Integrated Pest Management Strategic Plan

Prepared for:

The City of Dawson Creek

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Executive Summary

The control of unwanted plants, insects and diseases has traditionally been accomplished through the application of chemicals. However, in recent years undesirable impacts to human health and the environment from the overuse of chemical treatment have led to consideration of alternative methods of pest control.

Integrated pest management (IPM) combines knowledge of pests, horticultural expertise and ecological understanding. As a land and parks management tool, IPM has come to the forefront largely through public pressure but also as a result of staff concern both for the environment and worker health. In British Columbia, the *Pesticide Control Act* has been replaced by the *Integrated Pest Management Act.*

The *IPM Act* came into force in 2005 and requires anyone applying pesticides to adhere to the principles of IPM, namely:

- Planning to prevent pest problems,
- Identifying potential pest problems,
- Monitoring pest populations and damage,
- Establishing thresholds to aid in decision-making,
- Considering alternatives to chemicals, and
- Evaluating the effectiveness of treatments.

As a land manager applying pesticides to public land for the purposes of landscaping, the City of Dawson Creek would be required to have a licence from the Ministry of Environment. The general prohibition of the *Act* is that by following an IPM process, specifically by using thresholds and monitoring, that users will reduce their use of pesticides and not cause unnecessary adverse effects. The *Act's* regulations and supporting documents provide the details of what is expected of licensee.

This strategy is divided into two parts:

- Part 1 – IPM Backgrounder
- Part 2 – IPM Implementation

Part 1 summarizes the *IPM Act* and regulations and describes the IPM process. It illustrates how the city's policies, objectives and thresholds lead to specific pest management programs, and highlights how the IPM approach may require new training and awareness programs to successfully monitor the pest management programs. It also discusses the non-regulatory benefits of using an IPM approach.

Record keeping and reporting are highlighted, as they are the primary elements related to the city's interaction with the Ministry of Environment.

Part 2 describes each element of the IPM process and relates these elements to the City of Dawson Creek and the approach that was taken in the preparation of this strategic plan. Examples of cultural, mechanical and biological methods of pest control are provided, and supporting resources are identified, such as the Ministry of Agriculture and Lands' diagnostic laboratory and the pest management plan for noxious weeds that has been prepared by the Peace River Regional District.

The step-by-step discussion of implementing an IPM process includes summaries of Dawson Creek's known pest management issues and its recent use of pesticides. Table 3 (p. 17) addresses the city's known pest problems. This section breaks down the city's land into "landscape types" for the purpose of assessments, and classifies sites for the purpose of establishing appropriate thresholds (i.e., class A, B or C).

Based on the information provided by the Parks and Recreation Department and the city's pest management contractor, the control of noxious weeds is the city's main issue in terms of pesticide use.

This plan addresses city-wide policies and objectives, which are the keys to the prevention element of IPM. Finally, it presents four specific programs that address the city's current pest management issues:

- **General weed control** (including noxious and invasive weeds);
- **Turf weed control;**
- **Insect control;** and
- **Disease control.**

Each of these programs is then reviewed for the IPM elements of **identification, monitoring, thresholds, and treatment selection.**

References and resources are provided at the end of the report. The appendices provide summaries of information in table format (i.e., treatment summary tables), as well as providing forms that can be used to assess, monitor and report on the implementation of the IPM process.

IPM is an adaptive process that will evolve and become more precise as additional information is collected. The IPM framework used in this report lays out the strategy and identifies the pest management programs that will be a good starting point for the City of Dawson Creek. Working closely with partners such as the ministries and the regional district, as well as completing its own assessments and monitoring, will help the city to meet its goals for pest management, comply with the *IPM Act* and reduce the use of pesticides.

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1.0 INTRODUCTION

1.1 Definitions

Integrated pest management (IPM) is ***a process for making decisions.*** It is a process that utilizes a range of techniques to prevent pests or to suppress pest populations below damaging levels.

IPM looks at pest management through a lens of ecosystem health, not through a lens of pesticide application. If an environment, such as a plant community, is planned and maintained to be healthy, the origins of potential pest problems are managed so that pest infestations can be prevented. Killing pests with chemicals may not solve a pest problem; it is the stressors and conditions that contribute to the problem that need to be addressed.

Elements of IPM
The following definition is derived from the *Pest Control Products Act* (Canada) and the *Integrated Pest Management Act* (British Columbia):

An IPM process for managing pest populations includes the following six elements:

1. Planning and managing ecosystems to prevent organisms from becoming pests;
2. Identifying pest problems and potential pest problems;
3. Monitoring populations of pests and beneficial organisms, damage caused by pests and environmental conditions;
4. Using injury thresholds to make treatment decisions;
5. Suppressing pest populations to acceptable levels using strategies based on considerations of biological, physical, cultural, mechanical, behavioural and chemical controls in appropriate combinations; and
6. Evaluating the effectiveness of pest management.

The primary objective of an IPM process is to protect human health and the environment by limiting the amount of toxic chemicals that are used. Many elements of IPM have their own requirements for capacity building, communication, training and record keeping.

Figure 1 (following page) shows these relationships between city policy, the elements of an IPM approach, organizational needs, and the resultant pest management programs.

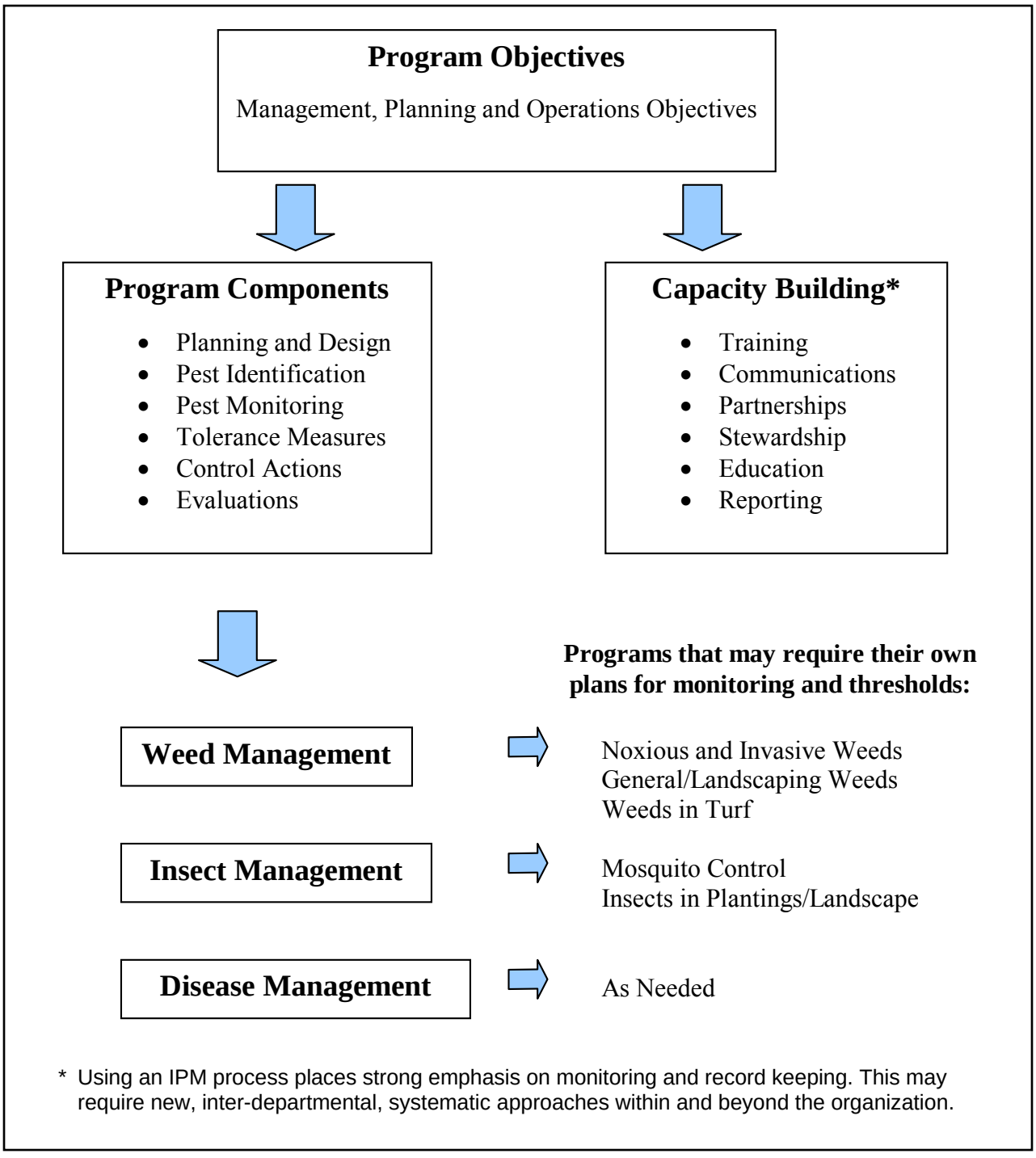

Figure 1. Relationship between IPM Objectives, Elements and Programs.

IPM combines **cultural** (e.g. selecting resistant plant species), **biological** (e.g. releasing predatory insects), **mechanical** (e.g. hand-picking pests), and **chemical** (pesticides) controls in the most efficient and cost effective manner. The emphasis of an IPM approach is placed on integrating all aspects of plant care and pest lifecycles and determining appropriate course(s) of action, as necessary.

The most important principles of IPM are the method, means and toxicity of pest treatment. Within an IPM program, treatment is only applied when the pest population will increase above an injury, aesthetic or safety threshold; and then, the least toxic treatment is considered first. Some who use an IPM approach have adopted this motto:

"Think first, spray last."

1.2 BC *IPM Act* and Regulations

This section is a descriptive summary of the new *IPM Act* and its general requirements. For information on specific items within the *Act,* the *Act* and its regulations should be consulted directly. If any interpretation is required about how the *Act* may or may not apply to the City of Dawson Creek, inquiries should be directed to staff at the provincial Ministry of Environment. The ministry's main portal for information on IPM is on the Internet at the following location: http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/ .

The *Act* highlights IPM as *a process*; it does not provide practical guidance on specific IPM strategies (although guidance materials such as a summary and "sector reviews" are available [WLAP 2005a and 2005b], and more materials are currently being developed). In addition to introducing the elements of IPM into legislation, the *Act* addresses permits and licences required for the sale and use of pesticides.

This new legislation came into force on December 31, 2004. There are still some uncertainties surrounding how its regulations will be interpreted and operationalized. Specific questions pertaining to the *Act* should be directed to the Ministry of Environment.

Prescribed uses and products
The permits, plans, notifications, licences and certifications of the *IPM Act* apply to the prescribed uses and thresholds that are identified in the *Act* and its regulations. The *Act* only applies to the sale and use of certain pesticide products. For example, managing landscape pests on public land is a prescribed use for which a licence is required; but a licence is only required if the city is applying non-excluded pesticides. Note that if a municipality contracts pesticide application to a commercial licensee, the city itself does not require a licence.

Schedule 2 of the *Act*'s regulations lists those pesticide products that are excluded from the *IPM Act*. The *Act*'s Administrator has identified excluded pesticides because it is not believed that use of those products presents a risk of adverse health or environmental effects. The *Act* embraces a risk management approach, focusing provincial regulatory involvement on higher-risk products and users. Conversely, pesticides can be identified

as high risk; Schedule 1 lists pesticides that require a permit (4-aminopyridine and monosodium methanearsonate or MSMA).

In addition, although aerial application of pesticides is generally prescribed as a use requiring a permit, Schedule 4 of the regulations identifies certain pesticides that may not require a permit for aerial application, though the requirements for licences and confirmations would still apply.

It is possible that the city's use of pesticides will not exceed the thresholds that would require the city to prepare a formal pest management plan (PMP) under the *Act* (see Figure 2, p. 5). It is also possible that the city need not apply even for a licence if it contracts the services of another licensee. However, regulatory requirements aside, the purpose of IPM (reducing risks to human health and the environment) is still of interest to the city, and there are still benefits to implementing an IPM approach.

Self regulation
Compared to the legislation that it replaces (the former *Pesticide Control Act*), the *IPM Act* places less emphasis on regulating pesticide use *per se*: more is placed on self-regulation, and less on permit approvals. Permitting and requiring preparation of a formal PMP will be targeted at the largest, highest-risk users of pesticides.

