OVMA

Ontario Vegetation Management Association
www.ovma.ca

IPM MANUAL FOR PUBLIC WORKS

ONTARIO VEGETATION MANAGEMENT ASSOCIATION

The Ontario Vegetation Management Association (OVMA) is a not-for-profit organization representing vegetation managers from across Ontario. Members work at the local, regional or provincial level in the electrical utilities, communications, pipeline, railroad and road authority sectors, as well as all the private support companies that provide products or services to these industries.

The mandate of these professionals is to keep the trees, weeds or other vegetation from interfering with public safety or the safe and efficient movement of energy, communications or products. The tools they use include mechanical mowers and cutters, chemical herbicides, bio-controls, and other physical tools that prevent vegetation from growing or becoming a problem. This multi-faceted approach to pest control is called integrated pest management or IPM.

August 2019 – revised April 1, 2022

Cover Photo Credits: Bob Burke, Nancy Cain and Diane Le Houillier

ACKNOWLEDGEMENTS

The OVMA could not have produced this document without the dedicated efforts of a team of contributing writers, including:

Diane Le Houillier, Vegetation Management Consultant and Chair of the IPM Manual Committee

John Bowen, Hydro One (retired)

Bob Burke, Hydro One

Jennifer Rose, Algoma Power

Nancy Cain, Cain Vegetation Inc.

Gord Gallaugher, OVMA

With additional input and support from:

Michael Irvine - Ontario Ministry of Natural Resources

Steve Ford - GreenStream Lawn and Vegetation Management

Brian Hill – Hydro One

Murray Purcell – Ontario Ministry of Transportation

Ken Langer and Joanne Tatham - TransCanada Pipelines and

Rob Brewer - Wilderness Environmental Services

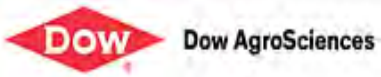
A special acknowledgement to the IPM Council of Canada for their support and to Teri Yamada, TY Environmental Strategies Ltd., our very accomplished editor, who pulled it all together.

SPONSORS

The OVMA would also like to thank the following sponsors without whom this manual would not have been possible.

OAK TREE Sponsor

TREE Sponsors



SAPLING Sponsors

PUC of Sault Ste Marie

SEED Sponsor

TABLE OF CONTENTS

CHAPTER 1: Statement of Purpose

Ontario's cosmetic pesticides ban took effect April 22, 2009 and prohibits the use of all pesticides in, on or over land in Ontario, unless an exception applies, or unless the only active ingredients used are listed on the Allowable List (i.e. biopesticide or lower risk pesticide), formerly known as Class 11 pesticides.

There is an exception to the ban for the use of unlisted pesticides to protect public health or safety as a land extermination on land that forms part of a public work. The public works exception requires that licensed industrial vegetation exterminators using an unlisted pesticide must be certified by an integrated pest management (IPM) body. The Integrated Pest Management (IPM) Council of Canada is approved by the Ministry of the Environment, Conservation and Parks as an IPM body to deliver this certification program. IPM-certified exterminators are responsible for ensuring that maintenance operations under the public works exemption are performed in accordance with IPM principles.

This manual was developed by the Ontario Vegetation Management Association (OVMA) for the purpose of preparing licensed industrial vegetation exterminators for the IPM certification examination for public works.

Many experienced professionals in the field of vegetation management across Ontario have volunteered their time to write parts of this manual. We trust it will not only be a valuable tool to those writing the IPM certification exam for public works, but also a useful reference for anyone working in the industrial vegetation management industry.

CHAPTER 2: Disclaimer

This manual has been produced by and is the property of the Ontario Vegetation Management Association (OVMA). It is a guide only and the OVMA accepts no responsibility for errors or omissions. However, we welcome your feedback.

It is the reader's/user's responsibility to comply with all applicable laws and regulations, and to have all staff appropriately trained. Always read and follow your equipment suppliers' operating manuals. Always read and follow the directions on all pesticide product labels.

Information in this manual that refers to the Ontario Pesticides Act (the Act) and Regulation 63/09 (O. Reg. 63/09) is for education purposes only and is not legal advice. If you find any discrepancies in the information in this manual, always refer back to the Act and O. Reg. 63/09.

CHAPTER 3: Integrated Pest Management for Public Works – An Overview

3.1 Integrated Pest Management (IPM)

Integrated Pest Management (IPM) is defined as a decision-making process for preventing pests from reaching damaging levels and for determining what actions to take when pest problems occur. The concept of IPM has been around for decades and is applied to many sectors including agriculture, golf course and specialty turf management, arboriculture, structural maintenance and industrial vegetation control.

Pests include harmful, noxious or troublesome organisms that may impact on crop production; be injurious to animals or humans; cause damage to facilities such as buildings, power lines, roads and railways; cause the spread of disease or adversely impact quality of life. Pests may include unwanted vegetation, insects, fungi, molluscs, microorganisms, fish, birds or rodents, or any organism that may reach damaging levels. Organisms may be pests in some situations and be of little or no consequence in other situations. The goal of an IPM approach is not the elimination of all pests, but the reduction of a pest population to a level that will not cause significant damage.

In an IPM approach, it is important to know the pest to be treated and all available control options to ensure that any controls are properly planned, economically viable and minimize potential harm to the environment and people.

IPM is necessary because it helps to ensure that pesticides are applied only when required, in a manner that will yield desired outcomes, while minimizing impact to the environment and the potential for conflict with landowners or the public. Proper use will also minimize the potential for pests developing resistance to pesticides.

IPM has a formal structure and components that include pest:

- prevention
- identification
- monitoring
- threshold establishment
- control methods, and
- control evaluation

3.2 Integrated Vegetation Management (IVM) and Public Works

IVM is a subset of IPM and is defined as a system of managing plant communities where compatible and incompatible vegetation are identified; action thresholds are determined; control methods are evaluated; and selected control(s) are implemented to achieve a specific objective. Choice of control method(s) is based on effectiveness, environmental impact, site characteristics, security, economics, current land use and other factors.

Control methods include:

- cultural
- biological
- physical
- mechanical
- chemical

A more detailed explanation of IVM and these individual control methods will be expanded upon in later chapters.

3.2.1 Strategies for Successful IVM Programs

Vegetation management planning is a very important component of any IVM strategy. Proper planning requires the gathering of all essential information, before deciding on the best approach or approaches to complete the necessary work.

- Understanding land use on and adjacent to the work area can help avoid potential conflict with landowners or other users of the land. Some activities and items that may be adversely impacted or disrupted would be organic farming operations, livestock, adjacent crops, or hiking/biking trails.
- It is also important to know the location of underground cables, pipelines and drainage systems to avoid any damage to these facilities.
- Environmental impacts such as the contamination of wells or adverse effects on species at risk, fisheries, wildlife or archaeological sites can be anticipated before start of work and mitigated.

Well-planned vegetation management programs include sufficient lead time to conduct comprehensive external communications with individual landowners, local municipalities, government agencies, local interest group and/or other utilities. Communications planning is discussed in greater depth in Chapter 7 of this manual.

3.2.2 Definition of Public Work

The term *public work* is defined in O. Reg. 63/09 as a structure that provides a benefit to the public and that is owned or operated by the Government of Ontario or Canada or by any board or commission thereof, or by any municipal corporation, public utility commission or by private enterprise and includes any railway, canal, highway, bridge, power works including all property used for the generation, transformation, transmission, distribution or supply of hydraulic or electrical power, gas works, water works, public utility or other work.

3.2.3 Responsibilities and Accountability

This section outlines the responsibilities and accountability of licensed exterminators, IPM Certified Applicators and the owner or operator of a public work.

The regulatory requirements, including those of the Pesticides Act and Ontario Regulation 63/09 are laid out in Section 9.2 of this manual.

Responsibilities with respect to precautions when employing mechanical controls are detailed in Section 8.4.5 and precautions when using chemical controls are detailed in Section 8.5.7. It is worth highlighting here the importance of reading all pesticide labels before using any product and adhering to all instructions on the label. The Safety Data Sheet (SDS) provides additional detailed facts about the product and it is also recommended to become familiar with this information.

