to protect new plantings from damage by maintenance equipment, animals and curious passers-by (Zoerb, 1993: 16).

The most successful of the NCC plots in Ottawa featured two methods of weed control: regular cultivation between plantings, and the installation of plastic sheeting covered with mulch at the time of planting. Of the two, the plastic and mulch technique was the most effective at preventing excessive weed growth, which can choke out new plantings and provide cover for browsing rodents. The plot in which this technique was used also yielded the highest survival rates for woody plantings of any of the plots: close to 100% for all species planted. This was attributed not only to weed control, but to the ability of the mulch to help maintain soil moisture in the critical first season and subsequent establishment years.

While the plots that were cultivated were successful, they required cultivation on a regular basis, which became more difficult as the plantings filled out. In contrast, it was reported that no maintenance was required on the plastic and mulch plot after installation. The only major drawback cited was that, since the plastic sheeting was non-biodegradable, it eventually had to be removed to enable soils to function naturally in the long-term (Hough, Wong et al., 1989: 26-39).

Woodland test plots planted by the City of Edmonton yielded results similar to those in Ottawa. Four different techniques for weed control after planting were tested: regular cultivation, treatment with Roundup herbicide, initial cultivation followed by a six-inch mulch application, and initial cultivation followed by application of a "weed blanket" and three inches of mulch. In two subsequent growing seasons, the bed with the weed-blanket required only pruning and debris removal, and no weed control measures. Although the regularly cultivated bed had the highest growth rates, the weed-blanket bed was second best (Nolan and Smith, 1992: 42-44).

This use of porous weed-barrier would allow moisture to reach the soil more easily than would plastic, but it too would eventually have to be removed, and so its higher cost is not justified on larger sites. It was suggested by the NCC project designers that a bio-degradable plastic sheeting or weed-barrier be used to avoid eventual removal. But according to Jim Thomas of Hilderman, Witty, Crosby Hanna & Associates (pers. comm., 1994), during the Kildonan Bridge naturalization project in Winnipeg, it was discovered that such a product is not yet readily available on the market. Plastic sheeting thus seems the best route. An alternative to removal might be to use pitchforks to manually break down the plastic into fragments small enough to allow natural soil processes to take place.

Since the climate in southern Manitoba is drier than Ottawa's climate, it is possible that the plastic weed barrier used in the NCC project may not be necessary to have success in a woodland naturalization project in Winnipeg. The installation of a thick layer of bark mulch may be enough to suppress weed growth. In the comparatively dry Winnipeg summer, the top layer of the mulch may well stay dry enough to prevent weed growth, while the bottom layer retains enough moisture to ensure the survival of the woodland plantings (Collicutt, pers. comm., 1994). As more naturalization projects are undertaken and monitored, it will become apparent whether the use of plastic barrier is worth the added cost and effort. In this project, its use will be recommended since it has led to success in other naturalization projects.

After a woodland is established, long-term management may involve some thinning if pathways or more open areas are desired, and the shrubs and turf along its borders may require occasional maintenance to improve appearance. Aside from this, the woodland will essentially have achieved the status of a maintenance-free amenity. The NCC plots demonstrated that, after establishment, a successfully naturalized site will behave and evolve in a manner similar to a natural site; woodland tree, shrub and groundcover species eventually begin to germinate within the site, from seeds either produced by the planted specimens or blown in from other seed sources (Hough, Wong et al., 1989: 28).

4.4) Wetland Areas

4.4.1) Functional Purpose of Retention Ponds

Naturalizing a retention pond differs from open and woodland community naturalization, in that any development must allow the pond to continue performing the function for which it has been designed, namely, stormwater management. The primary function of retention ponds in Winnipeg is "the attenuation of peak runoff flows to protect existing downstream drainage systems from flooding or to permit the construction of more economical conveyance systems to the rivers" (UMA, 1992: 1.1). Each pond is configured so that water from the pond must flow over a weir, which is typically located under a manhole where the pond outtake line connects to the main line. The weir is set up so that stormwater is impounded in the retention pond, until the water level reaches that of the weir. When the water in the pond is at a higher level than the weir, the excess water flows over it and into the stormwater line. The intensity of the flow is greatly reduced by the impoundment of most of the stormwater, which lessens the potential for erosion damage to the city's rivers and eliminates the necessity for large-diameter stormwater conduits (McNeil, pers. comm., 1993).

According to Doug McNeil, a land drainage engineer with the City of Winnipeg's Waterworks, Waste and Disposal Department, there has been no evidence to suggest that naturalized retention ponds in Winnipeg have functioned any less well than ponds in which vegetation is strictly controlled. The water intake and outtake pipes in the ponds are typically at least twelve inches in diameter, so that levels of algae concentrations in the water have no effect on their performance. The line openings are located deep enough down that there are no macrophyte plants close enough to affect intake and outtake. Dead plant material settles to the bottom, so it too has no effect.

McNeil cites as examples three retention ponds, located between Bishop Grandin Boulevard and the neighbourhood of Southdale, which were constructed in 1977, (eight years before the pond in Morley R. Kare Park, the study site, was constructed), and which have been allowed to naturalize. All three are still functioning as well as the study site pond. The Bishop Grandin ponds differ in that their drainage watersheds consist mostly of municipal right-of-way for the Boulevard. Both the right-of-way and the residential watershed of the study site pond consist primarily of mown turf, but the private yards surrounding Morley R. Kare Park are likely treated with more fertilizer than the grass is in the right-of-way. It might be concluded from this that naturalizing the pond in the study site could result in far more weed growth, due to the higher amounts of nutrients and grass clippings entering into it. But according to McNeil, both the Bishop Grandin ponds and the study site pond receive more nutrients in grass clippings alone than a pond plant community could take in. Since there are enough nutrients available in each case that the vegetation is typically at its collective condensation point[9] at any given time, the study site pond would probably naturalize to about the same extent as the Bishop Grandin Ponds if weed control were stopped, and it would almost certainly remain fully functional (McNeil, pers. comm., 1993).

It is probable that naturalizing a retention pond will allow it to be in a sense *more* effective in handling stormwater. The existing standards for Winnipeg's ponds emphasize the goal of managing water quantity, and do not address issues of water quality. The water that collects in a suburban pond is full of nutrients from topsoil, grass clippings and lawn fertilizers, along with various pollutants. This nutrient-rich water eventually finds its way

9 An individual plant can only absorb a finite amount of any nutrient before it reaches its "condensation point." If there is still an amount of nutrient remaining after the concentration point has been reached, it is unused by the plant, until the plant has processed the nutrients it has absorbed and is again in need of nutrients (Murphy, 1993).

into the Red, Assiniboine and Seine Rivers. The effect of high nutrient levels—especially phosphorus—is to create eutrophic conditions, in which algae blooms flourish, die and then decay. The ensuing oxygen depletion can make water bodies unlivable for fish and other aquatic animals.

In some American municipalities, where issues of water quality and pollution have become public priorities, retention ponds have been designed that improve water quality, by "scrubbing" the water to remove excess nitrogen, phosphorus, and various water pollutants. This is achieved by allowing pond plant communities to flourish so that they can absorb more nutrients and pollutants from the water, which is then cleaner by the time it gets to the river or lake downstream. McNeil contends that soon, issues of water quality in Winnipeg's rivers will become as important as quantity control when dealing with stormwater retention. He suggests that now is the appropriate time to begin studying the effects of naturalized retention ponds on water quality.

The primary emphasis of the design guidelines for retention ponds in Winnipeg is on stormwater management and on public safety. But the focus of a study on stormwater retention pond management—commissioned in 1992 by the City of Winnipeg—is how vegetation growth in ponds should be dealt with. Much of the present vegetation control on ponds is carried out because there is a perceived aesthetic preference for tidy, plant-free lakes. But the study reports that in many of the American municipalities there has been a change in aesthetic preferences, because of projects in which wetlands were developed for water quality improvement: "Over the past 15-20 years...public perception of groomed urban lake and shoreline areas has changed to favour more 'naturalized' settings." (UMA, 1992: 7.35). The study recommends that a retention pond in Winnipeg should be chosen as a pilot project for naturalization, to explore the potential monetary savings, environmental and wildlife benefits, and improvements to water quality. Specifically, it recommends that a residential site should be used, to see whether public opinion will shift in favour of naturalization, as it has in the American municipalities (UMA, 1992: 7.35 and 7.41).

4.4.2) Public Access

As is typically the case with all the suburban retention ponds in Winnipeg, the shore of the Lakeside Meadow retention pond is divided between public and private residential property. The existing city regulations on public access to ponds are vague. They merely stipulate that, for every 1.6 hectares of impoundment area (i.e. pond surface area), 0.4 hectares of land is required for "public access purposes." There are no regulations for the length of shoreline that is to be reserved for public access. In other words, there is no upper limit to the portion of the pond shore that is to be cut up into private shorelines (UMA, 1992: 8.32).

The current construction standard for revetments around Winnipeg's retention ponds stipulate that a revetment must stretch from 2 m below the normal water line (NWL) to 3.5 m above it. The boundary of a private lot extending to the shore is coincident with the NWL (UMA, 1992: 8.32). But since the revetment extends as much as 3.5 m onto the private side, the landowner is left with a strip of land with which he can do little. Further, there is a building restriction on properties adjacent to retention ponds that forbids any construction other than fences and docks within 12.6 metres of the NWL. This has resulted in a typical waterfront property featuring landscaping, a deck or a retaining wall that extends outward from the house to the 12.6 metre line, beyond which is mown turf stretching to the revetment. There is potential to use the bottom portion of this 12.6 metre margin—specifically, where the revetment is situated—for a public walkway around the pond. Arguably, the privacy of the lot-owner would not be greatly compromised, since the 12.6 metres is an ample buffer. In such a situation, owners who feel the need to separate their lots from a public pathway along the shore could erect buffers of plantings, which could even be provided by the city as part of the naturalization project.

However, though such a plan has the merit of providing complete public access to the pond, it would not likely be accepted voluntarily by the owners of waterfront property. Since they paid a premium to own waterfront land, it would be unfair to change the property line after the fact. Suffice to say that providing waterfront private property while at the same time accommodating full public access to the pond shore should be an important consideration in any new designs for retention ponds in residential subdivisions.

In order for people to enjoy the full benefits of a naturalized retention pond, though, some sort of increased access to the pond has to be provided as part of the redesign, to provide up-close contact with the pond environment. This is particularly true if the mown turf surrounding the pond is to be replaced by long grasses, reeds or shrubs. Siting a pathway that moves through the vegetation and along the edge of the water, or constructing a boardwalk that takes people through the shoreline vegetation and right out onto the water, are two potential means for providing better pond access.

4.4.3) Water Safety

The current standards for the shorelines of stormwater retention ponds were adopted by the City of Winnipeg primarily to address safety concerns. Any alternative strategy for shoreline treatment has to address the issue of safety to be viable. The existing guidelines established by the City stipulate that a retention pond must have a shoreline slope of 7:1 or shallower, from freeboard (highwater) elevation to the bottom of the pond. A revetment from 3.5 m above to 2.0 m below the normal waterline is required; the revetments around newer ponds are typically gravel laid over a weed barrier (UMA Engineers and Planners, 1992: 8.32). The rationale behind this is that a pond should be shallow and free of plant growth, so that someone who has entered the water for some reason will be able to get back out easily or, failing that, can be saved by an onlooker. From this point of view, the criticism directed at naturalization is that shoreline and emergent vegetation will make getting out of the pond much more difficult, and could lead to drowning—especially for a young child.

This safety standard is based on the need to mitigate danger *after* the fact of entry into the water; in that sense it is an attempt at a "cure" rather than a preventative measure. The chief method for indicating that the retention pond is not to be entered is the posting of warning signs, and the assumption is that people who cannot understand the signs—young children in particular—will be told by those who can read the signs—usually accompanying adults—to stay away from the water. But what if there were a way to convey the message in some way other than with signs?

In her practicum on alternative stormwater management in prairie cities, University of Manitoba student Heather Edwards argues that there are alternatives to existing standards for pond design that could be more effective in keeping young children out of danger from water. Edwards cites cognitive psychological data which show that pre-schoolers absorb spatial information through visual stimuli of the environment around them, and that their ability to understand rules (such as "Don't go near the water!") is in comparison undeveloped. Children between the ages of two to seven begin to understand "representation"—their ability to associate meaning with types of objects and environments. During this stage, most children learn to associate the notion of a gently-sloped shore, where access to the water is unobstructed, with memories of play and security from experiences at a wading pool or a beach.

Edwards argues that, based on their basic cognitive abilities and their limited experience, young children are likely to see a retention pond shore as a safe environment for playing, and that this perception is far more "real" to them than an instruction to stay away from the water. Physical, spatial impediments between the child and the water, such as shrubs, long grasses and reeds, are more likely to deter toddlers from nearing the water (Edwards, 1990: 41-46). It is reasonable to expect that naturalizing the land around retention ponds could distinguish them visually and spatially from more benign water environments in the eyes of young children, and that the plant material would provide physical impediment.

Of course, naturalization could produce new dangers; a young child could conceivably find his way to the water through naturalized vegetation or through a clearing, and then become entangled in submerged or emergent vegetation while trying to get back out. As is the case regarding personal safety, there are no clear-cut solutions that will eliminate the potential danger of water. Designers cannot produce solutions that account for all possible types of human behaviour—nor can they stop some people from breaking rules designed for their own safety (Edwards, 1988: 40). As well, designing a more sustainable landscape or an aesthetically pleasing landscape on one hand, and designing a landscape for safety on the other, are often divergent goals; there must be some trade-offs in one area to satisfy another. Naturalization can be used in a shoreline treatment that probably fits the cognitive abilities of young children better than the existing standards do.

4.4.4) Types of Retention Pond Naturalization

As it is for open communities, passive naturalization is a more viable option for stormwater retention ponds than it is in producing a woodland, due to the shorter time-frame required for results. The Bishop Grandin ponds provide an example of what a pond will look like if natural regeneration is allowed to take place. Since their construction in 1977, no vegetation control has been undertaken (McNeil, pers. comm., 1993). The result is that the ponds have developed stands of emergent macrophytes and grasses at their shorelines, giving them the appearance of small, "natural" wetlands. The success—albeit unintentional—of the Bishop Grandin ponds lends legitimacy to the recommendation in the 1992 management study that a naturalization pilot should be undertaken.

The retention pond in the study site already has a fair amount of emergent vegetation growing along both the public and private stretches of the shore. Although a quantitative species inventory has not been undertaken, it is clear that common cattail comprises the majority of the vegetation. Cattail is allelopathic, which means it produces substances which inhibit the growth of other plant species. Its presence on the site thus would make it difficult to establish other plant species through active naturalization. The eventual result of planting other species would likely be a community not very different than the one that already exists on the site. Thus in this particular study, active planting towards a wetland community is probably not the best use of scarce resources; passive naturalization is a more appropriate approach.

4.4.5) Installation Procedures and Plant Species

The slope of the entire perimeter of the retention pond on the study site is approximately 7:1, as is stipulated in the City's construction guidelines. Although plant growth in the pond is affected to some extent by varying levels of exposure to sun and wind, the overall uniformity of the environment could lead to a homogeneous band of vegetation around the pond as naturalization is allowed to occur. One way to alleviate this condition would be to add fill to the shelf just under the shore, and to shape it to create varying depths and degrees of slope. This would encourage spatial variety in the emergent plant stands, and would also create a variety of niches that would give species other than cattail a better chance of becoming established. This amending of the pond bottom along the shore would also make the pond more attractive to waterfowl. If the margin between open water and land features a varying profile of macrophyte groupings, the resultant spatial variety and sheltered pockets are attractive to many species of waterfowl, particularly Canada geese. Although waterfowl generally prefer rural, undeveloped wetlands as nesting areas, they will use urban and suburban ponds for staging areas in the spring and fall (Wark, pers. comm., 1994). The potential plant and waterfowl species diversity that can come from adding fill to the pond bottom will also provide more aesthetic appeal. The spatial variety will help to render the straight, engineered lines of the pond shore less obvious.

If passive naturalization is allowed to occur the shore of the pond, a distinct edge between the naturalized and regularly maintained areas is important, for the visual and aesthetic reasons outlined in section 3.2.2. A view of the retention pond is a selling point in many of Winnipeg's newer suburbs, and so there must be a purposeful look to the vegetation areas as they develop. Where shoreline vegetation is allowed to naturalize, its limit can be defined by a pathway, mown turf, or a buffer of sun-tolerant shrub species that favour wet conditions.

The pond on the study site features a revetment of crushed limestone which extends roughly six feet up from the NWL, although the dimension varies. Along parts of the shore where there is to be a circulation route adjacent to the water, the revetment could be topped up with new stone and converted to a pathway. Otherwise, the best way to encourage vegetation to colonize the revetment would be to remove the crushed limestone to expose the bare earth. The best time to do this would probably be following the first two or three seasons after the naturalization project has begun. That way, there will be a better chance that the surrounding vegetation, having become established, will colonize the revetment area and prevent a weed problem. If the revetment is left undisturbed, it will become overgrown with vegetation with time, as has been the case with the Bishop Grandin retention ponds. It is worth mentioning that the revetment on the study site is currently quite dilapidated. If it begins to look odd once the surrounding vegetation begins to grow in, it still might be an improvement over its present appearance, in that less of it will be visible from the rest of the site. If the community decides that it wants the revetment removed, it could be done manually, as a volunteer event.

As has been mentioned, common cattail is the dominant emergent plant present at the study site. But there are a number of other macrophyte (i.e. larger than algae) plant species that occur in Winnipeg's retention ponds. These can be grouped into four categories: emergent and rooted (including cattail); submerged and rooted; floating leafed and rooted; and free-floating (UMA, 1992: 4.1). Species commonly found in Winnipeg's retention ponds are summarized in Table 1.3 in Appendix 1.

4.4.6) Management

The current management regime for Winnipeg's retention ponds is primarily aimed at controlling emergent and other macrophyte plant growth, as well as algae growth, so that the ponds are not perceived as unkempt or polluted by the public (UMA, 1992: 4.1). There is a wide range of management techniques possible for these purposes, ranging from herbicide and algicide treatment, to bio-control methods such as stocking ponds with fish, crayfish or snails, to mechanical harvesting and derooting of emergent plants. Typically the most common concern is control of planktonic algae. The retention ponds in Winnipeg that elicit the most complaints usually have high planktonic algae counts; conversely, the City receives few complaints about ponds that have large populations of macrophyte plants (UMA, 1992: 5.41,).

The 1992 stormwater management study concluded that there is probably an inverse correlation between macrophyte plant levels and algae levels in Winnipeg's retention ponds. High algae levels tend to decrease the amount of sunlight that penetrates to the pond bottom, inhibiting macrophyte plant growth. Conversely, where there are high levels of rooted macrophyte plants, algae levels can be expected to be lower (UMA, 1992: 5.33).

If a passive naturalization approach is taken on a retention pond, the management of emergent plant growth would probably involve simply decreasing the frequency of harvesting or derooting. It is reasonable to assume that with decreased harvesting the plant stands will not spread out and colonize the open pond water. The maximum depth at which emergent plant growth has been recorded in Winnipeg's retention ponds is 0.79 metres, and the depth of the middle of the pond on the study site is between 1.8 and 1.9 metres

(UMA, 1992). Plus, the Bishop Grandin ponds have been unmaintained since 1977, and plant growth has only occurred around their peripheries.

Beyond drawing conclusions from the Bishop Grandin ponds, it is difficult to predict the management needs of a pond once certain types of control are curtailed or ceased, since there has yet to be a pilot project from which conclusions can be made. Judging by the inverse correlation identified in the 1992 stormwater management study, and by the vegetation on the Bishop Grandin ponds, it can be assumed that allowing emergent plants to flourish may keep algae in check and thus eliminate the need for algicides. This is notable, because the list of chemicals available for algicide and herbicide treatment is decreasing—Agriculture Canada has forbidden the use of many that were commonly used in the past (UMA, 1992: 7.51). Chelated copper (cutrine) was used as an algicide on the study site pond in the past, but its use is now prohibited (McNeil, pers. comm., 1994). Considering this, a sensible route towards algae control might be to allow more macrophyte plant growth on retention ponds, and to encourage those who live within the watersheds of the ponds to cut down on use of lawn fertilizer, thus decreasing the amount of nutrient run-off into the ponds. This could be included in a greater public education program, that would be a component of a neighbourhood naturalization project such as the one proposed in this study. One benefit of this approach is the fact that, if decreased nutrient levels in ponds reduce the need for herbicidal and algicidal treatment, eventually the water could be fit for secondary and even primary contact.

Briefly, then, an appropriate management plan for a naturalized retention pond would include a decrease in frequency of harvesting or derooting of macrophyte plant growth to once roughly every five years, coupled with a campaign to decrease the inflow of nutrients at the source. Algicide treatment may still be occasionally needed, but only as a last resort.