Therefore, a change in the regulatory framework is that the *IPM Act* will generally require less upfront review and approval by the province, but will rely more on the province's officers checking or auditing licensees to ensure that users are implementing and documenting the elements of IPM, and are not causing adverse affects to people or the environment as a result of pesticide use. Another change in the regulatory approach is that administration of the *IPM Act* will be more centralized. The different roles of Victoria and the regional offices (i.e., Prince George), and the provincial resources for auditing, and how these will affect pesticide users, are among the remaining unknowns as the new *Act* is implemented.

General prohibition of the *Act*
The main thrust of the *Act* is a requirement to follow the principles and elements of IPM (prevention, ID pests, monitor, thresholds, treatment selection, and evaluation). The goal of the *Act*, and its general prohibition, is to ensure that the use of pesticides does not cause an "unreasonable adverse effect" to human health or the environment.

Requirements
Licence holders must adhere to the IPM principle, which requires documented proof of the IPM process. For example, in its treatment records, a licensee will be required to include notes on monitoring results and the thresholds that were considered (Reg. s.35). The selection of treatment methods to control pests must be based on considering alternatives to pesticides (Reg., s.68). Therefore, a non-excluded pesticide cannot be used unless monitoring has been conducted, thresholds have been established and alternatives have been considered.

The city may currently employ a similar approach: pesticides should not be applied unless pests have been noticed and the pest populations are perceived to represent a problem. However, under the *IPM Act*, those actions need to be explicitly described and

documented. Record keeping and reporting are addressed in greater detail in Section 2 of this report. Figure 2 presents the prescribed uses for a licence.

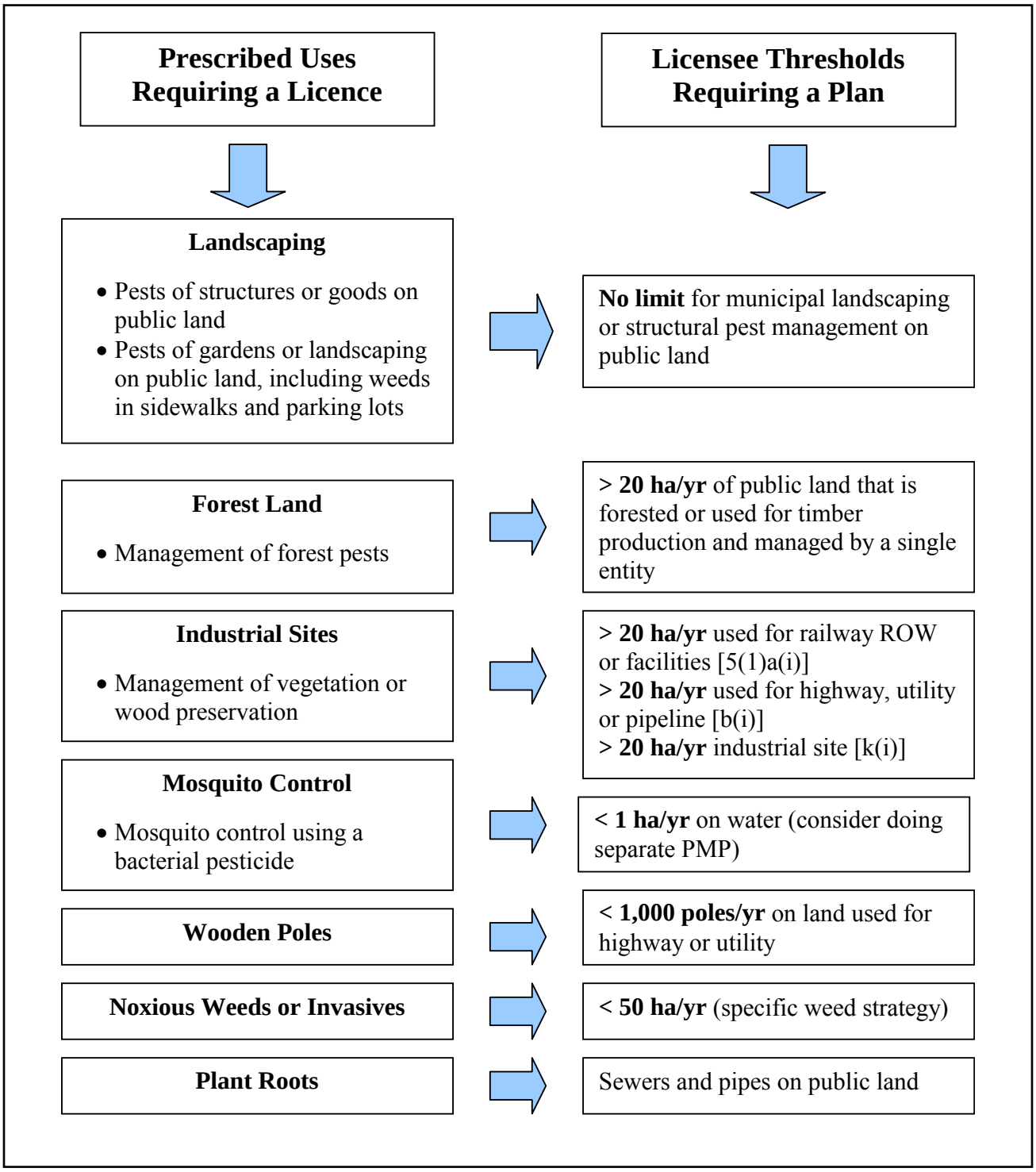

Figure 2. Prescribed Uses and Thresholds for Licences and PMPs.

1.2.1 Licences

A municipality (i.e., managers of public land) using any non-excluded pesticides for prescribed uses (i.e., controlling landscape pests) must hold a "non-service user licence" (commercial operations require a "service user licence") for pesticide use up to these maximums:

- Vegetation management on up to 20 ha/yr on rights-of-way or industrial sites,
- Management of forest pests up to 20 ha/yr,
- Weed/invasive management on up to 50 ha/yr of public land, or
- Management of structural pests and pests of gardens and landscaping (no maximum area is specified for pest control for general landscaping).

If the annual 20 ha or 50 ha treatment areas are exceeded, the municipality will be required to develop a pest management plan (PMP) and to receive confirmation of its pesticide use notification (PUN) from the province. However, PMPs and PUNs are generally intended for large, industrial, province-wide pesticide users. PMPs and PUNs are also required for mosquito control with a bacterial pesticide on more than 1 ha of a water body, or for non-bacterial mosquito control.

Figure 2 (p. 5) illustrates the prescribed uses and thresholds between a non-service user licence and full-blown PMP. Regardless of whether a PMP is required, licence holders are also required to comply with consultation, notification, reporting and record keeping provisions of the IPM regulations, as well as the process of IPM and the *Act*'s prohibition related to causing adverse effects.

Consultation
Aside from public notice (see below), licensees engaged in general landscape management are not subject to requirements for public consultation. An exception is licensees that will be treating > 20 ha of forest land; in which case they must provide an opportunity for input from neighbours (Reg., ss.9 and 62). As with other requirements (notification, mapping, buffer zones, etc.), more detailed consultation requirements are specified for users that are required to prepare a PMP and receive confirmation of their PUN.

Public notice
Notification is required by posting a "treatment notice" immediately before a pesticide treatment, and sending notice to the property manager following the application (WLAP 2005b, p. 11). Standard treatment notices at public areas must be posted at all gates or at intervals to ensure visibility. Notices must remain up for 48 hours after the treatment. Notification is not required for herbicides along fences or cracks, granular pesticides mixed into soil, or bacterial pesticides in water (WLAP 2005b, p. 14). Two-day notice of intent to treat is required to the *IPM Act* Administrator (Reg., ss.10.6 and 63).

Reporting
Licence holders must record and report the following (Reg., ss.35, 39 and 83):

- Use records for each treatment location and day of use (details are specified, and must be kept for 3 years);
- Records of consultations, if required;
- Annual use report (Jan 31 of the next year);
- Notice of intent to treat (2 days, 14 days for 1st treatment); and
- Notice of use on public land, 2-days prior to first use if not already specified in the licence application.

Fees
Annual fees are applied to a season from April 1 – March 31 each year, and can be arranged for 1- to 5-year terms. A basic non-service user licence costs $250 annually (but can be more for forest pests on larger areas). Getting a pesticide applicator certificate requires passing a $90 exam. For those pesticide users required to prepare a formal PMP and get a PUN confirmation, costs range from $500 to $2,000, depending on the area that is treated.

1.2.2 Applicator Certificates

Any person using a non-excluded pesticide requires an applicator certificate. Any person supervising the use of a pesticide for a licence holder also requires a certificate; a supervisor may oversee the work of up to 4 uncertified staff, under certain conditions.

Should the city contract out the application of pesticides rather than acquiring its own licence, having a certified applicator on staff would not oblige the city to apply for a licence. In fact, it would likely be considered best practices and due diligence to have the staff person who oversees the work of the contractor certified, in order to ensure that they too have been trained in and understand the IPM elements and requirements of the *Act.*

1.3 Benefits of IPM Approach

Although smaller municipalities might not exceed the aerial thresholds of using non-excluded products on forest land, industrial land or for the control of noxious weeds or mosquitoes, etc., and therefore under the *Act* would not be required to prepare a formal PMP and receive confirmation from the province, internal IPM processes, documents and records are necessary to define city policy, establish thresholds for pest control treatment, and to keep records so that the effectiveness of treatments can be reviewed and that the use of chemicals can be monitored.

It is also advantageous to have a documented pest management strategy so that the city, if a licensee under the *Act,* can prove, in the case of an audit by the province or inquiries from other stakeholders, that its use of chemical control has been considered in the context of all the elements of the IPM process, and that chemical control can be justified and is not causing unnecessary adverse effects.

Once an IPM program is established, the following outcomes can be expected:

- Reduction of pest problems through preventative measures and development of long-term solutions;
- Involvement of a broad range of staff and community stakeholders from planning through landscape installation to maintenance;
- Increased pest monitoring leads to proper timing of control measures, leading to a reduction in unnecessary pesticide use; and
- A pest management program that is environmentally sound and minimizes risks to human health.

Figure 1 (p. 2) provides an outline of the components of an IPM process. Considering the IPM elements embedded in the new *IPM Act* and the non-regulatory benefits of an IPM approach, the City of Dawson Creek's strategic plan for IPM is based on such a framework.

2.0 INFORMATION MANAGEMENT

As discussed in relation to the *IPM Act* and the elements and benefits of an integrated approach to pest management, the IPM process relies on data collection, including pest monitoring and site assessments, and record keeping. This monitoring-based aspect of the IPM process is perhaps more likely than the technical aspects of pest control to challenge city staff and draw on city resources. It requires a systematic approach and, as presented in Figure 1 (p. 2), may require institutional capacity-building in terms of training, communication, education and involvement with external partners and stakeholders.

2.1 Results-based Management

On one hand, maintaining detailed information about pests, sites, thresholds, and treatments and their effectiveness is the city's *due diligence* for proving that it is meeting provincial requirements for implementing the IPM elements. On the other hand, even if the city does not require a licence under the *Act,* this detailed information allows the city to adapt its program based on results; and to measure its progress towards achieving civic goals, such as lowering the frequency of pest control measures and reducing the volume of chemicals used (and the pesticide budget).

2.2 Record Keeping and Reporting

If the city seeks a licence under the *Act,* there are reporting requirements that are specified in the regulations (if the city chooses to use a licenced contractor, the contractor must meet the reporting requirements). In the *Act*'s regulations, record keeping is addressed in Sec. 35, and the annual reporting requirements are provided in Sec. 39. The requirements are summarized here because record keeping is an important aspect of the IPM approach, regardless of how it is regulated or enforced. However, for complete information on regulatory requirements, the *IPM Act* and its regulations should be consulted directly. As well, the regulations may change over time. If clarification is needed, the city or its contractor should contact the ministry.

In order for the city to continuously improve its pest management practices and management the risks of using toxic chemicals, the following records should be maintained for each treatment location and each day of use:

- Name and address of the owner or manager of the treatment location,
- Name and certificate number of the applicator/supervisor,
- Date and time of use,
- Target pest(s) for the use of the pesticide,
- Trade name of the pesticide and its federal PCP number,
- Method and rate of application and total quantity used,
- Weather conditions,
- IPM monitoring methods and thresholds used, and
- Advice given to property manger regarding re-entry or other precautions.

