Muskoka
WATERSHED
COUNCIL

Pesticides Background Paper

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Prepared by
The Policy & Research Committee, MWC

With special thanks to Nigel Tappin for preparing much of the background research used in the development of this document

A partnership of the
Muskoka Heritage Foundation
&
The District Municipality of Muskoka

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Executive Summary

The non-essential use of pesticides has come under debate in recent years. Several Area Municipalities have taken the initiative to hold public information sessions that highlight the advantages and disadvantages of pesticide use. Two significant literature reviews conducted recently by Toronto Public Health[1] and the Standing Committee on Environment & Sustainable Development[2] noted that pesticides used for lawn and garden care have been found to move from where they are applied to the surrounding air, water or soil. A growing number of scientific studies point to serious health risks and environmental damage associated with the use of pesticides. Based on these concerns, the Muskoka Watershed Council identified the non-essential use of pesticides as a major watershed issue.

In March 2003, the Muskoka Watershed Council passed the following resolution:

> The Muskoka Watershed Council support and endorse the use of environmentally-friendly pest control methods through the development of comprehensive education programs in partnership with each town/township, the Muskoka-Parry Sound Health Unit, and other community organizations in the District Municipality of Muskoka and neighbouring municipalities.

In recognition of the fact that chemical pesticides are currently in use, education programs will also advocate for a cautionary approach to their use, application and disposal.

Further, the Council approved this related motion:

> That the Muskoka Watershed Council recommends to District Council and the six Area Municipalities in the District Municipality of Muskoka that they establish a working group to explore the co-operative development of a pesticide use by-law.

The Federal Government regulates the registration of all pesticides in Canada under the Pest Control Products Act. Provincial legislation regulates commercial use and application of pesticides under the Pesticides Act and Regulation 914. Municipalities can regulate local use of pesticides under Section 130 of the Municipal Act. Several municipalities have passed pest control by-laws and the municipalities in Muskoka are currently reviewing their options.

Although there is no definitive epidemiological proof that pesticides cause major health issues, there is a growing body of science that links pesticides with increased risk of reproductive problems, brain and nervous system impacts, endocrine disruption and immune suppression disorders, and cancers, with children and seniors with compromised immune systems being more vulnerable.

From an environmental perspective, although some pesticides are species-specific, most do not differentiate between pests and beneficial organisms. Pesticides can harm non-targeted species such as bees, birds, soil and aquatic organisms. Pesticides have been known to move in the environment and have been detected in nearby streams and ponds. Concern has also been expressed with respect to the synergistic effects of various pesticides and chemicals within the environment and how these combinations may impact the health of individual species or the functioning of the ecosystem.

There are various strategies for reducing or eliminating the non-essential use of pesticides. Muskoka Watershed Council recognizes that a significant change in community values and human behaviour will be required before the elimination of pesticides can be achieved and support the full range of options that will lead to and encourage a reduction in pesticide use. These options

include municipal pesticide control by-laws, an education campaign, and the use of Integrated Pest Management programs or Plant Health Care regimes where a complete ban is not achievable in the short term.

Given the incomplete understanding we currently have with respect to the impact of pesticides on human health and within the environment, Muskoka Watershed Council supports:

> A ban on the non-essential use of pesticides and recommends a precautionary approach to the regulation of these chemicals.

Until such time as a complete ban on the non-essential use of pesticides can be implemented, Muskoka Watershed Council supports:

1) An immediate ban on the use of pesticides around facilities that cater to children and seniors.
2) Requiring a buffer along streams, lakes and other surface water, including stormwater management facilities.
3) The elimination of the non-essential use of pesticides on all public property.
4) A public education campaign undertaken in conjunction with Muskoka and the Area Municipalities.

In addition, the Muskoka Watershed Council will lobby senior levels of government to undertake studies to definitively determine the effects of pesticides on human and environmental health.

1.0 Introduction

A **pesticide** is defined by the Pesticide Management Regulatory Agency (PMRA) as "any product, device, organism, substance or thing that is manufactured, represented, sold or used as a means for directly or indirectly controlling, preventing, destroying, mitigating, attracting or repelling any pest. Control products include active ingredients used in the manufacture of end-use products and the end-use products themselves. Pesticide is a broad term that includes herbicides, insecticides, fungicides, antimicrobial agents, pool chemicals, microbials, material and wood preservatives, animal and insect repellents, and insect- and rodent-controlling devices."[3]

Pesticides are comprised of the **active** ingredients (the part with the pesticidal effect) and other ingredients, such as surfactants and adjuvants, used to augment the effects of the active ingredient. These, too, can be harmful to human health or the environment. Over 7000 pesticides are registered for use in Canada, with the large majority of these being "synthetic organic" chemicals. [4]

Pests are any organisms considered detrimental or disruptive to humans or their property in some or all contexts. This includes any injurious, noxious or troublesome insect, fungus, bacterial organism, virus, weed, rodent or other plant or animal.