5) Site Analysis

5.1) Site Description

The study site is Dr. Morley R. Kare Park, a community park located in Lakeside Meadows, a residential subdivision situated in the Winnipeg neighbourhood of Transcona, just east of Plessis Road (See Fig. 5.1: "Area Plan") Lakeside Meadows is a recently developed site, with most of the houses in the five to ten-year-old range . The park is named for an eminent agriculturalist, whose family owned a dairy farm in the area before it was developed into residential subdivisions. This site was chosen for the study because it is fairly representative of a typical suburban park in Winnipeg. It features large expanses of mown turf including sports fields, scattered specimen trees, and a stormwater retention pond at the centre of the park, and it is bordered by private single family residential property and street boulevards.

The park covers an area of approximately 6.72 hectares, not including a central retention pond. The park is divided by the pond into two parcels: an area of 5.84 hectares to the north of the pond, and an area of 0.88 hectares at the south end. The retention pond has a surface area of 2.97 hectares, is 1.83 metres deep, and has 907 metres of shoreline. It is the basin for a watershed that covers roughly 86 hectares of land, including most of the Lakeside Meadows Neighbourhood (UMA, 1992).

Within the northern portion of the park, there are two miniature soccer fields, a T-ball diamond, a playground area with play structures and a swing set, and a mini-basketball court covered in crushed limestone that is flooded in the winter to create a skating rink. There are a number of small berms around the periphery of the northern part of the park, and there is a hill at its centre, that rises about two metres above street level. The southern portion of the park has no facilities or berms; it essentially consists of a slanted plane sloping from street level down to the pond shore (See Fig. 5.2: "Site Plan").

5.2) Resident Data

5.2.1) Waverley Heights and Southdale Retention Pond Study

Recent studies conducted in Winnipeg reveal that there is a latent interest among many suburban residents in more natural or naturalized suburban open space. In the 1990 study conducted by Edwards, suburban residents were surveyed for their opinions on the stormwater retention ponds and public greenspaces at the centres of their communities.

The study areas were Waverley Heights and Southdale—neighbourhoods which feature open spaces and retention ponds that are more or less typical of suburban Winnipeg. Residents were asked to identify the features—existing or potential—that they felt enhanced their ponds and open spaces, as well as the features that detracted from the sites. For analysis and discussion, responses were grouped into three categories: whether each real or suggested feature would "detract," "have no effect on," or "improve" their lake and greenspace.

Residents were provided with a series of possible features or "conditions" on the ponds in the open spaces, and asked to choose whether each condition would detract, have no effect on, or improve visual quality. The feature most often chosen as potentially improving, chosen by 85.6% of respondents, was "wildlife." In more specific terms, a majority (53%) of the respondents preferred waterfowl and fish control to any other method as a means to control aquatic growth in ponds, and a similar majority (51%) approved of maintaining natural aquatic vegetation to provide food and habitat for wildlife. The response percentages for four questions—regarding supporting wildlife near the edge of ponds, the desire to live next to a pond, accepting fish and waterfowl as a means for controlling plant growth, and retaining plant growth for food and shelter for wildlife—were compounded to produce a composite figure out of 400 points. The figure was roughly 300 points for residents in favour of the four "nature-related" conditions, as opposed to roughly 100 for those not in favour. Respondents were also asked to rate five methods for controlling aquatic plant growth. Of the five, the use of chemical pesticides was the least attractive, cited by 66.2% of respondents as potentially detracting from pond quality. The use of wildlife as a means of vegetation control, on the other hand, was viewed as desirable by 62.5% of respondents (Edwards, 1990: 57-62).

Two things can be concluded from the preference, apparent in the survey results, for increased wildlife, more volunteer vegetation and less chemical application. Firstly, people are considering alternatives to conventional residential landscape form and management; and secondly, they are receptive to reintroducing nature into retention pond sites and, it can be reasonably assumed, suburban open space in general.

5.2.2) Domtar Site Study

In the fall of 1993, a design studio was conducted in the Department of Landscape Architecture at the University of Manitoba, for which the study site was the grounds formerly occupied by the Domtar wood preservative and treatment facility, in the neighbourhood of Transcona. In conjunction with the studio course, the students conducted a survey study of resident opinions in the community that adjoins the site. The purpose of the study was to determine specific resident opinions concerning the derelict site and possible future uses for it, and to gauge general opinions about environmental issues and leisure, educative and open space facilities in the community.

The survey covered a portion of residential Transcona, including the neighbourhood of Lakeside Meadows. The responses to aspects of the survey that dealt with general environmental issues in the community (i.e. questions not specific to the Domtar site) did not yield statistically significant differences between sections of the study site. Because of this, conclusions about Lakeside Meadows can be drawn from the general survey results. Opinions of both adult and school-age residents were measured, the former through a door-to-door survey and the latter by surveying classes in the neighbourhood schools.

The results of the adult part of the survey revealed that residents have strong opinions on environmental issues in their community. In the adult survey, 81% of respondents indicated that they are generally "environmentally concerned." Almost all of the adult respondents (98%) agreed that it is important to have a place to go in their neighbourhood to enjoy nature. 96% agreed that it is important to protect nearby natural environment, and 81% agreed that it is important to have wildlife conservation areas in the city. When asked to respond to a list of potential changes to their community, 86% of adult residents indicated that they would be happy with the introduction of a "nature/ educational park," into the neighbourhood, as opposed to just 3% who said that they would be unhappy with such a facility (Bell et al., 1993: 5 and 6, 1-13 appendix #1)

These results suggest that residents of Lakeside Meadows consider nature, wildlife and environmental awareness to be important aspects of their community life, and are in favour of more "natural" local park areas for both the recreational and educational opportunities they can offer. Given that there was near unanimous agreement (96%) on the necessity of protecting natural areas nearby the neighbourhood, it is reasonable to conclude that residents would be receptive to plans for naturalizing portions of their community open space, as long as the other leisure amenities within the park were preserved.

In a survey of students in grades four through six, the two most popular responses to the question "What changes would you like to see most in your neighbourhood?" were "Trees/ Forest," and "Parks." As well, "idea sketches"—drawings done by the students depicting the important features within their neighbourhoods—were full of trees, forests and park space. In one section of the survey, all the students, from grades four through six and seven through nine, were asked to indicate on a map which areas of the derelict Domtar site they preferred, if any. Most of the favourite places indicated by both the elementary school and junior high school students were within the bush areas on the site.[10] The younger group of students indicated they preferred the bush areas situated closer to residential land, located along a back lane that runs between the site and Lakeside Meadows. The junior high students on the whole favoured the bush areas in the part of the site furthest away from residential areas. Students in both the elementary and junior high groups used the bush areas for, among other things, building forts and playing in the "forest" (Anderson et al., 1993: 1-6, 20-24, 28 and 29).

The results from the elementary school survey show that children as young as fourth graders have no trouble expressing what sorts of environments they like. As was the case with the adult respondents, children consider nature—"trees, forests and parks"—a very important part of their community environment. The survey authors conclude from the responses about the Domtar site that both elementary and junior high students value wooded sites as play areas and meeting places. This supports behavioural psychologist Beate Jansson's argument that natural areas can play an important role in children's enjoyment of their environment:

> "From the age of six or eight years on...children who are looking for private places, or places that are socially, physically and intellectually suitable for their play, seem to find these qualities in playgrounds, as well as, with specific regard to natural elements, in 'wild natural areas.'" (Jansson, 1984: 105.)

According to Jansson, "wild areas" in the landscape play a vital role in a child's development by providing opportunity for "free, innovative play," that is not always provided by traditionally landscaped areas and playgrounds. Allowing children to play in a setting of naturalized or naturally occurring plant material "is an important asset in creating in children an emotional feeling and appreciation of a natural world." In the same vein, Cooper-Marcus points to the difference between the wilds outdoors and indoor play areas:

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10 The conclusions regarding preferences for "bush" areas were drawn from respondents' indications on the map of the site included in the survey. The only term provided in the survey for describing these areas was "brush"—the word used to label on the map what the surveyors later call "enclosed shrub" or "bush" areas in their discussions. These latter two terms adequately describe the range of conditions found in the "brush" areas on the Domtar site. They are collectively referred to here as "bush" areas, for the sake of simplicity.
The survey results revealed that, among both the elementary and junior high students, bush areas were more popular among boys than among girls.

> "Contrast these [outdoor] possibilities with the place-for-everything-and-everything-in-its-place mentality of most home interiors. No wonder the questioning child, especially from the ages of five through eleven, seeks the freedom of outdoors." (Cooper-Marcus, 1978: 36.)

The survey results showed that the younger children preferred bush areas closer to the residential area, likely out of a need to feel safe. Jansson contends that, for children up to around the age of eight, natural spaces within a neighbourhood are ideal, since play can take place within earshot and/ or viewing distance of a child's home. A community greenspace such as the study site would seem to be an appropriate site for naturalized play space for young children, since it is contained within the confines of the neighbourhood.

5.2.3) Lakeside Meadows Residents

The Domtar survey results provide an accurate picture of the attitudes of the community, according to Mark Baron, the president of the Lakeside Meadows Residents' Association. The fact that nature and wildlife are a valued by the community is demonstrated by the popularity of the various waterfowl that visit the retention pond during spring and fall migrations. Homeowners with waterfront property often put grain out near the shore for geese to feed on. Residents feel that, if encouraging the growth of emergent reeds, grasses and other natural vegetation around the pond will bring more waterfowl and wildlife to the area, they are in favour of it. Because of this, the City of Winnipeg has considered Morley Kare Park as a site for a naturalization project—particularly the two tracts of turfgrass on either side of the lake.

According to Baron, the turfed areas in the park other than the baseball diamond, soccer field and play areas do not get much use, with the turfed hill on the north side of the lake being the least-used area. Among the reasons for avoiding the open stretches are the lack of shaded areas and the lack of shelter from the wind, which makes for discomfort on cool spring and fall days and causes blowing and drifting snow in the winter. The most common complaint about Morley Kare Park is that there are not enough trees.[11] For these reasons, Baron feels that residents would be receptive to naturalization in turfed areas, as

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11 It is possible that residents are also put off by large expanses of grass because they contain few spatial elements to lend a sense of human scale. Kaplan (1985: 125) has observed this reaction elsewhere with regard to community parks:

"Rather than large open areas and mowed expanses...participants expressed a desire for and a delight in smaller areas that have some trees and shrubs."

well as around the lake. He adds that their support would be especially enthusiastic if an information program were successful in extolling the environmental advantages and the potential cost savings (Baron, pers. comm., 1994).

Recruiting both adult and school-age volunteers for tasks such as tree-plantings would not be a problem according to Baron, once the community has learned about the aims of the naturalization program. Successful neighbourhood tree-plantings have been organized in many other municipalities. In Ontario, a parkland reforestation program initiated by the City of North York has resulted in the participation of local residents, school children and Scouts groups in tree planting programs. During an Arbour Day reforesting event in one park, over 1000 woody seedlings were planted over the course of one day (Granger, 1989: 106). The various groups involved in the North York program have continued to volunteer their time, frequently playing a role in monitoring, upkeep and management of the parks after the initial plantings (Hough and Barrett, 1987: 111). Naturalist Cheryl Nielson (pers. comm., 1994) cites a Winnipeg example in which a group of about 60 school children hand-weeded the entire twenty-acre Bradley Field prairie site in less than a day. Getting the community involved in the naturalization project is one of the most effective ways of changing public opinion for the better (Nolan and Smith, 1992: 25).

The City's Parks and Recreation Department has discussed a naturalization plan for Morley Kare Park in meetings with the residents' association, which has expressed enthusiasm for the idea. However, any further development of the site has been shelved for the time being, due to budget constraints. All the standard recreational facilities are in place in the park, including playgrounds, baseball and soccer fields, benches, a basketball court and pedestrian paths. According to Tom Fred of the Parks and Recreation Department (pers. comm., 1994), any further development of the site by the City will probably involve naturalization, and would complement the existing facilities by concentrating on land around the pond and perhaps other turfed areas—spaces not programmed for any specific use in the original design .

Both Baron and Fred maintain that, in order to successfully introduce naturalization into Morley Kare Park, certain resident concerns must be addressed, namely:

> Residents who own property adjacent to the park space do not want the land right next to them to appear unkempt or scruffy; proper edge treatment at the borders of naturalized areas is important.
>
> Any design must address the issue of safety. Naturalized areas must be such that residents would feel safe approaching or walking through them.

A view of the lake from private residential properties is an important amenity; while naturalization can change the look of the lake and surrounding land, it should not block out the view of the lake.

Residents who own waterfront properties must maintain their view and access to the lake shore, and should be able to landscape their properties as they see fit.

5.3) Physical Site Analysis

An analysis of the site was conducted in a series of site visits during the period from January to April, 1994. The key data that were collected during the site analysis are discussed here and represented in Fig. 5.3, "Microclimatic Zones," and Fig. 5.4, "Existing Circulation and Views."

5.3.1) Microclimatic Zones

Since one of the main goals of naturalization is to fit plant communities to regional and site conditions, it is necessary to understand the physical characteristics of the study site. Therefore, the landscape of Dr. Morley R. Kare Park was analyzed in terms of slope, aspect, and elevation in relation to the retention pond.[12] The resultant information was used to define five "microclimatic zones:" hydric, wet-mesic, flat-mesic, sloped-mesic, and xeric zones. They are defined in Table 5.1: "Definitions of Microclimatic Zones." All the site's ecological conditions are collapsed into these five zones for the sake of simplicity, although in reality there are doubtless many more than five sets of conditions. The microclimatic zones determined what sorts of plant communities would be appropriate for different areas within the site.

12 It should be noted that, besides slope, aspect and elevation, soil type and macroclimate are also important factors in determining the make-up of an ecosystem and its plant communities. A detailed soils analysis for the site is beyond the scope of this study. However, some assumptions can be made about the soil profile, based on information about how the site was constructed. The topography of the site was artificially shaped using excavated material from the construction of house foundations, after which topsoil and sod were installed. The City of Winnipeg stipulates that the layer of topsoil on this type of site should be approximately 75 mm deep. The subsoil beneath the topsoil is probably very clayey, with no discernible horizon due to extensive regrading during site construction. Since this soil structure is more or less the same throughout the site, soil characteristics are not considered here among the variables that determine microclimatic zones, for the sake of simplicity.

Beyond identifying microclimatic zones, it would be useful to carry out an inventory of the vegetation communities that are currently found on the site. Even though, at first glance, there appears to be nothing more than turf grasses and specimen trees in the park, an inventory would reveal the extent to which other grass and forb species have become established in the turf. Smooth brome, quack grass, plantain, dandelions and clover are a few of the common plants that would likely be found. Such an inventory, coupled with some knowledge of the location of seed sources near the site, would allow the designer to better expect what plants (wanted and unwanted) would appear on the site once maintenance is curtailed. This would help in budgeting for maintenance during the establishment years—particularly with respect to the extent that weed control would be needed in the turfed areas designated as meadows, which is otherwise difficult to predict. A detailed plant inventory is beyond the scope of this study; but if this type of naturalization project were to be actually implemented, such an inventory would be advisable.

Table 5.1: Definitions of Microclimatic Zones

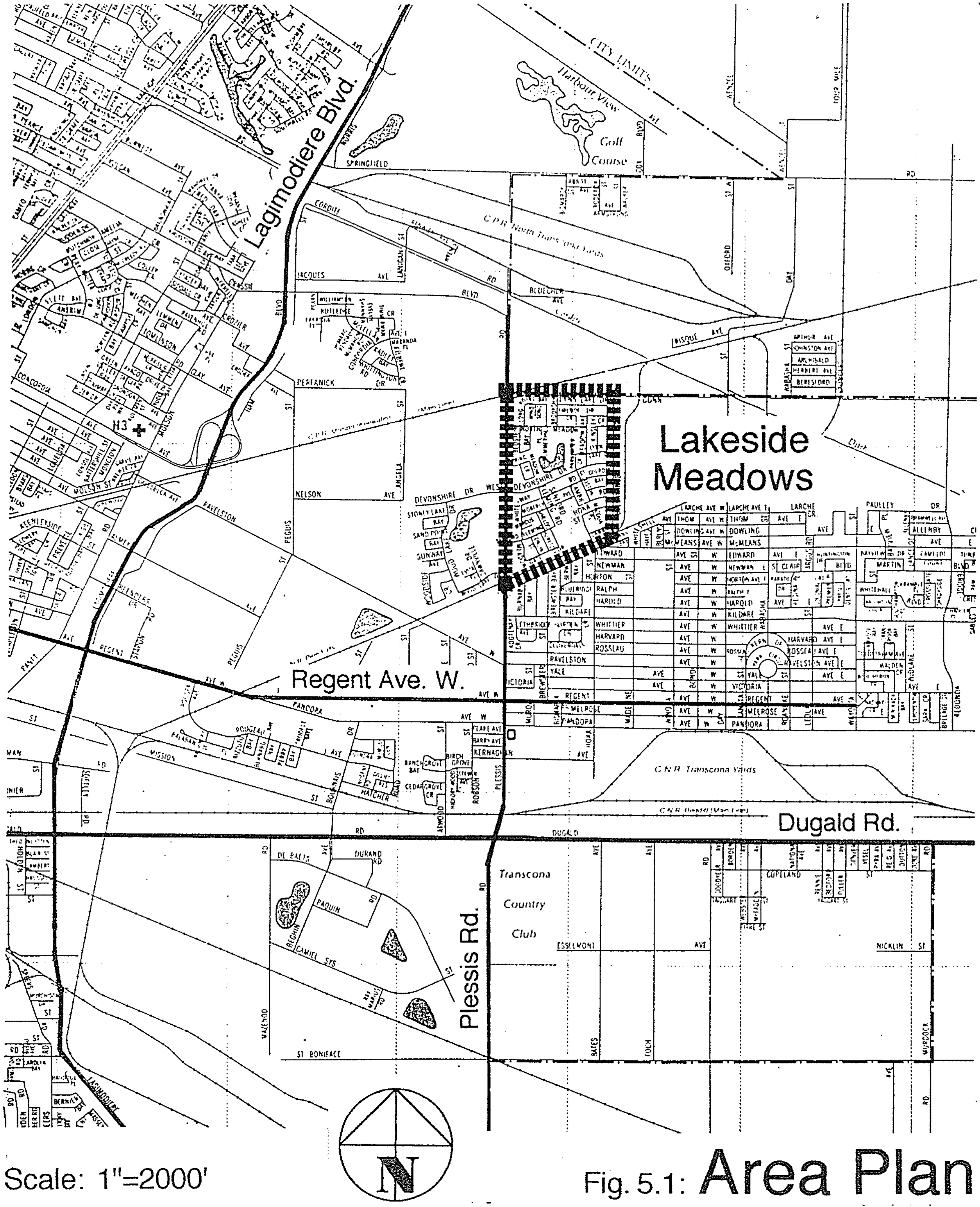
MICROCLIMATIC ZONE	CHARACTERISTICS
Hydric	All slopes and aspects; ranges in elevation from roughly just above the normal water level (NWL) of the retention pond to 1 metre below the NWL.
Wet-Mesic	All slopes; aspects ranging from North to East; ranges in elevation from roughly the high water level (HWL) to the NWL. Also in some swales.
Flat-Mesic	Slopes ranging from 0 to 3%; all aspects; elevations above NWL (except wet-mesic zones).
Sloped-Mesic	Slopes above 3%; aspects ranging from North to East; elevations above HWL.
Xeric	Slopes above 3%; aspects ranging from South to West; elevations above NWL.

5.3.2) Existing Circulation and Sight-Lines

Judging from observing site users and from desire lines evident in the mown turf, much of the pedestrian circulation through the northern portion of the site occurs along the existing crushed limestone path, which enters from North Meadow Drive at the north end of the site, and Blostein Bay and Spring Meadow Crescent at the west end. A fair amount of traffic seems to occur up over the central hill (although it seems as if it was not as well-traversed during the winter months, probably because of the lack of shelter from the wind), as well as between the T-ball diamond and the properties off Summerhill Place, down to the Blostein Bay and Spring Meadow Crescent entrances. These three circulation routes provided clues as to how new pathways should be routed to accommodate existing site use. It is worth noting that the pedestrian entrance from Spring Meadow Crescent is the shortest way for residents coming from the Devonshire Drive side of the park to get to the northern parcel, where all the recreational facilities are located; and even that route is rather circuitous, since pedestrians have to walk through back alleys to get from Devonshire Drive to Spring Meadow Crescent (see Fig. 5.2: "Site Plan"). This inconvenience is another justification for providing a more direct route around or across the pond, aside from the objective of encouraging closer contact with the pond environment.

Since the naturalization plan is to include mass plantings, it is important to consider which sight-lines are important to preserve in the park, both from the point of view of aesthetics and of safety. Many of the residential properties surrounding the park were marketed with a view to the pond as a key selling feature, so it is important to try not to obstruct such views with vegetation. Site visits revealed that there are only two places where there is a clear view to the pond from residential property, where there are no berms in the way and where there is a long enough stretch of water to be visible; from Devonshire Drive, looking across the southern portion of the park to the pond, and from the properties on Summerhill Place, looking across the west miniature soccer field to the pond. New plantings in these areas should not obstruct the view of the water. From all the other residential properties, the main elements of the park that are visible are the berms, plantings and the embankments that surround the ponds. In these areas, preserving the existing view is not as crucial.