Consistent with the rest of the *Act,* there may be additional requirements if the licensee is treating forest pests in an area larger than 20 ha or for the use of wood preservatives.

Forms for treatment records, as well as annual reporting, are available from the Ministry of Environment's IPM website under 'IPM Forms' and 'Pesticide Use Record.' The various forms are located at: http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/forms1.html . The model pesticide use record and its supporting information are provided in Appendix A.

By January 31 of each year all licensees and permit holders must submit an annual report to the administrator of the *Act* (i.e., treatments records from the calendar year 2005 would be due to the ministry by January 31, 2006). The annual report would need to include:

- Name, address and licence number of the licensee,
- For each non-excluded pesticide used:
    - Trade name,
    - Federal PCP registration number,
    - Active ingredient,
    - Amount in kilograms, and
    - Total area treated.

3.0 IPM IMPLEMENTATION PROCESS

3.1 Components of the IPM Process

As discussed in relation to the definition of IPM and the terms of the BC *IPM Act*, the six basic components of IPM are:

- **Preventing** pest problems through management and planning;
- **Identifying** potential pest problems;
- **Monitoring** populations of pests, beneficial organisms and damage;
- **Assessing** injury thresholds;
- **Suppressing** pests and by applying appropriate treatments; and,
- **Evaluating** the effectiveness of treatments.

Prevention
The Dawson Creek IPM strategy emphasizes the management of plants and habitats to prevent pest problems from developing in the first place. City staff will adhere to proper horticultural and arboricultural practices. These include, but are not limited to, proper soil management; nutrient, watering and seeding programs; and optimal pruning and planting techniques.

Dawson Creek planners and designers, including landscape architects and engineers, should be familiar with the principles of IPM and the design and planning considerations that prevent or limit pests from becoming established in the community.

When an unwanted plant, insect or disease must be treated, a re-evaluation of the management program for the site shall be undertaken to determine how to improve plant health and how to prevent the problem in the future.

Identification
Identification of pests and beneficial organisms is a key to effective pest management. The biology, life cycle, preferred habitat and other characteristics and needs of pests and beneficial organisms must be understood.

Key resources for identification include the field guides and fact sheets of the Ministry of Agriculture and Lands. These publications can be found on the Internet at http://www.agf.gov.bc.ca/cropprot/index.htm . Pests and beneficial organisms may be identified by:

- Physical appearance,
- Damage caused,
- Life cycle,
- Habits, and
- Host plant or environment.

If field identification is not possible, contact:

- The Plant Diagnostic Lab at the Ministry of Agriculture and Lands in Abbotsford (604-556-3126);
- The Horticulture Department at Kwantlen University College;
- Pest management colleagues or committees in your region; or
- Pest management consultants.

Once identification of the pest has been confirmed:

- Review the history of this pest in the community, if possible;
- Determine the historic threshold measures, if possible;
- Determine when, at what life stage, the pest can best be controlled; and,
- Which control method(s), if necessary, will suppress the pest effectively.

Monitoring

Monitoring is the regular, long-term, repeatable inspection and sampling performed to estimate the size, extent and location of pest and beneficial organism populations. Monitoring also provides information on how the plants are affected by different conditions. Monitoring results will provide current and historical information about the presence or absence of pest organisms and whether pests have reached a level or "threshold" that justifies control measures.

There are many methods that can be used to monitor pest populations, but two components remain constant to most monitoring programs:

1. Inspection or sampling at regular intervals, and
2. Written records of observations.

The information recorded will vary depending on:

- Species and location of plants;
- Pest and beneficial organism counts;
- Description and extent of damage or symptoms on plants; and,
- Relevant site observations.

The frequency of monitoring will depend on the specific situation. For example, if monitoring an insect pest that reproduces quickly, such as aphids, weekly monitoring may be necessary; whereas monitoring for weeds in turf may only be necessary once or twice a year. An example of a site-specific pest monitoring form is provided in Appendix B.

Thresholds

Thresholds are guidelines to help decide if and when it may be necessary to apply a pest control treatment to a particular area. As part of an IPM program, two thresholds are utilized:

The ***injury threshold*** is the point where the level of damage will result in economic, aesthetic or qualitative loss. It is the level where the pest or the damage caused by the pest becomes unacceptable.

The ***action threshold*** is the point *below the injury threshold* where control measures should be applied to avoid reaching the injury threshold. The action threshold will vary depending on the mode of action of the selected control measure and the extent to which injury is likely to occur. The action threshold for a pesticide application, which is fast acting, will be set higher than the threshold for other actions that typically take longer to have an effect.

Treatments
IPM treatments are the combination of different types of prevention and control measures used to suppress pest populations. For many years, pest managers typically relied more heavily on chemical treatments to control pests.

Many alternatives to the chemical option exist, including:

- **Cultural methods** include adhering to horticultural practices aimed at producing a strong, healthy plant community, such as the diversity of plantings, irrigation and fertilization.

- **Mechanical methods** involve the physical removal or containment of the pest, such as cutting out infested areas, pulling weeds, setting up pest barriers and traps. Hand pulling is effective on tap-rooted weeds in small areas and in loose or moist soil. Cutting and mowing may be effective to control weeds in larger areas, but will allow the weeds remain; it may be the only option adjacent to environmentally sensitive areas.

- **Biological methods** employ the use of natural enemies to reduce pest numbers. Natural enemies can be insect and mites, but also bacteria, fungi, birds or bats. There are two ways of using these: protecting the naturally occurring beneficial organisms or releasing commercial-reared beneficial organisms. Many biological control agents have difficulty getting established over winter, but the Ministry of Forests has had some successes and is the best resource for this approach.

- **Chemical methods** are another tool in the IPM toolkit - if used judiciously. The application of pesticides has inherent risks; however, with proper care and selection, these risks can be minimized. Some past problems with the use of pesticides had to do with their overuse and their misuse. Although not necessarily desirable, pesticides may be used within the IPM program. Whenever possible, the pesticides used should present the least risk to human health, the environment or non-target organisms. For example, depending on the pest, the site and the goal, selective pesticides that do not remain in the soils for extended periods may be desirable. Picloram has long soil residual activity, greater than a year, whereas glyphosate and 2,4-D amine last approximately 1 to 4 weeks. Glyphosate is non-selective. In addition, different products have different toxicity to different organisms (i.e., fish vs. mammals vs. soil microorganisms, bees, birds, etc.), and that should also be taken into consideration.

The *Noxious and Invasive Weed Pest Management Plan* of the Peace River Regional District includes relevant information on methods and herbicides related to the control of noxious weeds (PRRD 2004 and NEIPC 2005).

Evaluation
Evaluating the effectiveness of an IPM program may be one of the most important steps in the program. Keeping detailed monitoring, treatment, operations, efficacy and cost-effectiveness records are essential in order to be able to assess, adapt and enhance the IPM process. Record keeping is also required in case of auditing and for annual reporting to the provincial Ministry of Environment.

3.2 Step-by-step Implementation (Methodology)

To successfully implement IPM, it is necessary to have policies and objectives in place, and also to assess the landscape and its potential pests. There are several steps involved in setting up pest management strategies and programs. This section describes the steps as they were applied to the preparation of this strategy, and how they can be carried forward in an adaptive IPM program. Appendix C includes a table that further explains these steps and tasks and their role in the IPM process.

STEP 1: Break the landscape into specific sites

In an urban setting, the diversity of plantings and their associated pest problems can be extensive. Therefore, tackling the city as a whole may be overwhelming, inefficient, and difficult to evaluate. Dividing the city into landscape types, or units, will make it easier for city staff to assess the condition of these landscapes and compare pest problems over time.

It is more manageable to group together landscape types that have similar characteristics with respect to pest management. To assess the city's landscapes and group different sites, the habits and preferences of operations staff and historical pest problems and pest control measures are logical building blocks.

The landscape should be segregated into areas with similar plantings or pest problems. For each of these, manageable goals and clearly-defined objectives and thresholds should be set. The breakdowns could be made according to:

- Physically distinct sites (e.g. lagoons or cemeteries);
- Landscape-type specific sites (e.g. sports fields in city parks or planted gardens), and
- Key pests or key plants (e.g. aphids or noxious weeds).

Based on a profile completed by city staff, site visits, and a review of historical pesticide use, Table 1 presents the landscape units that were identified in Dawson Creek.

Table 1. Suggested Breakdown into Landscape Units.

Type of Landscape	Examples/Rationale
General Weeds	All lots, boulevards, facilities, etc. General and noxious weed control.
Turf	Sports fields are unique sites.
Trees	Street and park trees, wooded areas. Tree-specific concerns/diseases.
Gardens	Hanging baskets, planted gardens. Unique pests.
Water	Lagoons, ravines, ditches. Sensitive habitat.
Cemeteries	Distinct sites for operations/visits.

The purpose of breaking down the landscape in this way is to make detailed site assessments, pest monitoring and record keeping easier for staff. So, as the IPM programs evolve, staff should always be re-assessing whether the current breakdown works well for them. There can be as many or as few or as many "landscape types" as necessary, based on whatever variables and management techniques make the most sense to the operations staff.

STEP 2: Categorize the sites

In order to define where to concentrate pest management effort, staff time and resources, it is helpful to identify specific sites according to their maintenance requirements. This ensures that sensitive or visible sites remain a high priority. A site's maintenance requirements are frequently described by using the following three categories:

- Class A - High level of service: sites with high value, high visibility or high maintenance level (e.g. downtown area), and/or sites with few pests where spreading can stopped (e.g. weed-free lots).
- Class B - Moderate level of service: these are medium visibility or moderate maintenance sites (e.g. street trees).
- Class C - Low level of service: low profile or low maintenance sites (e.g. passive turf areas in city parks), and/or sites impacted by pests where maintenance is a more appropriate goal than elimination.

When conducting site assessments city staff should use these categories to identify high-, medium-, and low-maintenance sites/facilities.

This strategic plan makes use of the above categories. The maintenance level of a site will help to define treatment thresholds.

STEP 3: Assemble detailed background information

In addition to the background work necessary to breakdown landscape types and categorize sites, the following types of detailed information should be collected to help make IPM programs complete:

- Historical information - this may include notes on what previous pest problems have occurred, treatments/pesticides that have been applied, or previous landscaping work done to various sites (e.g. drainage systems, turf mixtures).
- Potential pest problems - collect information on what pests may occur on the plants in the region and in the various landscape types, and assemble details about each pest's lifecycle.
- Availability of treatments - for each potential pest, what treatments are available, and how appropriate are these treatments?
- Resource availability - what budget, labour, supplies and experts are available?
- Regulatory requirements - what federal, provincial, municipal or other regulations or policy commitments apply to these operations?

Pesticide records were available from the city's contractor for the past two seasons. Based on a review of these records, pest control has been limited to the use of three herbicides, primarily to control noxious weeds. Table 2 lists the pesticides that were used in 2003 and 2004.

Table 2. Pesticide Products in Recent Use.

Pesticides In Use Noxious Weeds and Nuisance Vegetation	**Use Rate**	**Volume 2004**	**Area 2004**	**Days 2004**	**Volume 2003**	**Area 2003**	**Days 2003**	**Sites**
Roundup Transorb (glyphosate) PCP# 25344 [non-selective - noxious weeds and total vegetation]	4.5 L/ha	107 L	24 ha	11	51.5 L	11.53 ha	17	Airport; lagoon; pumphouse; industrial park; curling rink; float plane; streets
2,4-D PCP# 20311 [noxious weeds]	1.25 L/ha	19.5 L	15.6 ha	4	32.5 L	26 ha	13	Streets and alleys; lots
Tordon (picloram) PCP# 9005 [noxious weeds]	2.25 L/ha	0	0	0	20 L	8.9 ha	6	Industrial park; streets; fairgrounds; compound; motorcross track; park

Table 3. Known Pests Expected to be Priorities.