CHAPTER 4: The Components of IPM for Public Works

Pest management should always follow an IPM approach. The components of this IPM strategy are pest prevention, pest identification, monitoring pests & environmental conditions, establishing pest thresholds, selecting appropriate control methods and evaluating the program results.

4.1 Pest Prevention

Preventing organisms from becoming problem pests by planning and managing ecosystems is a very important aspect of an IPM approach. In natural ecosystems, there are intricate biological balances that prevent the dominance of any one species or the complete destruction of any component of the natural system. Changes tend to happen over long periods of time. For example, succession of plant communities may take hundreds of years. Knowledge of how ecosystems work will allow pest managers to incorporate this information into preventing the establishment of harmful levels of pests and to take advantage of the potential of naturally-occurring controls within the environment.

Prevention should start with the site design and engineering. The construction phase of a new public work, whether a road, electrical utility, pipeline, or railroad – and all associated infrastructure with any of these – is the best time to start planning for future vegetation management needs. Selecting locations away from environmentally-sensitive areas makes vegetation management less restrictive.

Soil conditions and the types of vegetation that may eventually grow in the area should be considered. Consideration should also be given to establishing species compatible with the public work to compete with and reduce invasion by incompatible species.

4.2 Pest Identification

Identifying and distinguishing pests from beneficial organisms (natural enemies that may feed on the pest or compete with the pest to help reduce their numbers) is critical when planning a pest control program. In addition to the correct identification of pest species, research should be conducted to better understand the pest's life cycles, source (native or invasive), area of distribution and proven control methods, before any control options are selected.

Control measures should target incompatible species while retaining compatible species using physical or chemical selectivity. Physical selectivity would include spot herbicide applications or single stem treatments of the pest. Chemical selectivity would be choosing a herbicide that controls incompatible species without injuring the compatible species.

Knowledge of the pest life cycle will ensure that the best treatment method(s) are selected and made at the most effective time. For example, there may be only one stage in the pest life cycle where treatments can be successful. There may also be naturally-occurring, beneficial organisms present, capable of providing the desired controls without artificial intervention. Pest managers need to understand as much

as possible about the pest, its life cycle and interactions with other species, in order to make the best control decisions.

4.3 Monitoring

Monitoring is the regular scouting, inspecting or surveying of the growing conditions, as well as the population levels of both pest and beneficial species. It is a key component of a properly planned IPM program. Knowing the type and amount of damage and environmental conditions is essential to ensure management decisions are based on all the facts available.

Monitoring may be qualitative or quantitative. A simple *qualitative* approach is where observations are made and decisions are based on the experience of the individual making the assessment. A *quantitative* approach involving the counting of pests using traps or formal sampling plots. Knowing the number of pests and beneficial species present is required to ensure that treatments are both necessary and will not contribute to the development of pest resistance to specific treatments from over exposure.

Knowing the life cycle of a pest can help the person monitoring to look for specific stages where control is known to be effective. Not only should pest presence be noted, but an assessment should be made of the number of organisms and the extent of damage. When making an assessment, environmental and other external factors that may influence the population levels of both the pest and beneficial organisms should be considered. An example would be climatic conditions such as cold weather, early frost or drought which may temporarily reduce numbers.

Monitoring should also include an assessment of the growing conditions. Enhancing or manipulating the site to improve growing conditions to favour beneficial species may be a better option than treating the pest species.

4.4 Establishing Pest Action Thresholds

The presence of potential pests does not automatically create a problem. Pests become a problem only when the number present or potential numbers will cause an unacceptable level of damage. Establishing threshold levels to determine when to take "action" to treat pests is important. Treating when pest numbers are not capable of causing serious damage may not only result in an unnecessary use of resources, but may also contribute to pest resistance to certain treatments. However, there may be situations where early intervention is the best management strategy, such as with invasive species.

In public work situations, the threshold could be the number of undesirable plants that damage desirable plants or create an unsafe situation. Another common threshold is plant height that may contact a power line or obscure driver or conductor vision. In some cases, the consequences are so serious, such as power failure or potential accident, that even one plant, like a large tree would require control.
In order to determine compatibility of vegetation, maintenance planners must set clear objectives with respect to the operation of the public work area in question, such as:

- clearances required on, around or below facilities e.g. distribution lines, substations or along roadway, pipeline or rail line corridors
- areas where *any* vegetation would be a hazard, e.g. rail beds, transformer yards or pipeline compressor stations
- type of access required for maintenance or emergency equipment
- special habitats that require protecting
- time between scheduled maintenance operations

Rather than defining problem species, the mature physical characteristics of the species may be used to determine compatibility. Mature height range and plant vigour are examples of the characteristics in question. However, what is considered acceptable may differ between locations (compressor yard vs. pipeline), type of public work (rail vs. power lines) or even between different companies.

Thresholds will vary greatly depending on the circumstances. For example, a single stem of brush may be a serious hazard if allowed to grow into overhead lines where voltages and protection systems would cause a fault and loss of power. The same brush growing near different line configurations may not be as great a concern.

The decision to take action against a pest should consider the severity of the situation or its potential damage, to ensure that the action makes financial sense and will not result in unnecessary damage to the environment.

4.5 Pest Control Methods

Pest control methods may be used alone or in combinations, as part of an IPM strategy. Pest control methods include cultural, biological, physical, mechanical and chemical control methods. Knowledge of all potential control strategies is necessary to make the best decision on how to proceed. These individual control methods will be expanded upon in Chapter 8 of this manual.

4.6 Evaluation

The last step in an IPM strategy includes reviewing all aspects of the IPM program and evaluating the results. Evaluation should include a thorough assessment of what may have led to acceptable or unacceptable results. If possible, the evaluation should be based on several assessments rather than a single or limited number of observations.

Where pest control has not been successful, it is necessary to identify what changes can be made to improve the program's effectiveness. Evaluation should be quantitative and detailed in order to be useful. Casual observations will not provide adequate detail and may lead to false impressions. Other factors that may have impacted the results should be noted, such as weather, worker skill, vandalism or human error.

CHAPTER 5: Integrated Vegetation Management (IVM) for Public Works

As previously stated, IVM is a subset of IPM and is defined as a system of managing plant communities where compatible and incompatible vegetation are identified; action thresholds are established; control methods are determined; and selected control(s) are implemented to achieve a specific objective. This chapter discusses a number of approaches to vegetation management to reduce the need for remedial or corrective action. In a traditional crop-based IPM program, this would be part of the pest prevention component.

5.1 Vegetation Management Planning and Communications

Good program planning involves using all the essential information to inform any decision regarding the best approach or approaches to complete the necessary work. Communicating in a timely fashion with both those directly involved in the work and any other party who may be impacted by the work is also important. Please see Chapter 7 of this manual for more details on communications.

Safe work practices should be a state of mind. Time should always be taken to evaluate potential risks to persons, property or the environment, whether using chemical or mechanical control methods. Conducting a daily job safety meeting or "tailgate" meeting with everyone involved in the day's work is strongly encouraged. The scope of the planned work, all potential hazards of the site and accident avoidance should be discussed. Everyone on the site must be properly trained and equipped with appropriate personal protective equipment (PPE) for the work. Everyone on site should know emergency procedures that outline:

- critical steps to take in the event of an accident
- location of emergency equipment and supplies
- who to call

5.1.1 Site Design Considerations

The construction phase of a new public work is the best time to start planning for future vegetation management needs. Locations away from environmentally-sensitive areas make vegetation management less restrictive. Consider the soil type and what types of vegetation may eventually grow in the area. Consider re-seeding with compatible species to reduce invasion by incompatible species that may, for example, grow too tall.