The other important sight-lines on the site are the views to the pond at each of the two pedestrian entrances off North Meadow Drive, the view from the existing "lookout" on the north side to the south side of the park and back, and the view of the main hill from the rest of the site. These views can be enhanced in a naturalization plan by, among other things, framing them with vegetation. But they should also be considered from the point of view of safety. The sight-lines to and from all the entrances and from one area of the site to another should be considered when the naturalization plan is being designed. Existing views can be preserved, to ensure that users of the site can survey their surroundings and see the site exits, and thereby not feel threatened by larger areas of vegetation.



Scale: 1"=2000'

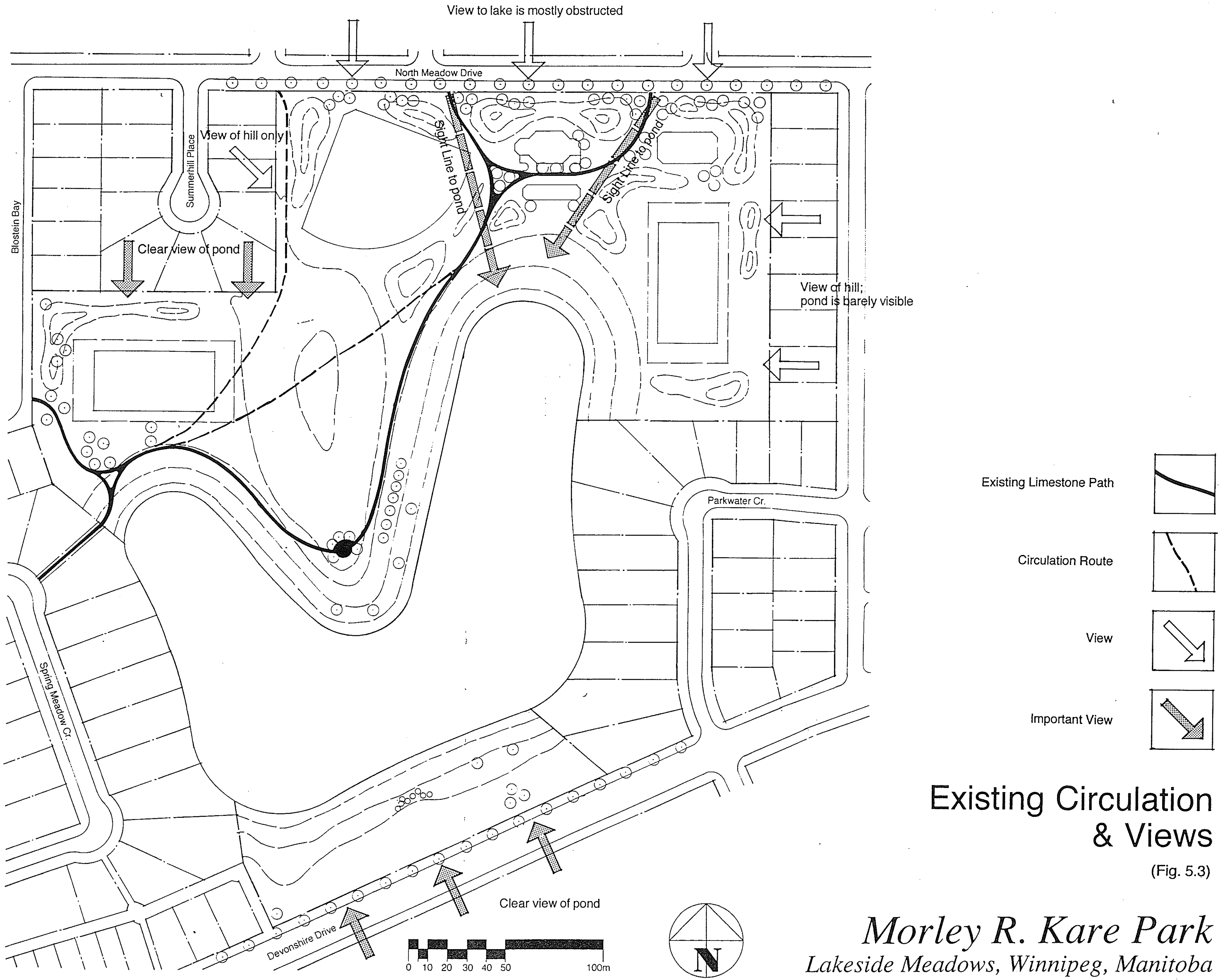
Fig. 5.1: Area Plan

Existing Site Plan

(Fig. 5.2)

Morley R. Kare Park

Lakeside Meadows, Winnipeg, Manitoba

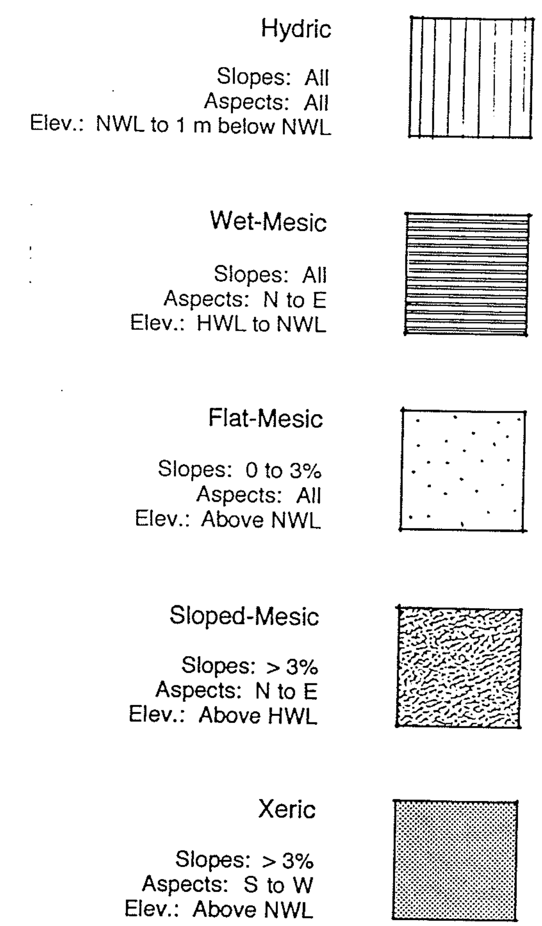


Existing Circulation & Views

(Fig. 5.3)

Morley R. Kare Park

Lakeside Meadows, Winnipeg, Manitoba



Microclimatic Conditions

(Fig. 5.4)

Morley R. Kare Park

Lakeside Meadows, Winnipeg, Manitoba

6) Design Stage

6.1) Design Process

Once the microclimatic zones were identified in the site analysis, the first step in the design process was to decide how naturalization was to be applied in each zone. Eight possible landscape "sub-types" were derived from the various naturalization techniques that were described in Section 4 within the context of the three "landscape types" (open, wooded and wetland communities). The three types and the eight sub-types, along with a summary of their installation and management requirements, are listed in Table 6.1: "Landscape Types and Sub-Types and Associated Implementation and Management Requirements." Each microclimatic zone was evaluated for potential suitability for one of the eight landscape sub-types. The distribution of sub-types through the microclimatic zones is illustrated in Table 6.2: "Distribution of Landscape Sub-Types through Microclimatic Zones."

Besides microclimatic conditions, there were a number of other factors that determined whether or not a particular area was to be naturalized, and in what way. No naturalization was planned for existing sports fields, or the area immediately surrounding the playground facilities. The most important sightlines that were identified in the site analysis were to be preserved, so in those areas nothing higher than tall grasses or low shrubs were included, or else savannah planting was considered.

It was kept in mind during the design process that naturalizing every square metre of the site that does not currently have an explicit use would be very expensive, and might also be too drastic a change to expect the public to accept. Therefore, a substantial portion of the site was left as mown turf, to offset naturalized areas in the form of margins at the edges of the site, ample pathway borders and lawn areas intended for passive recreation. In dividing the site up into areas to be naturalized versus areas to be retained as turf, an effort was made to design naturalized areas in each microclimatic zone. Since plants in each zone are subjected to different conditions, the overall species and community diversity on the site can be maximized by replacing part of the turf in each of the zones.

In order for site users to fully appreciate what the naturalized site will have to offer, an effort was made to route circulation through or adjacent to naturalization in each of the microclimatic zones. This was done with the existing pathway in the northern portion of the park, in an effort to make it more than simply a way of getting from the west to the north side of the site. New pathways, besides being sited where possible along existing desire lines, were routed through a variety of microclimatic zones and plant communities.

Each pathway, whether existing or new, was categorized as either primary or secondary (see Fig. 6.5: "South Dock and Plantings"). Primary pathways are 2.4 metres wide and are bordered with a one-metre strip of mown turf on either side, so that they are perceived as safe, open circulation routes. The secondary paths are 1.8 metres wide, and are not bordered by turf margins. They are meant to provide more immediate contact with naturalized areas.

Table 6.1: *Landscape Types and Sub-Types and Associated Implementation and Management Requirements*

L'SCAPE TYPE	SUB-TYPE	IMPLEMENTATION	MANAGEMENT
Open Areas	Turf	(Existing)	Regular mowing frequency decreased slightly; occasional herbicide treatment on sports fields as req'd (less than once/yr.)
	Unseeded Meadow	Decrease in mowing frequency on existing turf areas	Mowing (2x/year); occasional spot herbicide treatment as req'd; optional occasional burning
	Seeded Meadow	Decrease in mowing frequency on existing turf areas during season before seeding; overseeding in spring after mowing, burning or herbicide	Mowing (2x/year); occasional spot herbicide treatment as req'd; optional occasional burning
	Prairie	Site treated with herbicide or cultivated in spring; then seeded with native species	Mowing (2x/year); occasional spot herbicide treatment as req'd; optional occasional burning
Woodland Areas	Tree Plantations	Planting area cultivated; seedlings/whips planted; weed barrier & mulch installed; weed barrier removed after canopy closure	Regular irrigation for 2 to 4 yrs after installation; regular edge maintenance; occasional thinning as required to preserve sightlines
	Shrub Plantations	Planting area cultivated; seedlings/whips planted w/ Terra-mats; mulch installed	Regular irrigation for 2 to 4 yrs after installation; regular edge maintenance; occasional thinning as required
	Forest	Planting area cultivated; seedlings/whips planted along with shrub borders; weed barrier & mulch installed; weed barrier removed after canopy closure	Regular irrigation for 2 to 4 yrs after installation; regular edge maintenance; occasional thinning as required
Wetland Areas	Wetland	Fill added at various points on shoreline; boardwalk structure installed; existing veg'n allowed to naturalize	Occasional harvesting of emergent plants, and possibly occasional algicide treatment

Table 6.2: Distribution of Landscape Sub-Types through Microclimatic Zones

	LANDSCAPE SUB-TYPE							
M. ZONE	Turf	Unseeded Meadow	Seeded Meadow	Prairie	Tree Plant'ns	Shrub Plant'ns	Forest	Wetland
Hydric								X
Wet-Mesic	X (Existing)	X	X		X	X		
Flat-Mesic	X (Existing)	X	X	X	X	X	X	
Sl.-Mesic	X (Existing)	X	X	X	X	X	X	
Xeric	X (Existing)	X	X			X		

6.2) Design Proposal

The overall design proposal is illustrated in Fig. 6.1: "Proposed Plan," Fig. 6.2: "Sections A-A, B-B and C-C," and Fig. 6.3: "Section D-D." The discussion of the design begins with the smaller, southern parcel of land. Since it is important to preserve the sightlines to the retention pond from the properties on the south side of Devonshire Drive, the area of the southern parcel closest to the street is kept free of shrubs and trees, apart from the existing Colorado spruces. Three entrances provide pedestrian access to the park from the south side. The primary pathway in the middle passes around a small, semi-circular plot of prairie plantings at the edge of the park, which draws people in towards a larger patch of restored prairie that is the main focus of the south side of the park. Interpretive signage at the entrance deals with the subject of prairie restoration, explaining the endangered state of the prairie ecosystem in southern Manitoba, as well as introducing some of the main grass and forb species found in the site. The two secondary pathways on either side pass through an undulating margin of turf that faces Devonshire Drive.

The three pathways all pass through the main prairie area, which covers an area of about one acre (0.4 hectares). This plot is an attempt at an accurate restoration of southern Manitoba's tall grass prairie. The pathways then pass through a semi-circular shrub plantation of species suited to mesic to wet-mesic conditions. in the middle of the shrub plantation is a tree plantation of hybrid poplar and balsam poplar, a species which is appropriate for the low elevation and the north facing slope (see the detail plan, Fig. 6.4:

"South Dock and Plantings"). On either side of this semicircular plantation area, the margin between the prairie and the shore consists of unseeded meadow—the mowing regime on the existing sod is simply reduced to twice a year. During the establishment years, mown margins (the width of one swath cut by a 72" tractor mower blade) are maintained between all the different naturalization areas on the site. When they have established themselves to the point that they have a purposeful appearance, maintenance will cease on the margins and the zones will be allowed to merge.

The three pathways converge at a point on the shore of the pond, where a 2.5 metre-wide permanent wooden dock juts out 5 metres over the water. The dock provides enough room for a small gathering of people, and includes benches. At the end of the deck, a 1.5 metre floating boardwalk begins, which passes over roughly 60 metres of water to the north side of the park (again, see Fig. 6.4). By adding fill along the shorelines and around the dock, aquatic plant growth is encouraged, to provide spatial variety.

The naturalized areas in the southern portion of the park should help alleviate snow drifting in the winter. Currently, a snow fence is erected to keep snow from drifting on to Devonshire Drive in the winter months; vegetation in the proposed plan will do a better job at holding snow than the existing turf does.

Three tree plantations, consisting of equal proportions of trembling aspen and hybrid poplar, are proposed along the edge of the northern portion of the site facing North Meadow Drive. Plantations are appropriate here, since their transparency preserves visual connections between the street and the interior of the park. The plantations incorporate most of the specimen trees that are planted along the berms adjacent to the street. The two pathways off North Meadow Drive are retained, and naturalized areas are set back from these primary pathways so that sightlines down to the pond are unobstructed.

Interpretive signage at each of these entrances presents an introduction to the concept of naturalization. The process of matching different sorts of plant communities to different areas of the park is explained. An "invitation" to take note of the various plants and communities is given, with the promise that more interpretive information is available at the rest area situated at the top of the hill.

A third entrance off North Meadow Drive at the north-western corner of the park has been added, providing access to a secondary pathway that connects up with the existing pedestrian route just above the west "arm" of the retention pond. Between this new pathway and the existing T-ball diamond lies an unseeded meadow, which includes the existing berm. A strip of wet-mesic shrub plantings along an existing swale provides a clear edge to the meadow on the side that faces the residential properties off Summerhill

Place. A similar strip of plantings separates unseeded meadow from the Summerhill Place properties that face south onto the west soccer field.

Most of the area around the playground and swing sets remains in mown turf, due to the heavy use it gets. Unseeded meadow areas are located on the two berms to the north of the playground, immediately south of two of the tree plantations. Between the two berms, mown turf is maintained, to provide visual connection between the playground and the street. A seeded meadow is situated on the berm in the northeast corner of the park, which wraps around the basketball court/ rink area. The berms that surround the east soccer field are converted to unseeded meadows, with ample turf margins separating them from the residential properties on the east side of the park.

Between the swing sets and the east arm of the retention pond, a new secondary pathway loops south off the existing pathway, down to the pond's northernmost shore, and back up around a large seeded meadow to reconnect with the existing pathway. This route takes people past one of the two pine plantations, a seeded meadow, wetland vegetation, a xeric shrub plantation, and a mesic shrub plantation on an east-facing slope. Irregular growth of wetland vegetation on this side of the pond is also encouraged by the addition of fill below the shore.

Another aspen–hybrid poplar plantation is sited on the western edge of the north portion of the park facing Blostein Bay. The existing primary pathway from this side of the park moves past the north side of a small forest and cuts through a meadow, before it eventually leads up to the existing rest area where the Dr. Morley R. Kare cairn is located. The view from the rest area across the lake to the south parcel of land is retained. A new primary pathway leads from the rest area past a small xeric shrub plantation and through a seeded meadow down to the northern terminus of the boardwalk, where a dock like the one on the south side is located.

The hill at the centre of the north portion of the park is the location for the major forest areas. Along with two areas of turf that are provided for passive recreation, two large forest areas—one on the north side of the hill and one on the south side—as well as a xeric shrub plantation, are centred around a node at the top of the hill. The existing primary pathway cuts through the middle of the southern forest area, and a new primary pathway runs adjacent to the west side of the northern forest area, so that there is ample opportunity to observe the different shrub border conditions. Two expanses of turf are retained on the hill, on the south and east slopes, to allow for passive recreation and for tobogganing in winter. The forest areas should offer some shelter from winter winds, which currently can make walking over the treeless hill an unpleasant experience during the winter months.

The rest area at the top of the hill features interpretive signage and benches, and serves as a focal point for the park (see the detail plan, Fig. 6.5: "Central Rest Area"). It is visible from the site entrance off Blostein Bay, as well as from most points along the pathways on the east side of the hill. In the middle of the rest area are four specimen Manitoba maples, which will create an immediate visual impact while the forest plantings are developing. The maples are underplanted with red osier dogwood. The interpretive signage here answers some of the questions posed on the signage at the north entrances to the site, and also discusses the prairie interpretive feature found on the south side of the park. As well, a site plan is located here explaining the techniques and goals associated with the different areas in the park. Everything that is happening on the site is tied together in the context of the broad issue of sustainability. Here, at the focal point of the site, the ecological, social and economic benefits of preserving and reintroducing self-sustaining communities are discussed.

6.3) Installation and Management

The installation procedures and the management plan for the site were developed in tandem with the design. The proposal was designed to minimize costs of installation, and also to minimize long-term management requirements, so that the installation costs could be recouped in as short a period of time as possible. For some of the landscape sub-types, there are more extensive short-term management requirements. This is true both for woodland areas, which require regular irrigation during establishment years, and for prairie and meadow areas, which may require regular control of aggressive weedy species for a year or more until other species have established themselves. For all the landscape types, it is expected that these additional short-term management requirements will be unnecessary within roughly five years of installation. For a brief summary of the installation and management requirements for each of the landscape types, refer to Table 6.1. A detailed inventory of installation and management procedures can be found in the Cost Estimate Tables, in Appendix 2.

i) Turf Areas

There are no installation requirements for turf in the design proposal; existing turf is simply retained in certain areas. The management regime for turf involves a slight decrease in mowing frequency, from the twelve times a year that is current practice to ten times a year. Less mowing is required during the hot mid-summer months, when the cool-season turf grasses are dormant. Irrigation, if it is needed at all, will be done no more than three times a season; when the cool-season grasses are dormant, growth will not be encouraged by watering. Various turf invaders, like plantain, dandelions and clover will be allowed to co-exist with turf-grasses; the minimum standard for mown turf in the design proposal is basically that it is alive and mowable. Occasional herbicide treatment may be required to control large patches of clover, since bees attracted by the flowers can pose a threat to site users, particularly children.

During the design process it became evident that decreasing the area of mown turf on a site does not necessarily decrease maintenance costs. Groups of smaller turf areas can take longer to mow than one big expanse, if they are not arranged efficiently between the naturalized areas. Therefore, remnant turf areas were configured so as to minimize mowing difficulty. For instance, the margin of turf that borders Devonshire Drive on the south side of the park is wide enough to allow a gang mower to mow the entire area without much difficulty, as are the turf margins in the northern portion of the park between the east soccer field and the residential properties off Meadow Lake Drive. Between naturalized areas, margins of turf with a minimum width of five metres allow gang mowers to travel from one turf area to another.

Three quarters of the existing specimen trees on the site are incorporated into forest or meadow areas, which cuts down on the trim mowing requirements for the site. As well, the turf margins on either side of the main pathways are roughly one metre wide , which means they can be cut with one pass of a tractor with a 72" mowing blade. All the turf areas that are to be converted to unseeded or seeded meadows are delineated by standard garden lawn edging, so as to eliminate possible confusion for the mower operators as to where the boundaries between turf and meadow are located. Once the meadows are established, the vegetation will make those boundaries more pronounced.

ii) Unseeded Meadow Areas

Because of the high cost of native grass seed, it was decided that certain areas slated to become meadows do not have to be seeded. As with mown turf, there are no installation requirements for unseeded meadows; mowing is simply reduced to two times a season— once in the spring, and once in the fall. Unseeded meadows are located in areas which are not the most visually important on the site, and in areas where there is the potential for moderate traffic, which could adversely affect the growth of seeded species. The berms to the north-east and north-west of the playground area fall into this category.