Priority Pests	Threshold Issues (Damage)	Sites	Pesticides Used	Possible Alternatives
Noxious weeds - Sow thistles, Canada thistle, Scentless chamomile, Toadflax	Spread, economic impact, BC *Weed Control Act*	Lagoon, pumphouse, airport, storage compound, fairgrounds, industrial park	Roundup (glyphosate), Tordon (picloram) or 2,4-D - handwand or powerwand spray, or wick applicator [lagoons]	Prev: education, seed control (washing & tarping); Cult: seeding & irrigating; Mech: eliminate - hand pulling or roguing small areas (SC, ST, TF, not rhizmatous CT), pref. pre-bloom; control - cut or mow late bud or early bloom; Bio: flies, beetles and weevils available for control (CT, SC, TF); grazing
Nuisance vegetation - broadleaf weeds	Structural damage, trip hazard, aesthetics	Hard surfaces - Sidewalks, curbs; Sports fields; airport	2,4-D and Roundup (glyphosate) - handwand or powerwand spray	Cult: seal cracks, avoid brick, plant ground cover, geotextile and mulch; Mech: sweep, flush, heat, pick, aerate, drainage; Chem: herbicidal soap, acetic acid
Aphids, piercing & sucking insects	Nuisance & aesthetics (honeydew)	Street and park trees; hanging baskets; gardens	Not normally needed; harm to beneficials.	Cult: plant diversity, pollen & nectar plants; Mech: removal of plants or parts, washing, ant bands; Chem: insecticidal soap, dormat oil; Bio: ladybird beetles
Ants	Nuisance, structural damage	Cemeteries	Insecticide and baits available; not normally necessary outdoors. May be beneficials.	Cult: eliminate aphids and scales and nectar or fruit, remove woodpiles, debris, etc.; Mech: band trees, wash trials, rake hills, flooding, hot water
Birch leaf miner	Tree health, aesthetics; 25% OK, previous problems and 100% is bad; monitor weekly	Street trees, parks	Normally not necessary. Effective early season only, larvae and adult.	Cult: birch species & locations, water and fertilize; Mech: pinch/kill, capture larvae fall; Bio: some beetles, birds and wasps
Slugs	Plant health, nuisance, aesthetics; Daily monitoring & removal at first	Hanging baskets and gardens	Not normally necessary. Metaldehyde baits attractive and toxic to pets and children.	Cult: plant choice; Mech: hand picking at nigh or damp, phyical barriers, traps, remove debris; Bio: toads, frogs, beetles; Chem: iron phophate baits

Noxious weeds
Regarding noxious weeds (which are defined and required to be controlled by the BC *Weed Control Act*), an excellent resource for the City of Dawson Creek is the regional district's The *Noxious and Invasive Weed Pest Management Plan* (PRRD 2004) and the North East Invasive Plant Committee's plan (NEIPC 2005). The documents include relevant information on priority weeds, priority sites, treatment options, and on the characteristics of herbicides. The coordinated approach emphasized in the regional district's PMP, including the participation of the City of Dawson Creek and the provincial ministries, provides good opportunities for information sharing and other collaboration.

Based on a questionnaire completed by city staff, the pests listed in Table 3 are believed to be the main concerns in the City of Dawson Creek at the time this strategy was developed (August/September 2005).

This strategic plan represents a starting point for the City of Dawson Creek. As the IPM program evolves, the assembled information will become more detailed and more precise.

STEP 4: Conduct site assessments

The site assessment is a systematic inventory of the city's sites, and a collection of observations about environmental health and the presence and condition of pests or potential pest problems. As discussed, it may be helpful to organize the site assessments according to landscape units.
Information should be gathered on:

- The physical characteristic of the site (e.g. soil and light conditions);
- Presence of supplemental irrigation;
- The plant inventory (e.g. identify species and location of plants present and the conditions of those plants); and
- The use pattern of the site (e.g. who uses it and why).

This report is based on information provided by city staff through a questionnaire, a site visit, pesticide records and follow-up communications. Based on early discussions of this IPM strategy, the city's new gardener will complete a baseline site assessment. Site assessment forms are included with this report in Appendix D.

As and when the need arises (based on monitoring and treatment results of the IPM programs), city staff should continue to undertake periodic site assessments. Comparing site assessment data over time will provide information on pest management trends and help the city gauge the effectiveness of its programs, such big-picture assessments are recommended every 5 years.

In addition to the baseline assessment to be completed by the city, Tables 4 and 5 list sites where pest control was required in 2003 and 2004, respectively (as recorded in the records of the contractor's applicators).

Table 4. Sites with Known Pest Control Issues – 2003.

Priority Sites 2003	Pest Problem	Pesticides Used	Est. Area * (Ha)	Est. Visits/yr	Dates
Airport	Vegetation control	Roundup	2.25	2	Jul 22-25
Airport - storage compound	Noxious weeds	Tordon	0.44	1	21-Jul
Airport - fences and lights	Vegetation control	Roundup	2.23	5	Jul 3-15
Sewage lagoons	Noxious weeds	Roundup	3.37	3	Jul 15-Aug 14
Float plane site	Noxious weeds	Roundup	1.12	1	14-Jul
Pumphouse - 3rd St.	Noxious weeds	Roundup	0.56	1	21-Aug
Industrial park	Noxious weeds	RoundUp	1.9	2	Jul 21-25
Heritage Subdivision	Noxious weeds	2,4-D, Roundup	5.92	3	Jun 28-Jul 13
Motorcross park	Noxious weeds	Tordon	4.9	1	23-Jul
Fairgrounds - 116th Ave.	Noxious weeds	Tordon	2.22	2	Jul 24-27
Curling rink	Vegetation control	Roundup	0.67	2	Jul 6-15
8th & 9th St (116-121 Ave.)	Noxious weeds	Roundup	8.11	3	Jul 16-Aug 8
S of 102 Ave	Noxious weeds	2,4-D	2.8	2	Aug 10-11
Other Streets and alleys	Noxious weeds	2,4-D	6.8	5	Jul 29-Aug 1
Lots and parks	Noxious weeds	2,4-D, Tordon	4.27	3	Jul 29-Aug 13

Table 5. Sites with Known Pest Control Issues – 2004.

Priority Sites 2004	Pest Problem	Pesticides Used	Est. Area * (Ha)	Est. Visits/yr	Dates
Airport	Vegetation control	Roundup	13.23	7	Jul 6-19
Sewage lagoons	Noxious weeds	Roundup	9.19	2	Jul 15-16
N part of city land	Noxious weeds	2,4-D	0.8	1	23-Jul
Streets and alleys	Noxious weeds	2,4-D	8.5	4	Jun 29-Aug 9

STEP 5: Prepare specific strategies and programs

Using the background information and the site assessments, determine which key pests reside in different sites, which pest problems exist or may occur in the future, and what treatment methods may be appropriate for various pest issues. Strategies need to outline the pest management policies, objectives and preventative measures, while specific IPM programs need to present the thresholds and methods that will be applied.

Specific programs could be designed around either pest types (e.g. noxious weeds) or sites or landscapes (e.g. hanging baskets); but either way, depending on the preferences of staff, pest and site information need to be combined in order to determine the necessary IPM actions. In this report, programs are generally structured around pest types, and within those programs there are details about different sites, categories and thresholds.

As of 2005 there is little historical information regarding specific pest occurrences, populations, monitoring practices and treatment thresholds in the City of Dawson Creek. Therefore, the recommendations that follow rely on communications with staff from the City of Dawson Creek; interviews with staff from comparable jurisdictions, including Grand Prairie, Ft. St. John, Prince George and the regional district; information from provincial IPM staff with the Ministries of Environment and Agriculture and Lands; and IPM professionals from other municipalities, agencies and organizations; and also on the resources identified in Section 6.

As the monitoring records accrue over the first years of IPM implementation, an increasingly detailed database will be available to adapt the program. This will allow specific treatment thresholds to be determined where possible, and the IPM programs can be revised to incorporate those data.

4.0 POLICY AND OBJECTIVES

4.1 City of Dawson Creek IPM Policy

The weeds, insects and plant diseases that naturally occur on public land, including parks, open spaces, boulevards, gardens and other lands under the city's jurisdiction, will be managed through a program that integrates preventative measures (cultural, biological and mechanical) and chemical methods. Despite preventative planning to manage pests, pest control will be necessary when monitoring shows that pest damage will exceed thresholds. When control measures are deemed necessary, the least toxic, cost-effective treatment will be selected, and will be carried out in a manner sensitive to the public and to employees.

4.1.1 Management objectives

- The city will adhere to IPM principles as outlined in the *IPM Act*, and will collaborate with partners from other jurisdictions, other levels of government and with the public to manage noxious weeds, invasive species and other pests.
- Staff training and upgrading in the principles and practices of IPM will be an ongoing priority.
- Innovative methods of pest prevention, management and control should be tested, where feasible and affordable.

4.1.2 Planning and design objectives

- The planning, design and maintenance of the city's parks, streets and open spaces shall be integrated in order to preserve and enhance the ecological integrity of plant communities within the city's borders.
- Public landscapes will be planned to minimize the use of chemical pest control measures.
- Hard and soft landscapes will be designed utilizing materials and plants that are best suited to their micro climate, resistant to insects and disease and in soil that is not prone to weed infestation.

4.1.3 Operations objectives

- City parks should be managed and maintained utilizing methods that minimize citizen and worker exposure to chemical pest treatments.
- A continuum of actions - from the least toxic to more toxic - should be considered when pest treatments are chosen.
- Control of noxious weeds and invasive species should be considered an ongoing priority.

5.0 PEST MANAGEMENT STRATEGIES

5.1 City-wide Policy and Planning

City plans and policies are essential tools in an IPM program. Unlike the site and pest-specific strategies, planning and policy initiatives have overarching utility across landscapes and pest types. Planning and design are the keys to looking at pest management through an IPM or ecosystem lens instead of through a pesticide lens; they are important parts of the prevention element of IPM.

The following factors, elements and criteria should be utilized as actions are undertaken and policies considered, reviewed and amended in the City of Dawson Creek.

5.1.1 City Policies

- Incorporate public educational and interpretive opportunities to further the understanding of the city's ecosystems, to promote and explain IPM principles and treatments.
- Introduce and sustain training in sustainable landscape planning, design and management across all applicable city departments
- Appoint an IPM specialist within the city Parks and Recreation Department.
- Train appropriate staff in the principles and practices of IPM and encourage their involvement in the public education opportunities.
- Create and sustain an ongoing pesticide handling training program for applicable city staff.
- Certify staff, as required by the prevailing regulations of the Integrated Pest Management Act.
- Apply the criteria included in this policy to the review of all rezoning, streetscape design and development permit applications that include landscape plans;
- Create a "Sustainable Landscape Pilot Program" line item in the annual operation budget. Utilize these resources to test innovative IPM design, treatment and monitoring methods; research plant palettes and threshold criteria and test new hardscapes.
- Encourage staff to participate in an inter-agency IPM working group to enhance the organization's IPM skill set and professional development.

5.1.2 Urban Infrastructure Planning

- Plan medians, planters and other contained soil volumes with sufficient soil to meet the needs of the intended plant and its associated design objective;
- Plan and design sidewalks, curbs and gutters so as to minimize habitat for weeds;
- Plan urban green links that connect fragmented landscapes in order to optimize the movement of beneficial birds and insects through the city;
- Integrate the management of the city's ecologically sensitive areas, parks and other public open spaces in order to enhance the long term integrity of the city's ecosystem.

5.1.3 Park Planning and Design

Park design should integrate the following criteria:

- Hard landscapes should minimize the need for chemical pest treatment;
- Hard landscapes should optimize best stormwater management practices as this will enhance the long term health of the city's environment and in turn reduce the need for chemical pest treatment methods;
- Landscape paving should be designed to minimize places where organic materials, detritus and weed seed can accumulate;
- Hard landscape surfaces should be designed to minimize the establishment and/or encroachment of weeds;
- Edges between gravel and planted conditions should be designed to minimize encroachment of weeds into the gravel area;
- Planting and soil standards should be adopted to ensure weed free soil and nursery products are used in all soft landscape installations;
- Plant choices should be based on the following criteria:
- The right plant for the right location: consider planting and sub-surface soil type, exposure, sun/shadow and the anticipated maintenance regime;
- Choose plants that integrate habitat, aesthetic and design criteria;
- When designing ornamental plantings, be aware of adjacent potential pest problems and modify design to mitigate these impacts;
- Choose plants that are not known natural hosts to current or anticipated pests, and
- Choose varieties, where possible, that are resistant to known pests.
- Manage the trees and shrubs within the city with the understanding that, at times, removal is the appropriate management action.

Based on these overarching policies and strategies, city staff will need to extend the IPM principles/elements and create, implement and update IPM programs for specific sites and/or pests, such as:

- Weed control in general landscaped areas,
- Weed control in turf and other playing surfaces,
- General insect control,
- Disease control (where necessary), and
- Other specific pests or problem areas as they are identified.

