GEORGE MORRIS CENTRE

Canada's Independent Agri-Food Think Tank

Literature Review of Documented Health and Environmental Benefits Derived from Ornamental Horticulture Products

FINAL REPORT

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EXECUTIVE SUMMARY

The Canadian ornamental horticulture[1] industry, with a 2005 farm gate production of approximately $2.2 billion, is one of Canada's best kept agricultural secrets and success stories (Watson, 2006).

However, the domestic market for ornamentals has remained relatively flat, despite the increased interest in gardening and landscaping over the past two decades, because flowers, indoor plants and landscaping have to compete with many other luxury items for the Canadian consumer dollar. The recent slowdown in the Canadian industry has been mirrored around the globe as a result of higher energy and labour costs, increased competition and depressed consumer spending. To survive, the industry has to sell more plants or flowers and obtain higher prices. The four ways to increase ornamental sales are:

- Increase the number of purchasing households and younger customers
- Increase the frequency of purchases by existing buyers
- Increase the transaction value per buying occasion
- Create a popular culture of personal use and enjoyment of ornamentals

All of these require new and collaborative marketing schemes that promote ornamental flowers and plants in different ways than have been used in the past.

The purpose of the project was to provide the Ornamental Working Group of the Horticulture Value Chain Round Table, through its secretariat in Agriculture and Agri-Food Canada, with a summary of the current state of scientific knowledge related to the benefits from plants and flowers in one's daily life.

A review of the literature demonstrated that ornamental horticulture has a wider suite of benefits than expected. Plants can provide multiple benefits in terms of the economy, environment and human lifestyles. Many of these benefits, however, are not well known or understood within the general population. As a result, there is a considerable opportunity for the ornamental horticulture industry to sell more products based on the benefits identified throughout this literature review. The following is a summary of the benefits as outlined in the literature review:

Economic:

- Reduce energy costs (heating and cooling)
- Improve property values (residential and business)
- Enhance beauty of buildings and communities
    - Aesthetic contribution
    - Improved privacy and security
- Assist municipalities in reducing maintenance costs and deriving new economic benefits including economic spin-offs from parks, sporting facilities and increased tourism

[1] The Canadian floriculture and nursery industries together are often referred to as 'ornamentals' or 'the ornamental industry'. The phrase 'ornamental horticulture' also includes the sod and Christmas tree industries.

Environmental:

- Moderate urban climate extremes
- Mitigate urban heat islands
- Produce oxygen
- Sequester carbon
- Ameliorate pollution:
    - Improve air quality (indoor and outdoor)
    - Remove contaminants from soil (phytoremediation)
    - Improve water quality
    - Treat sewage and wastewater
- Improve water management (flood control) and erosion control
- Reduce impacts of weather through windbreaks and shelterbelts
- Reduce noise pollution
- Control urban glare and reflection
- Attract birds and other wildlife

Lifestyle:

- Reduce stress and improve productivity (workplace, schools)
- Introduce calming effects and reduced discomforts
- Quicker recovery (hospitals)
- Practice horticultural therapy to improve mind, body and spirit
    - Long term care facilities
    - Prisons
- Increase human health (e.g., use in medicine)
- Improve life satisfaction and well-being:
    - Increase positive emotions
    - Improve general quality of life in urban settings
    - Create pride in community through community gardens and allotment gardens
    - Attention and concentration improvements for children
- Reduce aggression and violence
- Provide space for recreation
    - Enhance sport field safety
    - Encourage healthy active and passive lifestyle pursuits

To enhance sales, marketing efforts may be connected with the benefits from the literature as well as key wordings and marketing and sales opportunities identified in this study.

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1.0 Introduction and Background

Scientists have, for decades, been trying to bring to the attention of people and their governments the importance of maintaining the biodiversity of planet Earth and of carrying out our daily lives in a fashion that ensures our offspring will inherit a cleaner, greener, more ecologically sustainable world. Governments everywhere, aside from sponsoring some minimally resourced initiatives, have been slow to catapult these issues ahead of things like health care, education, transportation, international trade, infrastructure development and human resources. Only very recently have policy makers realized the interconnectedness of human effort with the natural world, and that measures that not only protect but enhance the environment will be supported and demanded by the voting public and their children. Therefore, it is highly appropriate, in supporting the issues identified by the Horticultural Value Chain Round Table, that government (through Agriculture and Agri-Food Canada) begin to shift their historical emphasis on food agriculture to examining the value of the Canadian ornamental horticultural industry in the new policy context of ecological goods and services to which it can contribute significant quantifiable importance to Canada's future.

Early civilizations found plants that furnished foods, medicines, clothing and shelter. Ancient Chinese documented the many uses of plants. Plant collecting was an important activity on Egyptian military and commercial expeditions and Egypt became a breeding ground for plant magic. The Greeks excelled in their inventiveness of plant superstitions. Christian priests in Europe used plants and flowers as teaching tools, and missionaries brought back far flung plants to church herbal gardens. Those who preserved plant lore and achieved both good and bad with plants during the Renaissance were called witches or herb women. Victorian times saw the wealthy in several countries using flowers and plants for ornamental uses, sometimes paying enormous sums to collect and house their prizes. As more people gravitated toward cities during the Industrial Revolution they began to use plants as decoration, likely as reminders of their rural heritage and to improve the look and feel of their surroundings. In Canada, after both World Wars, the surge in immigrants with backgrounds in cultivation of plants, coupled with improvements in transportation, government disseminated production information, growing methodologies and technologies, and breeding of new varieties all encouraged the development of greenhouse and nursery facilities for growing ornamental plants.

The Canadian floriculture and nursery industries together are often referred to as 'ornamentals' or 'the ornamental industry' or 'non-food agriculture'. The phrase 'ornamental horticulture' also includes the sod and Christmas tree industries.

- Floriculture farmers produce about 6,000 species of
    - cut flowers, potted flowering plants, houseplants, cut foliage, bedding plants, bulbs, cuttings for propagation, food and medicinal plants in greenhouses and outdoor-grown cut flowers (Watson, 2006).
- Nursery farmers produce about 9,000 species of
    - annual and perennial plants, woody shrubs, deciduous and coniferous trees, roses, outdoor garden flowers, Christmas trees and sod.

The Canadian ornamental horticulture industry, with a 2005 farm gate production of approximately $2.2 billion, is one of Canada's best kept agricultural secrets and success

stories (Watson, 2006). Flowers represent 66% of the total production; nursery 26%; sod and Christmas trees the remainder (AAFC, 2005a). Ornamentals account for 42% of the total horticultural farm cash receipts and 6% of all of agriculture (AAFC, 2005b).

Statistics Canada (2006) shows 3,425 greenhouses covering 20 million m^2, and employing 42,620 people with a gross yearly payroll of $517 million and a capital investment of $3.3 billion (Statistics Canada, 2006). Floriculture represents 55% of these numbers, the rest being greenhouse vegetable production. Sod and nursery producers number 1,187, using 44,167 hectares of land, with 7,370 full-time and 7,465 part-time employees and a payroll of $216 million. The 3,000 Christmas tree farms cultivate approximately 40,000 hectares (AAFC, 2005b).

Floriculture and nursery production is concentrated in Ontario (51%) and British Columbia (23%), followed by Quebec (8.5%), with the remainder scattered across the Atlantic Provinces and the prairies. Ontario and B.C. ornamental farms showed higher net operating incomes and operating margins than other provinces because of the concentration of large operations (Statistics Canada, 2006).

A recent study of the Ontario greenhouse industry (TOGA, 2006) found it exhibited an economic output multiplier of almost 3.0 which, if extrapolated, suggests that the ornamental industry contributes almost $7 billion annually to the Canadian economy.

Federally, ornamental horticulture is the only agricultural commodity whose products are subject to the Goods and Services Tax (GST) upon sale to the consumer. The Ontario Greenhouse Alliance reports GST based on sales at the farm gate from floriculture sales in Ontario of approximately $50 million annually from 2002 to 2005 (TOGA, 2006). This does not include the value of mark-up between retail and wholesale, nor the value added components. When these are included, the Canadian Nursery Landscape Association estimates a contribution to GST of almost $500 million annually by the ornamental sector (CNLA, 2006).

The sector has shown a positive balance of trade since 1997, but the once lucrative export market ($453 million against $359 million imports in 2004, AAFCb) is in jeopardy due to the current exchange rate and increased security and plant health complications at the border. About 97% of ornamental exports go to the United States (U.S.). Growth opportunities are significant, given the quality of Canadian plants and flowers and the expansion plans of U.S. mass merchandisers to open new garden centres and retail floral shops.

The industry thrives on free trade and has no supply management, production subsidies or production quotas.

Flowers and plants are Canada's third largest crop after wheat and canola. Canada's per capita consumption of flowers ($47) lags several-fold behind most European countries but we buy 2-3 times more nursery products (AIPH, 2004). In Europe, flowers and plants are considered staple and lifestyle purchases like milk and bread. However, the domestic market has remained relatively flat, despite the increased interest in gardening and landscaping over the past two decades, because flowers, indoor plants and landscaping have to compete with many other luxury items for the Canadian consumer dollar. The recent slowdown in the Canadian industry has been mirrored around the

globe as a result of higher energy and labour costs, increased competition and depressed consumer spending.

The plant development, production, distribution and sales activities and the value chains of the ornamental industry are extremely complex, and vary with the different types of crops.

While the sector has recently experienced some consolidation, resulting in fewer but larger farms, the backbone of the industry is comprised of fiercely independent entrepreneurs who collaborate as an industry primarily when their livelihood is threatened. The need to expand ornamental markets is one of those threats. Ornamental producers have not organized to lobby governments or get their messages out in the media as effectively as other commodities.

Ornamental production costs are rising dramatically but selling prices depend on a world market that has many supply/demand imbalances during the year. To survive, the industry has to sell more plants or flowers and obtain higher prices. The four ways to increase ornamental sales are:

- Increase the number of purchasing households and younger customers
- Increase the frequency of purchases by existing buyers
- Increase the transaction value per buying occasion
- Create a popular culture of personal use and enjoyment of ornamentals

All of these require new and collaborative marketing schemes that promote ornamental flowers and plants in different ways than have been used in the past. Many recent attempts at such schemes have failed because of politics, failure to integrate all segments of the industry, too much emphasis on special occasion use, and variable product quality in the hands of the ultimate consumer. Successful examples for increasing the demand for cut flowers are the export marketing campaigns of South America, the United Kingdom's slogan of "buy some flowers for yourself" coupled with strict quality control, and Australia's development of markets for their commercialized wildflowers after the Olympics.

1.1 Purpose and Objectives

The purpose of the project was to provide the Ornamental Working Group of the Horticulture Value Chain Round Table, through its secretariat in Agriculture and Agri-Food Canada, with a summary of the current state of scientific knowledge related to the benefits from plants and flowers in one's daily life.

The specific objectives of the project were to:

1. Review the published literature from the biological, medical and social sciences to determine whether there were quantifiable physical and psychological benefits to human health, and to the indoor and outdoor environments, that could be linked to the purchase and use of ornamental horticulture products.

2. Recommend wording and/or strategies based on proven science that could form the basis for unique approaches to marketing ornamental

plants based on improving lifestyle, health, and the world in which people live, work and play.

3. Identify new opportunities for export and domestic marketing and increased sales of ornamentals beyond the traditional concepts of beautification of the indoor and outdoor environments.

4. Identify opportunities for further investigation into potential but, as yet, unidentified or unquantified benefits.

5. Provide a functional bibliography of sources of further information that could be quoted to justify any future marketing claims if necessary.

1.2 Report Outline

To meet the objectives outlined above, the report was divided into six sections. Section 1.0 above, provided an introduction to the report. Sections 2.0 through 4.0 provide a summary of the biological, medical and social science literature as it pertains to economic, environmental and lifestyle benefits from ornamental horticulture. Section 5.0, presents key trends in the industry, a summary of past and current marketing efforts, presents 'key wording' opportunities and suggests domestic and export marketing and sales opportunities based on the benefits found in the literature. Section 6.0 is a summary of the primary benefits provided by ornamental horticulture, as outlined in sections 2.0 through 4.0 and presents the conclusions and recommendations from the literature, and identifies opportunities for future research.

2.0 Economic Benefits of Ornamental Horticulture

This section provides examples of the quantifiable values that vegetation brings to people, business and municipalities well beyond the intrinsically aesthetic. Specifically, section 2.1 reviews the energy saving attributes of landscaping, section 2.2 reviews the potential for property value increases with landscaping and section 2.3 concludes with benefits to municipalities of ornamental horticulture including privacy and security, sports and fitness improvements, recreation/parks and tourism benefits.

2.1 Energy Saving Attributes of Landscaping (shade, cooling effects, windbreaks)

Many studies have calculated the energy savings plants can provide and documented the benefits of these savings in dollar values (as well as reduction in carbon emissions). Through a series of studies reported by Brack (2002), an average of $US 0.5782 ($CAN 0.8591[2]) in energy dollars saved was reported per square metre of tree canopy, per year, when shade trees were planted in urban centres.

Other studies have found significant energy savings for both cooling and heating of buildings (Rosenfeld et al., 1998; Akbari, 2002). The trees provide shade and reduce the amount of solar radiation hitting a building, thereby reducing energy requirements for cooling that building. Akbari (2002) estimated that planting one shade tree in an urban setting such as Los Angeles avoided the combustion of 18 kg/yr of carbon due to savings in demand for air-conditioning. This study suggested that deciduous trees were beneficial because they allowed radiation in the winter months to warm the building and conversely assisted in heating. However, use of evergreens in winter climates can also contribute to energy savings because they create windbreaks. Reductions in wind speed can reduce the infiltration of cold air into buildings by up to 50%, giving potential heating savings of 10-12% per year (McPherson, 2005). Plants can also be used to manage air movement and wind to create more comfortable and pleasant microclimates[3] (Robinette, 1972).

Collectively, trees can also affect the local climate by reducing the effect of urban "heat islands" often found in built up areas. The heat island phenomenon causes urban and suburban temperatures to be 1-6^{o}C hotter than nearby rural areas (US EPA, 2007b). Heat islands form as vegetation is replaced by asphalt and concrete for roads, buildings, and other structures necessary to accommodate growing populations (Rosenfeld et al., 1997). These surfaces absorb, rather than reflect the sun's heat, causing surface temperatures and overall ambient temperatures to rise (Rosenfeld et al., 1997). The obvious solution for counteracting urban heat islands is to plant trees and shrubs, which have a two-fold benefit. First, they provide cooling shade (as discussed above). Second, trees, like most plants, soak up groundwater. The water then evapotranspires from the leaves, cooling the leaves and the surrounding air (indirectly). A single properly watered tree can evapotranspirate 40 gallons of water in a day, offsetting the heat equivalent to that produced by one hundred 100-watt lamps, burning eight hours per day (Rosenfeld

[2] Average exchange rate for 1999 used as collection of studies was complied in 1999.
[3] Generally the climate of small areas which can differ significantly from the general climate of the region; stands often create microclimates (Government of British Columbia, 2001).

et al., 1997). The heat island effect can also be combated with "green roofs", creating gardens and planted areas on top of city buildings (GrowerTalks, 2006). Similar to the trees, the plants reduce heat by converting water into vapour, thus using heat energy that would otherwise heat the surrounding air (McPherson, 2005). Research from Pennsylvania State University found that peak temperatures on rooftops planted with *Sedum spurium,* a desert-adapted plant*,* were 30ºC lower compared with temperatures on standard roofs (Scott, 2006). Overall, table 2.1 summarizes the effects of vegetation on air temperatures.