Unseeded meadows may have short-term weed problems if an aggressive species like Canada thistle starts to take over, but as previously mentioned, such problems are very difficult to predict. After any initial weed problems are controlled, twice-yearly mowing, occasional manual removal or spot herbicide treatment for weeds, and annual spring or fall clean-up of debris should be the extent of long-term management requirements.

iii) Seeded Meadow Areas

Seeded meadows are located in visually prominent areas of the site. The first step in the installation procedure is to decrease mowing frequency towards the end of the growing season before the seeding is to occur, to encourage the existing turf grass to grow more in a vertical direction, to free more room at ground level for the incoming seeds. The meadows are seeded in the spring, immediately after a mow, so as to curb the growth of the existing cool-season grasses. A higher density of forb species is used at the peripheries of the larger seed meadow areas where they border pathways, to provide visual interest for site users. The exact makeup of the grass and forb seed mix will vary from meadow area to area, depending on what type of microclimatic zone a particular meadow is in. Where appropriate, short, drought tolerant grasses such as blue grama and porcupine grass are used, to provide a low-maintenance meadow of vegetation under about two feet in height (See Table 1.1 in Appendix 1 for appropriate species for wet-mesic, mesic and xeric conditions, as well as short grass species for meadow use).

As is the case with unseeded meadows, it can be reasonably assumed that the long-term maintenance regime for seeded meadows will involve little more than mowing two times a season, occasional spot weed control and annual site clean-up. Short-term weed problems following seeding might occur and would have to be controlled, although the presence of seeded species may lessen the potential for this to happen.

Since occasional burning is part of the maintenance regime for the prairie area in the proposed plan, both the unseeded and seeded meadows could also be burned at the same time, to help eliminate dead plant litter and to keep aggressive weed species in check. To minimize smoke problems, individual meadow areas could be burned on a yearly rotation system, rather than burning all the meadow areas at the same time as the prairie is burned.

iv) Prairie

The installation of the prairie area on the south side of the park involves an initial herbicide treatment to eliminate existing turf grasses, before seeding with native prairie grass and forb species is done with a seed-drill. Since the area on the site that the prairie is to occupy is classified as mesic, species listed under the mesic category in table 1.1 in Appendix 1 could be used.

The maintenance regime for the prairie would be similar to the regime for the meadow areas, in that the need for short-term weed control would eventually decrease to a point that occasional burning and spot weed control would be sufficient. Although one prairie restorationist recommends that burning be done every other spring for roughly the first ten years after establishment (Schramm, 1990: 170), others maintain that a burn once every three to seven years is sufficient (Nielson, pers. comm., 1994). In either case the frequency can be reduced after the prairie is well-established (Schramm, 1990: 170).

v) Tree Plantations

Installation for tree plantations involves cultivation of the site with a roto-tiller before planting in spring. Plantings are spaced at 1.5 metres on centre, in rows 1.5 metres apart. The deciduous species mix consists of 50% trembling aspen and 50% hybrid poplar, except in the plantation on the south side of the pond, which is planted with 50% balsam poplar and 50% hybrid poplar, because of the wet-mesic conditions. Ideally, the plantations would consist entirely of trembling aspen, but since it is expensive to obtain, half of it is substituted with hybrid poplar, which is available from the Prairie Farm Rehabilitation Administration (P.F.R.A.) for the cost of transportation only. The suckering tendencies of trembling aspen will ensure that the tree plantations will be sustainable over a long period of time, even after the hybrid poplars die off. The two pine plantations consist entirely of Scots pine seedlings, except for one large specimen Scots pine in each of the two areas, included for immediate visual impact.

After the seedlings are planted, plastic weed barrier is laid over the area and perforated with holes for the seedlings and to allow moisture to reach the soil. Wood mulch is then spread over the area. The plastic weed barrier is removed when the canopy of the plantings has closed, which is estimated to take about five years.

Management of the savannah areas is minimal; edge maintenance and periodic thinning of the poplars (and of any shrub species that appear) to maintain sightlines through the areas should be all that is needed.

vi) Shrub Plantations

The installation procedure for shrub plantations is similar to the procedure for tree plantations, except that a bio- and photo-degradable weed barrier called "Terra-Mat"[13] is used in place of plastic barrier. The Terra-Mat is available in three-foot-square units, which are installed around each plant. Since the plants in the shrub plantations are spaced at 1.0 metres on centre in rows 1.0 metres apart, almost all of the ground plane is covered by the

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13 The "Terra-Mat" product is available from Forest Suppliers Inc. (205 Rankin Street, P.O. Box 8397, Jackson, Miss., Postal Code 39284-8397, Ph. 601-354-3565), and is advertised in their 1994 catalogue.

Terra-Mats. The advantage they offer is that they do not have to be eventually removed, unlike plastic weed barrier.

The species used in the shrub areas will depend on the microclimatic zone. Species suited to sun and dry conditions, as well as species suited to shade and wet conditions, are listed in Table 1.2 in Appendix 1. Roughly 90% of the species in the shrub plantations are available from P.F.R.A. The remaining 10% include species that are not normally carried by P.F.R.A., such as saskatoon and American hazelnut. Most of the species to be planted are P.F.R.A. available, to reduce costs.

The management requirements for the shrub plantations, as with the tree plantations, are minimal; besides edge treatment, occasional thinning of taller shrubs and volunteer tree specimens may be needed to preserve any important sight-lines.

vii) Forest

The installation procedures for forest are the same as for tree plantations; cultivation is followed by planting and the installation of plastic weed barrier (which must be removed after canopy closure) and a layer of wood mulch. Tree seedlings are planted at 1.5 metres on centre. The species mixture consists of 75% pioneer species, and 25% sub-climax and climax species, planted randomly amongst each other. Of the pioneer 75%, 45% are hybrid polar, 20% are Manitoba maple, and 10% are trembling aspen. As is the case in the plantations, the hybrid poplar is an economical substitute for trembling aspen, of which there is only 10% since it is the only species included that is not available from the P.F.R.A. The Manitoba maple is included as a pioneer species because it will show rapid growth under full sun, but it could also be considered to be part of the sub-climax group, because it is long-lived compared with the poplars, and will tolerate shade once the forest is established. Of the 25% sub-climax/ climax group, 12% are bur oak, 10% are green ash, and 3% are white spruce. Fig. 6.6: "Planting and Development of Forest Areas" shows the planting pattern and intended development of the forest plantings.

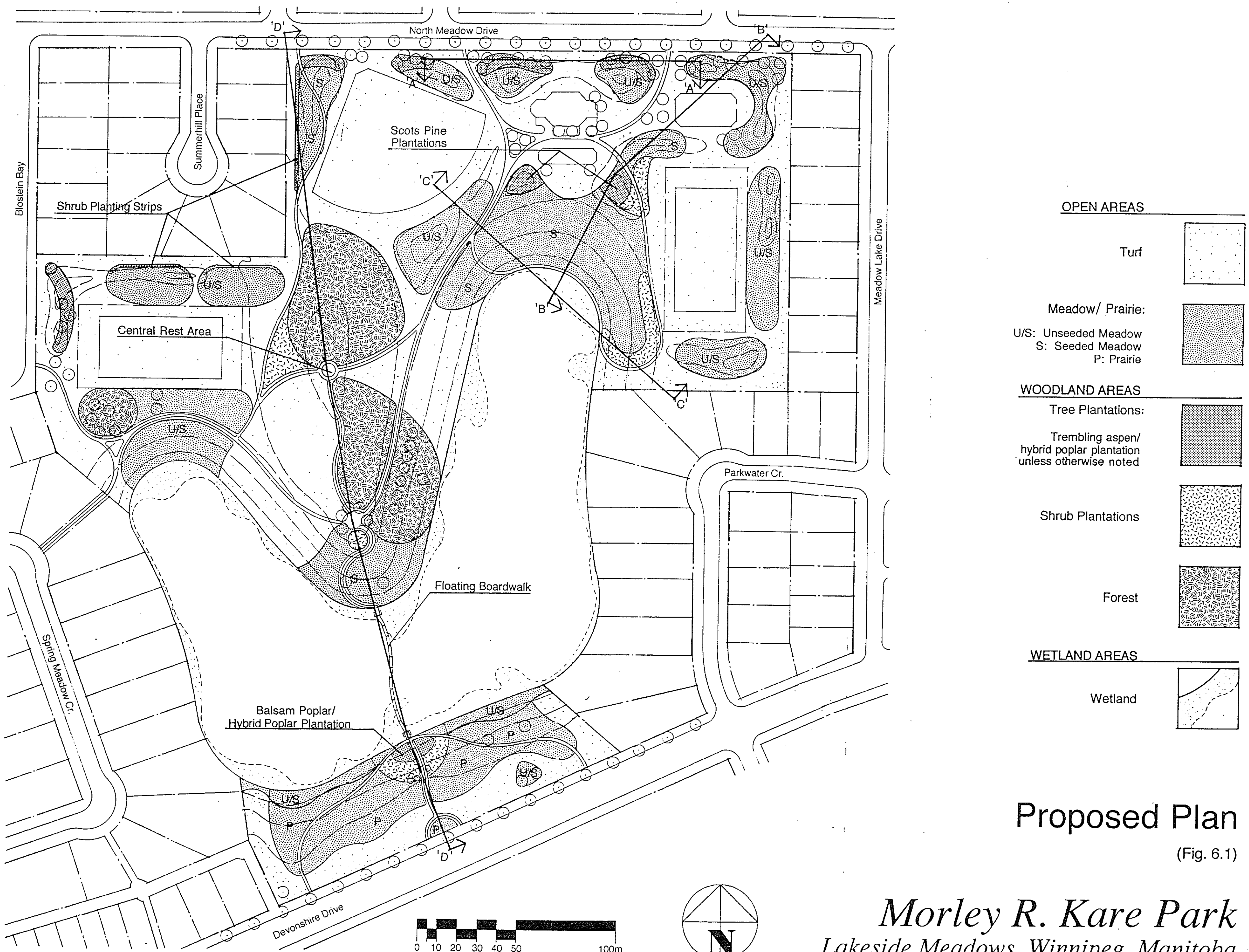
The shrub borders around the forest plantings differ according to what sort of microclimatic zone they occupy. Appropriate species are listed in Table 1.2 in Appendix 1. As in the planting areas consisting entirely of shrubs, the mix is here is 75% P.F.R.A. available species and 25% other species. The shrub borders are 1.5 metres deep, and shrubs are staggered within the 1.5 metre margin at 1.0 metres on centre. Herb stratum plants are not included in the forest area installations, due to the costs involved. A community volunteer effort could be co-ordinated to plant herb stratum plants within the forest after the weed barrier has been removed and the mulch respread; otherwise they will eventually colonize the site naturally. Table 1.2 in Appendix 1 also includes a list of herb stratum species commonly found in the aspen forest.

As with the shrub and tree plantations, management requirements for the forest areas are minimal, after the weed barrier has been removed. One eventual management objective could be to cut secondary paths through the interior of the forest areas, although children in the community might eventually create their own trails without any formal organized effort.

viii) Wetland

The only installations proposed for the retention pond are, firstly, the addition of fill along the shelf around the perimeter of the pond just below water level, so as to vary the spatial character and ecology of the wetland; and secondly, the construction of the boardwalk that connects the two sides of the park. The floating portion of the boardwalk is constructed in segments that are tethered to posts driven into the pond bottom.

Management requirements include occasional harvesting of emergent plants and possible occasional algicide treatment. Access for harvesting vehicles is provided at the west end of the south portion of the park, via the lane off of Devonshire Drive. The frequency of each of these is reduced significantly from present levels. The only other management need is the annual installation of the floating portion of the boardwalk in spring, and its removal before the pond freezes up.

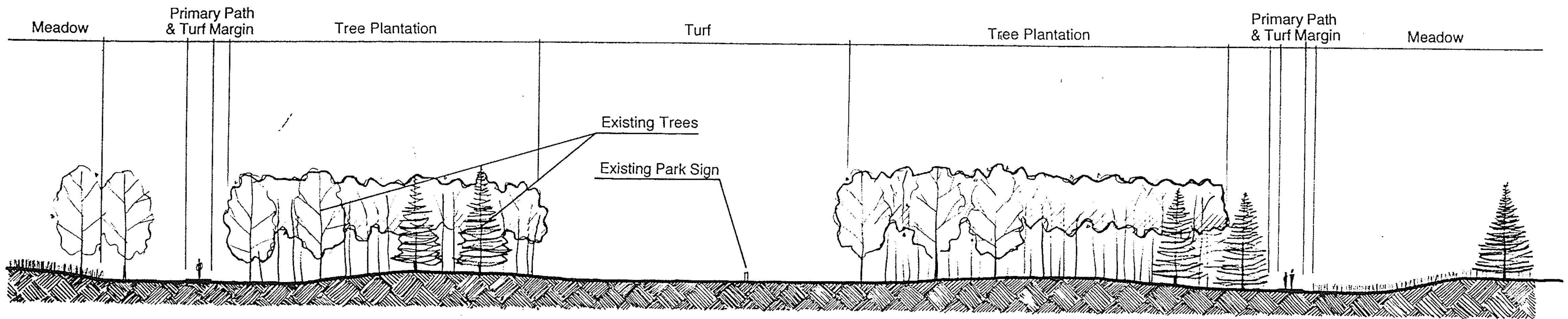


Proposed Plan

(Fig. 6.1)

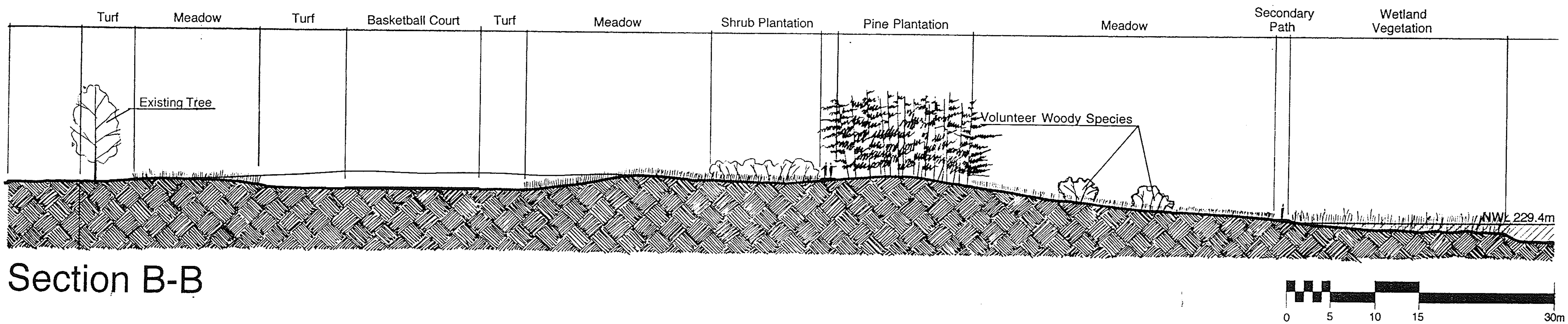
Morley R. Kare Park

Lakeside Meadows, Winnipeg, Manitoba

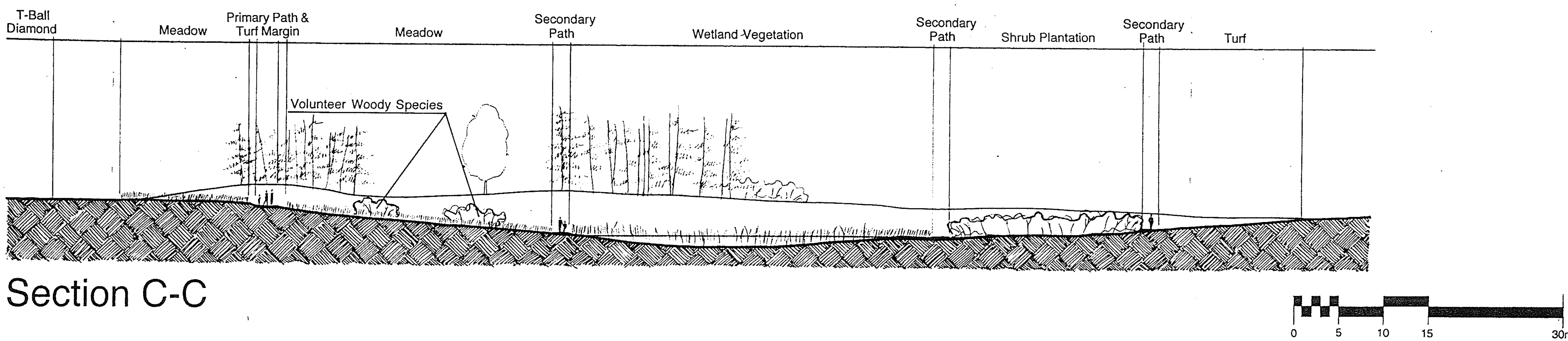


Section A-A

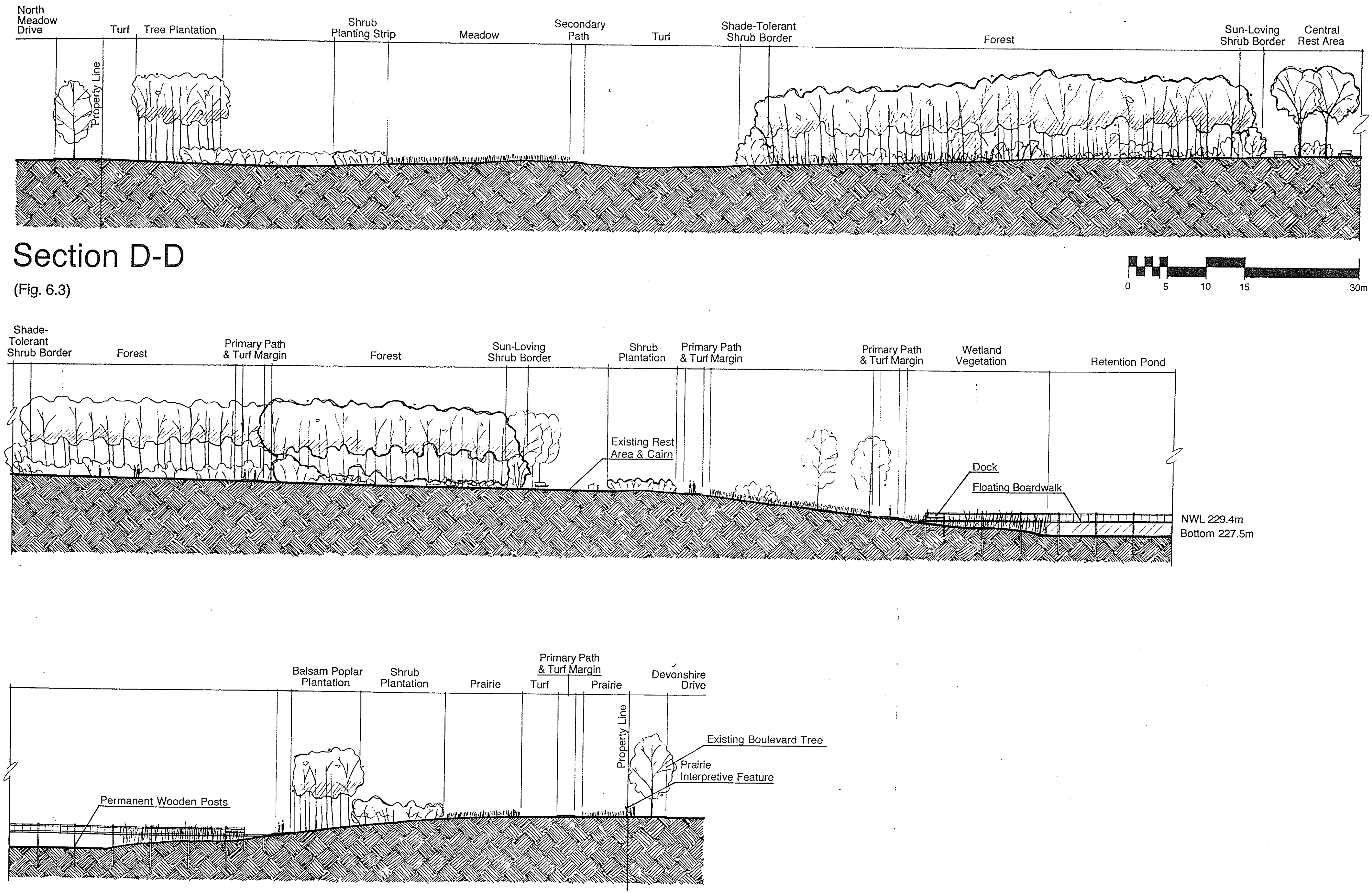
(Fig. 6.2)