5.2 Specific Programs

The following strategies outline an integrated approach to managing pests in the City of Dawson Creek. Although, from time to time, other strategies will be required in order to address new, urgent or site-specific pests, the following four strategies provide an effective integrated program of pest management.

Each strategy systematically addresses the middle four elements of an IPM process (identification, monitoring, thresholds and treatment). Prevention is addressed by the city-wide approaches discussed above, and evaluation is covered in the sections related to assessments, record keeping and reporting.

In addition to the programs described in this section of the report, Appendix E offers a summary of treatment options in table format.

5.2.1 General weed control

This section provides strategies used to control weeds within the City of Dawson Creek's park system.

Categories of facilities:

- Class A - Downtown “red brick” areas, medians and boulevards on main routes, high visibility planting beds.
- Class B - Medians and boulevards on side streets, low visibility planting beds.
- Class C - Naturalized or semi-naturalized areas in city's parks, fence lines.

IDENTIFICATION

Proper identification is essential because most treatments must be tailored to a particular species or type of weeds. Resources available to help with identification include:

- Ministry documents and field guides (see Section 6);
- The Internet (see Section 6);
- The Plant Diagnostic Lab at the Ministry of Agriculture and Lands in Abbotsford;
- The Horticulture Department at Kwantlen University College;
- Regional colleagues, partners or stakeholders; and,
- Pest management consultants.

MONITORING

Regular inspections provide the information required to decide whether treatments are necessary, the best timing of treatments, and how the treatments are working.

Monitoring may be done by:

- Visual inspection (best suited for Class C sites)
    - Scan the site to obtain a rough estimate of the weed population
- Weed counts (best suited for Class A & B sites)
    - Walk a transect, counting weeds in a 10 m2 area at every second step; or
    - Using a wire or wood frame placed randomly, count all weeds inside the frame;
    - Five to ten counts should be obtained.

Other than contextual information (weather, date, etc.), information recorded should include (see Pest Monitoring Form in Appendix A):

- Number of weed plants along a transect or in an area, or percent coverage of site;
- Species of weeds present;
- Stages of growth; and
- Other vegetation present (especially if desirable).

Frequency of inspections for different site sensitivities:

- Class A - up to 4 site inspections per growing season
- Class B - 2 to 3 site inspections per growing season
- Class C - 1 site inspections per growing season

THRESHOLDS

The thresholds will depend on the level of maintenance at a particular site and the consequences of leaving weeds untreated. There are a variety of factors that should be evaluated in this determination. These include:

- Safety and Security
    - degree of trip/slip hazards presented by weeds
    - impairment of sight-lines on roadways and parking lot exits
    - coverage of signs, curbs and light standards by weeds

- Damage to Structures
    - hard surfaces such as sidewalks, tennis courts
    - fence-lines, sign posts
    - building foundations
    - fire hazards

- Aesthetics of the site
    - visibility and use pattern
    - nature of area (rural or urban area)
    - adjacent facilities that might be affected
    - proximity to sensitive natural areas.

- Invasive species and habitat protection
    - threat of noxious and invasive species getting established
    - sensitivity of adjacent properties
    - habitat goals
    - environmental protection zones

The following thresholds should be considered a starting point. Ongoing monitoring is an essential aspect of refining these thresholds.

- Class A - 10% weed cover, trip hazards, structural damage or invasives
- Class B - 20-30% weed cover
- Class C - Since these sites are low maintenance areas, only if the weeds represent a public safety issue (presence of a noxious weed species or a fire hazard) should action be taken.

In the case of invasive species where none presently exist, control of single plants or small patches should be considered a priority. As described in the regional district's plan, noxious weeds and invasive species appearing on small areas, especially on high-priority (class A) sites, are a critical issue. Intensive elimination measures, such as hand pulling individual plants, should be applied.

In the case where invasive species have "established" they should not be allowed to expand their range. In these cases, the weeds, and their seeds, can be controlled with cutting or mowing and biological methods. Mowing is most effective in the late bud or early bloom stage.

TREATMENTS

Annual weed control should be focused on prevention of seeds spreading and dormant seed germination. Perennial weed control should focus on depleting the plant's nutrient reserves to starve it by targeting the pre-bloom stage.

- **Cultural Methods:**
  - Apply organic mulches or geo-textile to prevent weed from emerging or becoming established.
  - Cultivate the soil in late spring to expose young seedling roots to sunshine
  - Pathways - Fill cracks with a sealant to remove germination sites.

- **Mechanical Methods:**
  - Mechanical cultivation can be used to prevent weeds from becoming established.
  - Manual weeding - Removal of the perennial weed roots is a highly effective method for long-term control. Labour intensive and best for small sites.
  - Mowing - Mow turf areas to allow a) effective establishment and growth of turf and b) remove weed plants at the most vulnerable time.
  - Repetitive mowing or cutting of top growth of bushy weed species (e.g. red-twigged dogwood, swamp willow) will deplete the energy reserves of the root.

    Use chainsaws, brushsaws or heavy-duty mowers to control woody perennials.

    Regular mowing and string trimming of fence-lines and site perimeters.
  - Pathways - Remove weed seeds and organic material from cracks, by regularly sweeping, flushing with water or pressure washing.

    Apply heat using flamers, hot water or steam applicators or infra-red radiation.

Hand pulling
Note in Table 3 (p. 17) that pulling of rhizomatous weeds like Canada thistle may actually stimulate plant growth. Hand pulling is most effective on tap-rooted weeds, on gentle or moderate slopes, and in coarse-grained, moist soils. Pulling weeds in dry soils may result in plant breakage, leaving the weed able to re-grow. Pulling weeds in fine-grained soils on steep slopes may result in excessive soil disturbance, priming the soil as a seed bed for further weed infestation. It could also lead to slope destabilization and therefore environmental risk. If weeds are pulled before bloom the crimped stems can be left on site, otherwise they need to be collected and disposed of in heavy plastic bags. To eliminate the weeds from a site, it may be necessary to repeat hand pulling for several years, in order to deplete the seed (PRRD 2004, 21).

- **Chemical Methods:**
    - Preferred herbicides - Fatty acid and acetic acid herbicides are low in toxicity (and "domestic" products excluded from the *IPM Act)* and can be effectively applied to annual weeds, especially shortly after germination. If chemical controls are necessary, the least toxic, effective herbicide should be used.
    - Glyphosate is a systemic herbicide that is effective against some grass and broadleaf weed species.

5.2.2 Turf weed control

This applies to all turfed areas including: sports fields (sand or soil based), fine ornamental lawns, lawn bowling greens, boulevards, meadows, picnic areas and passive turf areas.

Categories of facilities:

- Class A - Sand based playing field, lawn boiling greens.
- Class B - Soil based sports fields.
- Class C - Passive turf areas in city's parks.

IDENTIFICATION

Proper identification is essential because most treatments must be tailored to a particular species or type of weeds. Resources available to help with identification include:

- Ministry documents and field guides (see Section 6);
- The Internet (see Section 6);
- The Plant Diagnostic Lab at the Ministry of Agriculture and Lands in Abbotsford;
- The Horticulture Department at Kwantlen University College;
- Regional colleagues, partners or stakeholders; and,
- Pest management consultants.

MONITORING

There are three sampling methods for weeds in turf.

- Transect method
    - Lay out a 10 m transect (straight line) through a representative section of turf and record the plants observed and % weed cover in a 10 cm2 area at 10 points along this transect.
    - Check 5-10 transects per site. Averaging the scores from each type of site gives an average of weeds in the turf.
    - The rope used to mark the transect line can be marked or knotted to show where the sample needs to be counted.
- Grid method
    - Using a 1-m^2 wire or wood frame, walk throughout the field, laying the frame down randomly.
    - Count all of the weeds and estimate % weed cover inside the frame.
    - Count 5-10 squares per site.
- Centerline method
    - Walk the centre of sports fields from goal post to goal post.
    - Estimate percent weed cover in a 10 m2 area at every second step.

Weed counts should occur in early spring and again in August.

THRESHOLDS

The thresholds will depend on the level of maintenance to a particular site and the consequences of leaving weeds untreated. There are a variety of factors that should be evaluated to help in this determination. These include:

- Comparing the cost of treatments and the value of the plant or the aesthetic values that would be lost if not treated.
- How much weed cover will the public tolerate?
- On sports turf, what are the safety considerations with weed growth?
    - **Class A** - Maintain turf "weed free." Playability, safety, wear-resistance, and changes in weed infestation level trends should be considered in determining action levels. Turf with 5-10% weed cover may be accepted by the public as "weed free." Action thresholds should be considered at 10-15% weed cover.
    - **Class B** - Some weeds are acceptable providing public safety and/or functional use of facility is not compromised. Thresholds should be considered at 20-40% weed cover.
    - **Class C** - Controls should only be implemented in the interest of public safety or if noxious weeds threaten to contaminate adjoining landscapes that are more sensitive. Thresholds should be considered at over 50% weed cover.

TREATMENTS

Annual weed control in turf should be focused on prevention of seeds spreading and dormant seed germination. Perennial weed control should focus on depleting the plant's nutrient reserves to starve it by targeting the pre-bloom stage.

- **Cultural Methods:**
    - Irrigate correctly: water deeply, infrequently and avoid shallow watering; utilize irrigation audits on an annual basis.
    - Mow high, keep cutting blades sharp and using a mulch mower to leave the grass clippings behind.
    - Keep thatch to a minimum through periodic removal by verticutting or raking.
    - Provide for regular aeration to reduce soil compaction using a deep tine or hollow core aerator.
    - Avoid compaction from overuse. If possible, rotate goalmouth areas and entrance points to turf areas for pedestrians and equipment; rotate player's benches and bleachers, or install them on permanent hard surfaces.
    - Promptly repair worn or damaged areas by over seeding, re-seeding or re-sodding.

- Select and apply fertilizers appropriate to turf grass nutritional requirements. Soil and tissue tests should be done regularly and the fertilizer regime adjusted accordingly.

- **Mechanical Methods:**
  - Hand-pull small populations of weeds prior to seed production.
  - Use a hand-held flamer or infra-red radiation applicator.
- **Chemical Methods:**
  - Ensure that the product selected is effective for specific weed type and registered for that use.
  - Use spot treatments instead of a broadcast application whenever possible.
  - If chemical controls are necessary, the least toxic, effective herbicide should be used. Some of the products registered include mecoprop and dicamba.

5.2.3 General insect control

This includes insect control, including mites and aphids, for all gardens, displays beds and borders, park and street trees, and naturalized and semi-naturalized areas.

Categories of facilities:

- Class A - High visibility horticultural display beds, hanging baskets, high visibility street trees (downtown area).
- Class B - Other display beds, other street trees and park trees.
- Class C - Naturalized and semi-naturalized areas, general park land.

IDENTIFICATION

Insects and mites that have been observed, or have the potential to become pests in the City of Dawson Creek, are:

- Piercing/Sucking insects:
  - Aphids - many different species, most are host-specific, occur on a wide variety of plants
  - Scales - sedentary insects that have a juvenile mobile stage known as "crawlers."
- Chewing insects:
  - Tent caterpillars - recognized by the conspicuous web-like "tent" the young live in, found mostly on trees and shrubs

    - Other caterpillars - a wide variety of species, the pest status seems dependent on the number of eggs laid per plant - the higher the number, the worst the pest (e.g. winter moth, leaf rollers).
- Root/crown feeding insects:
    - Weevils - nocturnal pests that attack many types of ornamentals, grubs feed on plant roots while adults feed on leaf margins.
- Mites:
    - Spider mites - recognized by the speckling of the foliage accompanied by very fine webbing
    - Eriophyid mites - produce galls or fuzzy growth on leaves, some species can cause harm to the plants but most cause unsightly but non-harmful damage.

MONITORING

When monitoring for insect pests, it is important to note:

- Plant species the damage is noted on (this often helps with pest identification);
- Species of pest present;
- Pest stage;
- Numbers observed;
- Extent of the damage, and
- Species and numbers of beneficial organisms present.

Monitoring methods include:

- Visual inspections - for many small insects, mites and for characteristic damage;
- Indicator plants - useful to observe pest presence or damage (these plants tend to be attacked first); and
- Pheromone traps.

Inspections for pests and/or damage must be conducted regularly. The frequency of the inspections will depend on the species of pest present, how quickly they complete their lifecycle, the type of damage caused and the nature of the site.

- Aphids on trees:
    - Monitoring should be conducted weekly starting shortly after leaf break.