Because they are marketed based on their toxic properties, pesticides are the subject of particular health and environmental concerns.

The PMRA considers the **non-essential** or **cosmetic** use of pesticides as the application of pesticides as part of a lawn care program when there are no pests or infestations apparent on the lawn.[5] In the Supreme Court Ruling of Hudson vs. Spraytech, the non-essential use of pesticides refers to their use in certain situations where the application is purely for an 'aesthetic pursuit.'[6] This would include pesticide applications when unwanted species, such as dandelions, are present but do not pose a risk to human or animal health or the environment. These definitions exclude pesticides used for agricultural purposes or to deal with a public health issue.

1.1 Current Status of Pesticide Use in Muskoka

With the exception of the Township of Lake of Bays, neither Muskoka nor any of the other Area Municipalities have an official policy regarding the use of pesticides on public lands. The Township of Lake of Bays passed a resolution in 2001 adopting a policy of non-use of herbicides on all municipally owned property [Resolution No. 7(a)(i)/02/27/01]. Most Municipalities have an informal understanding that pesticides are used only in cases of infestations, when dealing with noxious weeds under the Ontario Weed Control Act, or to maintain a sports field in a condition where injury is prevented.

Hydro One is routinely denied its requests by all seven municipal governments to spray pesticides (primarily herbicides) on public properties as part of its Forestry Maintenance Program.

When needed, the application of pesticides is carried out by independent licensed applicators.

Pesticides are applied on public properties for indoor control of insects, within swimming pools and for other essential purposes.

2.0 History

Synthetic organic chemicals first appeared in the late 19th century. The petrochemical industry, which today produces almost all such synthetics, first got started due to the near-extinction of whales in the 19th century and the consequent need for a substitute for whale oils. Kerosene, an oil product, was a major substitute.[7]

The use of synthetics began in the 1930s and became more widespread after the end of World War II. Today, there are many categories of chemical pesticides being used in Canada, of which there are five principal classes. From about 1945 to 1965, **organochlorines** were used extensively in all aspects of agriculture and forestry, for protecting wooden buildings and protecting humans from a wide variety of insect pests.

The discovery of a second, more powerful group of insecticides, the **organophosphates**, led to the replacement of organochlorines with many organchlorines now banned in Canada. Certain organophosphates are systemic: they are taken up by the plant' s tissues and the plant then inhibits or kills the bacteria, fungi or parasites.

Carbamate insecticides came into use later and are less widely used than the others. Their use is diverse; some are used extensively for forest protection, while others are widely used against potato and grain insect pests.

The synthetic **pyrethroid** group of insecticides was introduced in the early 1970s, although natural source pyrethrum has been used for hundreds of years. Synthetic pyrethroids are more stable to light and possess an insecticidal activity almost ten times that of most organophosphates and carbamate insecticides. The stability and activity of the synthetic pyrethroids are reflected in their increased use during the last two decades on fruits, vegetables and corn. The high insecticidal activities of these chemicals allow relatively small amounts to be applied (about 100 grams/hectare).

Although most of the groups mentioned above are insecticides, two of the best-known pesticides, 2,4-D and 2,4,5-T, are **phenoxy** herbicides. 2,4-D [(2,4-dichlorophenoxy) acetic acid] was the first successful semi-selective herbicide to be developed. After 50 years of use, products containing 2,4-D still account for one-quarter of all pesticides used in Canada.

Fungicides are also used in Canada, and account for about 60% of total agricultural pesticide use in the Atlantic region. In addition to the main chemical groups dealt with above, there are many other pesticides on the market, such as aldehydes, amides, pyridil, isoxazol and others.[8]

Between World Wars I and II, production of synthetic chemicals started in earnest, but remained relatively stable in total output after initial adoption in the 1920s. During World War II, both Allied and Axis Powers developed substances that began the widespread use of synthetic pesticides. While DDT (a chlorinated pesticide) was first synthesized in 1874, it did not achieve a use until World War II when the Americans started using it as a delousing agent in Europe. Soon after, U.S. bombers dropped it on the Pacific Islands to control mosquitoes.[9]

Annual U.S. production of synthetic chemicals remained constant from 1920 to 1940 at a few billion pounds per year. After 1940, production rocketed skyward, becoming almost exponential after 1960. By the end of the 1980s, total production had exceeded two hundred billion pounds per year.

During the late 1940s and 1950s, a growing body of evidence and research accumulated amongst concerned citizens, government scientists, and nature lovers that unrestrained use of

pesticides was having unintended consequences.