Section B-B

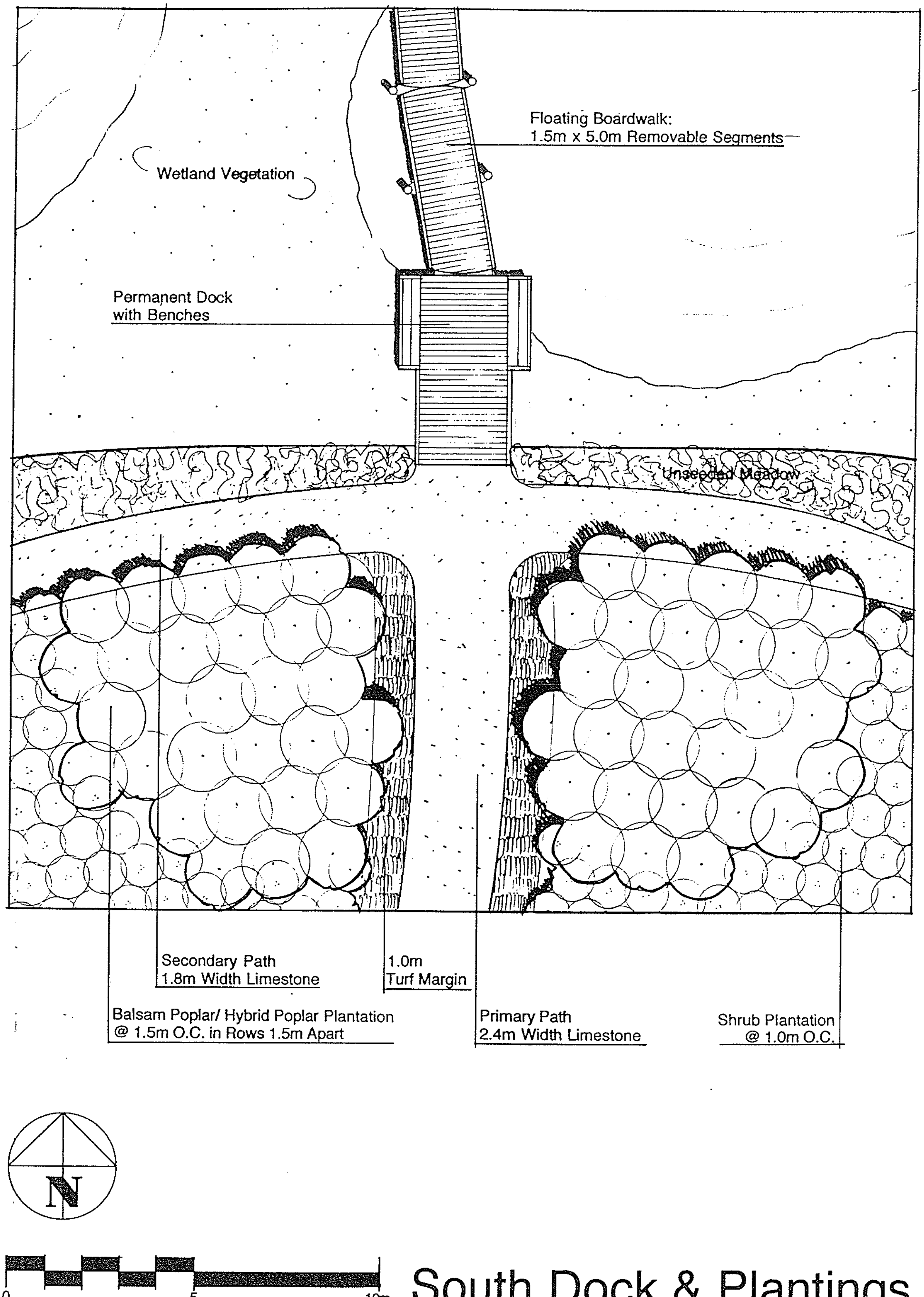


Section C-C



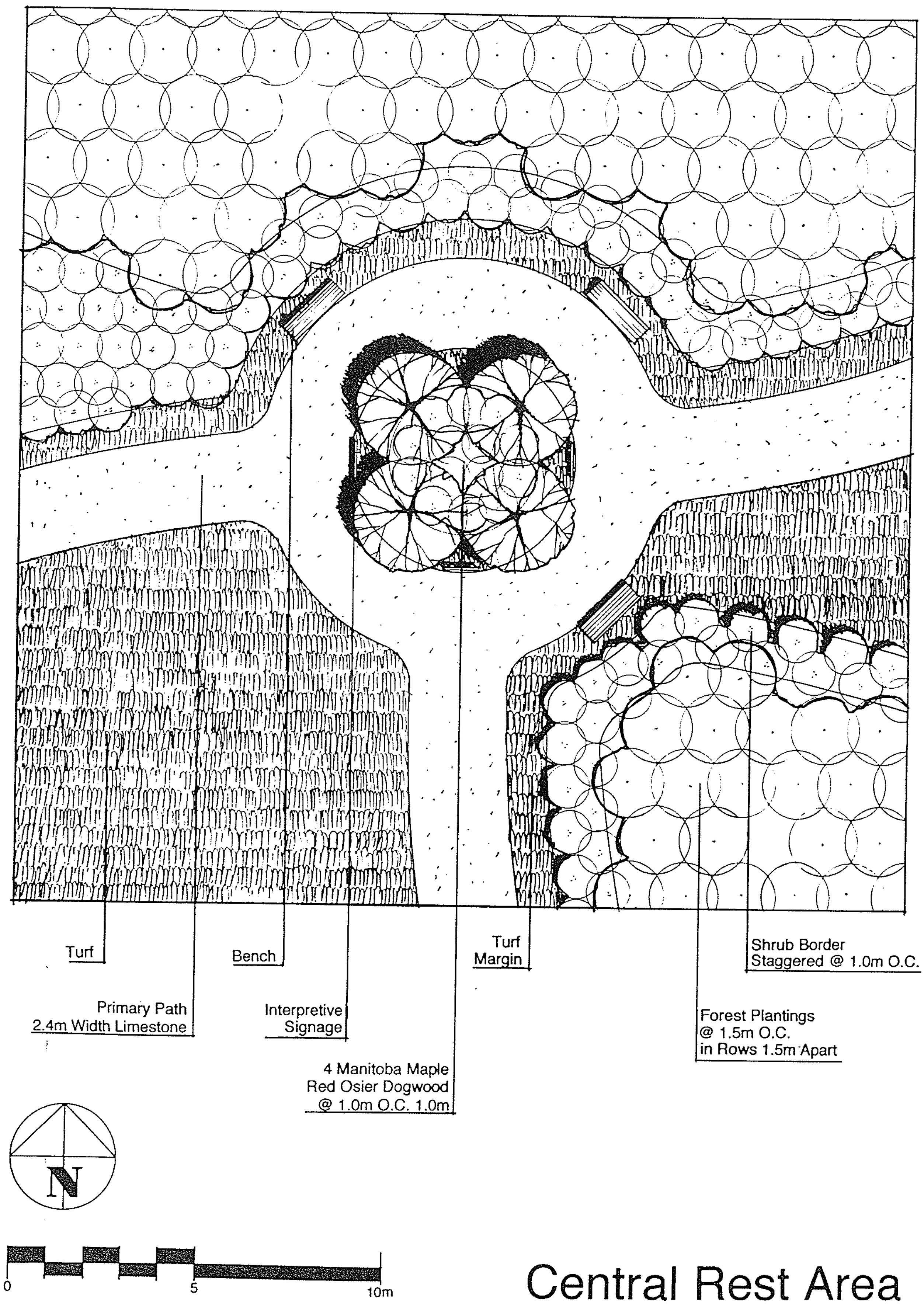
Section D-D

(Fig. 6.3)



South Dock & Plantings

(Fig. 6.4)



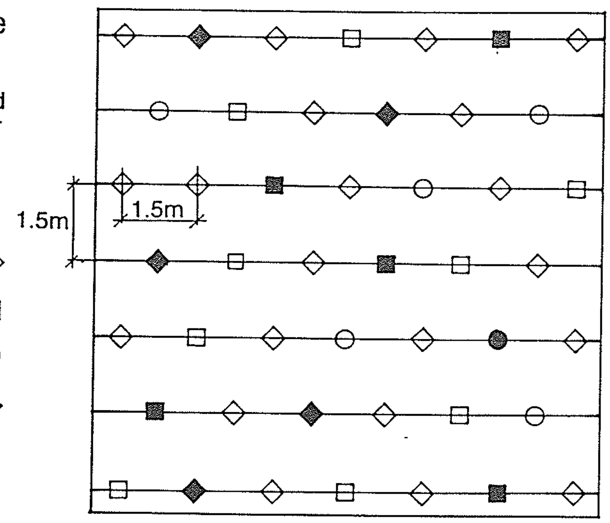
Central Rest Area

(Fig. 6.5)

1. Planting Procedure

Seedlings planted in rows to facilitate installation and removal of plastic weed barrier

Hybrid Poplar	45%	◇
Manitoba Maple	20%	□
Trembling Aspen	10%	○
Bur Oak	12%	◆
Green Ash	10%	■
White Spruce	3%	●

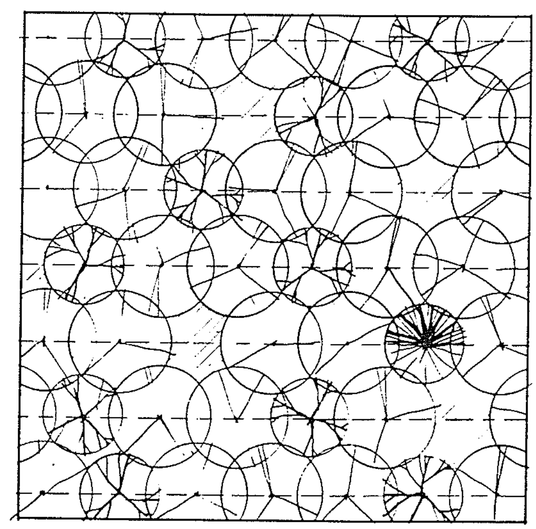


2. After Canopy Closure

Plastic barrier is removed, mulch respread

Some gaps left by die-off of plantings

Closed canopy creates optimum growing conditions for secondary tree species



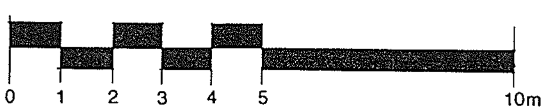
3. Mature Forest

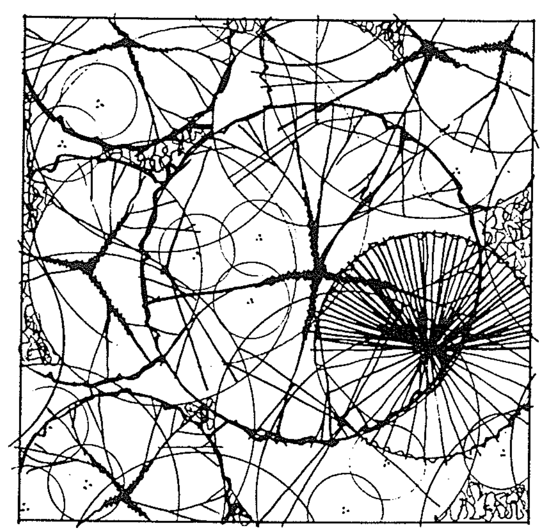
Pioneer species plantings eventually die off

Secondary species canopy closes

Volunteer trees, shrubs and herbs take root on the forest floor

Original planting grid becomes less and less evident





Planting and Development of Forest Areas

(Fig. 6.6)

6.4) Cost Analysis

Proponents of naturalization have often contended that, although costs of implementation may be high, reduced long-term maintenance costs make naturalized landscapes more economical than conventional open space. For instance, in the reforestation projects carried out in North York, it was calculated that, while an acre of traditional parkland had a three-year maintenance cost of $44,028, the cost of maintaining a one-acre reforested site over the same period of time was only $4,800 (Granger, 1989: 107-108). While a naturalized landscape is in the early establishment phase, maintenance costs admittedly may exceed those associated with a traditional landscape. Much of the cost, however, is in work-hours. Installation and maintenance for the naturalized landscape are labour-intensive, and do not rely so much on non-renewable resources. In contrast, conventional maintenance is more energy-intensive; it necessitates higher use of fuel and chemicals (Emery, 1986: 139). Manpower is a renewable resource; indeed, increasing dependency on labour instead of non-renewable resources is a step towards economic sustainability in that it creates employment opportunities. Thus the "low-tech" requirements of naturalized landscapes foster economic as well as environmental sustainability.

Naturalization techniques are site-specific; rather than determining the character of the site, they are to a large extent determined by it. The degree of the management that is necessary only becomes evident as the naturalization project progresses. Consequently, it is difficult to come up with reliable cost projections. Precedents are only partially helpful since they are by nature site-specific. Thus the North York results, while showing that cost savings are possible through naturalization, reveal little about costs in a suburban community park in Winnipeg. A further complication is the fact that the naturalization project proposed here would seek the volunteer involvement of the community. The extent to which volunteers would become involved in installation and management is difficult to gauge without actually initiating the project and finding out how involved the community becomes. Therefore projected naturalization costs should be regarded as rough estimates at best.

Installation and maintenance costs have been estimated for the proposed design. and are listed in a series of tables in Appendix 2. Included are existing annual maintenance costs for the study site, installation costs and projected annual maintenance costs for the design proposal, long term cost comparisons between existing and proposed conditions, and installation and maintenance costs per hectare. All costs are given in 1994 dollars.

There is a significant difference between the maintenance costs for the existing site conditions and the projected maintenance costs for the proposal after the naturalization areas have become established. The present annual maintenance costs are $17,713, while the projected annual maintenance costs for the proposed plan five years after installation are $13,497; maintenance costs are reduced by roughly 25%. This percentage is larger, if the maintenance items that remain unchanged from the existing conditions to the proposed conditions are excluded from the calculations—items such as the maintenance of the playground area and annual preparation of the sports fields and rink area. Excluding these items from the total, the maintenance costs are reduced by over 40% (See Tables 2.1 to 2.4 in Appendix 2).

During the establishment years, however, maintenance costs are higher than the existing costs; For years one and two, they are $29, 415 annually, and during years three and four, they are $14,831 annually. These high costs are accounted for primarily by irrigation requirements for the tree and shrub plantations and forest plantings. During year one, they are irrigated 24 times (once a week), and during years two, three and four, 12, 2 and 2 times respectively. These estimates may actually be higher than necessary, since, depending on how well the plantings are established after year one, little irrigation may be needed in subsequent years.

The major expense of the naturalization proposal is the capital cost of installation (See Table 2.5 in Appendix 2). The total cost, including eventual removal of weed barrier and an allowance for replacement of dead plantings, is $146,453.[14] The major components of this figure are the supply and installation of the tree and shrub plantings and the accompanying weed barrier and mulch, as well as the installation of additional crushed limestone paths and the boardwalk across the retention pond.

This installation figure assumes that there is no volunteer involvement from the community in the installation of the proposed plan. In this sense it could be called a "maximum cost estimate." Table 2.6 in Appendix 2 outlines a "minimum cost estimate," which is calculated with the assumption that substantial volunteer labour is used, and a major structural element is eliminated. In this alternative scenario, the plantings, mulch, weed barrier and the edging around the naturalized areas are installed by volunteers from

14 This figure does not include the cost of installing lighting along the existing main pathway through the north portion of the site. Since lighting is necessary if the park is to be used at night whether or not any further development takes place, the cost is not specifically attached to a naturalization scheme. If light standards were to be installed along the main path, 16 would be necessary at a spacing of 30 metres O.C. A supply and installation cost of $3,500 per unit, coupled with a $5,000 allowance for installing a service to the park, adds up to a total installation cost of $61,000 (City of Winnipeg Parks and Recreation Department).

the community. As well, the cost of the boardwalk is eliminated. This could mean that the boardwalk itself is eliminated from the design—in which case the pathways that run alongside the pond shore on the north side would become the main areas where wetland could be experienced—or else it could mean that funds for the boardwalk are generated by some other means. With these changes, the installation cost for the proposed plan is lowered to $69,497.

The costs of installation become important when they are put in the context of the existing versus proposed annual maintenance costs. Although a naturalization plan can be justified in terms of ecological sustainability and qualitative benefits for the community, the best way to justify the high costs of installation and initial maintenance is to demonstrate that lower annual maintenance costs over the long term will result in a recouping of the initial costs. Table 2.7 in Appendix 2 shows the number of years it will take for this to happen if the proposed plan is implemented, starting first with the maximum cost estimate for installation, and then with the minimum cost estimate. With the maximum cost estimate for installation, the turnaround period is 43 years. With the minimum, it is reduced to 25 years. Therefore, generally speaking it can be said that, if the proposed plan were to be implemented, savings would begin at some point between 25 and 43 years. It is clear from these figures that community involvement is central in achieving success in as short a time as is possible.

Not included in these calculations is the fact that a naturalization plan may increase property values in the neighbourhood. This could only have a beneficial effect in terms of public approval of the project. Residents may be more willing to accept the length of time required to recouped capital costs if they know that, as the naturalized areas become established, the value of their homes and property will likely increase.

Table 2.7 in Appendix 2 shows installation and maintenance costs per hectare for each naturalization technique or "landscape sub-type," as well as for conventional turf. The most expensive naturalization techniques are the woodland types—tree plantations, shrub plantations and forest areas—at roughly $80,000 per hectare to install. Seeded meadows are the least expensive to install into existing turf (not including unseeded meadows, which cost nothing to install) costing $4,106 per hectare. From these figures it can be deduced that one way to further reduce installation costs in the proposed naturalization plan would be to reduce the net area of woodland plantings and increase the meadow areas. The qualitative benefits that the woodland plantings bring to a site, however, justify at least some added installation expense. The costs for woodland installations are not unreasonably high, when compared with the installation cost per hectare for conventional turf, including topsoil, which is $50,000 (See Table 2.7 in Appendix 2). It is worth mentioning that the installation cost for turf makes a strong case for preserving as many existing woodland areas as is feasible when public greenspaces within new developments are constructed, and limiting turf areas to only what is necessary.

As would be expected, the maintenance costs per unit hectare for the naturalized landscape sub-types included in the proposal are all lower than the maintenance cost for conventional turf. The naturalized costs range from negligible amounts for woodland plantings (not including edge turf maintenance) to $575 per hectare for restored prairie. The cost for conventional turf is $933 per hectare, roughly 40% higher than the cost for prairie. These figures clearly demonstrate the advantage of complementing turf with naturalized areas. The projected maintenance savings from the proposed design are not as pronounced as the savings evident in these per hectare figures, probably because the turf remaining in the proposal is somewhat more difficult to maintain than an uninterrupted expanse of turf, despite efforts to make maintenance as simple as possible. The extent of the savings from introducing naturalized areas will probably vary from site to site, depending on the configuration of each particular site.

7) Conclusions and Recommendations

This study has explored the principles and techniques of naturalization and their connection to the concept of sustainability. Naturalization techniques have been applied in the redesign of public greenspace in an existing suburb in Winnipeg, Canada. The general issue of public perceptions of conventional versus naturalized greenspace has been explored. Specifically, through previously conducted surveys, the opinions of residents of the study site were analyzed to determine whether the community would favour a naturalization redesign of their public greenspace. From this analysis, it has been concluded that there is potential public support for such a project. A cost analysis has been done for the proposed naturalization redesign, and it is evident that, though installation and short-term maintenance costs are high, maintenance costs over the long run are lower than those for a conventional turfed landscape. The main conclusions that can be drawn from the study are summarized below.

1. Naturalization of greenspace contributes to the goal of sustainability, in that it creates landscapes that have better self-sustaining capabilities than does conventional urban and suburban greenspace. Less input of energy and resources is needed, which takes less of a toll on the larger environment. Naturalized greenspace also provides better wildlife habitat than does conventional greenspace.

2. There are qualitative benefits to naturalization that go beyond empirical sustainability. The ecological and spatial diversity it brings into a built environment can enhance the aesthetic appeal of that environment. Through the fitting of particular plant communities to particular conditions, it can provide a sense of identity to relieve the often generic character of suburban environments. The immediate contact with natural processes afforded by naturalized space has great educational value—especially for children—in that it can instill an appreciation for the natural world.

3. In defining an approach to naturalization, "functional restoration" rather than "full restoration" is usually the most prudent approach to take, though full restoration is valuable in that it is an attempt to restore as faithfully as possible a vanished or degraded landscape. The aim of functional restoration is that a site should function as an ecosystem with diversity and self-sustaining ability *similar* to

its previous natural state. This allows for the presence of non-native plant species, and generally is a less costly naturalization route.

4. Certain design guidelines should be followed in the implementation of a naturalization plan in a residential suburb, to ensure that it appears to the public as a worthwhile and purposeful undertaking. Borders around naturalized areas should be well-maintained, particularly in areas abutting private residential property. Structural elements should be present to offset the "wildness" of the naturalized areas. Wherever possible, elements that present an immediately "complete" appearance should be included in the design, to maintain the patience of the public until the naturalized areas become established. A variety of plant species should be used to create visual and spatial diversity, which are often lacking from the suburban environment.