  - Select five, 12" to 18" long terminal shoots and record the numbers of aphids on five to ten leaves of each shoot. Number of leaves inspected should be the same throughout the sampling season.
  - The averages can be compared from week to week.
  - As aphids numbers can get quite elevated, estimates may be taken using an increment system (0, <10, <25, <50, <100, >100).
- Aphids on roses:
  - Monitoring should be conducted weekly starting shortly after leaf break.
  - Examine five to ten leaf terminals and record the numbers of infested terminals.
- Scales:
  - Once the presence of adult scales has been noted, monitoring should target the crawler stage.
  - Scouting should be done by applying a double-sided sticky tape around small branches. The tape should be replaced weekly. The removed tape strip should be carefully inspected (using a microscope or hand lens) for the presence of crawlers.
  - For scale species that over winter as eggs, scouting for crawlers should begin one to two weeks before bud break.
  - For species that over winter as adults, monitoring should begin mid-summer.
- General insect damage:
  - The planting beds, hanging baskets, and high visibility trees should be inspected once or twice a month throughout the growing season.
  - This scouting is general, consisting only of a brief visual inspection of the plants for the appearance of leaf and stem damage or discolouration, and can be conducted during regular maintenance operations. Once damage has been noted, then further investigation into the cause of such damage may be necessary.
  - It is important to record these inspections even if no pest or damage is noted.

THRESHOLDS

How much damage is tolerable depends on what part of the plant is affected, the cost of treatments versus the value of the plant, or the aesthetic values that would be lost if not treated. In parks and other public facilities, the need for treatment often depends on how much damage the public will tolerate, rather than on the harm a pest might be causing to a plant.

Thresholds may be defined and recorded as:

- Percentage or proportion of leaves damaged on a particular plant; Percentage of plants affected on a site, and
- Number of pests or pest colonies counted.

Specific thresholds include:

- Aphids on trees:
    - Thresholds are very dependent on the public's tolerances for the sticky secretions and mold that grows upon accumulated sticky secretions;
    - For release of biocontrol agents (i.e. Ladybird beetles), once aphid numbers climb above five aphids/leaf (or 20 to 40% of leaves infested) biocontrol releases should commence.
- Aphids on roses:
    - Biocontrol operations should commence once five to ten percent of leaves are infested.
- Scales:
    - No threshold numbers have been set.
    - Treatments may be necessary if scale damage (yellowing of leaves, wilting, or twig dieback) was visible in the previous growing season.
- General insect damage:
    - Thresholds will be dependent on the insect present and the level of damage occurring.

TREATMENTS

Substituting cultural, biological or physical controls for chemicals should be promoted wherever feasible to conserve native beneficial species and reduce impacts on the environment. When pesticides are used, the least toxic yet effective product should be selected.

- **Cultural Methods:**
    - Establish alternate hosts to attract and maintain natural predator/ parasite populations. Try to alternate species with different flowering times to provide a more consistent nectar supply for beneficial insects.
    - Aerate soil around plants.
    - Remove infested, dead and fallen twigs and leaves.
- **Mechanical Methods:**

- Sticky barriers on tree or shrub trunks to control: ants (which remove natural enemies of aphids), adult weevils, and winter moth females.
- Water sprays for aphids and mites.
- Pruning out infested area: tent caterpillar tents, bronze birch borer infested wood, manually scraping off scales from stems.

- **Biological Methods:**
  - Aphid predators - Aphid predatory midge - *Aphidoletes aphidimyza*
    Lacewings - *Chrysoperla/Chrysopa* spp.
    Ladybird beetles - several different species, *Hippodamia convergens*
    Parasitic wasps - *Aphidius* spp.
  - Weevils and cutworms - Insect parasitic nematodes
  - Mite predators - Predatory mites - *Amblyseius* spp.
- **Chemical Controls:**
  - Spray programs may be required when populations are too high to successfully start a biological control program. Least toxic or low residual chemicals should be used as a cleanup before beginning a biological control program.
  - Preferred Insecticides - *Bacillus thuringiensis* var. *kurstaki* (Btk) for caterpillars.
    Insecticidal soaps for soft-bodied insects and mites, especially for spot sprays.
    Pyrethrins, low in toxicity, effective against aphids, some caterpillars, mites and thrips.
    Mineral oils (dormant and summer horticultural oils) for scales, mites, aphid eggs and moth eggs.
    Fenbutatin oxide for mites, compatible with some biological controls.
  - Other pesticides may be considered if all other control options have failed. Preferred application methods: spot sprays targeted to the specific location for the appropriate pests, placing systemic pesticides in bands, or using injectors on tree trunks.

5.2.4 Disease Control

This section covers diseases as they occur in display beds, park and street trees, indoor planting and hanging baskets. Although at this time diseases in the city parks are not a major concern, their control through IPM is a key part of a comprehensive strategy.

Categories of facilities:

- Class A - High visibility display beds, hanging baskets.
- Class B - Specimen trees and shrubs in parks.
- Class C - Street trees, naturalized or semi-naturalized areas.

IDENTIFICATION

Disease identification is often a difficult task. Often different diseases will exhibit similar symptoms and many symptoms are not actually caused by a disease but are due to an injury or an environmental stress. Sometimes symptoms do not occur at the location where the causal agent is found. Often a trained plant pathologist is required for proper identification.

Identification can be carried out by:

- Signs of the disease, such as fruiting bodies (spores, conks, mushrooms) or other actual parts of the causal agent (in the case of fungi - mycelium).
- Symptoms of the disease: wilting, leaf spots and discolouration, or rotting roots.
- Identification of the causal organism by sending a sample of the disease plant (or plant part) to the Plant Diagnostic Laboratory in Abbottsford.

MONITORING

The timing of disease and insect appearances should be considered and visual inspections should be done weekly when necessary. This will allow for rapid intervention as diseases can often move rapidly through a planting. Plants must first express the disease symptoms before the disease can be noticed. Some of the information that should be noted when monitoring include:

- Severity and extent of the problem (what is affected: a plant part, a whole plant and or an area?)
- Location of plant in planting
- Number of plants affected
- Whether plants appear to be in the early or advanced stages of the disease
- Proximity of other potentially susceptible plants.

As it is often hard to obtain counts when monitoring for a disease, using a disease severity index can be helpful. Plants would be rated from 0 to 10 with 0 for healthy and 10 signaling very severe symptoms (likely leading to the death of the plant). Use pictures or drawings to illustrate each level of the severity index would also be very helpful.

THRESHOLDS

In the case of plant diseases, thresholds will depend on several factors:

- What part of the plant is affected?
- Will the disease kill the plant and spread to others?
- What is the cost of treating the disease versus the cost of doing nothing?

TREATMENTS

When deciding on the appropriate treatment, it is important to consider the long-term implications. Diseases often become perennial problems if the plant has developed a susceptibility to it. Removal and replacement of the affected plant material may be the most effective control options.

- **Prevention/Cultural Methods:**
  - Increase the diversity of your landscape by using different cultivars, species and families of plants and trees to prevent monocultures that may be vulnerable to serious disease problems.
  - Use resistant or tolerant varieties.
  - Irrigate properly. Avoid overhead watering as spores may be splashed around.
  - Correct drainage to avoid pooling of water.
  - Remove infested, dead and fallen twigs, leaves.
  - Eradicate or reduce disease inoculum levels through removal of alternate hosts.
  - Rotate plants in beds - avoid planting a susceptible plant in the same site where a plant has been taken out due to disease (e.g. alternate plantings of tulips with other spring flowers to avoid build-up of tulip fire - *Botrytis tulipae*).
- **Mechanical Methods:**
  - Water washes (syringing) - regular rinsing of the leaves with water in the morning will wash off dew and dislodge spores before they germinate.
- **Biological Methods:**
  - Available beneficial microorganisms - *Agrobacterium radiobacter* for control of crown gall and *Trichoderma harzianum* for suppression of *Pythium, Fusarium* and *Rhizoctonia.*
  - Mycorrhizal fungi, which colonized plant roots, promote healthier plants and may help protect them from disease.
  - Preserve naturally occurring biological controls.

- **Chemical Methods:**
  - Preferred fungicides - Chose fungicides that are effective and registered for the specific pathogen.

    Ensure the fungicide is appropriate for its intended use: some are strictly preventative (or protective) and require application before the disease appears, while others are curative, serving to eradicate the disease from the plant.

    Chemical families should be alternated, preferably between systemic and contact products to help avoid inducing resistance.

6.0 REFERENCES AND RESOURCES

6.1 References

(*Act)* Queen's Printer, Victoria, BC. 2005. *Integrated Pest Management Act.* [SBC 2003] Chapter 58. Assented to 23 October, 2003. Available on-line: http://www.qp.gov.bc.ca/statreg/stat/I/03058_01.htm

(NEIPC) North East Invasive Plant Committee. 2005. 2005 Plan and Profile. 15 April. 31 pp.

(PRRD) Peace River Regional District. 2004. Noxious and Invasive Weed Pest Management Plan. Draft #1. 13 September. 53 pp plus appendices.

(Reg.) ____ . 2005. *Integrated Pest Management Act*- Integrated Pest Management Regulation. BC Reg. 604/2004. Updates to 8 February, 2005. Available on-line: http://www.qp.gov.bc.ca/statreg/reg/I/604_2004.htm

(WLAP) BC Ministry of Water, Land and Air Protection (now Environment). 2005a. *Integrated Pest Management Act* and Regulation: Summary. 28 February. 14 pp. Available on-line: http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/pesticide_pdfs/leg_summary.pdf

____ . 2005b. *Integrated Pest Management Act* and Regulation: Landscape/Structural Sector Review Paper. March. 17 pp. Available on-line: http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/pesticide_pdfs/landscape_review.pdf

6.2 Personal communications

Adams, Rob. Pesticides License Officer, Policy Standards and Authorizations Unit, BC Ministry of Environment. Victoria, BC. By telephone and e-mail.

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Rebman, Cynthia. IPM Coordinator, Environmental Services, City of Prince George. Prince George, BC. By telephone and e-mail.

Waring, Madeline. Pesticide Specialist, Plant Health Unit, BC Ministry of Agriculture and Lands. Abbotsford, BC. By telephone and e-mail.

Wright, Jared. Policy Analyst, Union of BC Municipalities. Vancouver, BC. By telephone.

6.3 Selected Resource Literature

Biological Control: A Guide to Natural Enemies in North America. Updated 2002. C. R. Weeden, A. M. Shelton, Y. Li, M. P. Hoffman (eds). Cornell University College of Agriculture and Life Sciences.

Common Tree Diseases of British Columbia. Forest Health Network, Canadian Forest Service of Natural Resources Canada.

Compendia of Plant Diseases. American Phytopathological Society Press.

Diseases of Trees and Shrubs. 1987. W. A. Sinclair, H. H. Lyon and W. T. Johnson. Cornell University Press. 574 pp. ISBN 0-8014-1517-9

Handbook of Integrated Pest Management for Turf and Ornamentals. 1994. A. R. Leslie. Lewis Publishers. 672 pp. ISBN 0873713508.

Insects That Feed on Trees and Shrubs. 1988. 2nd ed., rev. 1991. W. T. Johnson and H. H. Lyon. Cornell University Press. 556 pp. 0-8014-2602-2

Integrated Management of Landscape Trees, Shrubs, and Vines. 1998. 3rd Edition. R. W. Harris, N. Matheny & J. R. Clark. Prentice Hall; 687 pp. ISBN 0133866653

Integrated Pest Management Manual for Landscape Pests in British Columbia. 2000. L. A. Gilkeson and R. W. Adams. Province of British Columbia. 130 pp. ISBN 0-7726-4329-6

IPM Training Manual for Landscapes. 1992. S. Daar, H. Olkowski, W. Olkowski. Bio-Integral Resource Center. 80 pp.

Landscape Plant Problems: A Pictorial Diagnostic Manual. 2000. Washington State University Cooperative Extension. 172 pp.

Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses. 1998. 5th ed. M. A. Dirr. Stipes Publishing Co., Champaign, IL. 1250 pp. ISBN 0875637957

Natural Enemies Handbook: The Illustrated Guide to Biological Pest Control. 1998. M. L. Flint and S. H. Dreistadt. University of California Statewide IPM Project, Div. of Agriculture & Natural Resources. Pub. #3386. 154 pp. ISBN 1-879906-37

Pacific Northwest Landscape Integrated Pest Management (IPM) Manual. Revised 1999. V. M. Bobbit, A. L. Antonelli, C. R. Foss, R. M. Davidson Jr., R. S. Byther, R. R. Maleike. Washington State Univ. Cooperative Extension. 160 pp.