Table 2.1 Effect of Vegetation on Air Temperature

Vegetation Condition	Compared to:	Air Temperatures
Tree groves	Open terrain	9ºF (5ºC) cooler
Irrigated agricultural fields	Bare ground	6ºF (3ºC) cooler
Suburb with trees	New suburb, no trees	4 to 6ºF (2 to3ºC) cooler
Grass sport field	Parking lot	2 to 4ºF (1 to 2ºC) cooler

Sources: Maco & McPherson, 2003 and McPherson, 1998 as cited in (Wolf, 2004): 16.

Schoolyards may also act as heat islands, impacting school children and the surrounding communities. Research conducted by Moogk-Soulis et al. (2000) described how schoolyards act as heat islands and the resulting impacts on users as well as effective mitigation strategies. The temperature of fifteen schoolyards in Waterloo, Ontario was examined on September 3, 1999 in the study. When air temperature was just under 27ºC, the average of the unshaded schoolyard surface temperature was 52.8ºC, which was 20ºC hotter than that of the shaded surface.[4] It was also 5ºC hotter than the average of the surrounding lands. The study suggested the use of trees as an effective mitigation strategy. Trees can be used to shade surfaces, act as windbreaks to decrease the infiltration of hot air into buildings and cool the air through evapotranspiration. The results of the study suggested that the use of trees on one of the schoolyards decreased the surface temperature by up to 25ºC and decreased the air temperature by 10ºC (Moogk-Soulis, 2002).

Energy savings can also be gained from using indoor plants as temperature moderators. Interior plants can reduce the temperature of an office environment and maintain relative humidity in the range of 30-60% which is recommended for human health and comfort (Lohr and Pearson-Mims, 2003). A healthy tree inside a building, i.e. in an atrium or winter garden, can have the cooling effect of ten room-sized air conditioners operating for 20 hours a day (Gilhooley, 2002). According to the Associated Landscape Contractors of America, correct selection and placement of plants can reduce heating and cooling costs by up to 20% (Gilhooley, 2002).

An air conditioning unit operating in the shade of trees uses as much as 10% less electricity than the same unit operating in the sun (US Department of Energy, 2006).

Keywords:
Energy savings, temperature control, green roofs, heat islands

[4] These temperature differences are consistent with those found in other studies (Oke, 1987; Akbari, 1993 as cited in Moogk-Soulis, 2002).

2.2 Increased Property Values

Private landscapes can influence habitat and water quality, among other environmental attributes (Helfand et al., 2006). To capture these benefits, landscapes that incorporate ecologically beneficial land cover patterns have been designed on different scales for private homes (Nassauer, 1993). Many studies have documented the positive effect of landscaped yards on the value of residential homes.

A 2006 study by Helfand et al. employed a contingent choice valuation method to examine people's willingness to pay for ecologically beneficial landscape designs. The survey was designed based on conditions in southeast Michigan, where there was a lot of development on land that had previously been in agricultural production.

Respondents were asked to rate care, neatness, naturalness, attractiveness, and pride on a 1-7 scale of bipolar adjectives (good care – poor care, neat – messy, and natural – artificial). The study was intended to test whether the proportion of native plant garden areas in turf-dominated residential landscape affected public perception.

The study found that, in all cases, respondents were willing to pay more for alternative designs (landscaped) than for conventional lawns. The willingness to pay per month for maintenance of an alternative design yard compared to a conventional yard ranged across the alternatives. Based on three different cases (two replicates of street front yards and one shoreline back yard) and four different yard types (a conventional lawn, 50% prairie garden, 75% prairie garden and 75% prairie garden plus additional native shrubs), the willingness to pay per month for the upkeep of landscaping attributes varied as follows:

- Case 1 (street front yard): willingness to pay per month ranged between $94US and $138 US depending on the yard choice
- Case 2 (street front yard): willingness to pay per month ranged between $93US and $133US
- Case 3 (shoreline back yard): willingness to pay per month ranged between $95US and $143US.

The study indicated that with the right attributes, prospective buyers are willing to pay to maintain landscaped yards.

Des Rosiers et al. (2002) summarized a number of past studies dealing with the effect of landscaping on house values (Des Rosiers et al., 2002). The following table outlines the results of these studies.

Table 2.2 Impact of Landscaping on Property Values

Authors/Location	Type of Analysis	Results
Payne (1973)	• Traditional valuation techniques	• Market value of a single-family home received an average of 7% premium due to arborescent vegetation
Orland, Vining and Ebreo (1992) - Illinois	• Perception study • Effect of tree size on house sales	• Tree size had little impact on evaluation of house. • House attractiveness highly correlated with sale prices.
Kuo, Bacaicoa &	• Perception Study	• Presence of trees had strong, positive

Authors/Location	Type of Analysis	Results
Sullivan (1998) - Illinois	• Tested tree planting density and grass maintenance	effects on residents' preference ratings for courtyards.
Boyce & Favretti (1976) - Connecticut	• Hedonic analysis • 4 variables tested: location, house size, date of sale and tree cover	• A good tree cover could raise total sale price by 6-9%.
Anderson & Cordell (1985) - Georgia	• Hedonic analysis • 800 households	• The presence of trees added a 3-5% premium to sale price.
Luttik (2000) - Netherlands	• Hedonic analysis • Structural housing attributes regressed against location and environmental amenities	• In 6 of 8 cases, hypothesis of green structure adding value was rejected. • In remaining 2 cases, presence of trees/green area added a premium of 7-8%.
Dombrow, Rodriguez & Sirmans (2000)	• Hedonic analysis • 269 single-family homes, dummy variable to account for trees	• Mature trees contribute 2% of homes value in single-family home market

Source: (Des Rosiers et al., 2002).

As well, Des Rosiers et al., (2002) surveyed 760 single-family homes sold between 1993 and 2000 in Quebec. The survey focused on landscaping characteristics of homes and their immediate environment, i.e., the neighbourhood visible from the property.

Their results found the following relationships regarding landscapes and property values:

- A tree cover between the property and its immediate neighbourhood raises the house value.
- For bungalows and cottages, the higher the percentage of ground cover (lawn, flower arrangements, rock plants, etc), the higher the value of the house.
- The presence of a hedge or a landscaped wall raises a property's value by nearly 4%.
- The presence of a landscaped patio can result in as high as a 12.4% premium.
- Landscaped curbs also provide value, as high as a 4.4% premium.

Overall, a 7.7% market premium for either a typical bungalow or cottage was estimated could be achieved in the presence of different landscaping variables and the presence of a hedge.

A 2005 study by Behe *et al.,* investigated the effect of three components of a landscape design on the perceived value of a home. The objective was to provide a consumer perspective on the value of the components in a 'good' landscape and determine which attributes of a landscape consumers value the most. 1,323 participants across seven states in the United States took part in the study. The three attributes considered in this study were plant material type, design sophistication and plant size.
The overall result was that participants rated design sophistication as the top attribute. This was followed by plant material type and then plant size. It was also found that the

perceived home value increased from 5% to 11% for homes with a good landscape (Behe et al., 2005).

A number of other studies confirm the results from the above mentioned studies: namely that landscaping adds value to the (perceived) value of a property. These studies are synopsized briefly below:

- A study out of Clemson University (Henry, 1994) looked at the impact of landscaping on the resale value of single family residences. Homes that were classified as having excellent landscaping could expect a premium of 4 to 5% upon resale, compared to houses with good landscaping. Furthermore, homes with landscaping considered poor relative to homes with excellent landscaping in their neighbourhood could expect to receive a sale price that was 8 to 10% below homes with a good landscape appeal.
- A study by Joel Goldsteen, of the University of Texas, Arlington, found that landscape amenities had the highest correlation with occupancies of any other architectural and urban design variables evaluated (Saunder, 2003). He suggested that landscaping more than paid back the developer through higher occupancies, and higher rents.

Overall, the literature indicates that landscaping increases the property value of a home or business. Realtors are also aware of this fact, and it has been suggested that by spending 5% of the value of your home on the installation of a quality low-maintenance landscape, resale values can be increased by 15%, which translates into a 150% return on the landscape investment (Taylor, 2003).

Keywords: real estate premiums, landscaping adds value, landscape sophistication

2.3 Municipal Economic Benefits

Effective landscape design can also add value to municipalities and communities. The presence of landscaping has already been shown to increase property values, but it is also a wise city investment for many reasons:

- It increases community health and vitality through civic involvement in beautification projects.
- Beautification projects represent a sense of pride and value by residents and businesses.
- Plants stabilize soil and reduce runoff in open spaces (refer to section 3.0).
- Natural habitats protect biodiversity (refer to section 3.0).
- Low maintenance open spaces and xeriscaping reduce maintenance costs.
- Evergreen trees reduce the impact of cooling wind in winter and deciduous trees provide shade in the summer.
- Increases public safety and reduces crime and accidents.

(Gardner, 2006)

Community Beautification and Pride

Plants play a role in the development of healthy communities by:

1) providing a physical condition or appearance that makes people proud to be considered part of the community and by enhancing the economic and social condition of the community;
2) providing opportunities for sharing value interests and commitments; and
3) providing a surrounding that is more comfortable physically in which to live and work (Relf, 1992).

Research at the University of Washington examined how trees were valued in the community, across eight revitalized communities in the United States (Center for Urban Horticulture, 1998b). Participants of the study were asked to aesthetically rank 32 different scenes. Overall, the survey found that retail shopping districts with an orderly and well-maintained planting scheme, including both trees and accessory vegetation, received the highest visual quality ratings.

A mail survey of licensed drivers in Washington State was used to evaluate the perceptions of places that people may associate with roadside landscape (Center for Urban Horticulture, 2000). The study was aimed at determining whether the amount of green space and vegetation along the road and in a community influenced what people thought of the community. The survey found that the presence of trees and green space positively influenced consumers' attitudes about the character of a place, and also the prices that shoppers were willing to pay in local businesses (Center for Urban Horticulture, 2000).

Furthermore, trees and landscaping in neighbourhood commercial districts create a pleasant space that attracts patrons. A study of business owners and business association staff indicated that trees and landscaping attracted patronage through the following means:

- Acting as an outdoor extension of the business' customer service commitment.
- Developing a distinctive identity for and defining the boundaries of a business district, which encourages repeat visits.

(Center for Urban Horticulture, 1998a)

Enhanced Commercial Activity

The University of Washington also produced the following findings on the economics of landscaping in relation to retail and commercial environments:

- A survey of a southern community found that 74% of the public preferred to patronize commercial establishments where the structures and parking lots had trees and other landscaping attributes.
- A Weyerhauser survey found that 86% of real estate appraisers agreed that landscaping added to the value of commercial real estate. As well, 92% agreed that landscaping increased the sales appeal of commercial real estate.
- Another study found that those commercial office spaces with landscape amenities had higher occupancy rates.

(Center for Urban Horticulture, 1998c)
A shopping center in San Diego cites landscaping as the reason for high occupancy and the ability to charge rental rates that are double those of other shopping plazas. The

carefully designed project uses landscaping to create a refuge in the midst of a busy shopping area (Planet Professional Landcare Network, 2005).

A Chicago developer points to unique interior landscaping in a glass-roofed atria as a major selling point, and suggests that it was the reason that building occupancy rates were 21% above the national level. According to Judith Guido, Director of Marketing for LandCareUSA, landscaping can add as much as 14% resale value to a building and speed the sale of a building by as much as six weeks (Planet Professional Landcare Network, 2005).

Privacy and Security

Trees and shrubs can be used to build both physical and visual barriers, providing security and/or privacy. With specific reference to privacy, Robinette (1972) discusses that there are varying degrees of privacy and different lines of sight that should be considered in planting design. Thus, the density of planting and the types of plants used are necessary considerations. Privacy can bring with it a certain amount of security but hedges can be used to screen (block from view) a security fence that provides the physical secure barrier (Robinette, 1972).

Although gardens can provide assistance to intruders in accessing buildings via equipment or ornaments found in the garden, various plants themselves can provide a "natural line of defence", particularly plants that grow densely and have thorns (Cleveland Police, 2007). Some examples of plants used in the UK are given by the Cleveland Police (UK)[5] and HGTV also provides some examples of plants that can be used as aesthetically pleasing security barriers (HGTV, 2007).

Recreation, Parks, Sports and Fitness

Jackson, Mississippi, is an example of a city that is attempting to revitalize itself with the use of landscaping schemes (Burchfield, 2004). One of the primary efforts is the restoration of city parks and recreation areas. Due to its central location and amenable climate, Jackson is a prime area for regional athletic events such as softball and baseball, and the revitalization of recreation areas is expected to increase league play and bring in tournaments. This, in turn, has an economic benefit for the community. In 1998, it was estimated that parks and recreation events generated a US$5 million impact on the area, and in 2003, the figure amounted to US$47 million. Furthermore, there is a trickle down effect of the financial benefits to the improved parks and play areas. Local residents whose children are involved in local sports will tend to buy more gas (to shuttle children to games and practices), buy uniforms and shoes and equipment from local businesses.

The global promoter of sports, the Olympic movement, has acknowledged the importance of the environment by incorporating Agenda 21 into their action plan (International Olympic Committee, 1999). Agenda 21 is the global plan for sustainable

[5] Common Hawthorn, *Pyracantha, Berberis gagnepainii*, *Mahonia bealei* Winter Sun, *Rosa fruhlings* Gold Yellow, *Rosa blanc* Double de Coubert, *Berberis ottawensis* Superba, *Berberis julianae*, *Berberis stenophylla*, *Ulex europaeus*, *Rosa rugosa* Rubra Crimson, *Hippophae rhamnoides*. Note that not all cultivars will be available or applicable regionally.

development that emerged from the United Nations Conference on Environment and Development held in 1992. Recently the committee developed a guide for integrating sport, environment and sustainable development. The document covers many aspects of environmental protection and improvement. One aspect, which is of particular interest to the horticultural industry, is the promotion of biologically diverse environments. The horticultural industry is the provider of plants within built environments and sporting venues (International Olympic Committee, 2007). In addition to the opportunity for the horticulture industry, there are multiple spin-off benefits to the host city (from the Olympics initiative) as outlined above.

Tourism

A study conducted by Evans and Malone (Relf, 1992) looked at the hotel/tourism industry at Opryland. Twelve acres of indoor space had approximately 18,000 plants that were valued at over US$1 million. The study found that the landscaping positively impacted a number of things including a high occupancy rate (85%), numerous awards, and continuous expansion. Additionally, the higher rate charged for rooms overlooking the scenery, plus the high occupancy rate translated into approximately US$7 million in additional annual revenue.

A study that had a slightly different perspective on horticultural tourism was a study conducted by the Canadian Tourism Commission between September 1999 and April 2000. The study used a survey instrument to determine visitation and interest rates in horticultural tourism in Canada and the US. The study found that 25% of Canadian and American adults reported visiting a botanical garden or a garden attraction while on a trip between 1998 and 2000. 40.1% of Canadian travelers (6.9 million) either visited (25.9%) a horticultural attraction (between 1998 to 2000) while traveling, or expressed an interest (14.2%) in visiting one while on their next vacation. In the US, 36.8% of travelers (44.9 million) either visited (26.1%) a horticultural attraction or expressed an interest (10.7%). These values, although slightly dated, illustrate the potential economic benefits of garden inspired tourism for local communities (Canadian Tourism Commission, 2001).

The above studies show that landscaping brings positive economic benefits to communities. It encourages tourism, recreation, and attracts businesses to the area and all of this translates into more finances flowing into the community.