5. Since naturalization introduces an element of wildness into the suburban landscape, care should be taken to eliminate any perception of danger within the site. Circulation and activity areas should have clear physical and visual linkage to the outside of the public open space. Naturalized areas should be set well back from main pathways, and should be regularly checked for vandalism, since vandalized areas or objects attract more vandalism.

6. After installation of a naturalization plan, the most important short-term management concerns are the control of aggressive, weedy species while new plantings establish themselves, and the regular irrigation of new planting areas. After establishment of the naturalization plantings, maintenance requirements should be minimal compared with those associated with conventional public greenspace.

7. In deciding what sorts of plant communities should be introduced into an existing greenspace, the various microclimatic conditions present on the site should be identified. Then plant species, both native and non-native, should be chosen that are known to do well in each particular zone of microclimatic conditions.

8. Besides establishing self-sustaining plant communities, a naturalization plan for a site should provide users with opportunities to experience and learn about the naturalized site. This can be accomplished by routing pathways through a variety

of naturalized areas, as well as by providing interpretive signage in key areas of the site.

9. Decreasing the total area of mown turf on a site does not necessarily result in a proportional decrease in maintenance costs. Smaller areas of turf that are harder to mow can be as expensive to maintain as one large expanse of turf. Therefore, mowing regimes must be kept as simple as possible on remaining areas of turf in order to cut costs.

10. If the proposed naturalization plan for the study site were to be implemented, annual maintenance costs would eventually be reduced from existing annual costs by 25%. If only the greenspace areas are included in the calculation, and the features of the park that are to remain unchanged are omitted, the annual maintenance costs are reduced by 40% from the present level. However, in the short term, the proposed plan costs more than maintaining existing conditions because of installation costs and short-term maintenance costs.

11. For the proposed plan, the amount of time required for lower long-term maintenance costs to balance out installation and initial maintenance costs is 43 years. Community involvement is the most feasible way to decrease this amount of time; if volunteer labour is provided by the community (and the floating boardwalk is eliminated), the amount of time required to balance out initial costs is can be reduced to 25 years.

12. A comparison of installation and maintenance costs per hectare for turf and various types of naturalized areas shows that meadows are the least expensive naturalized landscape type to install. Woodland naturalization is the most expensive to install, but is still less than twice the cost of turf installation. All naturalized areas have lower maintenance costs per hectare than does turf, which in part justifies their higher installation costs.

This practicum has addressed some of the aspects of the broad topic of naturalization, but it has also raised many more issues that are worthy of further study and action. Following are recommendations on issues that have been raised during the course of this practicum:

1. A naturalization plan such as the one outlined in this study should be implemented in the Winnipeg region, so that it can serve as a test project that could provide valuable information for future naturalization projects.

2. "How-to" guides to naturalization and to community organization should be prepared, that provide instructions for neighbourhood residents—who do not necessarily have expertise in landscape design and planning—on how to implement a naturalization plan.

3. Interpretive material should be developed from academic research and from projects that have been implemented, that can help market the principles, techniques and processes of naturalization to the public and to governments. "Time-lines" showing how long it takes for naturalized areas to develop and for costs to be recouped should be included in the interpretive material.

Although the 25 to 43 years needed to realize the cost benefits of the plan proposed in this study could be considered a long period of time to have to wait, there *are* eventual savings, which probably could not be said for any conventional redesign scheme for the study site. The lengthy turnaround time is justified by a number of other benefits that a naturalization redesign plan can bring. If it were implemented, this project could serve as a pilot study for naturalizing other suburban public greenspaces. Lessons learned by trial and error on this project would translate into more efficient installation and management techniques for the next project, which would produce savings in a shorter period of time.

The qualitative benefits alone are arguably worth the expense of undertaking a naturalization project. Though many residents of a neighbourhood like Lakeside Meadows may not still be living in the neighbourhood when the project finally begins to pay for itself, there is value in taking part in a project that seeks to involve and bring together the community in achieving a more sustainable environment.

Through naturalization, a generic suburban open space—indistinguishable from so many others across North America—can be transformed into a unique focal point for the community, by bringing out a sense of the uniqueness of one particular place. Naturalization can provide a community with an immediate connection to natural processes, so that the traditional notion that humans should control nature can begin to be replaced with an ethic of sustainable land stewardship—one that accepts that future development must work *with* the natural world rather than against it.

Appendix 1: Species Lists

Table 1.1:	*Grass and Forb Species for Tall Grass Prairie Restoration and Meadow Naturalization*
Table 1.2:	*Plant Species for Woodland Community Naturalization (Forest, Shrub Plantations and Tree Plantations)*
Table 1.3	*Macrophyte Plant Species present in Winnipeg's Stormwater Retention Ponds*

*Table 1.1: Grass and Forb Species for Tall Grass Prairie Restoration and Meadow Naturalization**

SITE DESCRIPTION	COMMON NAME	BOTANICAL NAME
Mesic Conditions	GRASSES:	
	Big bluestem	*Andropogon gerardi*
	Little bluestem	*Andropogon scoparius*
	Indian grass	*Sorghastrum nutans*
	Canada wild rye	*Elymus canadensis*
	Porcupine grass	*Stipa spartea*
	June grass	*Koeleria cristata*
	Prairie dropseed	*Sporobolus heterolepus*
	Wheat grasses	*Agropyron spp.*
	FORBS:	
	Northern bedstraw	*Galium septentrionale*
	Canada anemone	*Anemone canadensis*
	Canada goldenrod	*Solidago canadensis*
	Prairie or wood lily	*Lilium philadelphicum*
	Prairie rose	*Rosa arkansana*
	Black eyed susan	*Rudbeckia hirta*
Wet-Mesic Conditions	GRASSES:	
	Prairie cord grass	*Spartina pectinata*
	Slough grass	*Beckmannia syzigachne*
	Switchgrass	*Panicum virgatum*
	Canada wild rye	*Elymus canadensis*
	Alkali cord grass	*Spartina gracilis*
	Nuttall's alkali grass	*Puccinellia nuttalliana*
	Northern reed grass	*Calamagrostis inexpansa* var. *brevior*
	FORBS:	
	Canada goldenrod	*Solidago canadensis*
	Baltic rush	*Juncus balticus*
	Canada anenome	*Anenome canadensis*
Xeric Conditions	GRASSES:	
	Stipas	*Stipa spartea, Stipa spp.*
	June grass	*Koeleria cristata*
	Side-oats grama	*Bouteloua curtipendula*
	Blue grama	*Bouteloua gracilis*
	Western wheat grass	*Agropyron smithii*
	FORBS:	
	Leadplant	*Amorpha canescens*
	Rhombic-leaved sunflower	*Helianthus laetiflorus* var. *subrhomboideus*
	Missouri goldenrod	*Solidago missouriensis*
	Silverleaf Psoralea	*Psoralea argophylla*
	Prairie or wood lily	*Lilium philadelphicum*
	Prairie rose	*Rosa arkansana*
	Dotted blazingstar	*Liatrus punctata*
	Prairie sage	*Artemesia frigida*

(CONTINUED)

For use in meadows (short, drought tolerant species)	GRASSES: Little bluestem Blue grama Buffalo grass† FORBS: Ascending purple vetch Groundplum	 *Andropogon scoparius* *Bouteloua gracilis* *Buchloe dactyloides*† *Astragalus striatus* *Astragalus crassicarpus*

* The plant species listed here are native to grassland communities in the region in which the study site is located, unless otherwise noted.
† Not native to study site, but potentially useful for naturalization purposes.

(Sources: Cohlmeyer, 1977; Looman & Best, 1979; Prairie Habitats, 1994).

Table 1.2: Plant Species for Woodland Community Naturalization (Forest, Shrub Plantations and Tree Plantations)

VEGETATION TYPE	COMMON NAME	BOTANICAL NAME	COMMENTS
Trees, Pioneer Species	Trembling aspen Hybrid poplar† Balsam poplar Manitoba maple	*Populus tremuloides* *Populus* x *hybrida*† *Populus balsamifera* *Acer negundo*	Not readily avail. from suppliers e.g. NW, Walker or Brooks #9 Prefers wet, poorly-drained areas Normally a riparian species
Trees, Non-Pioneer Species	Bur oak Green Ash White spruce Scots pine†	*Quercus macrocarpa* *Fraxinus pens.* *Picea glauca* *Pinus sylvestris*†	Aspen parkland climax species Normally a riparian species Native to northern aspen parkland Drought tolerant
Shrubs, Sun and Drought Tolerant (for borders on S&W slopes)	Snowberry Wolf-willow Chokecherry Pincherry Rose Saskatoon Buffaloberry Nannyberry Hawthorn Alpine currant†	*Symphoricarpos occ.* *Elaeagnus commutata* *Prunus virginiana* *Prunus pensylvanica* *Rosa spp.* *Amalenchier alnifolia* *Shepherdia argentea* *Viburnum lentago* *Crataegus spp.* *Ribes alpinum*†	Pioneer invader of prairie Pioneer invader of prairie Early successional species Prefers well-drained soils Has sharp thorns Tolerates wide range of cond's
Shrubs, Shade and/or Moisture Tolerant (for borders on N&E slopes, and within forests)	Red osier dogwood American hazelnut Beaked hazelnut Highbush cranberry Downy arrowwood Speckled alder Willows False spirea†	*Cornus stolonifera* *Corylus americana* *Corylus cornuta* *Viburnum trilobum* *V. rafinesquianum* *Alnus rugosa* var. *amer.* *Salix spp.* *Sorbaria sorbifolia*†	Spreads easily via suckers Dominant w/i aspen pkland forest Common but less so than *C.amer.* Only present in wet conditions Spreads vigourously via suckers
Herb Stratum Plant Species (Including both herbaceous and woody species)	Wild sarsaparilla Red baneberry Asters Northern bedstraw Sweet-scented bedstraw Pink wintergreen Bunchberry False lily-of-the-valley False Solomon's seal Strawberry Dewberry Grove-sandwort Wild columbine Twining honeysuckle Anise-root Currants	*Aralia nudicaulis* *Actaea rubra & A. rubra forma neglecta* *Aster spp.* *Galium septentrionale* *Galium triflorum* *Pyrola asarifolia* *Cornus canadensis* *Maianthemum canadense* var. *interius* *Smilacena stellata* *Fragaria spp.* *Rubus pubescens* *Areneria lateriflora* *Aquilegia canadensis* *Lonicera dioica* var. *glaucescens* *Osmorhiza longistylis* *Ribes spp.*	 Poisonous fruit Prefers acidic soil Small shrubs (CONTINUED)

* The plant species listed here are native to woodland communities in the region in which the study site is located, unless otherwise noted.
† Not native to study site, but potentially useful for naturalization purposes.

(Sources: Bird, 1962; Cohlmeyer, 1977; Looman & Best, 1979; PFRA)

Table 1.3 Macrophyte Plant Species present in Winnipeg's Stormwater Retention Ponds

MACROPHYTE TYPE	COMMON NAME	BOTANICAL NAME	COMMENTS
Submerged , rooted	Phragmites	*Phragmites communis*	Will root just above NWL; is allelopathic
	Leafy pondweed	*Potamogeton foliosis*	
	Slender pondweed	*Potamogeton pusillus*	
	Sago pondweed	*Potamogeton pectinatus*	
	Coontail	*Ceratophyllum demersum*	
	Northern/native milfoil	*Myriophyllum exalbescens*	
	White/water buttercup	*Ranunculus aquatilis*	
	Richardson's pondweed	*Potamogeton rrichardsonii*	
	Common bladderwort	*Utricularia vulgaris*	
	Water starworts	*Callitriche palustris*	
	Naiad	*Najas flexilis*	
	Widgeon grass	*Ruppia maritima*	
Emergent, rooted	Common cattail	*Typha latifolia*	Is allelopathic
	Bullrush	*Scirpus validus*	
	Arrowhead	*Sagittaria spp.*	
	Sedge	*Carex spp.*	
	Broadleaf waterplantain	*Alisma plantago*	
	Purple loosestrife†	*Lythrum salicaria*†	Will establish above or below water; forces out native species
	Horsetail	*Equisetum fluviatile*	
Floating leaved, rooted	Water smartweed	*Polygonum amphibium*	
	Floating pondweed	*Potamogeton natans*	
	Various-leaved pondweed	*Potamogeton gramineus*	
Free-floating	Duckweed	*Lemna gibba*	

† Not native to Manitoba

(Sources: UMA, 1992; Looman & Best, 1979.)

Appendix 2: Cost Analysis Tables

2.1 ANNUAL MAINTENANCE COSTS FOR EXISTING SITE						
			Unit	*Quantity*	*Unit Price*	*Annual Amount*
1)	420 Irrigation (12x/yr)					
	Labour (II)		hours	27	$14.31	$386
	Labour (III)		hours	0		$0
	Equipment		hours	27	$2.30	$62
2)	434/436 Mowing w/ Gang & 72" Mowers (12x/yr)					
	Labour (III)		hours	92	$16.02	$1,474
	Equipment		hours	92	$27.25	$2,507
3)	430 Trim Mowing (12 x/yr)					
	Labour (I)		hours	107	$13.64	$1,459
	Equipment		hours	107	$2.05	$219
4)	491 Manual Litter Collection (12 x/yr)					
	Labour (I)		hours	53	$13.64	$723
5)	527 Spring/ Fall Clean-up (1 x/yr)					
	Labour		ha	6.9	$198.87	$1,372
	Equipment		ha	6.9	$106.31	$734
6)	062 Weed Control (chemical) (1x/yr)					
	Labour (III)		hours	6.9	$16.02	$111
	Equipment		hours	6.9	$24.60	$170
	Material		lump sum			$75
7)	405 Fertilizing (1x/yr)					
	Labour (III)		hours	4.4	$16.02	$70
	Equipment		hours	4.4	$11.70	$51
	Material		lump sum			$75
8)	Weed Control on Pond					
	Herb/algicide tmt. & harvesting		lump sum			$1,500
9)*	Sports Fields Preparation		lump sum			$2,693
10)*	Play Equip. Maintenance		lump sum			$636
11)*	Rink Install'n & Mntce.		lump sum			$1,484
					Total:	$15,802
					20% Overhead on Labour:	$1,911
					Grand Total:	**$17,713**
* These costs will remain unchanged in the proposed maintenance regime.						

2.2: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: Years 1 & 2						
A. OPEN AREAS			Unit	Quantity	Unit Price ($)	Amount
1)	Turf: 420 Irrigation (3 c/yr)					
		Labour (II)	hours	7	$14.31	$100
		Equipment	hours	7	$2.30	$16
2)	Turf: 434 Mowing w/ 72" Tractor Mower (10 x/yr)					
		Labour (II)	hours	30.1	$14.31	$431
		Equipmt (0336)	hours	30.1	$14.25	$429
3)	Turf: 436 Mowing w/ Gang Mower (10 x/yr)					
		Labour (III)	hours	21	$16.02	$336
		Equipment	hours	21	$27.25	$572
4)	Turf: 420 Trim Mowing (10 x/yr)					
		Labour (I)	hours	40	$13.64	$546
		Equipment	hours	40	$2.05	$82
5)	Meadows & Prairie: 436 Mowing w/ Gang Mower (2 c/yr)					
		Labour (III)	hours	2	$16.02	$32
		Equipment	hours	2	$27.25	$54
6)	Meadows:434 Mowing w/ 72" Tractor Mower (2 c/yr)					
		Labour (II)	hours	4.2	$14.31	$60
		Equipment	hours	4.2	$14.25	$60
7)	Meadows and Prairie: Burning (0.5 x/yr. for site; rotation for specific areas)					
		Labour	lump sum	0.5	$550.00	$275
		Equip.	lump sum	0.5	$200.00	$100
B. WOODED AREAS			Unit	Quantity	Unit Price ($)	Amount
1)	Ropel applic. (1x in fall)		allow [lab. 500]	1	$1000.00	$1000
C. WETLAND			Unit	Quantity	Unit Price ($)	Amount
1)	Install/Remove boardwalk (2x/yr):					
	Labour		lump sum	2	$240.00	$480
	Equip. (0219 truck)		lump sum	2	$76.00	$152
2)	Occ. vegetation control		allow [lab. 150]	1	$300.00	$300
D. GENERAL						
1)	Irrigation of naturalized areas (24 x in yr. 1, 12 x in yr. 2):					
	Labour		lump sum	18	$480.00	$8640

	Equip. (0219 truck w/ tank)		lump sum	18	$152.00	$2736
2)	Gen. weed control (3x/yr)		lump sum	3	$500.00	$1500
3)	491 Manual Litter Collection (12 x/yr)					
		Labour (l)	hours	53	$13.64	$723
4)	527 Spring/ Fall Clean-up (1 x/yr)					
		Labour	ha	6.1	$198.87	$1213
		Equipment	ha	6.1	$106.31	$648
5)	Sports Fields Preparation		lump sum	1	$2,693	$2693
						$0
6)	Play Equip. Maintenance		lump sum	1	$636	$636
						$0
7)	Rink Install'n & Mntce.		lump sum	1	$1,484	$1484
					Total:	$25,299
		labour:	20578	20% Overhead on Labour:		$4,116
					Grand Total:	**$29,415**

2.3: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: Years 3 & 4						
A.	**OPEN AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Turf: 420 Irrigation (3 c/yr)					
		Labour (II)	hours	7	$14.31	$100
		Equipment	hours	7	$2.30	$16
2)	Turf: 434 Mowing w/ 72" Tractor Mower (10 x/yr)					
		Labour (II)	hours	30.1	$14.31	$431
		Equipmt (0336)	hours	30.1	$14.25	$429
3)	Turf: 436 Mowing w/ Gang Mower (10 x/yr)					
		Labour (III)	hours	21	$16.02	$336
		Equipment	hours	21	$27.25	$572
4)	Turf: 420 Trim Mowing (10 x/yr)					
		Labour (I)	hours	40	$13.64	$546
		Equipment	hours	40	$2.05	$82
5)	Meadows & Prairie: 436 Mowing w/ Gang Mower (2 c/yr)					
		Labour (III)	hours	2	$16.02	$32
		Equipment	hours	2	$27.25	$54
6)	Meadows:434 Mowing w/ 72" Tractor Mower (2 c/yr)					
		Labour (II)	hours	4.2	$14.31	$60
		Equipment	hours	4.2	$14.25	$60
7)	Meadows and Prairie: Burning (0.5 x/yr. for site; rotation through specific areas)					
		Labour	lump sum	0.5	$550.00	$275
		Equip.	lump sum	0.5	$200.00	$100
B.	**WOODED AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
	None					
C.	**WETLAND**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Install/Remove boardwalk (2x/yr):					
	Labour		lump sum	2	$240.00	$480
	Equip. (0219 truck)		lump sum	2	$76.00	$152
2)	Occ. vegetation control		allow [lab. 150]	1	$300.00	$300
D.	**GENERAL**					
1)	Irrigation of naturalized areas:					
	Labour		lump sum	2	$480.00	$960

	Equip. (0219 truck w/ tank)		lump sum	2	$152.00	$304
2)	Weed control(chemical & manual)		lump sum	1	300	$300
3)	491 Manual Litter Collection (12 x/yr)					
		Labour (l)	hours	53	$13.64	$723
4)	527 Spring/ Fall Clean-up (1 x/yr)					
		Labour	ha	6.1	$198.87	$1,213
		Equipment	ha	6.1	$106.31	$648
5)	Sports Fields Preparation		lump sum	1	$2,693	$2,693
6)	Play Equip. Maintenance		lump sum	1	$636	$636
7)	Rink Install'n & Mntce.		lump sum	1	$1,484	$1,484
					Total:	$12,987
		labour:	9218		20% Overhead on Labour:	$1,844
					Grand Total:	**$14,831**

2.4: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: Year 5 Onward

A.	**OPEN AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Turf: 420 Irrigation (3 c/yr)					
		Labour (II)	hours	7	$14.31	$100
		Equipment	hours	7	$2.30	$16
2)	Turf: 434 Mowing w/ 72" Tractor Mower (10 x/yr)					
		Labour (II)	hours	27.7	$14.31	$396
		Equipmt (0336)	hours	27.7	$14.25	$395
3)	Turf: 436 Mowing w/ Gang Mower (10 x/yr)					
		Labour (III)	hours	21	$16.02	$336
		Equipment	hours	21	$27.25	$572
4)	Turf: 420 Trim Mowing (10 x/yr)					
		Labour (I)	hours	40	$13.64	$546
		Equipment	hours	40	$2.05	$82
5)	Meadows and Prairie: 436 Mowing w/ Gang Mower (2 x/yr)					
		Labour (III)	hours	2	$16.02	$32
		Equipment	hours	2	$27.25	$54
6)	Meadows:434 Mowing w/ 72" Tractor Mower (2 x/yr)					
		Labour (II)	hours	4.2	$14.31	$60
		Equipment	hours	4.2	$14.25	$60
8)	Meadows and Prairie: Burning (0.5 x/yr. for site; rotation for specific areas)					
		Labour	lump sum	0.5	$550.00	$275
		Equip.	lump sum	0.5	$200.00	$100
B.	**WOODED AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Occasional thinning & misc. mtnce		allow	1	$250.00	$250
C.	**WETLAND**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Install/Remove boardwalk (2x/yr):					
	Labour		lump sum	2	$240.00	$480
	Equip. (0219 truck)		lump sum	2	$76.00	$152
2)	Occ. weed control (harvesting)		allow [lab. 150]	1	$300.00	$300
D.	**GENERAL**					
2)	Weed control(chemical & manual)		l. sum [lab. 200]	1	$300.00	$300