Pests of Landscape Trees and Shrubs. S. Dreistadt and M. L. Flint. 1994. University of California Statewide IPM Project, Div. of Agriculture & Natural Resources. Pub. #3359. 336 pp. ISBN 1-879906-18-X

Plant Health Care for Woody Ornamentals: A Professional's Guide to Preventing and Managing Environmental Stresses and Pests. 1997. J. Lloyd. International Society of Arboriculture, Champaign, IL. 223 pp. ISBN 1-883097-17-7

Scouting and Controlling Woody Ornamental Diseases in Landscapes and Nurseries. 1994. G. W. Moorman. Pennsylvania State University. 90 pp.

Turfgrass Disease and Pest Management Guide for Professional Turfgrass Managers in BC. 1996. L. MacDonald and H. Gerber. BC Ministry of Agriculture & Food / Western Canada Turfgrass Association. 80 pp.

Weeds of the Northern United States and Canada. 1999. F. Royer and R. Dickinson. Lone Pine Publishing. 434 pp. ISBN 1551052210

Weeds of the West. 2000. 9th Edition. T. D. Whiston, Western Society of Weed Science, University of Wyoming, Laramie, WY 630 pp. ISBN 0941570134

6.4 Selected Resource Websites

BC Ministry of Environment, Environmental Management Branch, IPM Program
http://wlapwww.gov.bc.ca/epd/epdpa/ipmp/

BC Ministry of Agriculture and Lands, Pest Management
http://www.agf.gov.bc.ca/cropprot/index.htm

BC Ministry of Forests and Range, Reports and Publications, Research, Pests
http://www.for.gov.bc.ca/pscripts/pab/whatsnew/si_search.asp

Bio-Integral Resource Centre
http://www.birc.org

Northwest Coalition for Alternatives to Pesticides
http://www.pesticide.org/

Responsible Pest Management (Federation of Canadian Municipalities and National Office of Pollution Prevention)
http://www.pestinfo.ca/

US Department of Agriculture, Invasivespeciesinfo.gov
http://www.invasivespeciesinfo.gov/

US Environmental Protection Agency, IPM
http://www.epa.gov/pesticides/food/ipm.htm

World Wildlife Fund Canada, Pesticide Reduction
http://www.wwf.ca/satellite/prip/index.html

APPENDIX A

Ministry's Pesticide Use Record

BC Ministry of Environment
Pesticide Use Record - Model Form

General Requirements

Attached is a model form that can be used for maintaining Pesticide Use Records by most Pesticide Use Licensees and with some additions - for large private forest land licencees and holders of Permits or Pesticide Use Notice (PUN) Confirmations.
The *IPMA* Regulation requires that these records be kept up to date. The records may be kept at or near the treatment location during the use, but within 60 days after the use must be kept at the business location identified on the licence or permit application or pesticide use notice. The records must be retained for a period of at least 3 years from the date of pesticide use.
The model form prepared by the ministry allows 6 pesticide use records per page.
Because of the page size limitations, there is minimal room on the form for data entry.
Abbreviations or codes may be used in completing the form, provided that codes are recorded and attached to the form.

Information required by the *IPMA* Regulation

A. Information required for most licencees

The information required for each record of use for a licencee as specified in the *IPMA* Regulation Section 35 (1) is listed below. There are locations for entering this information on the model form. Pesticide users may design their own form as long as it contains the required information.

The following information must be recorded for each treatment location and day of use:

a) if the use was performed as a service, the name and address of the person (or company) for whom the service was performed;
b) if the service was performed for another licensee or a permit or confirmation holder, the number of the person's licence, permit or confirmation;
c) if the use was not performed as a service, the name and address of the owner or manager of the treatment location;
d) the name and certificate number of the certified applicator who used the pesticide or supervised the use;
e) the date and time of the pesticide use;
f) the name of the pest targeted by the use or the purpose of the pesticide use;
g) the trade name of each pesticide used and its registration number under the federal *Pest Control Products Act*,
h) for each pesticide used, the method and rate of application and the total quantity used;
i) if the use was outdoors, the prevailing meteorological conditions including temperature, precipitation and velocity and direction of the wind;
j) pest monitoring methods and injury thresholds used to fulfill the licensee's integrated pest management requirements in relation to the use; and

k) advice given to the owner or manager of the treatment area in relation to the following:
   i. safe re-entry time;
   ii. the number of days before a crop can be harvested safely; and
   iii. additional precautions that should be taken to minimize exposure to the pesticide

B. Additional information that must be recorded by large private forest land licencees

The additional information that must be recorded by licencees who use pesticides for the management of forest pests on more than 20 ha per year of private land used for timber production - as specified in the *IPMA* Regulation Section 35 (2) is listed below. This information could be appended to the model form.

The following information must be recorded for each treatment location:

a) the results of pest monitoring carried out by the licensee in relation to
   (i) the pest population, and
   (ii) the damage caused by pests; .
b) the use of the monitoring results in a) to determine injury thresholds;
c) how public notification was given and where notices were posted;
d) the effectiveness and impacts of the pesticide use; and
e) for each piece of the licensee's pesticide application equipment that requires calibration, when the equipment was calibrated and the data upon which its calibration was based.

C. Information that must be recorded by a permit holder

The information required for each record of use by a permit holder - as specified in the IPMA Regulation Section 36 is listed below. This information includes most of the data that would be entered on the model form. Additional information requirements may be required as a term of the permit.

The following information must be recorded for each treatment location and day of use:

a) the name and address of the owner or manager of the treatment location;
b) if the use was performed as a service, the name and licence number of the licensee who performed the service;
c) if the use was not performed as a service, the name and certificate number of the certified applicator who used the pesticide or supervised the use;
d) if a confirmation was required for the use, the confirmation number; and
e) the information listed above for most licencees (items a to k) except not monitoring methods and injury thresholds (item j). Note that the information in j may be requested in the term of the permit if applicable.

D. Information that must be recorded by the holder of a PUN Confirmation

The information required for each record of use by the holder of a PUN Confirmation - as specified in the IPMA Regulation Section 37 is listed below. This information includes most of the data that would be required on the model form plus some additional data that could be appended to the model form.

The following information must be recorded for each treatment location and day of use:

a) the name and address of the owner or manager of the treatment location;
b) if the use was performed as a service, the name and licence number of the licensee who performed the service;
c) if the use was not performed as a service, the name and certificate number of the certified applicator who used the pesticide or supervised the use;
d) if a permit was required for the use or the class of pesticide, the permit number;
e) the information listed above for most licencees (items a to k) except not monitoring methods and injury thresholds (item j). Note the information in j) is to be contained in the Pest Management Plan prepared by the holder of the PUN Confirmation.

The following information must be recorded for each treatment location:

a) the results of pest monitoring in relation to
   (i) the pest population, and
   (ii) the damage caused by pests; .
b) the use of the monitoring results described in a) to determine injury thresholds;
c) how public notification was given and where notices were posted;
d) the effectiveness and impacts of the pesticide use; and
e) for each piece of the licensee's pesticide application equipment that requires calibration, when the equipment was calibrated and the data upon which its calibration was based.

Ministry of Water, Land and Air Protection

BRITISH COLUMBIA

PESTICIDE USE RECORD

Year:

Licensee Name: ____________________ License No: ____________

Address: ____________________

City: ____________________ Postal Code: ____________

Applicator's Name: ____________________ Applicator's Certificate No.: ____________

Permit or PUN Confirmation Holder Name (if applicable)[1]: ____________________ Permit or PUN Confirmation Number (if applicable)[1]: ____________

Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				**Injury Threshold**				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								
Date (mm/dd) Start Time	Name[2] Address[2]	Treatment Location (Address or Description)[3]	Target Pest or Purpose of Treatment	Pesticide Brand Name PCP Number	Application Rate Quantity of Pesticide Used	Application Method	Wind Speed[4] Wind Direction[4]	Temperature[4] Precipitation[4]
Monitoring Method:				Injury Threshold				
Precaution Advice Given[5]:								

1 Complete if pesticide application is performed by or for a Permit or PUN Confirmation Holder. Use separate pages to record information for each different Permit or PUN Confirmation Holder.

2 Customer Name and Address if pesticide is applied as a service, otherwise Property Manager Name and Address

3 Include forestry block or unit numbers, if appropriate.

4 Record if pesticide application is outdoors.

5 Safe re-entry time, days to harvest and other advice given

March 18, 2005

APPENDIX B

Pest Monitoring Form

City of Dawson Creek – Pest/Weed Monitoring Form

Site Location: _____ **Date**: _____

Address: _____ **Weather**: _____

Reported by: _____

Location Type: □ Planting Bed □ Hanging Basket □ Turf □ Water body

□ Forest □ Street Tree □ Bricked/Paved Area □ Median □ Facility/Lot

Other:

PEST RECORD (includes insects, mites and diseases)

Pest Name	Pest Lifecycle Stage	Pest Numbers	Host plant	Host Damage	Beneficials present

Comments: _____

WEED RECORD

Monitoring Method: □ Visual □ Transect □ Grid □ Centerline

Weed Name	Flowers or Seedheads (Y/N)	Weed numbers	% Weed Cover	Comments

% Total Weed Cover: _____

General Comments: _____

City of Dawson Creek – Pest/Weed Monitoring Form

Site Location: _____ **Date**: _____

Address: _____ **Weather**: _____

Reported by: _____

Location Type: □ Planting Bed □ Hanging Basket □ Turf □ Water body

□ Forest □ Street Tree □ Bricked/Paved Area □ Median □ Facility/Lot

Other:

PEST RECORD (includes insects, mites and diseases)

Pest Name	Pest Lifecycle Stage	Pest Numbers	Host plant	Host Damage	Beneficials present

Comments: _____

WEED RECORD

Monitoring Method: □ Visual □ Transect □ Grid □ Centerline

Weed Name	Flowers or Seedheads (Y/N)	Weed numbers	% Weed Cover	Comments

% Total Weed Cover: _____

General Comments: _____

APPENDIX C

Summary of Tasks and Purposes

Summary/Rationale of IPM Implementation Steps

IPM Tasks	Role and Frequency
Indentify Landscape Types/Units	Useful for site assessments, making the city manageable. Landscape types can be re-classified as needed by staff, but ideally remain constant for comparative purposes. Assessments are inventories conducted in order to compare the general status of pest problems.
Conduct Site Assessments	A systematic assessment of the city should be conducted about every 5 years.
Categorize Maintenance Level of Sites	Necessary for establishing thresholds. Sites should be identified as having high (A), medium (B) or low (C) maintenance requirements for pest management. Highly visible/sensitive sites will be high priorities and receive more aggressive IPM treatment. A site's maintenance level could change at any time, and should be evaluated whenever treatments, monitoring or assesssments are done.
Prepare IPM Programs	If necessary, as desired by city staff, distinct programs, or even documents, may be prepared to define the policies and methods relevant to specific pest management issues (i.e., noxious weeds or mosquito control).
Define Thresholds	Thresholds take into account the priority of the site, the pest, and the management issue (i.e., public safety, structural damage, spread of invasives). Thresholds mark the decision-making point for treatment. Since thresholds depend on several variables, they may change over time. Changes to the thresholds should be considered on an on-going basis, but the variable, rationale or policy for the change must be consistent with the IPM plan.
Treat Problem Sites	Where pest populations exceed thresholds and threaten to cause damage, the least toxic treatment method should be applied. If the use of a chemical pesticide is deemed necessary, the least toxic product should be used. Frequency of treatment will depend on the method, the sensitivity of the site, site/weather conditions, and should be based on monitoring results. Class A sites with priority pests may require multiple treatments during a season, other problems may require treatment once a year or less.
Monitor Problem Sites	Like thresholds, monitoring records are required to justify treatment. Sites should be monitored pre-treatment against the threshold, and should be monitored post-treatment to evaluate effectiveness. Certain sites and pests during certain seasons may require weekly monitoring, other issues may require annual monitoring or less.
Keep Records	The regulations of the *IPM Act* specify the information that must be recorded whenever pesticides are applied. Model forms are provided. Pesticide use must be reported annually and records kept for 3 years. In addition, records and documents on other monitoring, assessments, methods, etc. will help inform and improve the city's practices and help reduce its use of pesticides.
Collect Background Information	Ongoing. The city's involvement with the regional district's PMP and the NE Invasive Plant Committee is a good resource, as are the wbsites and publications of the Ministries of Environment, Forests, and Agriculture and Lands. Ongoing partnerships, education and trainiong are important to a successful IPM process.