Keywords: property values, customer care, customer satisfaction, municipal economy, community health, vitality and pride, occupancy rates, recreation, enhanced tourism

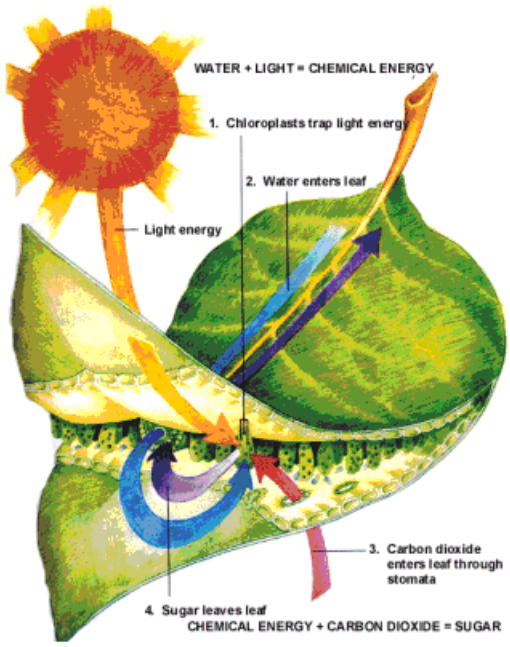
3.0 Environmental Benefits of Ornamental Horticulture

By some time in 2008 over half the world's population will live in an urban environment (Worldwatch Institute, 2007). The urbanization of the world is reducing the connectivity humans have with the natural environment. Despite human disconnectedness from the natural world, plants continue to provide environmental benefits at every spatial level: global, local and individual. This section outlines these environmental benefits. Specifically, it reviews oxygen production (section 3.1), carbon sinks (3.2), pollution amelioration (3.3), indoor air quality improvements (3.4), water management and erosion control (3.5), plants in ecological sewage and wastewater treatment systems (3.6) wildlife attraction and preservation (3.7), windbreaks and noise amelioration (3.8), urban shade, green space and location of plants (3.9).

3.1 Oxygen Production

The fundamental benefit provided by plants is their production of oxygen; thus providing the atmosphere with the element that allows humans to breathe and live on this planet. Oxygen is produced by the plant during the process of photosynthesis as shown in Figure 3.1. Photosynthesis is how plants produce their food (energy). It requires carbon dioxide, water and sunlight. The outputs of photosynthesis are sugars and oxygen. On average, a tree can produce 260 pounds of oxygen per year and two mature trees can produce sufficient oxygen for a family of four (Environment Canada, 2005). Similarly, a natural turf area just 50 feet by 50 feet releases enough oxygen for a family of four (Virginia State University, 2004).

Figure 3.1 Photosynthesis[6]



[6] Source of diagram: http://www.caribbeanedu.com/kewl/science/science04d.asp.

Keywords:
oxygen, breathe, air, photosynthesis

3.2 Carbon Sinks

Plants take in carbon dioxide and convert it to carbohydrates (sugars). These sugars provide the plant with energy to grow. As the plant or parts of the plant die, the decomposition of the plant material returns the carbon to both the soil and the atmosphere. The rate and levels at which carbon from decomposition is released into the atmosphere versus the soil continues to be studied (Idso and Idso, 2007). Carbon within soils can be released via agricultural tillage or soil disturbance (Kumar, Pandey, and Pandey, 2006). This cycle of removing carbon from the air and capturing it in plants and soil is called carbon sequestration. A tree in a forest removes 4.5-11 kg of carbon per year (Akbari, 2002) by simply growing and using carbon dioxide to do so.

Plants' ability to sequester carbon is an important process that can be used to mitigate the increases in carbon dioxide concentrations in the atmosphere that has been occurring since the industrial revolution (Alley et al., 2007). Carbon dioxide is a "greenhouse gas"[7] and as such is contributing to the increase in the average global temperature (Alley et al., 2007).[8] These changes are very likely to cause significant changes in climates around the world (Alley et al., 2007). Concentrations of carbon dioxide in the atmosphere have been increasing at an alarming rate, mainly due to the burning of fossil fuels but also due to changing land uses (Alley et al., 2007). To counter this trend, green spaces (or large trees) are planted in public rights of way, parks and open spaces in order to build the global availability of "carbon sinks" (McPherson, 2005).

Programs are emerging around the world where people are paying to plant trees in order to mitigate the emissions they contribute to the atmosphere via airline travel (Eilperin, 2007). By planting trees, travelers are creating a "carbon sink" and reducing their individual "carbon footprints". The trees absorb carbon as they grow and offset some of the carbon that is emitted by the burning of fossil fuels during travel. A number of entrepreneurial companies are providing tree planting services for people who wish to assist in reducing their impact on the increasing carbon dioxide levels (Eilperin, 2007), including the impact people have due to everyday living and working (Carbon Footprint, 2007).

Keywords:
Carbon sequestration, carbon footprint, greenhouse gases

[7] Greenhouse gases allow sunlight to enter the atmosphere but capture many of the reflected light waves, trapping the energy/heat within the atmosphere and consequently heating the planet like a greenhouse (Energy Information Administration, 2004).
[8] An important concern of the floriculture industry is that governments and the public not misunderstand that these gases are somehow created by the greenhouse industry and that by extension greenhouses are bad citizens.

3.3 Pollution Amelioration

Trees and plants have been labelled as the "lungs of cities" (McPherson, 2005) because they have the ability to remove contaminants from the air that is breathed. Acting as natural filters and reducing air pollution, it has been shown that plants generate health benefits by reducing the mortality rate and reducing visits to the hospital (Powe and Willis, 2004). A few ways in which plants reduce air pollution are as follows:

- Absorption of gaseous pollutants through their leaves, e.g., ozone, nitrogen oxides, and sulphur dioxide.
- Further reducing ozone concentrations at ground level by reducing the temperature via evapotranspiration as mentioned above.
- Collection of dust, ash, pollen and other particulate matter on their leaves hence reducing its presence in the air breathed.
- Releasing of oxygen, as mentioned above, which increases the quality of the air for human use.

(McPherson, 2005)

The amount of air-borne pollutants removed increases with leaf surface area. Therefore, trees tend to be better filters than shrubs and grasses. Due to their large surface area and year round coverage, conifers (evergreens) are very good pollution filters. However, conifers tend to be sensitive to phytotoxic air pollutants and deciduous trees are more efficient at absorbing gaseous pollutants. It is, therefore, beneficial to have a mixture of species in order to have the greatest effect in reducing air pollution (Bolund and Hunhammar, 1999).

The total amount of air pollution removed by urban trees annually within the United States is estimated to be 711,000 metric tons (Nowak, Crane, and Stevens, 2006). The ability of plants to remove specific polluting compounds from the Nowak, Crane and Stevens (2006) research is presented in the table below.

Table 3.1 Average Air Pollution Removal and Value for All Urban Trees in the United States

Pollutant	Removal (metric tons)	Value (million US $)
Ozone (O_3)	305,100	2,060
Particulate Matter (PM_{10})	214,900	969
Nitrogen dioxide (NO_2)	97,800	660
Sulphur dioxide (SO_2)	70,900	117
Carbon Monoxide (CO)	22,600	22
TOTAL	*711,300*	*3,828*

Source: (Nowak, Crane, & Stevens, 2006).

Researchers in the United Kingdom quantified the benefits of air pollution absorption in terms of mortality and morbidity. Powe and Willis (2004) estimated that the woodlands in Britain saved 5-7 lives and reduced hospital admissions by approximately 4-6 annually. This had an estimated economic value of at least £900,000 (CAD$ 2.15 million[9]). Their argument was that by absorbing pollution such as particulate matter

[9] The average exchange rate for 2004 was 2.384 pounds per Canadian dollar.

(PM_{10}[10]) and sulphur dioxide the woodlands provided additional benefits beyond the traditionally conceived market benefits, although the authors did indicate that these particular health benefits were relatively small in comparison to other non-market benefits of forestry.

Plants are also used to remove contaminants from the soil. This process of reduction or removal of pollution is known as *phytoremediation* (Glick, 2003; Licht and Isebrands, 2005). Phytoremediation includes strategies such as riparian buffer zones, often used within the agricultural sector to act as natural filters of agricultural run-off, consequently increasing local and regional water quality. Phytoremediation is also used within an urban context on brownfields[11] that will only achieve their economic value from development once the soil or water contamination is removed or controlled (Licht & Isebrands, 2005). Gas Technology Inc. has experience in the phytoremediation of soils, focusing on cleanup of manufactured gas plant sites and on soils contaminated with other hydrocarbons (e.g., crude oil). The company has identified several plant species that show promise for remediation of soils contaminated with polycyclic aromatic hydrocarbons (PAHs)[12]. The process of phytoremediation of PAHs is shown in Figure 3.2 below (Gas Technology Institute, 2007).

[10] Particulate matter (PM) consists of airborne particles in solid or liquid form. PM may be classified as primary or secondary, depending on the compounds and processes involved during its formation. Primary PM is emitted at the emissions source in particle form, for example, the smokestack of an electrical power plant or a recently tilled field subject to wind erosion. Secondary PM formation results from a series of chemical and physical reactions involving different precursor gases, such as sulphur and nitrogen oxides, and ammonia reacting to form sulphate, nitrate and ammonium particulate matter.

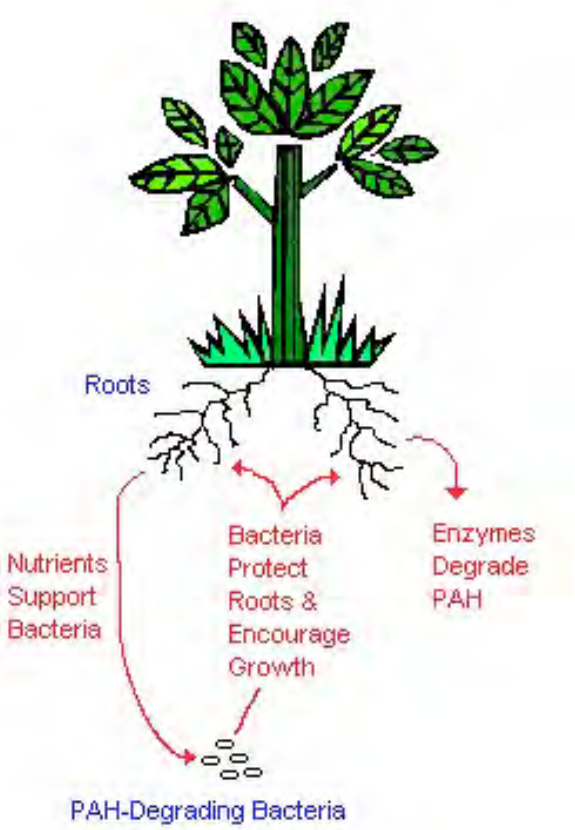
The size of PM particles largely determines the extent of environmental and health damage caused. For this reason, Environment Canada identifies different sizes of PM:

Total Particulate Matter (TPM) -airborne particulate matter with an upper size limit of approximately 100 micro metre (µm) in aerodynamic equivalent diameter
Particulate Matter <10 microns (PM_{10}) - airborne particulate matter with a mass median diameter less than 10 µm
Particulate Matter < 2.5 microns ($PM_{2.5}$) – airborne particulate matter with a mass median diameter less than 2.5 µm

Numerous studies have linked PM to aggravated cardiac and respiratory diseases such as asthma, bronchitis and emphysema and to various forms of heart disease. PM can also have adverse effects on vegetation and structures, and contributes to visibility deterioration and regional haze.

[11] Brownfields are abandoned or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contaminations (US EPA, 2006).
[12] Polycyclic Aromatic Hydrocarbons occur from the incomplete combustion of carbon containing fuels such as wood, coal, diesel, fat or tobacco.

Figure 3.2 Phytoremediation



Source: (Gas Technology Institute, 2007).

Even plants that are relatively tolerant to environmental extremes struggle to produce normal biomass in the presence of environmental contamination. Through the use of growth-promoting bacteria it has been possible to increase the speed and efficiency of phytoremediation (Glick, 2003). These developments contribute significantly to the ideas of Licht and Isebrands (2005) who illustrate the economic opportunities of linking biomass harvesting with phytoremediation. Trees that are grown on contaminated ground with growth-promoting bacteria can also be harvested for their wood so that the benefits are two-fold; increased phytoremediation efficiency (i.e., increased ability to grow in a difficult environment) and increased harvested product.

Environment Canada has collected the available research on plants that excel in environmental cleanup into two data bases. *Phytorem* lists plants that excel in the cleanup of sites contaminated by metal (Environment Canada, 2003b), while *Phytopet* lists plants that are specific to the phytoremediation of petroleum hydrocarbon contaminated sites (Environment Canada, 2003a). In most cases, the plants that have done the job are harvested and disposed of safely, with the additional potential of recovery and recycling of the contaminants and the use of the remaining cellulosic material in biofuel production.

Keywords:
clean, phytoremediation, filters, "lungs of our cities", recovery and recycling

3.4 Indoor Air Quality Improvement

As our population continues to urbanize, the number of people spending 80-90% of their time indoors (Orwell et al., 2004) is also increasing. Many studies have reported that the concentrations of volatile organic compounds[13] (VOCs) are higher indoors than outdoors (Sakai et al., 2004). Plants continue to function as atmospheric filters indoors as they do outdoors and enhance the air quality of confined environments. Recent studies show that indoor plants are effective at removing VOCs (Orwell et al., 2004; Liu et al., 2007). Orwell et al (2004) tested seven plant species/varieties[14] and demonstrated that the rhizosphere[15] (substrate) and the plant are both required to maximize the removal rate of VOC from the air.

A similar study conducted by Liu et al (2007) identified 10 species[16] of ornamental plants that are effective at removing benzene from the air and are, therefore, considered apt at removing other gaseous pollutants. The Green Dragon Tree[17] was found to be the species with the largest capacity to remove benzene from indoor air.

As with the outdoor environment, particulate matter such as dust, ash, pollen and smoke are also irritants and pollutants of indoor air. Lohr and Pearson-Mims (1996) found that the levels of particulate matter accumulation in a room were lower when plants were present than when they were not. In addition to finding a reduction in particulate matter it was also found that relative humidity was slightly higher when plants were present. An increase in relative humidity, particularly in heated environments, increases the comfort level. Another means by which indoor plants improve enclosed environments is by removing offensive odours from the air (Oyabu et al., 2003).

Biowalls were developed due to the evidence of plants as efficient filters of air. Researchers at the University of Guelph developed an air filtration system that has a wall of living plants which cleans the air of a building and incorporates it back in to the air distribution system. In the most complex systems, water to irrigate and fertilize the plants comes from integral waterfalls and vertical drip systems sourced from ponds

[13] Volatile organic compounds (VOCs) are emitted as gases from many solids and liquids e.g. carpeting, furniture, wall coverings and ceiling tiles (Dixon, 2006). Some of the chemicals labelled as VOCs may have short- and long-term adverse health effects (US EPA, 2007a).
[14] The seven plants tested were; *Dracaena* 'Janet Craig', *Epipremnum aureum*, *Dracaena marginata*, *Schefflera* 'Amate', *Spathiphyllum* 'Petite', *Spathiphyllum* 'Sensation', and *Howea forsteriana*.
[15] This is the zone that surrounds the roots of plants in which complex relations exist among the plant, the soil microorganisms and the soil itself (American Society for Microbiology, 2000).
[16] The ten species identified were: *Crassula portulacea*, *Hydrangea macrophylla*, *Cymbidium* 'Golden Elf'., *Ficus microcarpa* var. fuyuensis, *Dendranthema morifolium*, *Citrus medica* var. sarcodactylis, *Dieffenbachia amoena* cv. 'Tropic Snow'; *Spathiphyllum* 'Supreme'; *Nephrolepis exaltata* cv. Bostoniensis and *Dracaena deremensis* cv. 'Variegata'.
[17] *Dracaena deremensis* 'Janet Craig'

which support fish, plants and other organisms that cleanse the water while adding nutrients for the plants. The biowall system, known as Naturaire®, is adaptable to a variety of spaces including condominiums, homes, office buildings and public buildings, and may be used during space exploration in the future (Dixon, 2006; Prescod, 2005).