5.1.2 Site Evaluation

In order to plan an effective vegetation management program, the individuals planning the work must become familiar with the specifics of the location. This may be a relatively simple process for an existing site, such as a power or transportation station. However, with long distances associated with railways, roads, pipelines and electrical utility rights-of-way, more detailed information may need to be reviewed including:

- aerial photography or fly over of site

- easement documents for occupation rights and right-of-way widths
- internal company videos and/or digital mapping
- internal company patrol sheets
- topographic and other maps including drainage, vegetation, aquifers and soils
- government information sites e.g. species at risk
- condition surveys, profile plans or Canadian Standards Association (CSA) standards documents to establish clearances required to overhead lines
- historical information based on past maintenance documents, spray diaries, and special commitments

When evaluating the site, field visits by the individual planning the work are often valuable. Logistically it may not be possible to check the entire distance, however even spot checks can be of value.

When field visits are conducted, it is recommended that while on site, a series of good quality digital photos are taken. These will be of value when returning to evaluate the site in future years and will be a good record should subsequent complaints be received or public meetings be required. Photos should be date-stamped and include any locations where situations existed, prior to any work commencing that may be raised by landowners at a later date. Examples would include sites where rutting and other vehicle damage is evident, erosion locations, damaged culverts, presence of invasive plants or damaged gates and fences.

Some physical elements to look for include the presence of:

- vegetation types and their compatibility with the public work being protected
- special habitats such as native prairie grass or habitat for species at risk or old field succession vegetation communities with ecological characteristics that naturally impede establishment of woody vegetation
- invasive species where ground disturbance may promote further spread
- wetland species that may signal a high water table
- small or intermittent streams or seasonal ponds that may require protection of riparian areas
- soil types that are prone to pesticide leaching or to vehicle rutting or compaction
- topography that may increase erosion or run-off from the treatment location with special notation of nearby waterbodies, especially downstream
- poisonous plants that are potentially harmful to workers e.g. poison sumac, poison ivy, giant hogweed and wild parsnip
- large areas of shallow soil or exposed bedrock that may increase herbicide run off, be prone to erosion following disturbance or pose a hazard when operating mechanical equipment

Other things to note include:

- presence of other utilities
- First Nations lands or traditional use areas

- canoe routes, high boat traffic, highway scenic lookouts where visible impacts from maintenance may lead to public complaints
- recreational use such as snowmobile trails, hunting and camping
- traffic on the roads to determine safety of workers and need for traffic control
- possible off right-of-way access requiring landowner permission
- nature of the road use, e.g. brown out from herbicide treatment that may lead to complaints from local residents or cottagers
- types of incompatible vegetation that dominate, e.g. high density of conifers may require specialized herbicide applications or mechanical options as opposed to low density of conifers may allow control by hand cutting
- requirement for re-planting of a cover crop and the vegetation best suited to the site conditions and future use
- locations where public access may exclude the application of pesticides such as rest stops or paths
- locations where locked gates, controlled access highways, rivers or lakes may impede access for maintenance
- requirement for more intense clean-up such as chipping and/or removing material from site

Site evaluations should include measuring or estimating any areas that will likely be treated with pesticides as this information will be required for the annual pesticide usage reports that must be compiled for each calendar year as per Section 19 of O. Reg. 63/09.

5.2 Compatible Vegetation Management

When planning vegetation control programs, it is extremely important to determine whether all, some or none of the vegetation requires treatment. Compatible vegetation retained on sites can:

- provide a natural form of biological control
- provide enhanced wildlife habitat
- reduce complaints from the public about visual impacts
- prevent erosion
- reduce maintenance costs

Compatible vegetation management usually assesses the relative merits of tree species, woody shrubs, herbaceous, non-woody plants and grasses. See Section 8.1.1 of this manual for more details.

5.3 Total Vegetation Control

Total vegetation control is practised on gravel areas at transformer and distribution stations, pipeline facilities, railway ballasts (see Section 6.1.1) and any other areas where control of all vegetation is required.

Knowing the vegetation mix that needs to be controlled is important in developing a successful treatment program. Evaluation of sites should include gathering information on:

- slopes
- soil types
- plant species present
- plant growth density
- past treatment methods
- size of area to be treated
- adjacent land use
- accessibility

The concept of prevention can be applied to managing vegetation for total control. This may include improving drainage or adding additional gravel to make growing conditions less favorable and/or installing vegetation control fabrics to act as a barrier and prevent plant growth.

There are two recognized approaches to total vegetation control - long term and short term.

5.3.1 Long-term Total Vegetation Control

There are sites associated with the maintenance of public works where, for safety reasons, all vegetation (grasses, woody plants and broadleaf weeds) must be controlled. Long-term vegetation control is designed to reduce the need for repeat visits to the site by controlling all vegetation for an entire season or more. Long term control is preferred in locations such as long expanses of remote railway that are not readily accessible.

The most common method of providing long-term vegetation control is the application of herbicides with residual activity in the soil. These products control the plants that are growing at the time of application, as well as prevent re-establishment from seed.

As with all chemical applications, the precautions outlined in **Section 8.5.7** of this manual must be followed. Read all pesticide labels before using any product. The label may restrict certain uses or require mitigation measures to reduce the potential of run-off or leaching of product into surface or groundwater.

In addition, when applying herbicides with long soil persistence, special attention should be paid to situations that may cause the chemical to move away from the point of application. Avoid applying on or near steep slopes, areas with compacted or impermeable soil types e.g. hard clay, areas with a shallow water table, or near wells or drinking water intakes. Since many chemicals stay active in the soil, any vegetation adjacent to the application site should be noted since roots may extend into the treated area.

5.3.2 Short-term Total Vegetation Control

Short-term total vegetation control is used to rid an area of all vegetation for one growing season. Short-term vegetation control can be used alone or in the years following long-term vegetation control as spot treatment, in specific areas where vegetation has started to re-emerge.

Applying herbicides for seasonal control requires adherence to the precautions outlined in Section 8.5.7 of this manual. Selection of herbicide and timing of application are key for seasonal control. For example, foliar applications made during extended drought conditions may be wasted, if the target plants have gone dormant and unable to take in the herbicide applied.

5.4 Selective Vegetation Control

Selective vegetation control requires an understanding of long-term vegetation control objectives. The management of vegetation is required to prevent potential problems such as:

- growth into overhead lines
- impeded access to inspect and detect pipeline leaks
- exposure to poisonous plants
- damage to drainage systems
- reduced sight lines on roads and railways

However, removal of all vegetation is not always necessary and may have other consequences including:

- slope erosion
- wildlife habitat disturbance
- visual impacts
- increased unauthorized access
- the establishment of invasive plant species

Selective vegetation control would be more appropriate in these situations.

The vegetation manager may divide the area of control into *vegetation management zones*. This concept can allow for taller vegetation or woody shrubs at certain locations on a variety of rights-of-way associated with railways, power lines, roads and pipelines. While shorter vegetation would be required in other locations, such as under wires or at intersections where visibility is a concern.

There may be the potential to further refine these zones based on site conditions. For example, when managing vegetation on electrical utility rights-of-way, overhead line clearances may vary dramatically from span to span depending on ground contours and type of structure. Good vegetation management includes knowing clearances and then determining what species can be retained. For example, deep valleys may allow mature trees to be safely retained. Knowing clearances will result in eliminating unnecessary work and associated costs.

Determining vegetation compatibility around power lines must always be based on sound engineering data. This could include condition surveys, profile plans when available or at minimum, reference to CSA standards for minimum ground clearances. Line sags will vary depending on current flow and ambient temperature and the sag of the lines can be dramatic, especially on transmission circuits.

The *wire zone/border zone* concept is discussed in Section 8.1.2 of this manual. This concept is used to determine whether taller woody shrubs can be allowed to grow at certain locations on a variety of rights-of-way associated with railways, power lines, roads and pipelines.

Selective plant control also identifies herbaceous, non-woody species that may need to be controlled in certain situations. For example, the Weed Control Act 1990 requires control of noxious weeds next to agricultural land and this may involve land along a road or utility right-of-way.

CHAPTER 6: Applying IVM in Specific Public Works Sectors

Public works facilities can be classified into three main groups - Transportation, Energy and Communication. The application of IVM in each of these groups is discussed in this chapter.