3)	491 Manual Litter Collection (12 x/yr)					
		Labour (l)	hours	53	$13.64	$723
4)	527 Spring/ Fall Clean-up (1 x/yr)					
		Labour	ha	6.1	$198.87	$1213
		Equipment	ha	6.1	$106.31	$648
5)	Sports Fields Preparation		l. sum [lab. 3202]	1	$2,693	$2693
6)	Play Equip. Maintenance		lump sum	1	$636	$636
7)	Rink Install'n & Mntce.		lump sum	1	$1,484	$1484
					Total:	$11,905
		labour:	7963	20% Overhead on Labour:		$1,593
					Grand Total:	**$13,497**

2.5 INSTALLATION COSTS FOR PROPOSED PLAN					
A. OPEN AREAS		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Mown Turf & Unseeded Meadows	N/A			
2)	Overseeded Meadows:				
	Labour (III)	ha	0.74	$32.00	$24
	Equipmt (0335 Tractor w/ attach.)	ha	0.74	$37.00	$27
	Mat'l: Seed (@ 1/2 reg. density)	ha	0.74	$3,000.00	$2,220
3)	Prairie Rest'r'n Areas:				
	Total installat'n	ha	0.38	$6,000.00	$2,280
B. WOODED AREAS		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Cultivation:				
	Labour (I)	ha	1	$100.00	$100
	Equip. (0902)	ha	1	$24.00	$24
2)	Shrub Plantations:				
	Terra-mat, 36x36"	per shrub	2298	$1.20	$2,758
	Mulch, 75mm thick(Supply & Inst.)	ha	0.19	$15,000.00	$2,850
	Shrubs @ 1m O.C., 11,200/ha (Supply & inst., incl. replacement plantings)				
	PFRA suppl(90%)	ea.	2065	$3.50	$7,228
	Other spp. (10%)	ea.	233	$7.00	$1,631
3)	Tree Plantations:				
	Weed Barrier (Supply & Inst.)	ha	0.16	$10,000.00	$1,600
	Mulch, 75mm thick(Supply & Inst.)	ha	0.16	$15,000.00	$2,400
	Seedlings @ 1.5m O.C., 4950/ha (Supply & inst., incl. replacement plantings)				
	Aspen	ea.	260	$7.00	$1,820
	Balsam poplar	ea.	40	$7.00	$280
	NW poplar	ea.	300	$3.50	$1,050
	Scots pine	ea.	190	$3.50	$665
	Scots pine, 2 m ht.	ea.	2	$300.00	$600
	Remove barrier, respread mulch	ha	0.16	$15,000.00	$2,400
4)	Forest Areas:				
	Weed Barrier (Supply & Inst.)	ha	0.62	$10,000.00	$6,200
	Mulch, 75mm thick(Supply & Inst.)	ha	0.62	$15,000.00	$9,300
	Seedlings @ 1.5m O.C., 4950/ha (Supply & inst., incl. replacement plantings)				
	Nurse Spp.: NW Poplar (45%)	ea.	1395	$3.50	$4,882
	MB Maple (20%)	ea.	620	$3.50	$2,170
	Tr. Aspen (10%)	ea.	310	$7.00	$2,170
	2ndary Spp.: Bur Oak (12%)	ea.	372	$3.50	$1,302
	Green Ash (10%)	ea.	310	$3.50	$1,085
	W. Spruce (3%)	ea.	93	$3.50	$326

	Shrubs @ 1.6/lin. m (Supply & Inst., incl. replacement plantings)					
		PFRA suppl(75%)	ea.	828	$3.50	$2,898
		Other spp. (25%)		276	$7.00	$1,932
	MB Maple, 75-100 mm Ø			4	$350.00	$1,400
	Remove Barrier, respread mulch		ha	0.62	$15,000.00	$9,300
C.	**WETLAND AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
	Addt'n & shaping of fill					
	along shoreline (supply & inst.)		sq. m	2500	$1.00	$2,500
D.	**STRUCTURAL FEATURES**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Limestone paths (var. width)		sq. m	2260	$8.00	$18,080
2)	Boardwalk (w/ 2 perm.. landings)		sq. m	128	$133.00	$17,024
3)	Edging around nat'z'n areas		lineal m	1850	$4.50	$8,325
4)	Interpretive signs		allow	1	$5,000.00	$5,000
5)	Benches		ea.	10	$350.00	$3,500
					Total:	$127,350
					15% contingency:	$19,103
					Total Cost Estimate:	**$146,453**
	NOTE: Plant and seed quantities are calculated from the following areas taken off the design plan:					
			Prairie:	3800 sq. m		
			Seeded Meadow:	7350 sq. m		
			Shrub Plant'n:	1900 sq. m		
			Tree Plant'n (Tr. Aspen):	1040 sq. m		
			Tree Plant'n (Balsam Poplar):	160 sq. m		
			Tree Plant'n (Scots Pine):	380 sq. m		
			Forest Area:	6190 sq. m		
			Shrub Planting Strips:	170 lineal m		

2.6 INSTALLATION COSTS FOR PROPOSED PLAN, W/ VOLUNTEER LABOUR

A.	**OPEN AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Mown Turf & Unseeded Meadows		N/A			
2)	Overseeded Meadows:					
	Labour (III)		ha	0.74	$32.00	$24
	Equipmt (0335 Tractor w/ attach.)		ha	0.74	$37.00	$27
	Mat'l: Seed (@ 1/2 reg. density)		ha	0.74	$3,000.00	$2,220
3)	Prairie Rest'r'n Areas:					
	Total installat'n		ha	0.38	$6,000.00	$2,280
B.	**WOODED AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Cultivation:					
	Labour (I)		ha	1	$100.00	$100
	Equip. (0902)		ha	1	$24.00	$24
2)	Shrub Plantations:					
VOL	Terra-mat, 36x36"		per shrub	2298	$0.86	$1,976
VOL	Mulch, 75mm thick(Supply & Inst.)		ha	0.19	$7,500.00	$1,425
	Shrubs @ 1m O.C., 11,200/ha (Supply & inst., incl. replacement plantings)					
VOL		PFRA suppl(90%)	ea.	2065	$0.00	$0
VOL		Other spp. (10%)	ea.	233	$3.50	$816
3)	Tree Plantations:					
VOL	Weed Barrier (Supply & Inst.)		ha	0.16	$5,000.00	$800
VOL	Mulch, 75mm thick(Supply & Inst.)		ha	0.16	$7,500.00	$1,200
	Seedlings @ 1.5m O.C., 4950/ha (Supply & inst., incl. replacement plantings)					
VOL		Aspen	ea.	260	$3.50	$910
VOL		Balsam poplar	ea.	40	$3.50	$140
VOL		NW Poplar	ea.	300	$0.00	$0
VOL		Scots pine	ea.	190	$0.00	$0
	Scots pine, 2 m ht.		ea.	2	$300.00	$600
VOL	Remove Barrier, respread mulch		ha	0.16	$0.00	$0
4)	Forest Areas:					
VOL	Weed Barrier (Supply & Inst.)		ha	0.62	$5,000.00	$3,100
VOL	Mulch, 75mm thick(Supply & Inst.)		ha	0.62	$7,500.00	$4,650
	Seedlings @ 1.5m O.C., 4950/ha (Supply & inst., incl. replacement plantings)					
VOL	Nurse Spp.:	NW Poplar (45%)	ea.	1395	$0.00	$0
VOL		MB Maple (20%)	ea.	620	$0.00	$0
VOL		Tr. Aspen (10%)	ea.	310	$3.50	$1,085
VOL	2ndary Spp.:	Bur Oak (12%)	ea.	372	$0.00	$0
VOL		Green Ash (10%)	ea.	310	$0.00	$0
VOL		W. Spruce (3%)	ea.	93	$0.00	$0

	Shrubs @ 1.6/lin. m (Supply & Inst., incl. replacement plantings)					
VOL		PFRA suppl(75%)	ea.	828	$0.00	$0
VOL		Other spp. (25%)		276	$3.50	$966
	MB Maple, 75-100 mm Ø			4	$350.00	$1,400
VOL	Remove Barrier, respread mulch		ha	0.62	$0.00	$0
C.	**WETLAND AREAS**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
	Addt'n & shaping of fill					
	along shoreline (supply & inst.)		sq. m	2500	$1.00	$2,500
D.	**STRUCTURAL FEATURES**		*Unit*	*Quantity*	*Unit Price ($)*	*Amount*
1)	Limestone paths (var. width)		sq. m	2260	$8.00	$18,080
2)	Edging around nat'z'n areas		lineal m	1850	$1.50	$2,775
3)	Interpretive signs		allow	1	$5,000.00	$5,000
4)	Benches		ea.	10	$350.00	$3,500
					Total:	$55,598
					25% contingency:	$13,899
					Total Cost Estimate:	**$69,497**
NOT INCLUDED:						
	Boardwalk (w/ 2 perm. landings)		sq. m	128	$133.00	$17,024

2.7: L.-T. Cost Comparison: Existing Conditions vs. Proposed Plan (in 1994 Dollars)

Scenario 1: No Volunteer Labour						
Year		EXISTING CONDITIONS			PROPOSED PLAN	
1		$0	Installation		$146,453	Installation
		$17,713	Maintenance		$29,415	Maintenance
2		$17,713	"" ""		$29,415	"" ""
3		$17,713	"" ""		$14,831	"" ""
4		$17,713	"" ""		$14,831	"" ""
5		$17,713	"" ""		$13,497	"" ""
		$88,565	**5 Year Total**		**$248,442**	**5 Year Total**
6-43		$673,094	Maintenance		$512,886	Maintenance
		$761,659	**43 Year total**		**$761,328**	**43 Year total**
			Net annual savings after year 43:		**$4,216**	
			Cost turnaround time:		**43 years**	
Scenario 2: Volunteer Labour, Boardwalk not Installed						
Year		EXISTING CONDITIONS			PROPOSED PLAN	
1		$0	Installation		$69,497	Installation
		$17,713	Maintenance		$29,415	Maintenance
2		$17,713	"" ""		$29,415	"" ""
3		$17,713	"" ""		$14,831	"" ""
4		$17,713	"" ""		$14,831	"" ""
5		$17,713	"" ""		$13,497	"" ""
		$88,565	**5 Year Total**		**$171,486**	**5 Year Total**
6-25		$354,260	Maintenance		$269,940	Maintenance
		$442,825	**25 Year Total**		**$441,426**	**25 Year Total**
			Net annual savings after year 25:		**$4,216**	
			Cost turnaround time:		**25 years**	

2.8: A Comparison of Costs per Hectare for Turf and Naturalized Areas					
				Cost/ha	
1)	**Turf Areas**				
	Installation c/w 75mm topsoil:		Total:	$50,000	
			15% Contg.:	$7,500	
			Total:	**$57,500**	
	Annual Maintenance: mowing 12x:			**$933**	
2)	**Meadow (Seeded)**				
	Installation into existing turf grass:				
	Overseeding			$3,070	
	Weed control, 1st yr.			$500	
			Total:	$3,570	
			15% Contg.:	$536	
			Total:	**$4,106**	
	Annual Mtnce.: mow 2x & occ. weed control:			**$200**	
3)	**Prairie**				
	Installation on turf grass site:		Total:	$6,000	
			15% Contg.:	$900	
			Total:	**$6,900**	
	Annual Maintenance :				
	Mow 2x & occ. weed control			$200	
	Burning approx. every 2 yrs.:			$375	
			Total:	**$575**	
4)	**Shrub Plantations**				
	Installation on turf grass site:				
	Cultivation			$124	
	Weed mats (suppl. & inst. per indiv. shrub)			$12,000	
	Mulch (suppl. & inst.)			$15,000	
	Shrubs (suppl. & inst., 11,200/ha				
	incl. replacement plantings,				
	90% PFRA stock)			$43,120	
	Irrigation 36x over yrs. 1&2			$7,404	
			Total:	$77,648	
			15% Contg.:	$11,647	
			Total:	**$89,295**	
	Annual maintenance: occasional thinning			negligible	
5)	**Forest Areas**				
	Cultivation			$124	

	Weed barrier (suppl. & inst.)		$10,000	
	Mulch (suppl. & inst.)		$15,000	
	Seedlings (suppl. & inst., 5000/ha			
	incl. replacement plantings,			
	90% PFRA stock)		$19,250	
	Irrigation 36x over yrs. 1&2		$7,404	
	Shrub border(suppl. & inst., 640 lin. m			
	@1.6/lin. m, incl. replacement plantings,			
	75% PFRA stock)		$4,480	
	Removal weed barrier		$15,000	
		Total:	$71,258	
		15% Contg.:	$10,689	
		Total:	**$81,947**	
	Annual maintenance: occasional thinning		negligible	
6)	**Tree Plantations**			
	Cultivation		$124	
	Weed barrier (suppl. & inst.)		$10,000	
	Mulch (suppl. & inst.)		$15,000	
	Seedlings (suppl. & inst., 5000/ha			
	incl. replacement plantings,			
	50% PFRA stock, 50% tr. aspen)		$26,250	
	Removal weed barrier		$15,000	
		Total:	$66,374	
		15% Contg.:	$9,956	
		Total:	**$76,330**	
	Annual maintenance: occasional thinning		negligible	

Cost Analysis Tables: Explanations of Sources

(Items found in more than one of the tables are covered in the explanation of the first such table only.)

2.1: ANNUAL MAINTENANCE COSTS FOR EXISTING LANDSCAPE

Items 1-8, 9-11:	Maintenance Management System (MMS) statistics for Lakeside Meadows Park: City of Winnipeg Parks and Recreation Dept.
Item 9:	City of Winnipeg Waterworks, Waste and Disposal Dept.; and *Stormwater Retention Basin Review Study Report* ,a report commissioned by the W. ,W., and D. Dept.

2.2: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: YEARS 1 & 2

Items A1-A4:	MMS/ City of Wpg. Parks and Recreation Department. Mowing frequency for turf areas is reduced from 12 to 10 times per year.
Items A5-A6:	MMS/ City of Wpg. Parks and Recreation Department. Annual mowing frequency for meadows and prairie is reduced from 12 to 2 times per year.
Item A7:	City of Wpg. Parks and Recreation Department; figures based on controlled burns that have been carried out on the prairie at the Living Prairie Museum. "0.5 x" refers to occasional burning—once every 2-4 years.
Item B1:	Allowance for annual treatment of new plantings with Ropel rodent repellent: HWCH.
Item C1:	Allowance for inst. & removal of floating boardwalk: MMS/ City of Wpg. Parks and Recreation Department.
Item C2:	Allowance for vegetation control on retention pond is based on a fraction of the existing cost for annual treatment (see Item 9 in M1), with the assumption that harvesting will only be carried out every few years, if it is necessary to limit aggressive macrophyte growth. It is also assumed that chemical weed control will be reduced from present levels; only occasional algaecide treatment may be necessary.
Item D1:	Labour & equipment costs: MMS/ City of Wpg. Parks and Recreation Department. Irrigation requirements for the site after installation are assumed to be two workers on the site for days a week, with a truck equipped with a water tank, for 24 weeks during the first year, and 12 during the second year (HWCH).
Item D2:	Allowance for weed control during establishment years: MMS/ City of Wpg. Parks and Recreation Department, HWCH. This includes spot herbicide application with a backpack sprayer, and manual weed removal.
Items D3-D7:	MMS/ City of Wpg. Parks and Recreation Department.

Totals:	The City of Wpg. Parks and Recreation Department adds 20% of the labour costs to the total cost of maintenance for any given site, to account for overhead; the same thing has been done in these cost estimates.

2.3: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: YEARS 3 & 4

Item D1:	Irrigation requirements are assumed to be the same as outlined in M2, with frequency reduced to 3 times during year 3 and one time during year 4. Irrigation will only be needed regularly in years 1 & 2 (HWCH).
Item D2:	Weed control requirements after the first two years of maintenance are assumed to be one worker on the site for two days, once a year. This includes spot herbicide application with a backpack sprayer, and manual weed removal.
All other items:	See figures for M2.

2.4: ANNUAL MAINTENANCE COSTS FOR PROPOSED PLAN: YEAR 5 & ONWARD

Item D2:	Labour and equipment costs as in Item D2 of M2. The amount of mowing with 72" mower is reduced slightly, as regular mowing is ceased on border areas between meadows and wooded areas.
Item D:	No further irrigation is required for wooded areas.
All other items:	See figures for M2/ M3.

2.5 & 2.6: INSTALLATION COSTS FOR PROPOSED PLAN

Item A2:	Labour and equipment costs: MMS/ City of Wpg. Parks and Recreation Department. Material cost: "Prairie Habitats" native plant nursery, Winnipeg, MB.
Item A3:	Total installation cost, prairie: "Prairie Habitats" native plant nursery, Winnipeg, MB.
Item B1:	Costs per unit area: MMS/ City of Wpg. Parks and Recreation Department.
Items B2-B4:	Planting densities per unit area are calculated from planting spacings, which are taken for the most part from the NCC Naturalization projects in Ottawa. An additional 12% is added to plant quantities, to allow for some replacement of dead plantings (HWCH).
Item B2:	"Terra-mat" cost : Forest Suppliers Inc. 1994 catalogue (see note, p. 69). Mulch suppl. & inst.: Hilderman, Witty, Crosby , Hanna and Associates, Landscape Architects and Planners (HWCH). Shrub seedlings suppl. & inst.: HWCH. (All plant installation costs: HWCH.)

PFRA suppl.: Seedling stock of certain species are provided free of charge by the Prairie Farm Rehabilitation Administration (PFRA) for eligible projects .

Item B3: Plastic weed barrier suppl., inst. & removal costs : HWCH.

Mulch suppl. & inst. : HWCH.

Aspen cost: Shelmardines Nursery, Winnipeg, MB.

NW Poplar & Scots pine costs: PFRA/HWCH.

Scots pine, 2 m ht. cost: City of Wpg. Parks and Recreation Dept.

Item B4: Costs as in Item B3.

MB maple 75-100 mm Ø cost: City of Wpg. Parks and Recreation Dept.

Item C4: Allowance for fill suppl. & inst. along shore: City of Wpg. Parks and Recreation Dept.

Items D1, D5: City of Wpg. Parks and Recreation Dept.

Item D2: HWCH.

Item D3: Shelmardines Nursery, Winnipeg, MB.

Appendix 3: Glossary

The following is a glossary of selected terms used in this study. The sections in which the terms are defined are included with each definition. Sources for the definitions (other than the author) can be found in the sections listed.

Aspen Parkland:

The biome or major ecological community in which Winnipeg is located; a transition zone between the great plains of central North America and the coniferous forest of the Pre-Cambrian Shield. Aspen parkland contains two major plant communities—aspen forest and prairie—which are interspersed with each other. (Section 4.1)

Forest Areas:

Woodland naturalization areas in which a variety of pioneer and secondary tree species are planted, along with shrub plantings around the borders, with the intent of producing a community similar to a natural forest, through the managed succession approach. A landscape sub-type within the landscape type of "Woodland Areas." (Section 4.3)

Full Restoration:

The attempt to restore a landscape and its vegetation to its pre-disturbed, natural state, as faithfully as possible. (Section 3.1)

Functional Restoration:

The introduction of native and/ or non-native vegetation into a site, with the intent that the site should function as an ecosystem with self-sustaining ability and diversity similar to its pre-disturbed, natural state. (Section 3.1)

Macrophyte Plants:

Macroscopic plants found in aquatic environments such as retention ponds. The most common macrophyte plants found in Winnipeg's retention ponds are emergent, rooted plants such as cattail. (Section 4.4)

Managed Succession Approach:

An approach to woodland naturalization that involves strategic plantings of both pioneer and secondary wood species, with the intent of accelerating succession to a mature forest. (Section 4.3)

Meadow, Seeded:

An area of native and/ or non-native grasses and forbs that was formerly mown turf, which has been planted with grass and forb seeds, without the removal of the turf grass. Seeded meadows are maintained through infrequent mowing or burning. A landscape sub-type within the landscape type of "Open Areas." (Section 4.2)

Meadow, Unseeded:

An area of native and/ or non-native grasses and forbs that was formerly mown turf, which has been allowed to develop through a decrease in mowing, but which has not been planted with grass and forb seeds. Unseeded meadows are maintained through infrequent mowing or burning. A landscape sub-type within the landscape type of "Open Areas." (Section 4.2)

Microclimatic Zones:

Zones defined in the study according to various site conditions of slope, aspect and elevation. Five microclimatic zones are identified: hydric, wet-mesic, flat-mesic, sloped-mesic, and xeric. (Section 5.3)

Open Areas:

One of three general landscape types outlined in the study; areas in which vegetation consists of grasses and forbs, and which have an open spatial character due to the lack of larger, woody plant communities. Open areas include prairie, meadow and turf areas. (Section 4.2)

Overseeding:

The practice of planting grass and forb seeds into existing turf areas, without first removing the existing turf grasses, with the intent of creating a meadow. (Section 4.2)

Naturalization:

An approach to landscape design and management that aims to introduce and encourage self-sustaining plant communities, through the use of both native and non-native plants. (Section 1.2)

Naturalization, Active :

Naturalization through introducing plants or plant seeds, native and/ or non-native, into a site. (Section 3.1)

Naturalization, Passive :

Naturalization through allowing plant communities to generate and develop on a site, without planting or seeding any plants. (Section 3.1)

Overseeding

The practice of planting native and/ or non-native grass and forb seed into existing turf grasses, without first removing the existing grasses.