Rachel Carson, a retired biologist with the U. S. Fish and Game Service, wrote Silent Spring in 1962. The book documented evidence of health problems connected to pesticide use and drew widespread public attention and attack from industry.[10]

In it, she cited five lines of evidence that were alarming: first, while carcinogens occur naturally, man had created new ones in the 20th century against which we have no natural defence mechanisms; second, since the chemical age arrived after WWII, everyone, not just industrial workers, had been exposed to these substances chronically; third, cancer occurrence had become increasingly frequent since pesticides and other synthetic carcinogens entered widespread use in the 1940s; fourth, animal testing was demonstrating that low doses of pesticides in routine use produced tumours in mice, rats, and dogs, and that farm animals and wildlife living in contaminated environments were also developing tumours; and fifth, studies showed that these synthetics could cause mutations in DNA, mimic sex hormones and disrupt their proper functioning, and alter enzyme-directed metabolic processes.

Carson argued that these lines of circumstantial evidence from widely diverse papers and statistics linked cancer to environmental causes.[11] She called for large-scale follow-up studies on all these matters.

Other researchers have been repeating similar calls for case and cohort studies, and while many have been conducted on a small scale, sufficient funds to definitively determine the effects of pesticides and other synthetics as carcinogens, hormone disrupters, immune system suppressors, and neurotoxins have not been produced.

3.0 Pesticide Regulation in Canada

In Canada, pesticides are subject to regulation by the federal and provincial governments and may be regulated at the municipal level.

3.1 Federal Regulation

The federal legislation that applies to pesticides is the **Pest Control Products Act** (PCPA). Regulations under this Act provide that any pest control product used or manufactured in Canada must be tested and registered with the federal government, including pesticide products used on residential properties in urban environments.

The purpose of the federal **Pest Management Regulatory Agency** (PMRA), under Health Canada, is to protect human health and the environment against the risks posed by pest control products while preserving for society the benefits of these same products.

The PMRA bases its decisions upon a wide range of sources of information and relies on the judgment of scientific experts. When a pesticide manufacturer proposes a new chemical for use as a pesticide, it must provide the PMRA with the information that allows the Agency to judge the safety of the product. In order for the PMRA to assess safety, manufacturers have to provide results from multiple types of animal studies that test for toxicity.

The federal regulatory system acknowledges that there are risks associated with the products, but states that the risks are acceptable - by a very wide margin of safety - and can be managed through labelling information. This is what is meant by the saying, “pesticides are safe when used as directed”.

Most of the pesticides commonly used on lawns and gardens were registered long before the new standards described above came into effect and have all been under re-evaluation. The PMRA has identified eight “older” pesticides as candidates for priority re-evaluation. These are four insecticides (chlorpyrifos, diazinon, malathion and carbaryl) and four herbicides (2,4-D, MCPA, dicamba and mecoprop).

3.2 Provincial Regulation

Every province and territory in Canada has passed pesticide-related legislation. In Ontario, the **Pesticides Act** and its regulations cover the shipment, sale, application, storage and disposal of pesticides. The Act also provides for permitting requirements, training, certification and licensing of applicators and sellers of pesticides.

Provincial laws are designed to manage the risks posed by pesticides by controlling who may apply them. The Ontario Pesticides Act and regulations create six different pesticide classifications. The classifications rank products on the basis of how toxic and persistent they are. For example, a Schedule 1 pesticide is in the “Restricted Category”. Every pesticide in this category is very toxic, very persistent and highly mobile in the environment. Only licensed applicators or certified agriculturists may use this category of pesticide and must apply for a permit first. The provincial regulations require that applicators of pesticides in the restricted categories (Schedules 1, 2 and 5) be trained in pesticide safety and certified at least once every five years.

Three of the pesticide categories (Schedules 3, 4, and 6), ranging from moderate toxicity and persistence to low toxicity and no persistence, are available to homeowners without any licensing

or permitting requirements. Licensed applicators may use these pesticides without a permit. Provincial law requires homeowners and licensed applicators to follow the instructions on the product label.

3.3 Municipal Regulation

Ontario provincial legislation has not specifically addressed municipal by-laws dealing with pest control, leaving the field to municipalities under their general health and welfare residuary powers. This was the type of power that the Supreme Court of Canada considered in the Hudson, Quebec case.

Based on the decision of the Supreme Court, it is thought that Ontario municipalities have the power, under section 130 of the new **Ontario Municipal Act**, to enact pesticide by-laws, provided they do not cause a direct operational conflict with provincial or federal legislation. While a municipality cannot ban the sale of a pesticide, it can restrict its use through various mechanisms.

The Supreme Court found that municipal pesticide by-laws were consistent with the international **precautionary principle**, which states that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken, even if some cause and effect relationships are not fully established scientifically. The Supreme Court also stressed the importance of local governance; municipal governments can play a significant role in reducing reliance on, use of, and risk from pesticides.