During the 1980's NASA investigated the use of plants as air purifiers. The results of their investigation suggested that one potted plant per 100 square feet of indoor space in an average home or office was sufficient to cleanse the air of pollutants (Prescod, 1990). Prescod (1990, 1992) provides a list of plants which are effective air purifiers along with the pollutants that they are best at removing. Orchids are very effective at removing numerous pollutants during the daylight hours. They are also effective at removing carbon dioxide and xylene[18] at night, while at the same time releasing oxygen into the air. This is because orchids (and bromeliads[19]) have a unique metabolic process whereby their stomata[20] open at night. This is significant because air can be continuously filtered, day and night (Prescod, 1992).

It is important to acknowledge, however, that plants can also contribute to reduced air-quality by releasing pollen and spores (Lohr and Pearson-Mims, 1996) which can cause discomfort in the form of allergies. However, there is a substantial amount of research that indicates having indoor plants has the net effect of improving indoor air quality.

Keywords:
Comfort, reduced toxins, filters, space travel, biowalls, dust, relative humidity, air quality

3.5 Water Management and Erosion Control (retention, filtration, purification, flood control)

There are significant benefits that can be gained from plants with respect to water management. As the discussion above pointed out, plants can be used to remove pollution from soils and air. In addition, plants can also remove pollution through filtration and purification processes and can also assist in flood control by retaining water. For example, wetlands and green spaces both purify and retain water that would otherwise drain away putting overloads on storm sewers. This retention allows for aquifers[21] to be recharged.

These functions are also achieved by the turf grasses that cover residential yards, golf courses, parks and road medians (University of Minnesota, 2006). Plants can be used in conjunction with storm water management ponds to manage water run-off from urban areas (Inglis, 1999). Plants around the pond provide structure for the soil and reduce water erosion and, in doing so, reduce sedimentation in the waterways. The water flow is slowed by the presence of plants allowing the water time to infiltrate the soil (Brack, 2002). Consequently, this provides time for the process of phytoremediation (mentioned

[18] Xylene is found in paint, gasoline, and paint thinners.
[19] A large family of plants, those which are generally grown indoors are epiphytes which in their natural habitat acquire their moisture and nutrients from the air and rain.
[20] Microscopic pores which allow for exchange of gases and water (Torii, 2006).
[21] The underground layer of water-soaked sand and rock that acts as a water source for a well; described as artesian (confined) or water table (unconfined) (Environment Canada, 2004).

above with regard to soil contamination). As the water seeps through the soil biological organisms (plants and micro-organisms in the soil) reduce or remove pollutants from the water (University of Wisconsin, 2004). Additionally, storm water ponds provide green and open space for a community's year round enjoyment and provide unique habitat for wildlife (Inglis, 1999) that is rapidly being lost to urban development.

Using plants to reduce run-off and pollutants can occur in many situations. As watersheds increasingly become urban landscapes the amount of penetrable ground is reduced. This can be improved by using "rain gardens", a small swale or retention ditch, near impenetrable surfaces (e.g. roads, parking lots). This creates areas for water to be cleaned and reduces the speed with which water re-enters the watershed (University of Wisconsin, 2004). Plantings located on roof tops, known as green roofs, can also provide this service. The plantings filter and reduce run-off (Erskine, 2003).

The development of phytoremediation techniques has lead to more intensive use of plants in water purification. Ocean Arks International is a company that has specialized in this area and has developed purification systems for municipalities, food processing plants and agricultural operations. They design and install "restorers" which are engineered ecologies on floating rafts. The plants and micro-organisms that live on these rafts clean and purify the water by encouraging natural processes; they introduce oxygen to the stressed system allowing the ecology to re-balance. The system can reduce organic loading, and improve water clarity by reducing the total amount of suspended solids. Organic pollutants such as fats, oils and greases can be broken down and removed. Ammonia, nitrate, and pathogens such as fecal coliform levels are reduced and heavy metals can be removed from the water (Ocean Arks International, 2007).

The Krantzberg and Boer report (2006) to the Ministry of Natural Resources of Ontario characterizes the major uses of the Great Lakes for which economic value can be calculated either directly or indirectly. Eight million Canadians and 35 million U.S. residents live, work and recreate near, in, or on one of these lakes, and 1 in 3 Canadians and 1 in 10 Americans obtains municipal water from the six quadrillion gallons of these lakes. Of interest to this report is the $70 billion value that the authors place on the wetlands and plant biodiversity, including values of nutrient cycling, flood control, climate control, soil productivity, forest health, genetic vigour, pollution abatement, pollination and natural pest control. The opportunity for the ornamental industry lies in the future propagation of appropriate plants for the maintenance of and, if necessary, the remediation or expansion of these wetlands (Krantzberg and Boer, 2006).

Keywords:
Filtration, purification, flood control, erosion control, natural, efficient

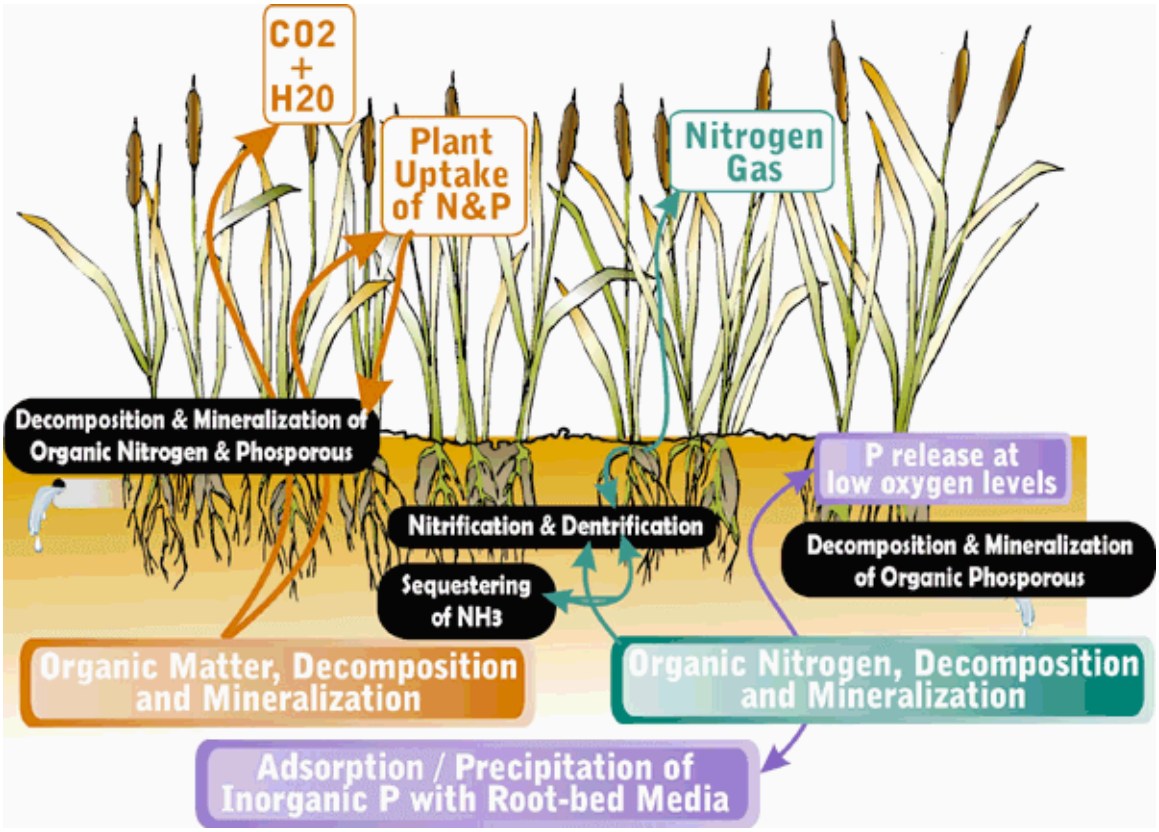
3.6 Plants in Ecological Sewage and Wastewater Treatment Systems

In the early 1990s, there were many scientists working on different technologies using various plants to cleanse wastewater from residences, businesses and towns. The systems produced energy from plant biomass, other reusable by-products and, most importantly, clean water that could be reused. Jewell (1995) summarized the technologies and gave examples of successful early installations (Jewell, 1995).

Watson (1995) proposed a multi-partner greenhouse-based waste treatment facility for the Town of Dundas, Ontario that would make use of plants and microorganisms to treat wastewater to prevent sewage and storm water from contaminating a regional wetland remediation (Watson, 1995). His report, including the potential for cropping the ornamental plants from the facility, was incorporated into a discussion paper written for McMaster University (Kendrick, 1995). The paper proposed a multi-stakeholder revenue-generating research facility using an integrated greenhouse sewage treatment facility based on the Sutrane system (then used in rural Mexico), but with modern greenhouse technology. The facility would test the feasibility of biologically engineered systems on a large scale in the treatment of sewage. The specially designed educational floriculture greenhouse facility known as Niagara-Under-Glass (now called Silver Vase Orchids) near Grimbsy, Ontario used both a biowall to cleanse the air in its classroom and exhibit area and an engineered wetland to purify its sewage and other wastes (Aalbers, 2007). Graphical representation of the treatment processes that occur within the engineered wetland[22] (in this case the AQUA Wetland System) is provided in Figure 3.3 below.

[22] The following is an excerpt from Lloyd Rozema's Master's thesis as cited in Aqua Treatment Technologies, 2007: "Physical, chemical, and biological processes combine in wetlands to remove contaminants from wastewater. Theoretically, treatment of wastewater within a constructed wetland occurs as it passes through the wetland medium and the plant rhizosphere. A thin aerobic film around each root hair is aerobic due to the leakage of oxygen from the rhizomes, roots, and rootlets (Hammer, 1989). Decomposition of organic matter is facilitated by aerobic and anaerobic micro-organisms present. Microbial nitrification and subsequent denitrification releases nitrogen as gas to the atmosphere. Phosphorus is co-precipitated with iron, aluminum, and calcium compounds located in the root-bed medium (Brix and Schierup, 1989; Davies and Hart, 1990; Fried and Dean,1955; Patrick and Reddy, 1976; Sah and Mikkelson, 1986). Suspended solids are filtered out as they settle in the water column in free water surface (FWS) wetlands or are physically filtered out by the medium within the subsurface flow (SF) or vertical flow (VF) wetland cells. Harmful bacteria and viruses are reduced by filtration and adsorption by biological films on the sand media in SF and VF systems."

Figure 3.3 Treatment Process that Occur within an Engineered Wetland



Source: (AQUA Treatment Technologies, 2007).

A company called Living Technologies has installed working "Living Machines" that use plants to treat human and production waste in places like The Body Shop head office in Toronto, the YMCA in Kitchener-Waterloo and several notable locations in the USA and the UK. In colder climates, the systems are covered by greenhouses. The company currently offers a wide range of lake restorers, eco-restorers and designer reedbeds for different applications (Living Technologies Ltd., 2007). Similarly, John Todd Ecological Design Inc. offers "The Eco Machine" a wastewater treatment system that naturally treats sewage and industrial waste with plantings that also incorporate helpful bacteria, fungi, plants, snails, clams, and fish that thrive by breaking down and digesting organic pollutants, pollutants that normally deprive the water of oxygen. This clean, simple approach efficiently transforms high-strength industrial wastewater and sewage into water clean enough to be recycled for reuse (John Todd Ecological Design Inc., 2006). Today there are many different solutions being installed around the world that use plants in wastewater management.[23]

[23] For additional information, refer to the Green Pages at http://www.eco-web.com/index/chapter/2.html).

Keywords:
Sewage, wastewater, treatment, water cleansing, engineered wetland

3.7 Wildlife Attraction, Preservation and Biodiversity

Ornamental plants can also provide environments that encourage the presence of wildlife both during production of the plant (e.g. Christmas trees and other nurseries) and at the end use in the garden or parkland.

With the production of Christmas trees for example, it takes 7-10 years for the trees to reach heights of two metres, at which point they are ready for sale. During this time, the trees provide habitats for a variety of birds and other animals (Canadian Christmas Tree Growers Association, 2004).

Research out of South Carolina has shown that establishing landscape corridors encourages plant biodiversity (Damschen et al., 2006). The researchers used a large-scale replicated experiment, in forested areas of the Savannah River site, southeastern South Carolina, to show that habitat patches connected by landscape corridors retained more native species than isolated patches. The research also found that corridors do not promote invasion by exotic species. Overall, patches connected by landscape corridors had 20 percent more species of plants than the unconnected corridors (Damschen et al., 2006).

Organizations and individuals such as the National Wildlife Federation in the United States and P.M. Lloyd in the United Kingdom provide information on the particular ornamental plants that can be used in the garden to attract wildlife (Lloyd, 2007; National Wildlife Federation, 2007).

Another company has launched American Beauties™, a line of plants supplying the market with native species for gardens. The promotional materials assist consumers in deciding which plants would be best to achieve the garden desired e.g., attracting birds or butterflies (Landicho, 2007).

Creating and maintaining green public spaces in which people can experience wildlife and open space has significant value, demonstrated by the fact that people are willing to put themselves in front of bulldozers to prevent infilling of these spaces within cities. Simply knowing that a green space exists is a source of satisfaction for many people (Woodley et al., 2004).

Keywords:
Beauty, satisfaction, birds, animals, wildlife, preservation, biodiversity

3.8 Windbreaks and Noise Amelioration

Across the Canadian Prairies, the Canadian government has been providing trees for farmers since 1901. Programs have encouraged the planting of hardy trees to build shelterbelts that protect the prairie soils from wind erosion, and encourage the protection of a natural resource. Added benefits of the shelterbelts are that they make working in a prairie farm yard more pleasant because the cold winter wind is blocked, and in the summer song birds inhabit the stands of trees. The trees planted in shelterbelts are also carbon sinks as discussed above (AAFC, 2002).

An article by Wah (2007) in the Toronto Star about the carnage and property losses created by recent multi-vehicle pile-ups in winter storm whiteout conditions recommends that conifers be planted along open stretches of roadways to reduce blowing snow and provide critical visual references for suddenly blinded drivers (Wah, 2007). Examples of coniferous trees that are recommended as windbreaks include White Spruce, Norway Spruce, Austrian Pine, White Pine, Lombardy Poplar and Cedar (Anonymous, 2003).

Screens and hedges also provide noise reduction, especially in urban areas where noise is easily reflected from hard surfaces like pavements or buildings. Plants are better at absorbing high-frequency sounds, which are most bothersome to human ears, than they are at absorbing low frequency sounds (Fare and Clatterbuck, 1998). Noise is measured in decibels (on a logarithm scale) and is best reduced when plants are placed in two or three rows. For instance, two feet of plant width can decrease the decibel level by four, while increasing the plant width with two or three plants can lower the noise level more than seven decibels. Some examples of noise levels include:

- people talking, 30-60 decibels
- large trucks, 60-80 decibels
- jet airplanes, more than 120 decibels (Fare & Clatterbuck, 1998).

Another approach to noise reduction is the development of an earthen berm about 3-4 feet high (the sides of the berm typically slope about 5-20 percent, with an optimal slope of 10 percent) (Fare & Clatterbuck, 1998). The combination of the berm and the plant material planted on the top and/or sides can reduce the noise level 6 to 15 decibels, which the human ear perceives as one-third to one-half as loud (Fare & Clatterbuck, 1998). Planting on an earth berm can also provide privacy as well as noise reduction (Fare & Clatterbuck, 1998).