A good understanding of the reasons vegetation must be managed in specific public work situations will assist property managers in determining the level of control required and in selecting the most appropriate tool(s) to manage problem vegetation. Various control methods and options will be discussed in subsequent chapters.

6.1 Transportation

This group includes mainly railways, highways, roadways, airports and helipads. They all include the actual driving surface, as well as the area located between the shoulder of the driving surface and the outside property line or fence line (the right-of-way). Also in common is the use of both types of vegetation management control - total and selective vegetation control.

The driving surface requires total vegetation control, meaning that no vegetation is tolerated. The goal is to keep the area vegetation free, as much as possible. These areas would include around rail guards for highways and roadways, railway track beds, airport tarmacs etc.

The right-of-way area can allow some vegetation growth, as long as it does not interfere with the safe operation and maintenance of the public work. Railways, highways and roadways can tolerate low-growing vegetation on rights-of-way, as long as it does not interfere with operations (reducing sightlines, blocking signals and signs, etc.). However, airports can only allow mowed vegetation like grass, because low-growing brush or weeds can shelter wildlife that can create a hazard for planes.

On highways, roadways, airports and helipads, the areas that have to remain vegetation free are usually paved or sometimes, especially for roadways, compacted and might be covered with gravel. When the soil is paved or compacted, the maintenance to prevent vegetation growth is minimal and requires fewer interventions.

6.1.1 Railways

Railways require the most maintenance of all transportation public works in terms of total vegetation control, due to its loose gravel area called the *ballast*. The gravel in the ballast section is not compacted and is thick enough to allow plants to grow. This area must be kept vegetation-free for many reasons, including to:

- prevent water retention that softens the track bed, allowing track movements that will compromise structural integrity
- prevent vegetation from overgrowing the rails that can allow train wheels to slip and hinder track inspections, maintenance, repairs and can be a safety hazard for employees from tripping
- reduce humidity that can increase the decomposition of railroad ties

Selective vegetation control is required along the railway rights-of-way to:

- maintain sightlines at all crossings (road, pedestrian and farm) and along curves
- ensure clear visibility of signs, signals and other utilities
- reduce hazards to employees from tripping or contact with poisonous plants
- reduce fire risks due to sparks

6.1.2 Highways and Roadways

Highways and roadways are comprised of engineered features such as embankments, drainage courses and areas within interchanges. Roadsides, particularly in areas of intense agriculture, often provide important natural areas commonly used by wildlife.

Vegetation is controlled along highways and roadways to:

- provide clear sight lines to signs and intersections for driver safety
- control noxious weeds under the terms of the Weed Control Act
- manage snow accumulation, drifting and storage
- promote road drainage and drying to reduce the potential for icing and other unsafe driving conditions
- improve roadside vegetation to aid in erosion control
- improve visibility by motorists of wildlife preparing to cross the roadway

6.1.3 Airports and Helipads

The tarmac is paved and requires very little vegetation management. However, the right-of-way is the area in need of vegetation control to:

- provide clear sight lines to signs and signals
- control noxious weeds under the terms of the Weed Control Act
- reduce snow accumulation
- promote drainage and drying of the tarmac to reduce the potential for icing
- improve turf and other compatible plant cover to aid in erosion and dust control
- reduce obstacles in case of an emergency and provide easy access for emergency vehicles and equipment
- reduce or eliminate wildlife attractants such as food sources or nesting sites for birds

Examples of Integrated Vegetation Management in the Transportation Sector

Photo credit: Bob Burke

Vegetation control is required for rail integrity along railway ballasts (gravel area) and visibility at all crossings.

Photo credit: Bob Burke

Unpaved areas around airports, helipads and roadways require vegetation management to protect sightlines, drainage and access, while reducing issues related to dust, erosion and wildlife.

Photo credit: Jennifer Rose

6.2 Energy

This group includes electrical utilities and pipelines (oil and gas) and associated infrastructure. Control areas include their respective facilities and generation sites (dams, reservoirs, penstocks, dikes, spillways and diversion channels, nuclear, hydraulic and thermal generating stations) and rights-of-way.

Total vegetation control is required around facilities, substations, dams, etc. and selective vegetation control along rights-of-way. The specific reasons for vegetation control for each type of energy public work is discussed below.

6.2.1 Power Line & Pipeline Rights of Way

Total vegetation control is required in maintaining power lines and facilities to:

- preserve the structural integrity of dams and penstocks
- ensure the crushed rock base used at electrical facilities is free of vegetation since it is part of the grounding system and vegetation has the potential to increase risk of electrical hazard and worker injury
- reduce the potential risk of power outages from plant interference with electrical components
- preserve access to electrical components for maintenance, safety inspections and emergency response
- keep fences vegetation-free to reduce risk of unauthorized entry and theft
- avoid attracting wildlife that may lead to inadvertent electrical contacts and possible outages
- eliminate tripping hazards to employees

The reasons for total vegetation control around pipeline facilities and substations are similar to those for power lines and facilities discussed above with some minor variations. Total vegetation control around pipeline facilities is used to:

- prevent encroachment of vegetation into apparatus
- avoid creating a source of combustible fuel that could lead to fires
- preserve access to facilities for surveillance, work and inspections
- keep fences vegetation-free to prevent and identify any security breaches.

Selective vegetation control around power line rights-of-way is used to:

- prevent vegetation from contacting powerlines and creating public safety hazards, fire hazards and system outages
- preserve access and sightlines for construction, inspection and maintenance of tower footings, wood poles, guy wires and other system components
- protect from erosion and other potential damage to facilities

Within powerline rights-of-way, small brush is tolerated as long as it does not interfere with regular operations. Taller vegetation will be tolerated mainly along the property limits. Vegetation managers of powerlines may divide the right-of-way into zones. The *wire zone* is the area directly under the wires where only shorter vegetation, including shrubs, are considered compatible. The other zone is

the *border zone*, along the edges of the right-of-way, where taller vegetation may be considered compatible. Zoned Vegetation Management is discussed in greater detail in Section 8.1.2 of this manual.

6.2.2 Generation sites

At power generation sites, vegetation is managed to:

- prevent deterioration of dams and dikes by deep roots that may penetrate impermeable layers of packed earth or damage concrete
- avoid any decreased water flow through canals

Photos courtesy: Bob Burke

Powerline rights-of-way, power facilities and pipelines are kept clear of vegetation for safety.

6.3 Communication Facilities

Communication facilities such as radio towers and microwave towers may include areas where gravel has been installed. It is often preferred to keep these areas clear of vegetation to:

- facilitate inspections
- provide grounding
- prevent fire damage
- allow ease of movement of vehicles and personnel working on the site
- keep fences clear for security reasons

Photo credit: Jennifer Rose

6.4 Wood Pole Treatment

Wooden pole maintenance is primarily used with power lines and communications.

Under proper use conditions, wood can give many years of good service. However, wood can be readily damaged and destroyed by fungi and insects when conditions favour these pests. Wood must be protected to maximize service life and minimize replacement costs. The principles of IPM described in Chapter 4 can be used to effectively manage damage caused by wood rot and other pests.

Pest Prevention
The purchase of poles that have been treated to prevent rot or that are made of steel, concrete or other synthetic materials will prevent or minimize the ability of pests to cause damage. Poles that are located in soils that are well drained will reduce the probability of attack by both fungi and some insects.

Pest Identification
Several kinds of insects attack living trees, logs, lumber and finished wood products for food and/or shelter. These pests include wood-boring ants, wood-boring beetles and termites. Signs of damage to wood poles will include visual evidence of the presence of the insects. This could include round or oval holes on the surface of the poles, piles of sawdust-like material or wood fibers at the base of the poles, or galleries under the surface of the wood which may be filled with excrement or other material.

Ants do not eat the wood, they use poles for nesting which causes structural damage and will weaken the poles. Ants prefer damp wood and will normally be found in wetter environments. Termites eat wood. They live in large colonies and may excavate galleries in the wood to move between underground nests and the wood poles. Beetles normally are associated with damp areas near the ground line. Damage is caused by the beetle larvae that live in the wood.