4.0 Human Health Effects

Definitive epidemiological proof does not exist that pesticides cause or are major contributors to cancer, fertility problems, birth defects, endocrine disruption effects, neurological conditions and respiratory conditions in the general human population.

In epidemiology, **proof** requires evidence involving three sorts of studies.

Ecological studies are often the ones most easily performed. Such studies are ones demonstrating a correlation between exposure and an adverse health reaction. Epidemiologists and toxicologists consider "ecological" evidence the least rigorous because although exposure and an adverse health outcome may happen together, it does not mean that the exposure caused the outcome. This type of study can only suggest that the exposure may cause the problem in the absence of other explanations, but it does not demonstrate causality.[12]

The other two types of epidemiological evidence are supplied by what specialists call analytical studies: one is large-scale **case** studies comparing exposed and non-exposed populations, with the unexposed population being the case control; **cohort** studies follow a given group of subjects over time.[13]

People can be exposed to pesticides from many different sources: trace levels in food, indoor pesticide use, and many different kinds of pesticide use out-of-doors. Because pesticide exposures come from so many sources, researchers have not been able to conduct a perfectly controlled scientific study on how lawn care pesticides may affect people's health. Pesticides may impact on human health in many different ways and some health effects, such as cancer, may take decades to manifest.

In recent years, scientists have observed associations between pesticide exposures and adverse effects on reproductive and neurological health, and some forms of cancer. While not all studies show consistent results[14], a growing body of research suggests that even low levels of pesticides can have a negative effect on human health.

Pesticide manufacturers tend to argue that until proof to epidemiological standards is provided, licensed products are safe if used in accordance with the extensive labelling instructions set by the Federal Pesticide Management Regulatory Agency.

4.1 Reproductive Effects

- Some studies of men and women who work with pesticides (including pesticides used on lawns and in gardens) suggest they have increased risks of fertility problems, spontaneous abortion and miscarriage.[15]
- Some studies (mainly of workers) suggest that maternal exposure during early pregnancy to pesticides used in gardening is associated with increased risks of several types of birth defects (such as cleft lip and palate, spina bifida, limb anomalies).[16]
- The evidence is starting to show (although more research is necessary) that exposure in the womb to very low levels of hormonally active agents found in some pesticides may cause reproductive system abnormalities and may increase the risk of contracting some kinds of reproductive system cancers.[17]

4.2 Brain and Nervous System Effects

- Some studies of workers exposed over a long period to pesticides known to be neurotoxic (such as organophosphates, carbamates, and some fungicides) have shown impairment in information processing, memory and reflexes, as well as other subtle psychological, behavioural and cognitive effects.[18]
- Researchers conclude that there is reasonable evidence for an association between exposure to pesticides and a moderately increased risk of Parkinson's disease.[19] More research is required to establish which pesticides contribute to the increased risks.

4.3 Cancer

- Recent studies show increased risks of testicular, prostate and cervical cancers, non-Hodgkin's lymphoma and multiple myeloma among those exposed – particularly farmers – to pesticides through their work.[20] As with the neurological effects research, more studies are required to establish which pesticides contribute to the increased risks.

4.4 Children

- Several studies have shown moderately increased risks of some cancers (particularly leukemia, non-Hodgkin's lymphoma and neuroblastoma) and some birth defects with pesticide exposure around conception, in the womb and in early infancy.[21]
- Several studies in young animals suggest that the developing nervous system is particularly vulnerable to long-term cognitive effects from some insecticides, such as those from the organophosphates and carbamates classes. This has led to the phase-out of two common lawn insecticides in Canada, chloropyrifos and diazinon.[22]
- A number of recent biomonitoring studies in the U.S. found that when children were tested, more than 90% had traces of certain insecticides or their breakdown products in their urine. These very low levels were not associated with health effects but researchers caution that potential impacts may depend on the timing of such exposures in the young.[23]

Children are not the only people considered vulnerable to the effects of pesticides. Other groups, including women, people with compromised immune systems, people with multiple chemical sensitivities, and seniors are also at risk from exposure to pesticides at lower levels than healthy adults in their prime.[24]

4.5 Synergistic Effects

Synergistic effects refers to the environmental and health impacts associated with a combination of one or more chemical compounds. There have only been a few studies done on the synergistic effects of select pesticides with other chemicals in the environment[25], even though it is thought that their synergistic effects may be amplified by as much as 1000 times.[26] Most pesticides contain more than one chemical, and during spraying season most people are exposed to more than one product as they move around their own neighborhoods.[27]

In light of the uncertainty when dealing with the possible synergistic effects of the many pesticides released into the environment, the Canadian Environmental Law Association and the Environmental Health Committee, Ontario College of Family Physicians stated in their report *Environmental Standard Setting and Children's Health* that "regulatory action on dangerous, persistent substances must include a precautionary and preventative approach".[28]

4.6 Endocrine Disruption and Immune Suppression

The endocrine systems in vertebrates (fish, reptiles, amphibians, birds, and mammals) are remarkably similar to each other. Human and animal estrogens and testosterones are almost identical. Studies on animals in this field are applicable to most species, including in humans.