Plantation Approach:

An approach to woodland naturalization that involves planting only tree species, with no shrub species and with no intent to accelerate succession through planting both pioneer and secondary species. (Section 4.3)

Prairie:

Original or authentic grassland that supports vegetation which is native to the site or region. Prairie naturalization is the attempt to re-establish native prairie. A landscape sub-type within the landscape type of "Open Areas." (Section 4.2)

Shrub Plantations:

Naturalized areas with shrub species, installed according to the plantation approach. A landscape sub-type within the landscape type of "Woodland Areas." (Section 4.3)

Sustainable Greenspace:

Open space that has increased capacity over conventional open space to maintain and regenerate itself with minimized energy input, adverse effects on the larger environment, and economic cost, in which the cycle of nutrients is ideally closed and self-sufficient, given a constant supply of solar energy. (Section 1.2)

Tree Plantations:

Naturalized areas with tree species, installed according to the plantation approach. A landscape sub-type within the landscape type of "Woodland Areas." (Section 4.3)

Turf Areas:

Areas of conventional mown grass, consisting of standard lawn grasses such as Kentucky bluegrass and creeping red fescue. A landscape sub-type within the landscape type of "Open Areas." (Section 4.2)

Wetland Areas:

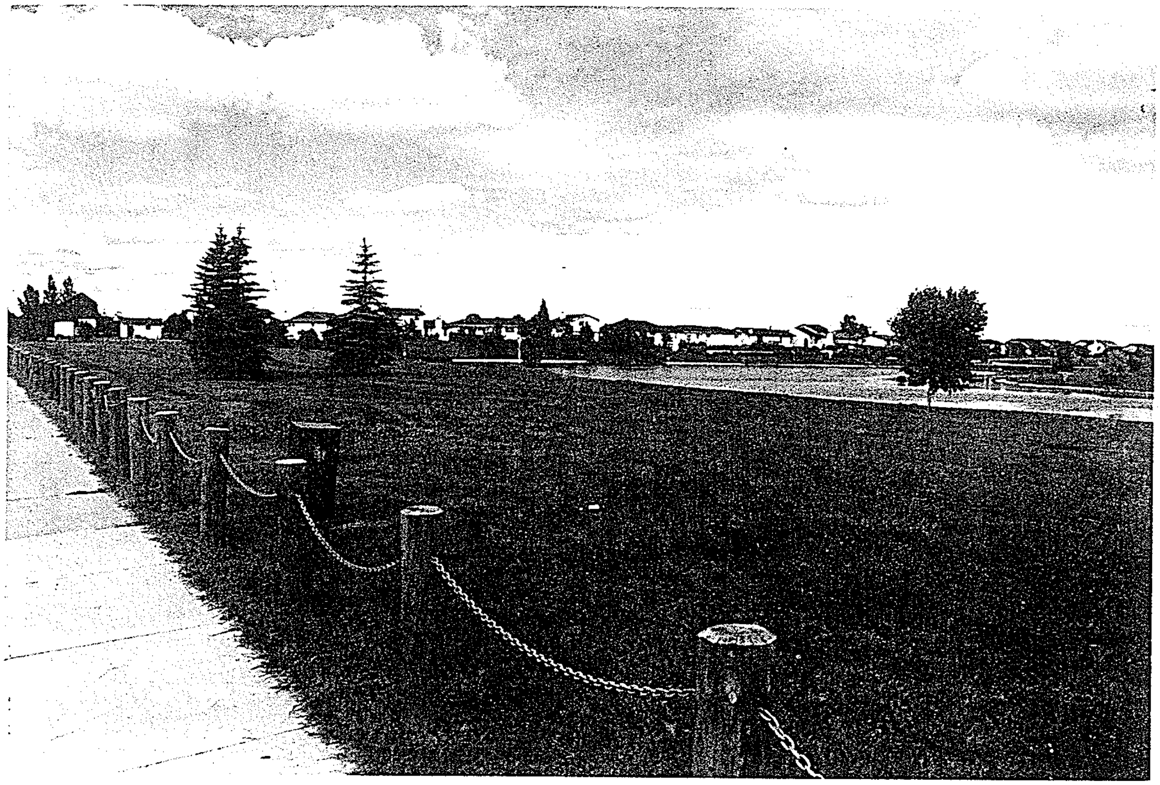
One of three general landscape types outlined in the study; areas such as retention ponds and their shores, where aquatic vegetation grows. (Section 4.4)

Woodland Areas:

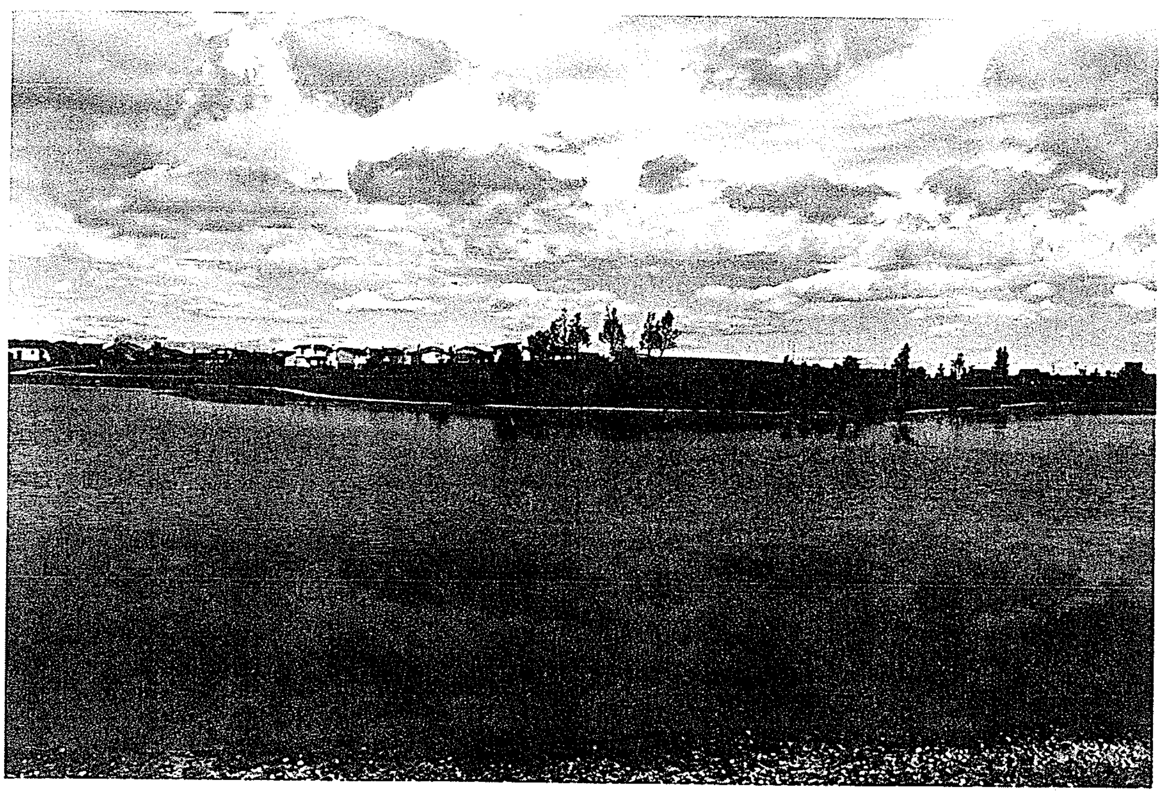
One of three general landscape types outlined in the study; areas in which woody species are planted, including forest, tree plantations and shrub plantations. (Section 4.3)

Appendix 4: Site Photographs

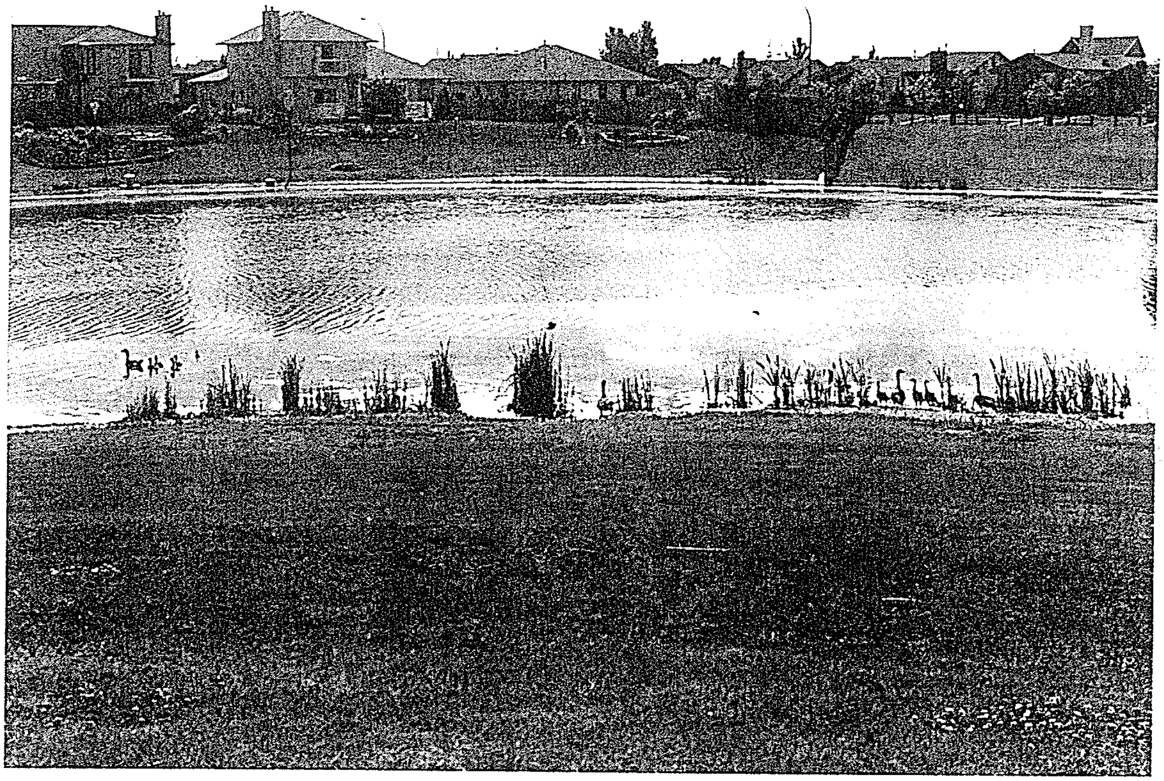
Photographs of Existing Site Taken June, 1994.



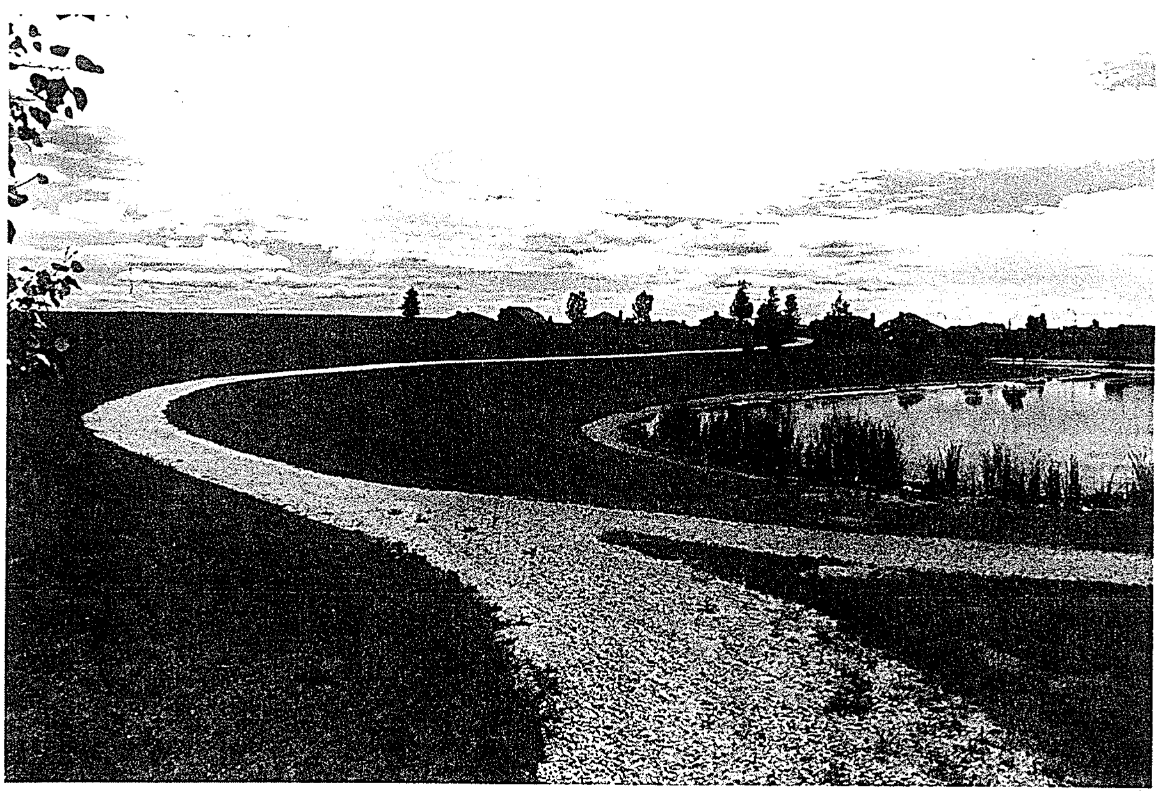
1. View South-West into Site from Devonshire Drive



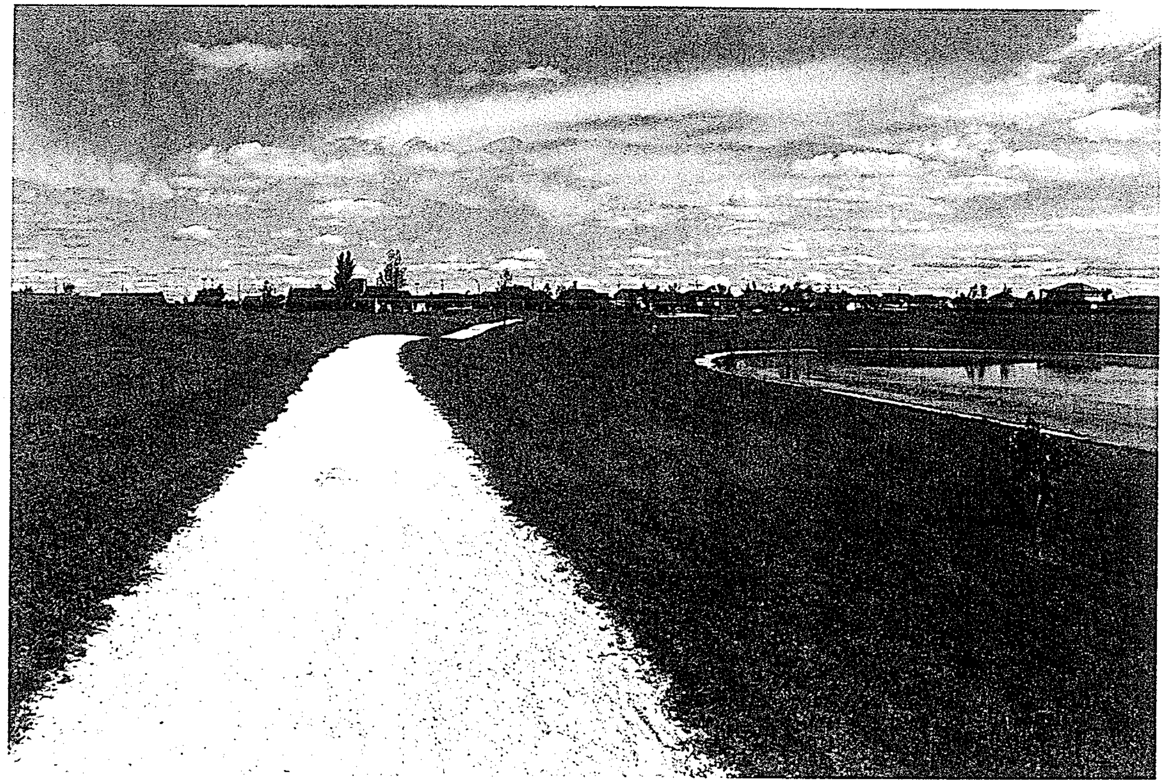
2. View North Across Pond from Southern Portion of Site



3. View North-East Across Pond from William R. Kare Cairn & Rest Area

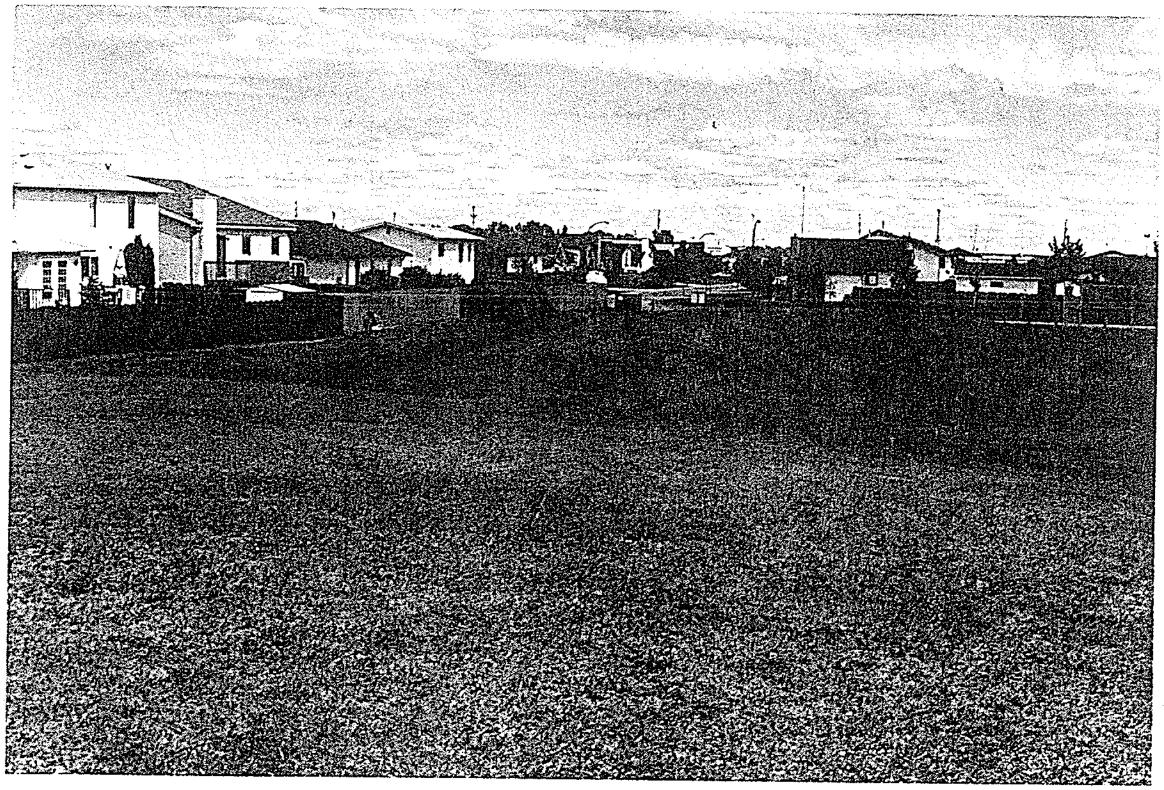


4. View East from Site Entrance off Blostein Bay



5. View North Along Main Pathway on East Side of Hill

6. View North -West Towards Playground Area from Northern Tip of Pond



7. View North-West Across T-Ball Field Towards North Meadow Drive From Hill

8. View West Across Basketball Court Towards Hill

9. View South Into Site from East Entrance off North Meadow Drive

10. View South-East into Site from North Meadow Drive

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