The species of insect can normally be identified by:

- comparing specimens with an insect collection
- referring to pictures or pictorial keys from text books and on-line reference materials
- recognizing characteristics of the damage, excrement or castings (frass)
- consulting experts for assistance with difficult or unfamiliar species

Fungi are common pests of wood poles and may lead to rot. Fungi cannot produce their own food and must feed on other organisms that are either living or dead. Fungi grow via tubular cells called hyphae, which can penetrate through the wood and some can even transport water from surrounding moist soil. Decay-causing fungi attack the cells of the pole, reducing structural strength.

There are many fungi that develop on or in wood and cause damage. Wood-destroying fungi, e.g. brown rot, white rot and soft rot, are of concern on wood utility poles. They reproduce by releasing millions of

tiny spores that can be distributed by wind, water or insects and are capable of starting new infections if they land on damp, unprotected wood.

Monitoring

The most effective monitoring programs involve scheduled pole inspections. The inspections involve evaluating the physical integrity of the poles and its serviceability. Testing can involve visual inspections or sounding, drilling or boring with specialized equipment.

In recent years, poles are located with GPS co-ordinates and some utilities use bar codes to scan and record data. Whichever method is used, monitoring should be carefully recorded to ensure crews assigned to treat or replace poles can quickly locate the individual pole.

Establishing Pest Action Thresholds

There are many variables that impact on what actions, if any, should be taken to control pests. Determining when the action threshold is reached will depend on the type and age of pole, loading strains related to construction, environment in which the pole is located and the extent of insect or fungal infection.

Pest Control Methods

The control options available for wood utility poles damaged by insects or fungi are implemented after the pole is inspected. If an area has been excavated around a pole, the excavated area should be refilled and firmly tamped to avoid the possibility of subsequent settling. Settling can create a basin for water to pond and lead to future deterioration.

Evaluation

The treatment method used and its effectiveness should be recorded during the next scheduled return to test the pole. Where testing reveals a pole requires replacement due to deterioration, once removed, the damaged pole should be cut across at the line where bore testing had been completed and checked against the test results to evaluate the assessment methods being used.

CHAPTER 7: Communications

Communication is essential to planning and implementing a good vegetation management strategy. Ultimately, it will be up to the company and individuals doing the work to determine the best time and way to communicate about the proposed work. This chapter provides some elements to consider when planning any work.

A communications plan should include both internal communications - within the company planning the work and externally with landowners and outside parties. Proper communications is required for the work to be completed efficiently, at the best time to minimize impacts to the environment and without confrontation.

Individuals interacting with the public must have the proper training, knowledge and experience. This could include an exterminator's licence and IPM certification, if pesticides will be involved. They should be prepared with key messages and information about the work activities. They should review all applicable pesticide labels; have knowledge of all the equipment and activity options; know who will perform the work, as well as the nature and extent of the work; and know when the work will start and most likely be completed. Effective communication tools include: brochures, handouts, pictures and information on company websites. These should provide clear explanations of good vegetation management practices, pest control strategies and work activities in language that the public can understand.

In the short term, effective communication with the public will lead to fewer immediate complaints, improved ease of operations, higher acceptance rate and even a happier workforce. Longer term benefits of effective communication and public outreach are better relationships with landowners, ease of operation during future visits, more secure relationship with customers and sustainable industry work practices.

7.1 Internal Communications

Any organization undertaking pest control programs must ensure there is a well-documented, internal communications process in order to avoid problems such as:

- other departments within the company removing, replacing or disturbing the facility or treatment site after vegetation or other pest control strategies have been completed
- delay or cancellation of scheduled pest management work due to other crews working on the site
- duplicating work on facilities already recently treated
- delays in work or negative interactions with the public due to known local landowner sensitivities

Examples of internal communications are:

- presentations to other departments on vegetation and other pest control management objectives and strategies

- sharing annual work plans well in advance, to aid in determining any known customer/landowner constraints, impacts on other departments and suitable work scheduling
- notification and posting of work schedule prior to starting work

Proper internal communications also include preparing work packages for in-house or contract crews completing the planned work. Work packages should include:

- any documents required under O. Reg. 63/09 for the use of unlisted pesticides (see Chapter 9 for details)
- detailed work instructions to ensure that herbicide restricted areas, areas with restricted access, locations where prior notice must be given to landowners (e.g. to move livestock), locations of species at risk, bee hives, wells, organic farms etc. are all clearly identified and demarcated
- copies of any special permits for restricted pesticides, species at risk and/or for working on or near other facilities such as railways and roadways
- spray diaries or other template for tracking pesticide applications, to complete the pesticide annual report, as required by O. Reg. 63/09 and for future reference should any inquiries be received and for maintenance in future years

7.2 External Communications

Effective vegetation management planning provides adequate time to conduct comprehensive external communications with individual landowners, local municipalities, government agencies, local interests group and/or other utilities. Early communication helps to identify areas of potential conflict with existing activities to allow the planned work to either avoid or mitigate potential issues.

There are two distinct communications activities that should occur when creating an IPM plan. *Project planning communications* assists in understanding any potential issues that may impact the planned work. *Communication prior to work beginning* ensures that any individuals or groups who may be impacted by the work are kept informed.

External communications explaining the company vegetation management strategies may take the form of:

- community or public meetings
- meetings with municipal councils, government agencies and/or special interest groups
- mail outs, phone calls and/or site visits to individual landowners
- newsletters, website information, newspaper ads or brochures to a broader audience

7.2.1 Project Planning and Communications

Once the site evaluation is completed, project planning and a communications plan should be created, to ensure as much information as possible about the site is known. Proper planning should include enough lead time to accommodate any required review with government agencies, municipalities or other local agencies impacted by the work, as permits and/or permission for access may be needed.

When completing the initial evaluation, the planner may determine that potential impacts will be restricted to the landowners and/or tenants occupying the lands where maintenance will occur. This project planning will then involve contacting each landowner and tenant where potentially contentious work is necessary, to seek permission to proceed. Examples of this sort of work are pesticide applications, mechanical removal of brush or hand-cutting of large areas. This allows each landowner to voice any concerns and to provide information about the presence of wells, known species at risk, bee hives or other items of interest to be considered.

When work may have larger scale impacts and public issues will likely arise, formal public meetings should be considered. However, the public's right to know has to be balanced with respecting individual landowner rights. Other locations that require special consideration are within provincial parks, nature reserves and conservation areas where associated government agency(ies) will provide input and direction regarding public consultations/engagement. Public consultations may be dictated by environmental assessments (EA) or park master plans. Owners of the public work and individuals planning work on their behalf should be thoroughly familiar with any associated EA or master plan to ensure compliance and to include known exceptions in any negotiations.

Many land use arrangements or agreements and occupation rights will be encountered with most public work maintenance activities, especially rights-of-way work. These may include:

- easements where companies purchase limited rights for a set number of years or in some cases in perpetuity
- actual land purchase and ownership of title
- federal and provincial crown land occupation licences
- Memorandum of Understanding (MOU) with government ministries or local municipalities
- MOU and/or permits with First Nations

These land use arrangements may have additional communication and work notification requirements and work specifications to be adhered to when planning work.

In addition to the directly-affected lands there will be many adjacent landowners that may potentially be affected by planned maintenance activities. It is important to also communicate with these individuals. Encounters with the public should be anticipated, particularly in high profile areas such as near trails, schools or residential neighborhoods and need to be considered when planning work.

7.2.2 Communications Prior to Work

Communications prior to work will depend on the nature and extent of the work planned and adjacent land uses. To address public concerns, the O. Reg. 63/09 requires notification of pesticide use in Ontario on non-residential land areas and on residential land areas where pesticides are applied by any person (unless exempt under the Regulation). The notification requirements provide specific information regarding the application of a pesticide and allow the public the opportunity to make an informed decision as to whether to enter the treated area. See Section 9.2 for details.