Studies on mammals have shown fetuses are incredibly sensitive to variations in hormones including estrogen, testosterone and others. Aggression, abnormal sexual behaviour, deformed reproductive tracts, and other effects have been demonstrated to result from parts per trillion changes in both natural hormones and many synthetics known to have mimicking properties.[29]

While many synthetics are called "weak" estrogen mimics due to mild effects on adult subjects, many of these have been found to not be blocked by mechanisms that inhibit uptake of natural estrogen in the blood, so that all, not just part as with natural estrogens, reach the fetus.[30] Some synthetics also work by blocking androgen (male hormone) receptors. Many pesticides and related persistent organic pollutants (POPs) have been shown to cause such effects.[31]

4.7 Bioaccumulation and Biomagnification

Bioaccumulation occurs with chemicals that are stored in the fatty tissue of animals, including humans. These chemicals are not excreted easily and will accumulate over time. Older animals tend to have higher concentrations of chemicals in their bodies, often due to continual exposure to low level doses of chemicals that get stored in their bodies over time.

Biomagnification refers to an increase in the concentration of a chemical as you get higher up the food chain. As chemicals get stored in the fatty tissues of animals, they are passed on up the food chain as one animal becomes food for another.

Humans, at the top of the food chain, are at great risk of exposure to pesticides as a result of bioaccumulation and biomagnification.

Organochlorines are chemicals that are stored in the fatty tissues of animals and tend to make their way up through the food chain in increasing concentrations.

5.0 Environmental Health Effects

From an environmental perspective, although some pesticides are species-specific, there are others that do not differentiate between pests and beneficial organisms. Pesticides can harm non-targeted species such as bees, birds, soil and aquatic organisms.[32]

5.1. Movement in the Environment

Once applied to a lawn or garden, a pesticide may migrate or be dispersed into the air, soil, and water. The degree of movement will depend upon both the chemical and physical characteristics of the pesticide (for example, volatility, persistence and solubility) and the climatic conditions such as wind speed at the time of application, soil moisture content, application method and the degree of wind, heat and rainfall/moisture that follows application. While the quantities may be minute, there are no definitive studies on long-term cumulative effects of low-level exposure of pesticides on the environment.[33]

Two significant literature reviews conducted by Toronto Public Health and the Standing Committee on Environment & Sustainable Development noted that pesticides used for lawn and garden care have been found to move from where they are applied to surrounding air, water or soil.

Pesticides that are sprayed can move through the air as vapour, particles or droplets and end up in other parts of the environment, such as in soil or water. Pesticides that are applied directly to the soil may be washed off into nearby bodies of surface water or may percolate through the soil to lower soil layers and groundwater. The application of pesticides directly to bodies of water for weed control, or indirectly as a result of runoff from soil or other routes, may lead not only to build up of pesticides in water, but also may contribute to air levels through evaporation.

Both the Toronto Public Health and the Standing Committee reviews referred to a 1998 Environment Canada study on pesticides within the urban environment[34]. Water sampling in two Toronto-area streams and three stormwater holding ponds in Guelph often detected the herbicides 2,4-D and MCPP and the insecticides diazinon and chlorpyrifos after rainfall events.

In both Canada and the U.S., pesticide residues in surface waters are sometimes found to exceed water quality standards for the protection of aquatic life. Overall, however, little information is available regarding the levels of pesticides within our water sources. Regular testing of water for pesticide residues is not routine for any level of government in Canada, although the Ministry of Natural Resources tests fish for pesticides in areas of concern for its Guide to Eating Ontario Sport Fish publication.

Most information sources note that although individual pesticides can be detected within our urban and water environments, the effects on the ecosystem are difficult to identify or quantify.

Toxicity testing of individual active ingredients is used to determine the concentration that will trigger a chronic or acute effect. Application rates for use are then designed so as not to exceed these concentrations in the environment. However, some of the common lawn and garden pesticides in use are toxic to other organisms beyond the target species for which they were designed. For example, Methoprene is an insecticide that is commonly used for reducing mosquito populations. However, it is considered to be highly toxic to freshwater invertebrates and moderately toxic to fish.[35] As this product is applied to water, chances are high that non-target species will be negatively affected by its use.