Keywords:
protection, song birds, shade, noise reduction, urban tranquility, shelterbelts, windbreaks, highway safety

3.9 Urban Shade, Green Space and Location of Plants

Ornamental plants can be strategically located to engineer a more pleasant environment in which to live. They can be placed around pools to provide shade but also to reduce the glare that is reflected up to surrounding buildings; they can be placed in front of houses to prevent lights from vehicles or the street shining into the house; and they can also play a roll in reducing noise from highways (Robinette, 1972). Green roofs also reduce noise distractions from the outside world (GrowerTalks, 2006).

Plants in the urban environment provide shade to escape the heat of the summer sun and they also provide green spaces for rest, relaxation and recreation. However, there are various ways in which green spaces can be designed. For example, they can be managed as natural woodland areas or manicured to provide formal settings such as those found in botanical gardens. For some people the "natural" landscape is something that should be kept for wilder places and doesn't have legitimacy within the urban context due to an association of "natural" with fear of physical danger (Özgüner and Kendle, 2006). Others, however, feel a natural landscape gives them a sense of freedom and is a better place to socialize than the formal landscape. Conversely, Özgüner and Kendle (2006) found that in a formal landscape people had a sense of safety and that they found it a better place to relieve stress, and that it was more peaceful, quiet and calming.

Extending the calming effect beyond parklands, Wolf (2006) suggests that forested urban roadways increase the level of safety, both by defining the roadside and focussing the drivers' attention. They also create a more pleasant, less stressful environment in which to operate. In a separate study, Wolf (2004) provided a comprehensive list of environmental, social and economic benefits that can be achieved from utilizing trees in parking lots. Not only do the trees provide shade for the parked vehicles and, therefore, make returning to a vehicle a more pleasant experience, but the trees were also found to provide many other benefits simultaneously. Wolf (2004) points out that healthy vegetation lowers energy use, reduces air pollution and greenhouse gas, decreases storm water runoff and improves ecosystems, all of which have been discussed above.

Green roofs are an innovative way to incorporate the benefits of plants into the urban landscape. Many of the benefits discussed in this section were reiterated in the literature discussing green roofs. Green roofs[24] produce oxygen and help with energy savings via climate control both inside the building and for the city as a whole (refer to section 2.1 above). They assist in water management by cleaning and retaining water, and can reduce the noise levels around the city (Erskine, 2003). An Environment Canada study showed that green roofs reduced greenhouse gases by approximately 2.18 metric tons (MT) based on 6.5km^2 of green roof coverage. Additionally, 30 MT of pollutants were removed from the air and summer temperatures were reduced by 1-2^{o}C. The reduction in temperature also lead to a reduction in energy requirements (Erskine, 2003).

The United States Golf Association also points out that golf courses are green spaces with trees, turf grasses and natural areas that provide many of the benefits illustrated in this section (United States Golf Association, 2007). The USGA has been involved with numerous studies evaluating the relationship between golf and the environment and highlighted the benefits of golf courses as follows (United States Golf Association, 2007):

[24] Green roofs can be intensive or extensive. Intensive requires additional engineering consideration to accommodate the increased weight on the roof from the 6-14 inches of soil. Intensive systems generally have increased maintenance and irrigation programs associated with them. However, extensive systems can be lightweight and require very little maintenance (Erskine, 2003).

- *Provides wildlife habitat*: More than 70% of most golf courses are rough and non-play areas which include natural grasses, trees and shrubs that, with the open areas of fairways and greens, make golf courses an attractive area for wildlife habitat.
- *Protects topsoil from water and wind erosion:* The dense system of roots and shoots helps turf control erosion by capturing and slowing down water from storms. Studies have shown that during extremely intense rainstorms (three inches per hour), turf holds up to 20 times more soil than traditionally farmed cropland.
- *Improves community aesthetics*: Turf improves community aesthetics in a number of ways including keeping things cooler on a hot day, reducing noise pollution, reducing the glare of sunlight on pavement and buildings, and building in areas that were damaged by mining or landfills.
- *Absorbs and filters rain*: Turf easily absorbs rainwater that might otherwise flow into streams and lakes.
- *Improves health and reduces stress for people who participate in golfing*: Research studies show that participants of golf lowered their cholesterol levels by walking the course when they played.
- *Improves air quality*: The growth process for turf takes carbon dioxide from the air and releases oxygen. Studies have shown that a landscape of turf, trees, and shrubs about 2,000 square feet in size can generate enough oxygen for one person per year.
- *Captures and cleanses runoff in urban areas*: Turf provides a good growing area for many microorganisms and these microorganisms, in turn, help cleanse water by digesting the pollutants in the trapped water and speeding up their normal breakdown.
- *Discourages pests, pollen and disease (e.g. ticks and mosquitoes)*: Turf that is dense and well maintained reduces weeds and the pollen that aggravates allergy sufferers. Furthermore, mowed turf discourages pests such as mosquitoes, ticks and chiggers, which, in turn, reduce the threat of Lyme Disease.
- *Restores damaged land areas (e.g. former landfill or mining sites)*: Restoring damaged areas such as abandoned quarries, strip mines and landfills with golf courses combines the benefits of turf with the benefits of a landscaped area and results in a reclamation of previously unused land for the community.
- *Makes substantial contributions to the community's economy*: Golf is growing in popularity, and appealing to a broad range of people. Golf courses can have large impacts on the economy by providing jobs and creating tourism to an area.

The combination of mowed turf, trees and natural areas provides a diverse environment for people and wildlife, and preserving these green spaces improves the environmental quality of the entire community (United States Golf Association, 2007).

Keywords:
natural, designed, green roofs, heat reduction, peaceful, quiet, calming, stress relief

4.0 Lifestyle Benefits of Ornamental Horticulture

The World Health Organization (WHO) defines health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (World Health Organization as cited in Frumkin, 2001). Given the WHO definition of health, the following questions arise: Does contact with the natural environment contribute to our complete physical, mental and social well-being (Frumkin, 2001)? What is the role of plants in enhancing human health? This section explores the literature in search of evidence of the health and well-being benefits of ornamental horticulture. Specifically, the section reviews mental and physical health (section 4.1) in the workplace, hospitals and long term care facilities and at home. Section 4.2 looks at the health impacts of ornamental horticulture for sports and fitness, while section 4.3 reviews the benefits for community beautification and pride.

4.1 Mental and Physical Health

4.1.1 In the Workplace and Schools

Reduced Stress

Plants have been shown to reduce stress across a broad spectrum of individuals. A study by Ulrich in 1979 (Frank, 2003) found that college students under exam stress had increased positive feelings and reduced fear and anger when they had a view of plants. Lohr, Pearson-Mims and Goodwin (2007) have also demonstrated that plants in the workplace reduce stress levels. It was found that when plants were present in the interior space systolic blood pressure was reduced by one to four units (Lohr, Pearson-Mims, and Goodwin, 2007), added to which worker's productivity was also increased.

Improved Productivity

People often use plants in offices to change the atmosphere of the working environment. A study by Shibata and Suzuki (2002) examined the impacts of plants on the task performance and mood of undergraduate students as a model for the effects of plants in working environments. Undergraduate students performed either an association task[25] or a sorting task[26] under different room arrangements. One room arrangement had no plants and the other two arrangements had plants located either in front or to the side of the student in order to assess the impact of visibility on the research results. The results of the study indicated that the task performance of male students in rooms with plants arranged in front of the students was higher than the performance of male students working without plants. The results also indicated that the presence of plants affected the association task more than the sorting task and male students more than female students (Shibata and Suzuki, 2002).

In 2004, Shibata and Suzuki further investigated the effect of an indoor plant on task performance and mood. The 2004 study compared the performance of undergraduate students in completing a word association task when placed in a room with an indoor

[25] The association task was to create no more than 30 words for 20 different items.
[26] The sorting task was to sort 180 index cards into Japanese syllabary order.

plant, or a magazine rack, or neither of those objects. To assess mood, students were asked about their feelings regarding the task, task environment, and effect of the environment on task performance. The results of the study indicated that female participants performed better when the plant was in the room, compared to when the magazine rack was in the room. Participants' task performance was better when the object in the room was perceived as calming and not distracting. Mood was better with the plant or magazine rack in the room compared to a room with no objects (Shibata and Suzuki, 2004).

Intuitively, most people perceive plants as enhancements to the office environment (Larsen et al., 1998). Research conducted by Larsen et al. (1998) looked at the effects of indoor plants on productivity, attitude and perceptions in the office environment. The research examined productivity under three different working conditions: an office without plants, an office with a moderate number of plants (10) and an office with a high number of plants (22). Participants in the study were largely undergraduate and graduate students. The participants performed three tasks: a low-intensity sorting task; a high-intensity letter identification productivity task; and a survey questionnaire. Surprisingly, the results of the productivity task were opposite to those expected; participants in the office without plants had the highest productivity scores. However, the results of the study support the conclusion that attractive settings positively increase participants' well-being ratings and that the presence of indoor plants increases the comfort and attractiveness of the office environment (Larsen et al., 1998).

Physiological and Psychological Benefits

A study by Chang and Chen (2005) focused on the conditions in the workplace and human physiological and psychological responses. The research explored the effects of natural versus urban views from windows and the presence of indoor plants on physiological and state-anxiety[27] well-being. Different combinations of plants and window views were used to stimulate a participant's physiological response.[28] Psychological reactions were based on an individual's feelings and state-anxiety levels. In general, the results of the study indicated that a window view results in a more positive effect in an office workplace than indoor plants and that a window with a view of nature has more effect than an urban view. Given this information and the fact that a large portion of a person's day is spent in the workplace, the authors presented thoughts as to how to improve the psychological and physiological well-being of office workers as shown in Figure 4.1 (Chang and Chen, 2005).

[27] State-anxiety is a short term emotional state stimulated by a certain situation or environment (Spielberger et al., 1983 as cited in Chang and Chen, 2005).
[28] Physiological response was measured using electroencephalography (EEG) (i.e. recording brain waves), blood volume pulse (i.e., measuring cardiovascular responsiveness to stress), and electromyography (EMG) (i.e. measuring muscle tension in the forehead).

Figure 4.1 How to Improve Well-Being of Office Workers

- Design plants and landscapes around buildings from an inside-out perspective, not just from an outside perspective.
- Plant selection and landscape design need to consider the view outward from windows.
- In areas such as universities, industrial parks and open environments, planting larger and faster growing trees that can be viewed from the windows of high buildings is recommended.
- In urban environments where space is limited, flower gardens, indoor plants and window boxes are recommended.

Source: (Chang & Chen, 2005)

In 1998, Fjeld et al. investigated the extent that indoor plants affect the well-being of people who are working in modern office buildings and who often complain of health and discomfort problems. Common complaints included cough; irritation of the nose, upper airways, throat, skin and eyes; and neurological symptoms such as drowsiness, nausea, dizziness, headache and loss of concentration. The participants of the study included 51 employees at a Norwegian oil company who worked in single office rooms. A previous survey revealed that these people had in the past experienced symptoms which they considered to be caused by poor indoor air quality. The participants completed a questionnaire every second week about 12 different health symptoms in the spring of 1995 and 1996. Plants were placed in half of the offices, while the other half of the offices did not contain plants. The findings of the study strongly suggested that foliage plants in the office improved the health and reduced discomfort symptoms of the office employees. The results may have the following explanations: improvement in air quality by the plants; an increase in general well-being due to the perception of foliage plants; or the effect of increased attention paid to the subjects of the study (Fjeld et al., 1998).

Keywords:
calming, comforting, increased attractiveness of office environment, reduced discomfort, reduced stress, improved productivity

4.1.2 Hospitals and Long Term Care Facilities

Quicker Recovery

In 1984, Ulrich investigated whether a hospital window view could influence a patient's emotional state and might accordingly affect recovery. The effect of natural views on 46 patients who had undergone gall bladder surgery was examined in a suburban hospital in Pennsylvania. Windows in the hospital looked out at either a stand of deciduous trees or a brown brick wall. Data used to assess recovery included the number of days of hospitalization; number and strength of analgesics[29] each day; number and strength of doses for anxiety; minor complications requiring medication (e.g. headaches, nausea);

[29] Analgesics are medicines that relieve pain. Source: http://www.surgeryencyclopedia.com/A-Ce/Analgesics.html.

and notes relating to the patient's condition and course of recovery. The results of the research concluded that patients assigned to rooms looking out on a natural scene of trees had shorter postoperative hospital stays, received fewer negative comments in evaluations by nurses, and took fewer potent analgesics than patients with windows facing a brick wall (Ulrich, 1984).

In addition to hospital settings, window views of nature in prisons are associated with lower frequencies of prisoner stress symptoms such as headaches and digestive upsets, and with lower use of health care facilities in comparison to views of walls, buildings or other prisoners (Moore, 1982 as cited in Ulrich, 1989; West, 1985 as cited in Ulrich, 1989).

Use in Medicine

Botany and medicine have been closely linked for most of recorded time. The medicine man or shaman was always an accomplished botanist. Hippocrates, it is said, coined the word "physician" from the Greek *physis*, meaning nature, to separate pharmacy from sorcery (Watson, 1994). In addition, traditional Chinese herbal medicine is based on the use of a rich and diverse flora to treat the whole body in an effort to restore harmony and balance between the five elements of fire, wood, earth, metal and water (Watson, 1994).

Plants are used extensively in medicine, both for treatment and preventative measures. In fact, the World Health Organization places 80% of the world's population as dependant on traditional medicine involving plant materials (Watson, 1994).

Certain ornamental plants have been the source of modern medicines of significant economic benefits. The common foxglove is the source of digitalis used to treat congestive heart failure. The Madagascar periwinkle flower contains vincristine and vinblastine used today to fight Hodgkin's disease and childhood leukemia cancers. Cascara buckthorn is a key ingredient in many commercial laxatives. Black poplar and white willow bark and leaves contain salicin the prototypical aspirin from which acetylsalicylic acid was derived. Aloe juice provides instant relief for minor burns and wounds and is used as a salve for radiation burns. On the other hand, some ornamental plants like monkshood, yew, belladonna, rhododendrons, horse chestnut, black locust and mayapple are deadly poisonous (Dobelis, 1986).

The variety of plant parts from which natural medicines have been obtained is surprising. In addition to leaves and flowers, the following examples come from native North American plants: sap (birch, aloe), bark (willow, black cherry) seeds (angelica, flax), fruit (hawthorn, mulberry, raspberry), wood (lignum vitae), nut (cola, palm), stem (bittersweet), resin (pine), straw (oats), tuber (hemp, curled dock), bulb (garlic), and roots (peony, Indian snakeroot). Virtually every plant listed above can be found in today's nursery catalogues of ornamental plants. For additional references on medicinal plants, refer to (Dobelis, 1986), (Chevallier, 1996) and (Bunny, 1993).

There is renewed interest in screening plants for clinical substances that could be of use as pharmaceuticals and in natural medicine. Despite advances in synthetic drugs, recent discoveries of great potential have come from species in tropical rain forests (Watson, 1994). The opportunity for the ornamental industry lies in the development of commercial production practices for medicinal plants to protect the wild populations and

in working with researchers to cultivate quantities of plants with predictable concentrations of active ingredient to be used to develop effective and reliable therapeutic products.