Any person who applies a pesticide as a land extermination is required to post a "Non-Residential area" or a "Residential area" sign or use one of the alternatives to non-residential signs in the Regulation, which require either notice to be provided to the Director or receive written Director's approval for an alternative method of public notification for a land extermination.

Although not dictated by regulation, in some cases, it is recommended that advance public notice be considered for non-pesticide management such as the physical removal of brush and trees. This may simply involve a letter to each affected landowner stating reasons for the work and a number to call if they have any questions. In other situations, where large-scale operations with the potential to impact lands or raise public concerns, enhanced public consultation and/or engagement should occur. This may be in the form of formal public meetings, meetings with municipal councils or notification of members of parliament or local conservation groups.

When conducting consultations, whether with individual landowners or larger groups, the following considerations will contribute to a positive outcome. Individuals representing the owner of the public work should:

- carry formal company-issued identification; call in advance if possible; drive identifiable company vehicles; and wear suitable apparel so that customers are comfortable
- be completely familiar with the scope of work; reasons the work must be completed; timing and extent of planned work; approximate time to complete the work; and the labels of any pesticides to be applied
- keep detailed records of any contacts whether in person or by telephone, including name of consulted person, organization the individual represented e.g. Conservation Authority, date, time and details of the conversation
- include these records in the detailed IPM plan for reference during and following completion of the work

The requirement to contact adjacent landowners will be a judgement call on the part of the individual completing the planning. Items to consider should include:

- potential to cause damage to adjacent property
- disruption from excessive noise, dust or other disturbance due to work

Crews conducting work will greatly reduce potential conflict with adjacent owners by confining equipment to the area to be treated; being fully aware of the property limits; and confining work to

the area where they have permission. Maintaining good public relations is equally important. Should crews be approached by adjacent owners, they should be courteous and take the time to outline the reasons for their work and what is planned. Crew members should always have business cards or contact information for a supervisor or the planner of the work, should the adjacent owner request more information. Crews should also use this contact information for additional guidance, to report any conflicts and for any media inquiries.

Good communication should always include a timely return of phone calls or e-mails from the landowner, adjacent owner or member of the public. Contentious issues handled promptly by staff knowledgeable of the specifics of the planned work will more likely be resolved favorably and avoid negative publicity or unnecessary delays in completing the planned work.

All correspondence should be recorded and filed with the work package. This will ensure that any concerns are addressed in future maintenance activities and improve the planning process by avoiding repeating any errors. Good records will also allow for good decision making in subsequent years.

There may be situations where local cottage associations, nature clubs or special interest groups object to the planned work. The owner of the public work will have to balance the permissions received from individual landowners with these volunteer organizations. Where feasible, a presentation of the IPM plan and a question and answer period would be a worthwhile endeavor.

Normally, notification of the local media prior to completing work is not required. However, having a communication strategy to handle any enquiries from the media is important. A media relations protocol should be followed to ensure that all questions are handled efficiently and accurately by individuals knowledgeable about the work and comfortable dealing with the media.

CHAPTER 8: Control Methods

The choice of control method(s) depends on a number of factors. These may include the:

- needs and design goals of the site
- environment
- budget and tools available to the vegetation manager

Often a combination of methods used together or concurrently over time will provide longer term control or control more species.

The use of chemical, mechanical and other methods of vegetation control is generally accompanied by **cultural** or **physical controls** that were incorporated into the design when the public work was built. Examples of design-incorporated controls are the:

- ballast located on a rail line;
- grass seeded along a pipeline; or
- crown vetch seeded on a roadside slope

These can be augmented by operational control methods such as chemical or mechanical controls

Physical and mechanical controls are most effective on annual species that do not re-root and regrow. Many perennial and woody species will re-grow after physical and mechanical control efforts. This is when combining a physical or mechanical treatment with an herbicide application can prevent re-sprouting of rhizomatous species, providing longer-lasting and even total control.

8.1 Cultural Control

Cultural control involves encouraging compatible plant species to compete with and reduce the invasion of non-compatible vegetation like weeds and brush. This can be a combination of selecting and introducing compatible species, with modifying the growing environment to favor desirable species. Ideal compatible species would be low-growing, establish quickly and thrive in the conditions of the area being managed. The early establishment of lower-growing cover species can reduce the number of less desirable taller, woody species by shading tree seedlings and competing for water and nutrients.

Early establishment of compatible species does not guarantee that undesirable species will not need to be controlled. However, cultivation of compatible species can reduce the amount of control required long term.

8.1.1 Compatible Vegetation Management

Compatible vegetation, such as low-growing shrubs under hydro lines or grasses beside roadways are not targeted for removal or control, as they do not interfere with the public work, pose a safety hazard, cause interruption of service or impede access to the public work for service or maintenance. Conversely, incompatible vegetation, e.g. trees and tall, dense shrubs, must be managed or controlled to prevent safety issues or interference or damage to the public work.

Determining whether vegetation is compatible or incompatible depends on many factors such as type and potential height of vegetation, its location within the right-of-way and proximity to the public work.

The ability to identify plant species is required to successfully implement IVM by vegetation managers and field crews. Correct plant identification will:

- assist in the selection of appropriate control methods
- reduce treatment costs due to misidentifying immature trees as shrubs or treating shrubs that are mistaken for young trees
- determine appropriate placement and selection of vegetation based on the growth potential of the species and site-specific height or width restrictions for an adjacent public work
- provide safer working conditions, by avoiding or ensuring proper work protocols are followed when dealing with known plant hazards such as thorny or poisonous plants
- improve public interaction by assisting field managers and crews in advising the public on the concept of "right tree, right place" and reasons why some vegetation is incompatible
- reduce the environmental impact of pesticides by treating only incompatible vegetation
- assist in maintaining or improving habitat for species at risk by applying species-specific site management practices
- assist in maintaining or enhancing the diversity of compatible plant communities on the right-of-way by controlling only incompatible vegetation

One of the prime functions of vegetation on a right-of-way is to provide soil stabilization and erosion control. When vegetation has been removed during construction, maintenance or natural events, it is important to re-establish compatible vegetation for the protection of the surface soil and structural stability of the public work area. Additionally, preventing eroded soils from entering water ways, wetlands and other environmental features is critical for environmental and wildlife protection.

8.1.1.1 Selective Management

When planning vegetation control programs, a critical step is to determine whether all, some or none of the vegetation requires treatment. Determining compatible vegetation species involves assessing the relative merits of tree species, woody shrubs and herbaceous (non-woody, including grasses) plants. Once compatible species become established on a public work site, the goal of selective management is to provide growing conditions that encourage these plants to flourish and propagate.

Since the 1980s, the use of global positioning system (GPS) and geographic information system (GIS) mapping has provided tools to create a directive for targeted treatments that avoid sensitive areas. This directive is used to guide the sprayer, record spray operations and aid in follow-up control assessment.

The same principles can be applied in maintenance operations where GPS/GIS equipment is not available. Instead, paper or digital records of areas of problem vegetation, compatible

vegetation and environmental sensitivity is provided to all personnel involved in the maintenance operation.

8.1.1.2 Establishment and Natural Regeneration

Re-establishment of vegetation is required on a public work site after construction or disturbance caused by operations such as ditching or intensive brush mowing or grubbing. IVM goals should be considered in the re-vegetation program.

Natural regeneration of native and naturalized plant species will eventually establish from the seeds and plant parts present in the soil. Other sources can be seed brought in by wind, water and animals or rhizome or root growth from adjacent areas. A mixture of herbaceous and woody vegetation communities will develop naturally over a 5 to 10-year period following disturbance.

Where soil stability or aesthetics are of concern, broadcast seeding, hydraulic seeding or transplanting will help to speed up establishment of compatible ground cover. The selection of introduced species will be determined by the level of maintenance planned for the area. Introduced plants may simply augment species that would naturally establish or a more manicured monoculture may be selected. Typical seed mixtures for use around public works contain horticulturally-improved varieties of grasses and/or forb (any broad-leaved herbaceous plant that is not a grass). These seed mixtures employ fast germinating nurse grasses that compete with emerging weeds while the permanent species establish.