5.2. Synergistic Effects

As with human health effects, data do not exist on the synergistic effects of various pesticides or other compounds within the environment and how these combinations may impact the health of individual species or the functioning of an ecosystem community. Many researchers call for more study as well as for a reduction in the numbers of compounds that we emit and the reduction or elimination of the more toxic compounds in use. The latter is suggested as a more practical approach due to the increasing number of compounds emitted to the environment. In other words, it is likely an almost impossible task to adequately assess the interactions of the various compounds in use for their impact upon the wide variety of species within our environment.[36]

6.0 Pesticides and Golf Courses

The modern history of golf began with the founding of Golf Clubs in the 18th century. St. Andrews is universally regarded as the home of golf and the game has probably been played on its links since the 12th century. The club was founded in 1754.[37]

Golf courses have a history long predating the introduction of chemical pesticides in the 1930s and 1940s. For about two centuries the St. Andrews Club prospered without the use of chemical pesticides; its links likely existed for eight centuries without the aid of these substances now considered to be essential for maintaining good turf.

Today, while most course operators maintain it is impossible to maintain world-class standards without post-1940 methods, some golf courses in Colorado and California have switched to organic methods.[38] Blackburn Meadows Golf Course on Salt Spring Island, B.C. claims to host the only organic golf course in Canada.[39]

The two approaches to pesticide use on golf courses are preventative and curative applications, with curative being the most common approach. Pesticides that are used on golf courses fall into three categories: insecticides, herbicides and fungicides, with insecticides being used to a lesser extent than either herbicides or fungicides. Herbicides, if used for two to three consecutive years, may eliminate most weeds of concern. Fungicides are used to prevent fungal pathogens from causing severe loss of grass on a golf course.[40]

Integrated Pest Management (IPM) is being implemented on an increasing number of golf courses each year, as courses try to reduce their use of pesticides and the associated costs. The goal of IPM on golf courses is to limit pest populations to sufficiently low thresholds to avoid economic damage to golf course operations with the least possible hazard to people, property, and the environment. Although IPM favours natural pest manipulation by selecting proper turfgrass, seeding, irrigation, and fertilization practices, it does not exclude chemical controls when required. [41]

The terrain (thin soils) conditions found within Muskoka provide conditions that would favour the leaching of pesticides into the groundwater. The recommendation for golf courses in the Muskoka area is that golf course design and operations should take these conditions into account and provide measures that would reduce the potential for pesticide loss. This would include such measures as the creation of a thatch layer at the surface and stringent controls over the timing and application rate of pesticides.[42]

In addition, non-chemical methods of pest control and management should be considered as the preferred approach to pesticide management. The overall environmental management objectives of the course should act to minimize the need to apply pesticides. The selection of pesticides should consider the potential for off-site movement, fate, non-target toxicity and persistence. [43]

A Golf Course Study has been undertaken in Muskoka and should provide some information as to the impact of pesticides on nearby surface waters once results are released.

7.0 Strategies for Reducing Pesticide Use

Many municipal governments, industries, and private citizens are trying to reduce their use of pesticides for non-essential purposes. Actions range from voluntarily reducing the use on individual properties, to implementing IPM or Plant Health Care in larger areas, to enacting by-laws for whole municipalities.

7.1. Municipal Initiatives

There are many ways that a municipality can reduce the use of pesticides for non-essential purposes. The majority of municipalities who are considering approaches to reduce pesticide use within their boundaries have generally started with efforts to reduce non-essential pesticide use on their own properties. Many municipalities are currently evaluating how they might accomplish reductions of pesticide use on private property and are involved in review and public consultation on the issue. Municipalities that have passed municipal regulations include Shediac NB, Halifax NS, Hudson PQ, Toronto ON, Perth ON, Caledon ON and Cobalt ON.

The size of a municipality is reflective of the possible complexity of the implementation in such areas as the range of land uses, number of residents or users requiring education, number and range of sites where enforcement will be required, scope of program support costs for such areas as sample analysis, and transportation.

7.2. Pesticide By-Laws

For those municipalities that now regulate the non-essential use of pesticides, they generally do not impose complete bans or total prohibitions. Rather, the by-laws tend to define which uses of pesticides or in what circumstances they are permitted (not purely for aesthetic reasons) and what areas or land uses are or may be exempt from the restrictions, with or without phase-out provisions. For example, the Halifax Region Municipality by-law applies to residential and municipal properties only and does not apply to commercial, industrial or institutional properties. These by-laws would appear to be consistent with the pesticide reduction and restriction authority that the Supreme Court ruled (Hudson case) in 2001 to be within the jurisdiction of a municipality.