Another form of medicinal therapy involving the use of plants is aromatherapy. Aromatherapy[30] is the use of volatile plant oils, including essential oils, for psychological and physical well-being, sometimes in combination with other alternative medical practices and spiritual beliefs. An essential oil is a liquid that is generally distilled from the leaves, stems, flowers, bark, roots, or other parts of a plant. At the scent level essential oils activate the emotional centers of the brain. When applied to the skin (commonly in form of "massage oils") essential oils activate thermal receptors, and can kill microbes and fungi.

The consensus of the position of medical professionals in the U.S. and England is that while pleasant scents can be relaxing, lowering stress and offering related effects, there is insufficient scientific proof of the effectiveness of aromatherapy. Scientific research on the cause and effect of aromatherapy is limited, although in-vitro testing has revealed some antibacterial and antiviral effects. There are some treatments generally accepted in Western medicine to give a form of relief for the airways in case of cold or flu, such as mint and eucalyptus essential oils.

Therapeutic Effects

Anecdotal evidence of the benefits of gardens for people with dementia suggests that involvement in a garden can enhance sensory pleasure, provide a sense of achievement and a sense of companionship. Pollitt and Moriarty (2006) emphasized that gardens have become an integral part of the support to people with dementia at Parkview House in London, United Kingdom. The range of activities for people with dementia living in care homes is often very limited. By establishing a sensory garden, woodland garden and allotment garden, residents were offered greater choice in terms of how to spend their day. The gardens facilitated different levels of participation for residents from digging and weeding to walking, sitting, touching or looking (Pollitt and Moriarty, 2006).

Another effort to enhance the lives of people with dementia through gardens was described anecdotally by Furness and Moriarty (2006). In Warwickshire, United Kingdom, the Alzheimer's Society created a therapeutic garden within Charlecote Park where people with dementia would feel safe and where they could relax or work. The aim of the garden was to integrate people with dementia into a public space in order to improve public awareness of the condition and to allow people with dementia to continue their ordinary lives as much as possible (Furness and Moriarty, 2006).

Horticultural Therapy

Horticultural therapy is the use of plants and garden activities to improve body, mind and spirit. The idea behind horticultural therapy is that it takes advantage of the human need to be around plants, and provides physical, mental and social benefits to individuals working with and growing plants (Galveston County Master Gardeners, 2007). As stated

[30] Sources: www.wikipedia.com and www.aromaweb.com.

by (Relf, 1981), horticultural activities bring about beneficial change through three mechanisms:

- Interaction, which is concerned with how people interact within the horticultural setting;
- Action, which is concerned with persons actively working with plants; and
- Reaction, which is concerned with peoples' response to passive involvement with plants.

York (2001) cites the basis of horticultural therapy as an experiment in the 1970s in which 300 people were asked to visualize "an environment that would be healing for someone feeling helpless, wounded or in pain". Every single person described an environment with nature (York, 2001). Now, horticultural therapy uses nature and gardening activities to improve body, mind and spirit with the intervention of a trained therapist. It is popular for diseases for which there may be no cure but where there is plenty of room for healing. York, in her experience with horticultural therapy, vouches for the fact that more grows in the garden than just plants, including self-esteem, optimism, camaraderie, creativity, satisfaction, a sense of purpose as well as physical and mental abilities (York, 2001).

The Chicago Botanical Garden has offered a comprehensive year-round horticultural therapy program for more than twenty years to capitalize on the many special benefits of using plants to help people grow (Chicago Botanical Garden, 2002). It characterizes horticultural therapy as "the use of professionally directed plant, gardening and nature activities for the purpose of restoring the physical and mental health of its participants" (Chicago Botanical Garden, 2002). Horticultural therapy, in their experience and through scientific research, maintains or improves physical health by providing unlimited opportunities for exercising, increasing flexibility, improving coordination and balance, building physical strength, relieving stress, providing a non-threatening atmosphere, alleviating depression and helping people connect with nature (Chicago Botanical Garden, 2002).

More information is available from the web sites of the professional associations of horticultural therapists in North America at www.ahta.org and www.chta.ca.

In addition, horticultural therapy and gardening may be used and prove beneficial in prisons (Purdue University, 2004). Although rigorous evidence is not available, observers have noted that gardening has a "strangely soothing effect," making "pacifists of potential battlers" (Neese, 1959 as cited in Frumkin, 2001) and seems to decrease the number of assaults among prisoners (Lewis, 1990 as cited in Frumkin, 2001).

Mythical and Folkloric Benefits

According to ancient myth and folkloric belief, plants and trees[31] provide many benefits which enhance human well-being. An article written by Biley (2001) provides folkloric

[31] The benefits of the native trees of Canada to those before us from the earliest settlers to recent immigrants are undoubtedly different than the benefits perceived about those same species of trees today. In describing the desirability of certain new cultivars of trees to potential consumers of the future, there may be merit in explaining the history and earlier practical uses of the ancestors of the sapling at hand. A good place to look for such information is the book, "A

evidence of the benefits of trees in hospital settings. The article describes different types of trees that could be planted in hospital grounds where patients, visitors, and staff could benefit not only from the aesthetic appeal of the trees but also from their mythical powers, as described in the following table (Biley, 2001).

Table 4.1 Mythical and Folkloric Benefits of Different Types of Trees

Type of Tree	Mythical and Folkloric Benefits
Oak	• Associated with protection, strength, success and stability • Brings vitality and long life • Preparations made from oak trees include antiseptics, tonics, anti-diarrhoeals and wound dressings.
Mountain Ash	• Thought to counteract witchcraft, negative energies and enchantment • Preparations made from Mountain Ash trees have been used as an astringent and an antibiotic.
Yew	• Has been viewed as a guardian against evil and negative forces and as a protector of the dead. It is also a symbol of immortality. • In small quantities, preparations made from Yew have been used as a cardiac tonic, treatment for rheumatism, anti-inflammatory, and as a homeopathic preparation. More recently, a successful anti-cancer agent (Taxol) has been synthesized from the yew.
Hawthorn	• Generally viewed as a tree which brings good luck to the owner, prosperity on the land on which it grows and is capable of dispelling negative energies. • The leaves and blossoms of the hawthorn tree are used to create a tea to help reduce anxiety, increase appetite and improve circulation. The hawthorn is thought to strengthen cardiac function.
Ash	• The ash tree is thought to link the inner and outer worlds, focuses on strength of purpose and brings peace of mind, prosperity, protection and healing. • It is well known in the field of herbal remedies and is used as a laxative, diuretic, to strengthen the liver and spleen, and to heal wounds.
Beech	• Associated with good luck, protection and nurturing. • Preparations are thought to reduce swellings and skin inflammations and it is also thought that the tree can help balance mental health.

Source: (Biley, 2001).

The folkloric link between plants and medicine is described by Aikman (1977) in a book published by the National Geographic Society entitled, “Nature’s Healing Arts – from Folk Medicine to Modern Drugs”. The book offers an excellent history of folk medicine in North America, and the adventures of ethnobotanists around the world determined to track down remedies from the past and link them to modern medicine. Of considerable interest are the descriptions of how natural medicines continue to help fight age-old scourges such as malaria, smallpox and leprosy, and the beginnings of the study of marine plants and other organisms that may yield new “wonder drugs” (Aikman, 1977).

Natural History of Trees” (Peattie, 1963) that couples the scientific with the historical and legendary.

Keywords:
Therapeutic, shorter hospital stays, natural medicines, sensory pleasure, sense of achievement, sense of companionship, improve body, mind and spirit

4.1.3 At Home

Life Satisfaction and Well-Being

There is a widely held belief that contact with trees and other vegetation is beneficial to human well being (Ulrich, 1989). Contact with nature through hobbies such as gardening[32], and gardens as green spaces, not only support physical well-being, but can have positive effects on mental well-being.[33] Research by Waliczek, Zajicek and Lineberger (2005) supported the idea that gardening is a hobby that may lead to enhanced life satisfaction and overall health. The objective of the research was to investigate the influence of gardening on perceptions of life satisfaction. Online and paper surveys based on the Life Satisfaction Inventory were used to measure quality of life including zest for life[34], resolution and fortitude, congruence between desired and achieved goals, high physical, psychological and social self-concept, and a happy optimistic mood. The sample of respondents included 220 gardeners and 223 non-gardeners. Results indicated that gardeners appeared to have more positive perceptions of life satisfaction when compared to non-gardeners. For example, more than 75% of gardeners agreed with the statement, "I have enough energy for everyday life" compared to only 57.7% of non-gardeners. As well, more gardeners tended to rate their overall health and physical activity levels higher than did non-gardeners (Waliczek, Zajicek, and Lineberger, 2005).

Community allotment gardens are another form of gardening that has been linked to a number of lifestyle benefits. A study conducted in England discovered a wide range of direct and indirect social, economic and ecological benefits that impact the lifestyle of those who live in communities with allotment gardens. These benefits are presented in Table 4.2 below (Perez-Vazquez, Anderson, and Rogers, 2005).

[32] An interesting resource discovered as part of this literature review, which may be of interest (although not incorporated in this review) was von Bayer's book (1984) "Rhetoric and Roses". The book provides an illustrated history of ornamental gardening in Canada from the 1600s to present day but focuses on 1900-1930. She emphasizes the close entwining of gardening with the recreational, educational and social fabrics in the early years of Canada. It is the uniquely Canadian story of the development of ornamental and civic gardens, of public parks, of botanical gardens, of parkway schoolyard and vacant lot gardens and of the railway gardens of Canadian Pacific that beckoned as floral advertisements of the fertility and hospitality of the Canadian west. She also chronicles the growth of the horticultural societies, school gardening programs, and the emergence of agricultural colleges and the horticultural press that were important in developing and fostering the ornamental industry in Canada (von Bayer, 1984).
[33] Sources: Cammack et al., 2002; Kaplan, 1973; Lewis, 1978; Patel, 1991; Waliczek et al., 1996 as cited in Waliczek, Zajicek and Lineberger, 2005.
[34] Zest for life involves the level of enthusiasm a person has in various ideas or activities, regardless of the rewards involved for participation in the activity (Neugarten et al., 1961 as cited in Waliczek, Zajicek and Lineberger, 2005).

Table 4.2 Social Benefits Derived by Residents from Community Allotment Gardens

	Social	Economic	Ecological
Direct	• New horticultural skills	• Fresh vegetables and fruits	• Green area for living things
	• Peaceful neighbourhood	• Money saved	• Space between houses (providing privacy)
	• Nice View	• Changes of buying vegetables	• Open natural space
	• Organic food and good food		• Fresh air
	• Socializing/friendships developed		• Enjoyment of wildlife associated with allotments
	• Exchange of ideas and vegetables, fruits, and flowers		
	• Contact with a green population		
	• Exercise		
	• Health (knowing what you are eating, keeping your mind active and having some occupational therapy)		
	• Relaxing hobby		
Indirect	• Quality of life	• Site saved from development	• Attractive open space
	• Satisfaction from watching things grow	• Improved value of resident's houses	• Peace and quiet
	• Sense of community		• Green space
	• Sense of security		• Nice view behind the houses
			• Buffer zone
			• Less noise from urban roads
			• More rural atmosphere

Source: Adapted from (Perez-Vazquez, Anderson, & Rogers, 2005).

In 2006, Botanic Gardens Conservation International (BGCI) published, "Botanic Gardens: Using Biodiversity to Improve Human Well-Being" a major review highlighting how botanic gardens across the world are involved with projects to improve human well-being. For the purposes of the report, BGCI divided human well-being into four main areas: (1) improving healthcare, (2) improving nutrition, (3) alleviating financial poverty, and (4) improving community and social relations. The case studies within the report illustrate how botanic gardens across the world are contributing to these aspects in many diverse ways (Waylen, 2006).

Reductions in Aggression and Violence

In 2001, Kuo and Sullivan published research within a relatively unexplored area – the effects of natural environments on aggression and violence. The research explored whether natural elements such as trees and grasses decreased aggression and violence of inner city urban public housing residents in Chicago. Interviews were conducted with 145 residents of a public housing complex who were either exposed to relatively low levels of nearby nature or relatively high levels of nearby nature. The interviews assessed residents' attention capacity, aggression, and other factors likely to affect aggression such as mood, stress and social integration. The results of the study found that residents living in relatively barren buildings reported more aggression and violence than did their counterparts in greener buildings. Moreover, levels of mental fatigue were higher in barren buildings and aggression accompanied mental fatigue. Overall, the results of the research suggested a new role for environment and behaviour research in addressing aggression and violence in inner cities. A final contribution of the research was to suggest that the geographic distribution of nature matters (Kuo and Sullivan, 2001b). Although large central or regional parks are important components of urban design, perhaps cities should be designed with nature at every doorstep (Kaplan, 1985 as cited in Kuo and Sullivan, 2001a).

As a rule, people often believe that vegetation facilitates crime because it hides perpetrators and criminal activity from view. However, in 2001, Kuo and Sullivan published research suggesting that high-canopy trees and grass may actually work to deter crime in poor inner-city neighbourhoods. The study used police crime reports to examine the relationship between vegetation and crime in an inner-city neighbourhood in Chicago, Illinois. Crime rates for 98 apartment buildings with varying levels of nearby vegetation were compared. The findings of the analysis revealed a negative relationship between the density of trees and grass around the buildings and the number of reported crimes per building. Therefore, the greener a building's surroundings were, the fewer crimes reported. This pattern held for both property crimes and violent crimes (Kuo and Sullivan, 2001a).

Effects on Children

In 2002, Taylor, Kuo and Sullivan published research examining whether children's self-discipline was enhanced by contact with nature. Specifically, the research explored whether, in an inner city neighbourhood, children with 'greener' views from home were better able to concentrate, inhibit initial impulses[35] and delay gratification[36]. The research was conducted at a large public housing development in Chicago, Illinois with ninety one boys and seventy eight girls. Previous research had hinted at gender differences in the effects of near-home nature on children (Taylor et al., 2001 as cited in Taylor, Kuo and Sullivan, 2002). As such, the relationships between nature and self-discipline for this research were examined separately for girls and boys. The results of the research found that the greener a girl's view from home, the better her ability to

[35] Inhibiting initial impulses requires overcoming the tendency to jump to conclusions or to act on impulse.
[36] Delaying gratification requires overcoming impatience and the tendency to favour short-term rewards over long-term goals. The ability to delay gratification is important because reaching future goals often requires postponing immediate rewards.

concentrate, inhibit impulses and delay gratification. Therefore, while girls showed consistent and often strong links between nature and self-discipline, boys showed only the barest hint of such a link (Taylor, Kuo, and Sullivan, 2002).

Taylor, Kuo and Sullivan also conducted research on specific disorders related to the attention function in children. In 2001, the authors published a study focused on children with Attention Deficit Disorder (ADD)[37]. ADD reduces childrens' attention capacity and, in doing so, may have detrimental effects on many aspects of life (e.g. school, interpersonal relationships, and personal growth). The study examined whether contact with nature assists the attention function in children with ADD. Specifically, the study investigated whether attention deficit symptoms (e.g. can't stay focused, can't complete tasks, can't listen and follow directions, easily distracted) were more manageable after activities in green settings in comparison to other settings, and whether a greener everyday environment influenced the manageability of symptoms in general.
The findings of the research suggested that ADD symptoms were milder for children with greener play settings. Surprisingly, however, the greenness of childrens' residential settings was unrelated to the severity of their ADD symptoms (Taylor, Kuo, and Sullivan, 2001).

Positive Emotions

For centuries, in cultures around the world, flowers have been used to communicate emotional information among people. Flowers are expected to convey sympathy, guilt, romance or celebration (Heilmeyer, 2001 as cited in Haviland-Jones et al., 2005). Flowers are also used to express religious feelings and for spiritual communication (Stenta, 1930 as cited in Haviland-Jones et al., 2005).