Regardless of the species being established, good site preparation will help to ensure successful establishment. Once the site has been cleared of unwanted brush and other vegetation, cultivating equipment will be required to prepare a friable, loose seeding bed. It is important to establish a cover crop or compatible species as quickly as possible by selecting the appropriate seeding time for the species being planted.

Without intensive cultural practices and weed control, natural regeneration forces will continue to establish existing species, resulting in a mixture of naturally-occurring and introduced species. For example, a dense stand of turfgrass can prevent weeds from establishing, however, a maintenance regime involving watering, fertilizing, cutting and weed control is required to maintain its competitive edge against weed encroachment.

Certain grass and forb species are particularly competitive with allelopathic qualities that reduce establishment of brush species (see Section 8.2.1 for details). As well, there are competitive woody species including vines, shrubs and short trees that are compatible with certain public work sites or zones. Native plant communities containing these species can be seeded or transplanted on rights-of-way. However, establishing native species from seed is more challenging than establishing improved seed varieties of horticultural grass and forb species.

Over the life of a public work site, both compatible and problem vegetation may establish naturally. Selective management to encourage compatible species to provide natural control of weeds and brush through competition is a good long-term strategy to reduce the amount of work required to manage problem vegetation in the future.

8.1.2 Zoned Vegetation Management

The concept of differential vegetation management zones (zoned management) has been applied in many different public work rights-of-way and facility situations. The goal is to optimize management resources and reduce costs, by reducing the total area managed. Thresholds such as height, accessibility or other requirements are used to determine acceptable vegetation species in different zones or parts of the site. The zoned management concept should be an integral part of any vegetation management plan. The classic example is the ***Wire Zone/Border Zones*** designation of linear zones on power line rights-of-way.

Zoned Vegetation Use on Power Lines

The *wire zone* is the section of a transmission or distribution line right-of-way that is located directly under the overhead wires and extending horizontally out for a safe distance (usually ~3 meters) towards the right-of way edge. The plant height threshold and safe vertical distance from the power lines to vegetation can vary based on line voltage and design. The specifics are determined by the utility's engineering department. For example, in certain wire zones where lines sag and clearance requirements will be greatest, the height threshold may be as low as 3 meters in height, thus limiting compatible plant species to those with mature heights of 3 meters or less.

The *border zone* is the area located between the designated *wire zone* and the right-of-way edge. These areas have increased sag clearances so taller shrubs or short tree species may be tolerated, therefore there is a taller height threshold. The mature plant height thresholds may vary for different types of lines and from company to company.

Zoned vegetation management with power lines *Photo credit: Jennifer Rose*

Other Zoned Applications

The zoned concept of vegetation management has also been applied to railways, roads and pipelines where the amount of vegetation tolerated will range from zero (the railway bed and along highway median dividers) to low-growing vegetation (immediately over pipelines or along the shoulders of

roadsides). On highways, roads and railways, the area immediately next to the roadway is called the *Safety Clear Zone*. This area must be kept clear of woody vegetation to minimize contact by vehicles that may stray from the driving surface. This area must also be clear of any tall vegetation to maintain a clear line of sight for drivers. The width of the clear zone will depend on the topography, as well as the level and speed of traffic. Beyond the clear zones, there is flexibility to retain taller vegetation species along the outside (fence line) edges of the right-of-way or in interchange areas. Appropriate control(s) would be required to remove or contain problem plants that exceed the height threshold in any zone.

8.2 Biological control

Biological control makes use of the characteristics or actions of one organism that are detrimental to an undesirable plant species. These characteristics are exploited to reduce the population of undesirable species below levels that are considered damaging. Biological controls are usually only one part of a cultural control program. Creating an environment that favours an antagonistic organism over the undesirable plant species can develop naturally or antagonistic organisms can be introduced. It should be noted that biological controls require a certain level of management of the target organism to maintain its population and can be adversely affected by the application of non-selective or broad-spectrum pesticides.

8.2.1 Allelopathy

Naturally-occurring allelopathic chemicals within some species can reduce the establishment of woody plants within a plant community. The chemicals produced by these plants are released into the soil environment and inhibit the establishment or growth of other species. This inhibitive action can be used with the plant's other competitive qualities to reduce the establishment of incompatible weeds and brush species in a vegetation management plan. Examples of plants that have been shown to produce allelopathic chemicals are black walnut, black knapweed and goldenrod.

Once identified, compatible allelopathic species may be established by seeding or transplanting. Alternatively, natural stands of these plants may be identified and managed to encourage their survival and expansion. This can include protection from disturbance or herbicide damage. More research is required to determine the level of efficacy in the field.

8.2.2 Antagonistic Organisms

There is on-going research to identify natural predators of many invasive plants and other landscape pests. Potential tools may include insects, diseases or other organisms that help reduce populations of problem weed species in Ontario. One example is the search for natural pests of dog-strangling vine. Once an organism is found to provide effective control of the target weed, it must be tested to ensure there are no negative impacts on other plant species or the environment, before it can be released as a biological control.

8.2.2.1 Insects

In the 1990's, two European leaf-eating beetles, *Galerucella calmariensis* and *G. pusilla* were approved for release for control of purple loosestrife. These beetles are no longer commercially available, but populations may be moved from established sites to control purple loosestrife in a problem area. The Ontario Invasive Plant Council can provide locations of established *Galerucella* locations and methods for moving beetles to new sites. For more information, go to: www.ontarioinvasiveplants.ca

8.2.2.2 Diseases

There are biological control products available for broad-leaved weed suppression on turf landscape sites around public work facilities. One product contains *Sclerotinia minor* that suppresses top growth of dandelion, plantain and clover in turf and another contains *Streptomyces acidiscabies* for dandelion suppression.

A paste containing *Chondrostereum purpureum* is registered for use on red and Sitka alders. The fungus colonizes and decays the stumps before they can re-sprout.

8.3 Physical Controls

Some publications may treat mechanical controls as a type of physical control. For the purposes of this manual, physical controls refer to controls that are used by individuals with or without hand-held tools and mechanical controls refer to controls achieved with the use of larger, motorized equipment designed for larger areas.

Physical controls use equipment or the management of environmental factors to control unwanted vegetation. The number of incompatible plants present can be significantly reduced by physical, horticultural practices while maintaining strong and competitive growth in compatible plants, such as mowing of broadleaf weeds in turf.

8.3.1 Removal by Hand

Hand weeding and hoeing are effective for annual plants but less so with deep-rooted biennials and perennials. Hand weeding is only practical in smaller areas and one has to ensure that the waste is properly disposed of to prevent spreading of seeds and roots.

8.3.2 Mowing

Mowing with machines or with weed whips can be effective when the debris does not have to be removed but can be unsightly or pose a hazard when the vegetation being mown is tall. Mowing can improve sight lines along roadsides and guide rails and can reduce the population of annuals before they go to seed. Mowing should not be used if plants with toxic sap are present, e.g. poison ivy or poison oak.

8.3.3 Cultivation

Rototilling and cultivating using small, person-directed equipment are effective for the control of annual weeds prior to planting or natural regeneration. These methods can be limited by rocks in the soil or by the size of the area. Perennial weeds, depending on the species, can re-establish from pieces of stem, rhizome or root. Therefore, using a systemic herbicide on perennial species before rototilling or cultivating may be required for effective control.

8.3.4 Cutting

Chainsaw - The use of a chainsaw can allow the operator to be more selective when cutting incompatible vegetation. Workers on foot can access areas where mechanical machines cannot. Disadvantages include:

- operator fatigue and the potential of injury from repetitive bending or kick-back from the chainsaw
- specific training and personal protective equipment are required
- debris may need to be cleaned up
- suckers will grow from cut stumps, if not removed or left untreated

Manual cutting with a chainsaw may result in suckers growing from untreated stumps. *Photos courtesy: Gord Gallaugher*

Brush saw - A brush saw can be effective for the removal of larger areas of brush stems. There is less operator strain compared to the chainsaw but the same disadvantages as with the chainsaw still exist: specific training and personal protective equipment are required; debris may need to be cleaned up; and suckers will grow from cut stumps, if not removed or left untreated.