Hudson, Quebec

- By-law prohibits the use of pesticides throughout the territory of the Town of Hudson
- Exemptions are allowed for swimming pools, water purification, inside a building, to control or destroy animals, plants or insects on infested property, and for use as a wood preservative
- Regulations regarding signage and wind velocity for application of pesticides are specified
- Allows for use on golf courses
- Issues an average of 15 permits per year
- The Town of Hudson estimates 90% voluntary compliance with their by-law, but no formal studies have been undertaken to support this estimate.

Halifax, Nova Scotia

- By-law phased-in over three years
- Allows pesticide application for non-cosmetic purposes through a permit process
- Enforcement not specified in by-law, but is only in response to complaints and relies on eye witness testimony and physical evidence such as product containers
- Emphasizes that the focus of the program is voluntary compliance, leadership by example and the promotion of practical alternatives
- Enforcement is viewed as a last resort

Cobalt, Ontario
- First by-law in Ontario
- Is similar to Hudson's, but with fewer exemptions
- By-law does not indicate need for permit or signage
- Does not exempt golf courses
- Enforcement is not specified in the by-law

Shediac, New Brunswick
- Is a combination of Hudson and Halifax by-laws
- Non-essential use is prohibited throughout the municipality with the same exemptions as Hudson
- Provides specifications for signage
- Pesticides are banned within a 50 metre radius of a school, licensed day care centre, park, playground, licensed senior citizens' residence, university, church or hospital
- Pesticides may not be applied within 5 metres of a watercourse, 15 metres of a surface well, 3 metres of an artesian well, when wind velocity is greater than 15 km/h or during a drought
- Pesticides are allowed on golf courses for 5 years

Perth, Ontario
- Its by-law regulates and controls the use of pesticides
- It includes signage specifications
- Contains more restrictions on where pesticides cannot be applied e.g. within 10 metres of a watercourse
- Specifies a list of permitted pesticides e.g. soaps, nematodes, injected tree treatments, etc
- By-law must be posted at point of sale and warning signs must be made available by anyone selling pesticides
- Permitted on golf courses, hydro corridors and railway right-of-ways with restrictions

Toronto, Ontario
- By-law is similar to Hudson's
- Includes a series of exemptions
- Does not mention signage, notification, or use on golf courses
- Enforcement is not specified in the by-law
- Is currently being challenged in court

Caledon, Ontario
- By-law indicates where pesticide use is allowed
- Requires applicators to meet certain requirements
- By-law includes signage requirements
- Makes use of a 'Public Information Record' that keeps a record of commercial applicators operating in the Town
- Allows for use on golf courses

Most jurisdictions, particularly those in Quebec where by-laws have been in place for many years, believe that pesticide use reductions had occurred, that residents were developing a preference for alternative methods and products, and that public support for their by-laws was high. However, very few municipalities have done a methodical evaluation of their by-laws, or have studies to support findings of pesticide use reductions.

Westmount, Quebec reported that in the first year of its bylaw (1994), residents made 100 applications for permits to spray pesticides, but the number subsequently declined to approximately 10-15 a year. A fall 2002 opinion poll in Halifax found that 93% of homeowners surveyed were using mainly alternatives to pesticides, compared with only 7% who still used pesticides as their primary mode of pest control. A Halifax spokesperson estimates these responses represent a substantial increase in those reporting they use alternatives to pesticides in the two-year implementation period of the bylaw.

The former mayor of Chelsea, Quebec stated that, each year since the bylaw was passed in 1998, the infractions are less because people are squealing on the companies that come into Chelsea to treat lawns. At the time that Halifax was collecting background research for its bylaw, the Town of Chelsea reported that it hasn't had to enforce its bylaw through tickets or court proceedings since voluntary compliance through its awareness program has been successful.

At present, other that surveying residents, there are few mechanisms readily available to municipalities that can measure reductions in pesticide use. The new federal Pest Control Products Act will require that sales figures for pesticides be reported to the federal Minister. This mechanism has the potential to help meet the needs of municipalities to evaluate the effectiveness of their pesticide by-laws.

7.3. Public Awareness Campaigns

Not all municipalities are turning to by-laws to reduce pesticide use on private and public lands. The City of Ottawa is an example of a municipality that is using an aggressive public awareness campaign to encourage people to voluntarily reduce their use of pesticides. The City is highlighting the unnecessary use of pesticides and asking the public sector to take the lead in reduction and the use of healthy alternatives. The objective of the City's three-year pesticide strategy is to achieve a reduction of 70% on residential properties, a reduction of 100% on institutional properties, and a 65% reduction on the remaining non-residential properties by the end of 2005. If the City experiences difficulties reaching these targets, a by-law may once again be considered.

It is recognized that an important component in any action that is taken with respect to pesticides is a strong public awareness and education campaign. Such campaigns usually include educational materials, workshops, hotlines, websites, surveys, and media material (e.g. newspaper articles, television and radio advertisements).