In 2005, Haviland-Jones et al. published research summarizing three studies that explored social and emotional responses to flowers. The first study analyzed women's emotional response, through smiles and mood change, to receiving flowers in comparison to receiving a gift basket of fruit and sweets or a large candle. The results of the study of 147 women indicated that true smiles were exhibited by 100% of the women who received flowers. Furthermore, increases in positive moods (after 3 days of gift receipt) were reported only for those who received flowers (Haviland-Jones et al., 2005).

The second study presented by Haviland-Jones et al. (2005) explored whether a broader range of social behaviours might be affected by the receipt of flowers in comparison to other gifts. The study observed the behaviour of male and female college students under four different conditions in a constrained social situation – an elevator. Under the four conditions, the participants either received a single flower; were exposed to a basket of flowers, but did not receive anything; received a pen; or received nothing. Experimenters observed the participants' facial reactions and social behaviour while in the elevator. The results of the experiment indicated that both men and women presented with flowers (as opposed to a pen or nothing) were more likely to smile, stand at a social, rather than impersonal distance, and to initiate conversation (Haviland-Jones et al., 2005).

[37] ADD is defined as a persistent pattern of inattention "that is more frequent and severe than is typically observed in individuals at a comparable level of development". Source: American Psychiatric Association, 1994 as cited in Taylor, Kuo and Sullivan, 2001.

The third study tested the effects of repeated exposure to flowers to determine whether the observed effects of flowers were short term in nature. Participants (senior retirees) in the third study received two, one, or no flower bouquets over a two week period. The results of the third study confirmed the results of the previous studies in that people receiving flower bouquets were happier and perhaps less depressed than people who did not receive bouquets. In addition, there was some evidence that participants who received two bouquets may have been happier than people who received one bouquet. The study also revealed that the increase in positive emotion related to the flowers may have secondary benefits. Participants who received flowers had higher scores on a memory task than those who had not received any bouquets (Haviland-Jones et al., 2005).

Keywords:
Positive effects on mental well being, enhanced life satisfaction and overall health, increased zest for life, improved energy, true smiles, positive mood for 3 days, better gifts

4.2 Sports and Fitness

There has been substantial documentation of the health benefits of physical activity; however, the "no pain, no gain" philosophy to physical activity is not the only path to improved health. Daily tasks such as cleaning the house, walking and gardening are now considered just as beneficial (Lee, 2006). By burning 100 calories per day health benefits begin to accrue, with the lowest death rates occurring in those people who burn approximately 300 calories per day. Thirty minutes of gardening burns approximately 125-200 calories, while thirty minutes of walking burns 142-227 calories (Lee, 2006).

Sports field turf grass, when well maintained, has been shown to reduce the number of injuries incurred by players (Rochefort and Dionne, 2002).

Parks and Recreation

Parks provide opportunities for a variety of physical activities and different organized and personal sports, as well as passive activities such as bird watching and communing with nature. Along with providing the associated health benefits, the scenery in the park also has an impact on the level of use (Bedimo-Rung, Mowen, and Cohen, 2005; Brownson et al., 2001) and the segments of the population to which the park appeals. Thus, ornamental plants have a role in providing or building the environment in which these physical activities can occur and the associated benefits can be achieved.

4.3 Community Beautification and Pride

Ornamental plants contribute to the beautification and, therefore, the pride people have in their cities, towns or dwellings. The pride and development of community is seen especially when gardening is done on a collective basis by the residents of a community. It encourages community interaction, opens the doors of communication, and builds friendships (Malakoff, 2007). Community gardens are only one mechanism by which

people use the interaction between plants and humans, gardening, to boost community development. Programs focusing on the interaction of plants and people as a driving force of community development are evident globally. Examples are Communities in Bloom in Canada[38], America in Bloom in the United States[39], and Australia's Open Garden Scheme[40], all of which have the betterment of the community at their core, not just via increased economic activity through tourism, but also increased social activity within the community itself (America in Bloom, 2007; Australia's Open Garden Scheme, 2006; Communities in Bloom, 2005).

If people are proud of their surroundings they are more likely to spend time in those surroundings. A study by (Kuo et al., 1998) found that common spaces are used more when there are more trees and grass, and that with the increased use there are likely to be increased neighbourhood social ties. These increased social ties increase the supportive nature of the community, thus having the potential to improve the quality of life within the community (Kuo et al., 1998).

[38] Communities in Bloom is a non-profit Canadian organization that is "committed to fostering civic pride, environmental responsibility and beautification through community participation and the challenge of a friendly competition" (Communities in Bloom, 2007). Beginning in 1995, Communities in Bloom has grown to more than 100 national communities and hundreds of municipalities registered in the provincial editions.

[39] American in Bloom, in the United States, is an "independent, non-profit organization dedicated to promoting nationwide beautification programs and both personal and community involvement through the use of flowers, plants, trees and other environmental and lifestyle enhancements…" (America in Bloom, 2007). Since 2001, America in Bloom has helped over 130 communities across the United States to improve the quality of life for residents and visitors.

[40] Australia's Open Garden Scheme is a non-profit organization that began in Victoria in 1987. The aim of this program is "to promote the knowledge and pleasure of gardens and gardening across Australia" (Australia's Open Garden Scheme, 2006). Currently, the program has approximately 5,000 gardens. Each year approximately 650 private gardens are opened to the public for one or two weekends each season.

5.0 Primary Benefits of Ornamental Horticulture

This section aims to identify marketing opportunities for the ornamental horticulture industry given the economic, environmental and lifestyle benefits associated with ornamental horticulture. Section 5.1 presents key trends in the industry in order to promote understanding of the nature of the market. Section 5.2 presents a summary of past and current marketing efforts so that the industry can learn from its previous experiences. Key words and phrases to promote sales are described in section 5.3. Given the benefits of ornamentals, marketing opportunities (domestic and export) are outlined in section 5.4.

5.1 Key Trends for Ornamental Plants[41]

The following section presents key trends in the ornamental horticulture industry. These trends provide background information that is essential in understanding the nature of the market and in guiding future marketing efforts.

Companies

- There is on-going consolidation in both the floriculture and nursery industries resulting in fewer operations of larger size.
- Amalgamations of former competitors under one company are also occurring.
- While American companies are growing large numbers of species for a regional market, Canadian companies are taking advantage of their proximity to the US border and specializing in a few products. Canadian companies are taking advantage of economies of scale to produce extremely high quality products for both export and domestic markets.
- There is an increase in the number of companies who provide specialized services or grow ornamental products for only a portion of their life cycle then sell them to other companies who prepare the plants for final sale.
- Garden centres and flower selling establishments are trying to establish long term relationships with their customers by trying to meet their needs beyond the immediate purchase.

Plants

- Consumers are willing to pay extra for plants that are larger, more mature and already loaded with flowers or are ready to flower. Similarly, several companies are producing annuals and bedding plants in oversized containers that are several weeks more mature than usual.
- Plants branded with recognizable names or phrases (Simply Beautiful®, Proven Winners®, Gigantico, President's Choice©, etc.) instil a comfort level in their purchase as well as a reminder of quality for future purchases.
- Improvements in plant breeders' rights legislation around the world will ensure that breeders receive appropriate compensation for their work thus ensuring a

[41] Information in this section has been synthesized from 10 years of editorial articles retrieved from the Greenhouse Management & Production (GMPRO) magazine (www.gmpromagazine.com) and the Nursery Management & Production (NMPRO) magazine (www.nmpromagazine.com).

steady supply of new cultivars of plants and flowers with superior colours, performance and pest resistance to entice consumers.

Flowers

- Traditional florists are regaining market share formerly lost to mass merchandisers by providing information, finding specialty niches, giving exemplary and value added services along with their flowers.
- New varieties of cut flowers, potted plants, bedding plants and garden trees and shrubs provide a continuous opportunity for the industry to interest consumers in their products.
- Flowers are beginning to become a personal enjoyment purchase rather than a special occasion purchase.
- Flowers are less "relevant" or "top of mind" today than in the past. This offers an opportunity for retailers to focus on flowers' tremendous, almost unmatched, ability to convey emotion and provide serenity, a sense of well-being and beauty that no other purchase can.
- Florists in some areas are portraying themselves as "the heart and soul of their communities" attaching themselves to all key community events, historical celebrations and civic activities[42].

Consumers/customers

- They will pay more for instant colour and upsized plants.
- Immediate gratification from purchasing blooming plants has replaced the long wait times associated with rearing plants from seed or seedlings.
- Outdoor living as an extension of the home is a long term trend that gets stronger and more diversified each year.
- Extension of the house to the garden means an increase in the purchase of outdoor plants in movable containers.
- One-upmanship is driving garden aficionados to push the boundaries of climate zones to grow something their neighbours thought impossible.
- Consumers want to "live the dream" cultivated by Martha Stewart and Home and Garden TV (HGTV)©.
- Lifestyle advertising around the enjoyment of plants and flowers is replacing advertising of specific plants, flowers and floral holidays.
- The advent of programs like Communities in Bloom and America in Bloom are providing people with new opportunities for civic pride, participation in beautification activities and expanding their gardening acumen through volunteerism.

Mass merchandisers

[42] (Pohmer, 2006) suggests that there is still a place in tomorrow's marketplace in the industry for traditional florists despite the growing competition from supermarkets, convenience stores, warehouse clubs, Internet sites, street vendors and farmers markets. Pohmer suggests that instead of just trading customers and dollars among retailers three things will allow florists to grow and prosper: relevancy, value and relationship. Flowers are not "top of mind" and to get them to be more relevant, florists have to sell the innate traits and benefits of flowers, not price. Florists can themselves be more relevant by becoming "the heart and soul of their communities". Florists will need to deliver incredible service and expertise to maintain their customers' confidence. Florists, unlike supermarkets, have a unique competitive opportunity to develop experiential relationships with their customers that can build loyalty and lifetime value benefit.

- The most significant change is the implementation of "pay-by-scan" technology wherein the grower does not get paid for the product until it is out scanned at the cash register. There is considerable debate about whether this will prove to be good or bad for growers.
- The next most significant development is growers accepting responsibility for the care and maintenance of their products while they are on the shelves of the retailer (usually a grocery or big box store) in an effort to reduce losses caused by poor retailer maintenance and subsequent financial loss due to pay-by-scan.
- These merchants rely heavily on impulse purchases by customers.

Industry

- Consumers are being encouraged to purchase plants, especially those that are not mature or in flower, by attractive care tags, point of sale displays and informational brochures and web sites.
- The American Floral Trends outlook funded by the California Cut Flower Commission annually identifies four "trends" that offer a wealth of styles, products, materials and colour palettes to customers. The trends for 2006 were: rose hip, hydroponic, gatherings and infusion. The outlook provides examples and suggested flowers for each.
- More segments of the industry are offering comprehensive care and handling instructions for their customers to ensure that their purchases will provide the maximum possible enjoyment thus encouraging repeat business.
- The ornamental industry has developed various certification programs on the premise that customers will be more attracted to businesses whose staff are formally certified and have a special body of knowledge and expertise.
- The industry tried for several years to entice customers with low price points which did not work. Now the industry is concentrating on quality, information and value added products.
- Improvements in ornamental transportation technologies have allowed a shift from regionally-based sales to the ability to offer products from around the world.
- Ornamental associations around the world are now offering consumers a wide variety of useful publications and websites to show them new ways of enjoying ornamental products.
- A whole new industry of tourism has recently developed around garden tours, eco-travels, visits to public and botanical gardens, hands-on gardening and floral design education.

5.2 Past and Current Marketing Efforts

The ornamental industry for decades sold everything it grew so there was little need to market their product. Marketing of flowers was largely done by the floral flowers-by-wire companies (wire services) who had the budgets to get their message out to many consumers on behalf of their retail florist members who also paid handsomely for promotional items for their customers often personalized with their store name and logo. Their major focus was on special occasion purchasing. Marketing of nursery products was very much a local or regional activity to advise regular customers what was available and when at "their" nursery. Nurseries and garden centres have a time period in which to sell their products defined all too frequently by unanticipated shifts in weather.

Florists were the first retailers along with booksellers to take advantage of the Internet to sell their floral designs and also to take advantage of on-line buying technology and transaction security. Given the beauty for their creations, this was only natural and today the websites of key florists and now others in the floral industry are simply spectacular.

The ornamental industry at all levels has been characterized by family businesses of fiercely independent and creative entrepreneurs. Many, however, while they loved what they were doing were not very good business managers and when the advent of the big box stores and the competition from offshore growers materialized, those that did not develop or buy business acumen, including marketing skills, suffered the consequences.

Growers for several years now have had their profit margins eroded by increasing costs of almost every input against stagnant or declining prices complicated by a world trade market made possible by modern plant transportation technology. Mass merchandisers entering the flower and plant business have had an enormous, and some say, negative, impact on the prices growers can get for their products. Cut flowers are perhaps the most affected because of their perishability. Potted plants can survive some delays in getting to market or can sometimes be grown on for another day. Trees, shrubs and perennials that are not sold can be grown until the next season when the selling price hopefully covers the additional maintenance costs.

It follows then that cut flower growers were the first to consider working together to stave off competition and sell more flowers. An early effort in the 1970s called Floraboard was approved by the cut flowers and greens partners but scuttled by other sectors. The California Cut Flower Commission (www.cfcc.org) has been very successful with its mission to provide a unified effort by growers to enhance the performance of the California cut flower and greens industry. In 1994, after enormous startup effort, the first national promotions order for flowers called Promoflor ran for three years. The “Think Flowers” TV campaign with spokesperson Buzz the Bee was very successful increasing the number of first time buyers and non-holiday sales, but the program failed for complex political reasons. When it did, floral sales immediately fell 10%.

In 1999, an anti-dumping suit between Colombia and the US was settled with the formation of the Floral Promotion Organization. In its five test markets, it raised sales by 21% through creative lifestyle ads; however, there is some doubt about its future. Flowers Canada has had preliminary discussions about bringing the program to Canada and Flowers Canada (Ontario) is exploring a levy system to provide sufficient funding.

In 1996, Canada passed legislation (Bill C-54) enabling check-off for agricultural commodities on a national level. This allowed industry to establish an organization to collect a levy for financial support of both research and promotion. Each province also has enabling legislation for provincial marketing boards or industry-controlled agencies like the federal Promotion Research Agencies (PRAs). The Canadian Nursery Landscape Association (CNLA) attempted to set up a national pilot program for nurseries but the initiative failed due to the scepticism of several provincial associations.

Recently, as costs and competition continue to rise and sales and prices for ornamental products decline or flat line, there has been renewed debate about the merits of establishing an American national cut flower promotion program. The pros and cons have been well described by eminent industry members in the “They Say...” and “We

say...” columns of Greenhouse Management Pro and Nursery Management Pro magazines over the past three years. The debate on the nursery side seems to be more centred on the concept of branding quality plants to be more attractive to consumers and to attract a premium price from them and on the relative merits and responsibilities of growers, wholesalers, mass merchandisers and retailers.

There are several big impediments to a national program in Canada:

- Persuade everyone that a single national agency should receive the provincially collected funds rather than having to run 13 different agencies (only provinces have the authority to impose levies on trade within their borders).
- Change the legislation that allows producers to opt out or request refunds if they are not satisfied and make it mandatory.
- It must be industry requested and industry driven and the requirements for demonstrating this support vary across the country.
- There is much misunderstanding of the whole principle, most detractors fearing another government control of their freedom through a “marketing board”.
- The agencies would only be accountable to producers thus alienating other industry sectors.
- There must be provision added to levy imports.
- Agencies must be coordinated through a single government department for all their needs.
- There is a fundamental stalemate with governments waiting for producers to request agencies and producers telling them to fix the system first.