APPENDIX D

Site Assessment Forms

IPM Tasks	Role and Frequency
Indentify Landscape Types/Units	Useful for site assessments, making the city manageable. Landscape types can be re-classified as needed by staff, but ideally remain constant for comparative purposes. Assessments are inventories conducted in order to compare the general status of pest problems.
Conduct Site Assessments	A systematic assessment of the city should be conducted about every 5 years.
Categorize Maintenance Level of Sites	Necessary for establishing thresholds. Sites should be identified as having high (A), medium (B) or low (C) maintenance requirements for pest management. Highly visible/sensitive sites will be high priorities and receive more aggressive IPM treatment. A site's maintenance level could change at any time, and should be evaluated whenever treatments, monitoring or assesssments are done.
Prepare IPM Programs	If necessary, as desired by city staff, distinct programs, or even documents, may be prepared to define the policies and methods relevant to specific pest management issues (i.e., noxious weeds or mosquito control).
Define Thresholds	Thresholds take into account the priority of the site, the pest, and the management issue (i.e., public safety, structural damage, spread of invasives). Thresholds mark the decision-making point for treatment. Since thresholds depend on several variables, they may change over time. Changes to the thresholds should be considered on an on-going basis, but the variable, rationale or policy for the change must be consistent with the IPM plan.
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Collect Background Information	Ongoing. The city's involvement with the regional district's PMP and the NE Invasive Plant Committee is a good resource, as are the wbsites and publications of the Ministries of Environment, Forests, and Agriculture and Lands. Ongoing partnerships, education and trainiong are important to a successful IPM process.

Landscape Unit:	**General (weeds)** - sidewalks, curbs, compounds, facilities, vacant lots			
Site or Location	**Class** (A, B, C)	**Types of Uses/Users** (Contact, visitation, visibility,…)	**Existing Pests** **Weeds**	**Insect or Disease**

APPENDIX E

Treatment Summary Tables

Pests	Preventative Plan/Design	Cultural	Mechanical	Biological	Chemical
WEEDS Annuals (e.g. Pigweed, Mustard, Foxglove, Crab grass)	Use weed-free nursery stock and bedding plants to prevent importation of weed seed Install brick-patterned concrete or asphalt instead of using bricks or paving stones Fill cracks with a sealant to remove germination sites	Before planting new beds, deplete the seed bank in the soil Provide ideal growing conditions, including light, fertilizer, water and other conditions for desired plants so that they out compete the weeds Apply organic or geotextile mulches to prevent weed from emerging or becoming established Plant aggressive ground-covers and massed planting that rapidly cover the soil surface and reduce the space, nutrients and light available to weeds Apply organic mulches, leaves, wood chips in areas likely to be infested by persistent weed species Promptly repair worn or damaged areas	Remove weed seeds and organic material from cracks, by regularly sweeping or flushing with water Apply heat using flamers, hot water or steam applicators or infra-red radiation Manually remove weeds including roots Regular mowing and string trimming of fence-lines and site perimeters		Preferred control is by design, cultural and mechanical methods. Preferred herbicides are fatty acid, acetic acid or herbicidal soap of low toxicity and which are effective on annuals Pre-emergent herbicides should be applied before weed seeds germinate as they will not kill established plants Post-emergent, selective, herbicides can be effective in controlling annuals while in an actively growing stage, before seed heads may form The most target-specific, spot-treatment application techniques available should be used where practical – back-pack or hand-held sprayers, low-volume closed-system applicators and “wipe-on” applicators Ensure that product selected is not phytotoxic to desirable turf species Chemical herbicides: Glyphosate and dichlobenil – spot treatment Other registered chemicals: bromoxynil, dicamba

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Perennials and noxious weeds (e.g. Canadian thistle, Sow thistle, Scentless camomile)	Same as above Education programs about seed control	Same as above Important to quickly repair, seed, irrigate and monitor disturbed areas	Same as above Target removal efforts on small high-priority sites to prevent spread Mowing of established weeds, especially during late bud or early bloom, can control spread Pulling not effective on CT	Check Ministry of Forests and PRRD for most recent trials and recommendations (some flies, beetles and weevils available) Grazing	Prevent establishment by seed control, cultural, mechanical and biological methods, including pulling where appropriate Post-emergent, selective, herbicides can be effective in controlling perennials while in an actively growing stage Post-emergent, non-selective herbicides may be appropriate for use as spot treatments on deep rooted or rhizomatous perennial weeds in open ground, where there is no desirable vegetation present Apply chemical to actively growing weeds before seed heads form Glyphosate and dichlobenil – spot treatment Other registered chemicals: 2,4-D, picloram

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Aquatic Weeds	When constructing ponds, reservoirs , ditches etc Steep banks with a 1 to 1.5 slope that extends to a least 3 feet below designated water level will help to prevent establishment of many emergent and bank weeds Remove fertile top soil from the pond or reservoir basin If possible, prevent water heavily laden with silt and nutrients from entering an impoundment Provide means to control water levels and water flow	Shading after physical removal offers the best solution; increased flushing, lower temperatures and less nutrient input all lessen pesticide requirements	Cut the submersed and immersed weeds with an underwater mower, a mechanical weed harvester, or a chain and remove severed vegetation from the water Cut the ditch bank weeds with a mower or scythe Burn ditch bank weeds. Sear the first time and burn thoroughly 7 to 10 days later		Chemical use can be reduced by cultural and mechanical methods If chemical required, used the least toxic, effective chemical available Algae – copper sulphate Submersed weeds in flowing water – acrolein Magnacide H, petroleum distillate Xylene Submersed weeds in non-flowing water – fluridone Sonar Submersed weeds in lakes and pond – diquat (moderately toxic), 2,4-D granules Broadleaf, floating, immersed, marginal and bank weeds – glyphosate Round-up or Rodeo

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INSECTS Sucking insects and mites	Use optimum site design and plant diversity Select plants suited to the sun exposure, soil type, draining and other environmental conditions Select healthy, well-grown planting stock Choose pest resistant plants Grow bedding plants from seed to avoid plant-borne pests Use non-soil mixes for planting nursery stock and bedding plants to avoid soil-borne insects	Make the landscape more attractive to beneficial insects by planting flowers that are good sources of nectar near trees attacked by scale Aeration to relieve compaction will provide good oxygen content in the root zone, thereby producing more vigorous, healthy turf that can remain unaffected by moderate amounts of insect damage Avoid use of fast acting, high nitrogen fertilizers that promote succulent, insect	Prune out infested branch tips or foliage Remove aphid by spraying plants with strong stream of water Sticky barriers on tree trunks to control: ants, winter moth and weevils Traps for weevils Sanitation – remove infested, dead and fallen twigs, leaves and fruit from base of trees and shrubs, especially where soil-borne or root/crown feeding insects have been a problem	Aphid midge, *Aphidoletes aphidimyza* are released in the spring 2-3 times at 7-10 day intervals to add to the natural population. Later summer release can reduce the overwintering aphid population Naturally occurring predators such as ladybird beetles and parasitic wasps often provide an adequate control for scale *BTK* *Phytoseiulus persimilis* for two-spotted spider mite	Use non-residual insecticides such as insecticidal soap or horticultural oil; apply them as spot sprays whenever possible Dormant oil sprays are effective on overwintering eggs of aphids on deciduous trees when applied just before the buds start to open Several organophosphate and carbamate insects are registered as foliar sprays for scale Organophosphates should only be used as a last resort if in the event of major infestations that cannot be controlled using other methods Insect growth regulator, Kinoprene (Enstar) effect on aphids and whitefly Diatomaceous earth (silicon dioxide) applied to soil for thirps and fungus gnats on potted plants Pyrethrins, low in toxicity to mammals but post-treatment delays in introducing some beneficial arthropods may be required because of the compound's potential impact on them Pririmor and Vendex for mites,

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					compatible with some biological controls Placing systemic pesticides in bands or injectors on tree trunks
Slugs	Plant selection		Hand picking at night or during damp conditions Use physical barriers and traps Remove debris	Toads, frogs, beetles possible	Not normally necessary Iron phosphate baits Metaldehyde baits attractive and toxic to pets and children
Carpenter Ants		Eliminate plants or trees with nectar and fruit	Remove woodpiles and debris Rake hills, wash ant trails Band trees	Eliminate aphids and scales	Not normally necessary outdoors Silicon dioxide dust
Leaf eating insects (e.g. Birch leaf miner)	Select resistant species and use optimal conditions for water and nutrients	On site where chewing insects, such as sod webworm are a chronic problem, consider reseeding with endophytic grasses	Pruning out or pinch egg masses and web nests Capture larvae fall Destroy caterpillars by crushing them or dropping them in a bucket of soapy water High pressure water sprays can be used to remove caterpillars and old webbing	*BTK* Investigate suitable beetles, birds and wasps	Not normally required Effective early-season only on larvae and adults

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Root/crown feeding insects		Aeration to relieve compaction will provide good oxygen content in the root zone, thereby producing more vigorous, healthy turf Sanitation – remove infested, dead and fallen twigs, leaves and fruit from base of trees and shrubs, especially where soil-borne or root/crown feeding insects have been a problem		Biologicals for root weevils; however not in an enclosed area very difficult to maintain near infected plant	Chemical
DISEASE Fungi	Ensure new planting sites are properly prepared; plant into friable, uncompacted soil Plant cultivars with the highest degree of disease resistance that grow well in local conditions Inspect planting stock and purchase only healthy plants – check tree root collars for circling, kinked roots, basal cankers, check condition of main	Ensure proper horticultural and arboricultural practices are adhered to including proper soil management, nutrient and watering program and pruning and planting techniques Select and apply fertilizers based on regular soil and leaf tissue tests – usually a slow release fertilizer is preferred because it provides a more balanced release of nutrients Schedule maintenance procedures to avoid working in climatic and turf conditions that favour the spread of diseases you are trying to control	Remove and destroy diseased tissue and overwintering stages of the disease organisms Isolate or remove diseased stock to avoid spreading diseases such as *Pseudomonas, Verticillium, Armillaria* Regular syringing leaves with water in the morning to wash off dew and dislodge spores before they germinate (e.g. black spot and powdery mildew) Sanitation – remove infested, dead and fallen	Preserve naturally occurring biological controls	Synthetic fungicides have varying impacts of different turf fungi – it is important to target specific fungicides against particular diseases Chose fungicides that are both reasonably effective and the least disruptive to the beneficial organisms protecting the plant from insect and disease Powders are generally more disruptive as they are more residual and can impede respiration in beneficial insects Broad spectrum systemic compounds which are effective in controlling multiple disease organisms should be used in

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	roots and for girdling ropes or wires; ensure plants are in good health and conform to BCNTA standards Design irrigation system taking into account the difference in water requirements between turf, shrubs, trees at varying sites Ensure regular and adequate water during plantings	Aerate as require to reduce compaction Control access and manage play on playing fields and sports turf to reduce damage and excessive wear, especially during wet, cool weather Keep thatch levels at a depth of ½ - 1 cm as thicker thatch creates conditions suitable for disease development Control insect and weeds that are agents of disease or harbour disease pathogens	twigs, leaves and fruit from base of trees and shrubs		situations where extended control is required Flowable sulphur is generally pretty safe Where possible, control products should be used alternated between systemic and contact products to reduce the probability of disease resistance Protectants may be required when vulnerable turf is under extreme disease pressure All funigicides must be applied with target-specific application techniques whenever practical
DISEASE Fungi (cont'd)	Quarantines and inspections – conduct routine inspections of incoming plant material; grow or start your own plant material Evasion of the pathogen – use vigorous seed, maintain proper planting dates and	Eradicate or reduce disease inoculum levels through removal of alternate hosts, rotating plants in beds, avoid planting a susceptible plant in the same site where a plant has been taken out due to the same disease and remove/destroy infected leaves, prune infected branches and other plant debris that may harbour the pathogen			

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	sites Keep proper distance between disease susceptible plants by inter-planting with non-susceptible stock Use pathogen-free propagating material Use resistant or tolerant varieties; select native species that possess resistance factors to local disease Avoid overcrowding plants				