7.4. Plant Health Care

The Plant Health Care approach focuses primarily on preventative measures – those that encourage plant vigour and maintain healthy, balanced growth. Plant vitality is the best protection against pest problems. The basic components of Plant Health Care are plant selection, planting and maintenance.[44]

Plant Selection
No amount of maintenance will compensate if the plant is not adapted to site conditions. Since the site is often difficult to change, the best solution is to select a species that is site tolerant. Horticultural considerations that help in proper plant selection include site characteristics, plant characteristics, source of plant material, and health and vigour.

Planting
Proper planting is also critical to the success of plants in the landscape. A frequent mistake is planting trees too deeply or not properly preparing the soil when laying sod. Proper planting

procedures include preparation of planting area, time of digging/planting, watering, fertilizing, pruning roots/shoots, backfilling, staking, mulching, and using sod or seed.

Plant Maintenance
Depending upon the plant species and situation, cultural practices can optimize plant health. Steps include developing a plant inventory and map of the property, monitoring through regular check-ups, diagnosing plant problems, following cultural practices (fertilization, mulching, overseeding, etc.), using IPM, biocontrol, mechanical control, and chemical control.

7.5. Integrated Pest Management

Integrated Pest Management (IPM) is a decision making process that uses a combination of techniques to suppress pests and must include, but is not limited to, the following elements:

1) Planning and managing ecosystems to prevent organisms from becoming pests;
2) Identifying potential pest problems;
3) Monitoring populations of pests and beneficial organisms, pest damage and environmental conditions;
4) Using injury thresholds in making treatment decisions;
5) Reducing pest populations to acceptable levels using strategies that may include a combination of biological, physical, cultural, mechanical, behavioural and chemical controls;
6) Evaluating the effectiveness of treatments.[45]

In response to concerns about pesticide use, chemical lawn care industry groups are developing voluntary protocols and training programs to reduce pesticide applications based on IPM. Residential IPM is relatively new in Ontario, with the PRMA promoting an IPM initiative.

8.0 Conclusions

Pesticides are designed specifically to be toxic to life and studies are inconclusive as to the long-term impacts of pesticides on non-target organisms, including people. The evaluation and regulation of these products has been based on the prevention of *acute* health and environmental effects. Only recently have people begun to consider that chronic or complex effects may occur due to long-term exposure to low concentrations of one, or a mixture of pesticides. Studies are beginning to indicate that developing and young children, those with chemical sensitivities, and those with compromised immune systems are at a greater health risk as a result of exposure to pesticides.

The precautionary principle states that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken, even if some cause and effect relationships are not fully established scientifically. Given the incomplete understanding we currently have with respect to the impact of pesticides on human health and within the environment, Muskoka Watershed Council supports:

> A ban on the non-essential use of pesticides and recommends that the sale and use of these chemicals be regulated to minimize the possibility of damage to human and environmental health.

Until such time as a complete ban on the non-essential use of pesticides can be implemented, Muskoka Watershed Council supports:

1) An immediate ban on the non-essential use of pesticides around facilities that cater to children and seniors.
2) Requiring a buffer along streams, lakes and other surface water including stormwater management facilities.
3) The elimination of the non-essential use of pesticides on all public property.
4) A public education campaign undertaken in conjunction with Muskoka and the Area Municipalities.

In addition, the Muskoka Watershed Council will lobby senior levels of government to undertake studies to definitively determine the effects of pesticides on human and environmental health.

9.0 Additional Resources

9.1. Papers and Reports

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City of Toronto – Toronto Public Health
http://www.city.toronto.on.ca/health/hphe/pesticides_index.html

Crop Protection Institute of Canada
http://www.cropro.org

EPA Office of Pesticide Programs
http://www.epa.gov/pesticides/

Halifax Regional Municipality – Naturally Green
http://www.region.halifax.ns.ca/pesticides/index.html

IPM Accreditation
http://www.planthealthcare.ca/

Landscape Ontario Horticultural Trades Association
http://www.landscapeontario.com/

National Pesticide Information Center
http://npic.orst.edu/index.html

Organic Landscape Alliance
http://www.organiclandscape.org/

Pest Management Regulatory Agency
http://www.hc-sc.gc.ca/pmra-arla/

Pesticide Free Ontario
http://www.pesticidefree.ca

PMRA - Healthy Lawns
http://www.healthylawns.net/

Pros and Cons of different pesticide bylaw choices
http://www.chebucto.ns.ca/Environment/RATE/Pros_and_Cons_of_different.html

Responsible Pest Management
http://www.pestinfo.ca

Sample Pesticide By-laws
http://www.sierraclub.ca/national/pest/pesticide-bylaws/index.html

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