5.3 Opportunities and Key ‘Wordings’ for Canadian Ornamentals

The purpose of this section is to provide key phrases and words that have been used in marketing campaigns around the world to promote the sale of flowers and plants. Key phrases and words are presented in Table 5.1.

Table 5.1 Key Wordings

Source	Key Wordings
Flower Promotion Organization[43]	• Alive with Possibilities™ • Bring some home today
Project EverGreen[44]	• Because GREEN Matters
Plants*for*Life	• Get Your Greens (buy foliage plants) • Contain Yourself (plant them) • Green Gyms (parks & public gardens) • Lift Your Spirits (go garden) • J'adore les plantes • Forever Green
Society of American Florists[45]	• Flowers Equal Happiness • Flowers Make Intimate Connections • Share Your Space with Plants • Try Some Flower Therapy • Flowers, Instant Attitude Adjustment • Boost Your Confidence with Irises • Increase Your Energy with Red Roses • Get a Good Night's Sleep with Bluebells • Enhance Alertness with Sunflowers • Flowers, Mother Nature's Social Security
	• Marketing to 'your' backyard environment
Plant*for*Life[46]	• Inspired Living • Get outdoors…and make the most of your garden
Plants at Work[47]	• Live plants improve business • Create your workplace oasis
Plants for People[48]	• Plants for People
Tree Canada Foundation	• Green Streets Canada
Flowers & Plants Association (UK)[49]	• Love Flowers • Cool Flowers • Enjoy Flowers • So simple. So try it. • Buy some flowers for yourself

In addition, the ornamental industry may use key words and phases to market the individuals and companies that make up the industry. For example, people in the ornamental industry may be perceived as:

- Earth Stewards
- Gardeners of the Ecosystem
- Green Innovators
- Brokers of Tranquility
- Guides to Greenery
- Lifestyle Designers
- Custodians of the Ark Earth

[43] Source: (Flower Promotion Organization, 2007).
[44] Source: (Project EverGreen, 2007).
[45] Source: (Society of American Florists, 2006).
[46] Source: (PlantforLife, 2007).
[47] Source: (Plants at Work, 2007).
[48] Source: (Plants for People, 2007).
[49] Source: (Flowers & Plants Association, 2006).

- Sellers of Sustainability
- Restorers
- The Ecological Agriculturalists

5.4 Opportunities for Export and Domestic Marketing

This section outlines ideas for marketing of ornamental horticulture products. The section begins by suggesting specific marketing efforts that address the economic, environmental and lifestyle benefits of ornamentals. The section concludes by presenting general marketing ideas that can be applied regardless of the type of benefit.

Marketing of Economic Benefits:

- Promote the potential for increased property values through home landscaping by promotional advertising in realty guides and home renovation magazines.
- Ask tourism bureaus, hotels and restaurants to emphasize the enjoyment of flowers and plants in their establishments.
- Promote the use of special plants as privacy and security barriers in lieu of fences and walls.
- Work with municipalities on 'streetscaping' for crime prevention and improved safety on highways.
- Show business owners, mall operators and landscape designers the benefits of good landscaping and interior use of ornamentals.
- Urge municipalities and residents to plant trees and beautify boulevards and curbs. Then publicize the benefits of the projects (and who provided the plants).
- Promote the energy savings of having plants and trees indoors and out.
- Remind municipal governments what plants can do for them and their citizens and who grows them. Look for opportunities to tell "the good news stories" about plants in all municipal communications with residents.

Marketing of Environmental Benefits:

- Urge municipalities and residents to use plants to remove or control contaminants in brownfields.
- Sponsor TV shows about the benefits of wetlands and woodlands to the health of people and the special roles of plants in phytoremediation and pollution abatement.
- Brand plants shown to have special air quality improvement characteristics.
- Tell consumers how plants cleanse the air and water and explain the industry that produces them and how they can obtain these benefits.
- Advertise the role that plants can play in quieting urban spaces, offices and residences.
- Promote the energy and greenhouse gas savings of having plants and trees indoors and out.

Marketing of Lifestyle Benefits:

- Urge residents to plant trees to generate the multiple benefits of having more greenspace in their neighbourhood.
- Advertise the role that plants can play in relieving the stresses of daily life.
- Arrange for popular press articles on the multiplicity of benefits of plants on peoples' well-being in the home, workplace and schools and show them simple ways of increasing their use of plants in their surroundings.

- Work with landscape architects, hospitals and other long-term care facilities to incorporate plants into their patients' experiences to enhance their recovery and reduce costs.
- Advise inner city residents on exciting ways to incorporate plants into their lives and home and community spaces to increase their sense of well-being and reduce crime and aggression in their neighbourhoods.
- Research and provide some of the mythical and folkloric information about plants and trees to consumers at the point of sale.
- Encourage park planners to use specific ornamentals to steer the park's appeal and usage to specific segments of the population as well as to entice people to use the space for the potential social benefits to the community.
- Provide examples of how community gardening, beautification, allotment gardens etc. have benefited various communities and encourage others to become involved.

General Marketing:

- Increased sales should be targeted to more households, younger buyers, more frequent purchasers, increased value per purchase occasion and a change in culture of the buyers.
- Encourage generation X and Y members to use the Internet to garner new information on the joys of gardening and the tools and information available from professional members of the industry to make their experiences easy and successful.
- The International Association of Horticultural Producers (AIPH) yearbook of international statistics on flowers and plants lists 240 special occasions throughout the year when flowers and plants are appropriate to express emotion and religious celebration in countries around the world. Marketing could take advantage of the multicultural makeup of Canada and promote opportunities for citizens to purchase flowers and plants (AIPH, 2006).
- Closely examine the past and present flower and plant marketing and promotional programs that are working successfully so as not to reinvent the wheel.
    - Consider partnering with the successful programs rather than trying to develop a Canadian program 'from scratch'.
- Find a reliable source of marketing funding that can be passed on to the consumer.
- Help consumers understand the incremental costs that go into marketing floral arrangements and mixed plant containers that they currently perceive to be 'too expensive'.
- Educate consumers on how to extend the life of arrangements, containers and mixed basket products by replacing shorter-lived components with other flowers or plants to extend the enjoyment of the whole product.
- Remind consumers that flowers and plants do not last forever, even in nature, and that their senescence provides an opportunity to buy more and recycle the old in the compost.
- Follow the trend setters and trend writers and change marketing specifics within an overall theme to promote the trends thus giving consumers different things to do with flowers and plants on a regular basis.
- Work with Communities in Blooms partners to support the program and offer discounts on plants and landscaping materials.

- Use the 'key wordings' from this report to sell more products and help people appreciate flowers more than they might without the added knowledge.
- Partner with organizations such as Plants-at-Work, Plants-for-People, Green Roofs, Green Streets Canada, Flower Council of Holland and Society of American Florists to cross promote flowers and plants and deliver appropriate messages to consumers.
- Collaborate with like-minded associations to promote to their members the roles that plants play in their environment and the numerous simultaneous benefits that accrue from their extensive utilization.
- Collect 'best practices' in marketing ornamentals from association members and circulate them widely to improve the industry.
- Send a complimentary copy of this report to everyone who provided leads and advice and ask them to circulate it to their colleagues to promote increased sales of ornamentals.

Given the vast array of benefits and marketing opportunities identified, there may also be new opportunities to connect with many new types of customers. Some examples of potential customers (based on the benefits outlined in this study) may include:

- Property and business owners
- Educational facilities
- Remediation companies
- Health practitioners
- Gardening dabblers and enthusiasts
- Municipal staff (parks and recreation)
- Outdoor enthusiasts
- Homeopathic and natural medicine
- Users of energy

6.0 Summary, Conclusions, Recommendations and Future Research Opportunities

Section 6.0 is a summary of the results of this study. Section 6.1 recaps the purpose and objectives of the research and provides a summary of the results, while section 6.2 presents the conclusions drawn from the literature review. Section 6.3 suggests recommendations for next steps to market the benefits identified in the literature review. The section concludes with future research opportunities (section 6.4).

6.1 Summary

The purpose of this project was to provide the Ornamental Working Group of the Horticulture Value Chain Round Table, through its secretariat in Agriculture and Agri-Food Canada, with a summary of the current state of scientific knowledge related to the benefits from plants and flowers in people's daily lives.

The specific objectives of the project and the corresponding results are outlined in the paragraphs below:

To review the published literature to determine whether there were benefits to human health and the environment that could be linked to the purchase and use of ornamental horticulture products.

A review of the literature in sections 2.0-4.0 demonstrated that ornamental horticulture has a wider suite of benefits than expected. Plants can provide multiple benefits in terms of the economy, environment and human lifestyles. The following is a summary of the benefits as outlined in the literature review:

Economic:

- Reduce energy costs (heating and cooling)
- Improve property values (residential and business)
- Enhance beauty of buildings and communities
    - Aesthetic contribution
    - Improved privacy and security
- Assist municipalities in reducing maintenance costs and deriving new economic benefits including economic spin-offs from parks, sporting facilities and increased tourism

Environmental:

- Moderate urban climate extremes
- Mitigate urban heat islands
- Produce oxygen
- Sequester carbon
- Ameliorate pollution:
    - Improve air quality (indoor and outdoor)
    - Remove contaminants from soil (phytoremediation)
    - Improve water quality
    - Treat sewage and wastewater
- Improve water management (flood control) and erosion control

- Reduce impacts of weather through windbreaks and shelterbelts
- Reduce noise pollution
- Control urban glare and reflection
- Attract birds and other wildlife

Lifestyle:

- Reduce stress and improve productivity (workplace, schools)
- Introduce calming effects and reduced discomforts
- Quicker recovery (hospitals)
- Practice horticultural therapy to improve mind, body and spirit
    - Long term care facilities
    - Prisons
- Increase human health (e.g., use in medicine)
- Improve life satisfaction and well-being:
    - Increase positive emotions
    - Improve general quality of life in urban settings
    - Create pride in community through community gardens and allotment gardens
    - Attention and concentration improvements for children
- Reduce aggression and violence
- Provide space for recreation
    - Enhance sport field safety
    - Encourage healthy active and passive lifestyle pursuits

To recommend wording and/or strategies based on proven science that could form the basis for unique approaches to marketing ornamental plants based on improving lifestyle, health, and the world in which people live, work and play.

Section 5.3 highlights opportunities for 'key wordings' based on the literature that was reviewed.

To identify new opportunities for export and domestic marketing and increased sales of ornamentals beyond the traditional concepts of beautification of the indoor and outdoor environments.

Section 5.4 highlights opportunities for export and domestic marketing and increased sales, based on the literature that was reviewed as well as general opportunities based on the industry experience of the authors of this report.

To identify opportunities for further investigation into potential but, as yet, unidentified or unquantified benefits.

Section 6.4 below presents the future research opportunities that were identified as this research was completed.

To provide a functional bibliography of sources of further information that could be quoted to justify any future marketing claims if necessary.

Included with this report is a CD of the references used throughout this document. The electronic files have been re-named to correspond with the authors identified in the reference section of this report (section 7.0). The documents (i.e., files on the CD) have been organized into the following folders: introduction, economic, environment, lifestyle, marketing and miscellaneous. The miscellaneous folder includes documents and lists of references that were not referenced in this report, but were deemed interesting and potentially relevant for future work.

6.2 Conclusions

The literature reviewed for this study clearly illustrates that there are significant benefits from ornamental horticulture, whether economic, environmental or lifestyle. Many of these benefits, however, are not well known or understood within the general population. As a result, there is a considerable opportunity for the ornamental horticulture industry to sell more products based on the benefits identified throughout this literature review. What will be necessary is that the marketing efforts be connected with the benefits from the literature as well as key wordings and marketing and sales opportunities also identified in this study.

Given these conclusions, some obvious recommendations emerged and are outlined in section 6.3 below.

6.3 Recommendations

- Tell consumers about the 'big picture' benefits of ornamental plants and how comprehensive the 'good news' story is.
- Study and emulate the successful marketing programs of Europe, the US and Australia.
- Work more closely with municipalities to show them how flowers and plants can improve their bottom line, make citizens happier and more proud of their community, and reduce crime and violence in inner city locales.
- Work with wholesalers and retailers to determine what the 'customers' want based on trends.
- Create a shift in buyers' impressions about ornamental products from "luxury special occasion items" to plants for everyday using the new benefits identified in this study.
- Improve the likelihood of consumer satisfaction with their purchases through enhanced post-harvest care, better handling and maintenance directions and enhanced transportation technology.
- Develop world-class centres of ornamental excellence that will be immune to the political nature of government and changing agricultural policy.
- Emphasize practical technology transfer to the entire industry value chain, not just growers.
- Provide better information to appeal to groups of potential buyers to determine what the growers grow and how the new products are presented.
- Find ways to channel the creative, entrepreneurial, progressive characteristics of individuals that have made the ornamental industry what it is today to develop

national, well-organized and integrated mechanisms to take advantage of strengths and benefits identified to prepare the industry for the challenges ahead.
- Increase and stabilize the levels of research funding for the industry.

6.4 Future Research Opportunities

- Examine and promote the positive effects of programs such as Communities in Bloom and shows like Canada Blooms.
- Conduct a national economic benefit study for nursery and floriculture like the Ontario greenhouse industry study done by the Ontario Greenhouse Alliance (TOGA) in 2006. Another excellent model would be the recent work by Hall, Hodges and Haydu (2005)[50] that was the first attempt to quantify the economic impact of the total national U.S. green industry (Hall, Hodges, and Haydu, 2005).
- Investigate opportunities presented by climate change.
    - Greater variability in temperature, day/night temperatures, water and more extreme events may make today's plants unsuitable regionally.
    - Longer summer growing and irrigation seasons may lead to landscape watering and population growth restrictions.
    - Customers will turn to nursery professionals for advice on landscapes that can tolerate these changes.
- Investigate visitor attitudes, values and lifestyles of those visiting public gardens to determine ways of marketing the different benefits of enjoying public gardens to more demographics.
- Investigate greener pest management solutions for the industry to promote to consumers.
- Investigate the opportunities for recycling nursery and greenhouse wastes into cellulosic biofuels.
- Develop an economic and environmental impact manifesto about the industry for the press and governments.
- Examine opportunities for new crops for commercial production by the ornamental industry (e.g. medicinal plants, plants required by green roof and green city programs and those specialized plants required for ecological remediation and restoration activities).
- Some producers of ornamental plants are taking advantage of the consumer desire to promote natural habitat and wildlife. A line of products called "Circle of Life" focuses on their eco-friendly production and "sustainable horticultural" techniques. These techniques include minimal use of chemicals, pots that can be composted, soils that are biologically enriched[51], and organically-based fertilizers (Ball Horticultural Company, 2007). Thus, the industry should further investigate opportunities for ornamental growers to appeal to consumers by operating more environmentally consciously by reducing their reliance on plastics

[50] Hall, Hodges and Haydu (2005) estimated the U.S. green industry in 2004 at approximately US$315Billion including outputs from production and manufacturing, horticultural services, and wholesale and retail trade, value added, labour and taxes. They also estimated the economic value of urban forest trees and services at US$50Billion. The total employment represented by both these sectors was 2.22 million jobs. The authors acknowledged that they did not include the values of non-monetary and non-market impacts including energy savings for buildings, reduction of atmospheric carbon dioxide, improved air quality, reduction of storm water runoff, increased property values and aesthetic benefits etc.

[51] Soil is inoculated with beneficial microbes that promote growth of the plant.

and providing ways of recycling things like polyethylene hoophouse and greenhouse coverings, pots, trays flats, irrigation lines etc.

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