Tree Trimming - Not all vegetation can be removed along right-of-way corridors. Tree trimming may be required to maintain specific distances from power lines, sight lines or right-of-way edges. This can be achieved by several different methods:

Photo credit: Gord Gallaugher

- Trimming from the ground using a pole pruner can be physically challenging when longer extensions are used.
- Climbing the tree allows an arborist to reach the limbs/branches to make proper cuts. This can be physically demanding and requires special training and protective equipment.
- Aerial devices mounted on trucks or off-road equipment like rubber-tired tractors and tracked units provide easier access with less physical effort. These devices are useful when dealing with a greater number of trees, but requires training and special licenses to operate.

8.3.5 Girdling

Girdling refers to the cutting around the circumference of the stem/trunk to a depth that destroys the cambium, eventually killing the non-desirable plant. Some advantages to this method are:

- non-chemical control
- highly effective on thin barked species
- low risk to the exterminator
- inexpensive
- highly mobile
- easily learned

Some of the disadvantages are:

- growth continues for up to three years
- standing dead trees are hazardous
- complete girdles are difficult on steep slopes or multiple coppiced stems
- work is demanding
- tools require continual sharpening
- may not be effective on thicker barked species

8.3.6 Mulches and Barriers

Various products can provide a physical and/or sunlight barrier to seed emergence or to regrowth from rhizomes or perennial roots. The use of mulch or synthetic barrier or a combination of both can be very effective in preventing plant growth but the effect is localized to the application site.

Natural and artificial mulches can provide a degree of weed control if applied thick enough to shade out emerging plants germinating from seed. Some natural mulches, such a wood chips, need to be renewed since they break down over time. Seeds will then germinate on the mulch surface. To be effective, organic mulches should be at least 10 cm. deep and replenished frequently. Vigorous perennial plants will grow up through mulches from rhizomes, crowns or perennial roots.

There are numerous geotextiles, underlays (applied above or below ground), barriers and blankets that can inhibit seedling growth and rhizome penetration. These products have a limited life and are used on limited areas. They may be made from natural products such as straw or coconut fibers or may be netting or other fibrous products. Many of these materials are also used for other purposes during construction, such as a barrier between subgrade and gravel under roadways.

8.4 Mechanical Controls

Some publications may treat mechanical controls as a type of physical control. For the purposes of this manual, physical controls refer to controls that are used by individuals with or without hand-held tools and mechanical controls refer to controls achieved with the use of larger, motorized equipment designed for larger areas.

Mechanical vegetation control involves the use of ride-on machinery to remove vegetation from sites. Machines can achieve control over larger areas where physical methods would not be cost effective or efficient. Mechanical options are also considered to be safer than cutting by hand with brush saws, weed trimmers and chainsaws when treating high densities of undesirable trees and brush. Mechanical vegetation control is a short-term solution, as plants will grow back from the root system, plant debris and the soil seed bank.

Mechanical options provide immediate control of all vegetation and are often well suited for creating new rights-of-way or re-establishing sites after years of neglect. They are also often considered after chemical controls are ruled out due to issues that may include:

- landowner concerns
- very high brush densities requiring high volumes of herbicide
- concern with brown out from herbicides
- potential off-target damage to adjacent vegetation or public access requirements

A large variety of machinery is available such as brush mowers attached to a tractor or other device, grinders attached to excavators or tracked units, bulldozers, crushers and excavators. Vegetation

managers need to be aware of all the mechanical options when making IVM decisions and selecting the best equipment for the job.

There are several key points to consider when determining the specific type of mechanical option to be used. These can range from the conditions of the site to seasonal conditions to the availability of equipment. Following is a partial checklist of considerations:

Site Considerations

- steep slopes that may make operation of vehicles dangerous
- archeological sites, migratory bird habitats, rare plant communities or other species at risk
- potential concerns for habitat fragmentation and impacts to wildlife corridors by creating large, artificial openings on areas previously dominated by tree and shrub complexes
- underground pipelines and utilities that certain types of mechanical options may damage either from the operation or weight of the equipment over the utility. (Federal Acts dictate conditions working on or near some large pipeline rights-of-way with heavy equipment)
- fences, survey markers or septic systems that may be damaged by mechanical vegetation removal
- overhead clearances to power lines, communication lines or other potential overhead hazards
- large rocks, stumps or buried debris that may pose a hazard to equipment and operators or restrict operation of specific types of equipment
- soil types and depths that may be prone to rutting or mixing with sub-soil from operation of heavy equipment or certain types of mechanical equipment
- streams that should not be forded by equipment and riparian areas where damage to vegetation may lead to increased runoff, siltation of aquatic habitats or removal of important shade and habitat
- road surfaces and driveways that require mats for tracked or very heavy equipment and the width of the gravel shoulders that may also require mats or floating of equipment as work progresses
- adjacent land uses that eliminate some types of mechanical options due to potential hazards from flying debris, e.g. pedestrian or vehicle traffic
- blind curves and hills requiring special safety precautions when loading and unloading machinery

Equipment Considerations

- availability of equipment when work must be completed
- extent of work to be completed and the hourly rates for equipment as well as any float charges to deliver equipment to the site
- potential for vandalism or theft if equipment will be left on site unattended

Seasonal Considerations

- timeframe for use of equipment and whether cover crops can be successfully planted
- types of roads to be used to transport equipment to work site and time of year when half load limits may be imposed

Larger machines are rarely able to treat 100% of the vegetation in an area. Some vegetation will remain inside tower bases, next to fences, around rock outcrops, near guy wires etc. Physical controls or herbicide treatments will be required as part of the IVM strategy to fully complete the work.

When selecting equipment for any type of mechanical control, the best approach is to determine the long term objectives for the area being maintained, then consult with contractors, equipment manufacturers and industry experts. Operation manuals for each piece of equipment should be reviewed and thoroughly understood before any decisions are made.

There are five main categories of mechanical control:

1. Mowing
2. Cultivating
3. Grubbing
4. Excavating
5. Tree Cutting

8.4.1 Mowing

Mowing is most commonly associated with maintaining large areas covered with grass. However, mowers can also be designed for cutting brush or non-woody vegetation, so can be appropriate for maintaining mixed species zones. Mowing is an effective tool when the goal is to sustain an existing compatible vegetative community like grass. Knowledge of the life cycle of the vegetation to be mowed is important to ensure proper timing. For example, it would be best to cut weeds before they can produce seed.

Consideration should be given to whether the species being mowed will re-sprout. Conifers will not re-sprout from cut stumps, whereas deciduous woody vegetation will not only re-sprout, but may become more vigorous with increased stem densities in future years. Mowing deciduous woody plants will need to be continued on a regular basis and may need to be augmented with herbicide treatments. There are mowers available that cut and apply herbicides all in one operation. This is called *wet blade technology* and is an effective option for controlling brush and broadleaf weeds using a selective herbicide.

Photo credit: Bob Burke

Wet blade mower applies herbicide as blade cuts vegetation.

Mowing for brush removal may result in sites that are difficult to travel for vehicles or on foot. Cut debris may be a tripping hazard or may puncture tires. The resulting slash from mowing may also act as a possible fuel source for fires.

Mowing for turf maintenance is most effective when performed more frequently. Frequent mowing (monthly or more often) thickens a turf cover and controls some weed species. Infrequent, low mowing that removes more than one third of the grass blade puts negative stress on the plants resulting in thinning turf over time.

Mowers can be flail or rotary types with rubber tires or tracks and may be mounted on vehicles or run from arms. There are a variety of mower widths and configurations for treating flat land or ditches with a wide difference in operational capabilities such as turning radius. Rotary type mowers are often referred to as "brush hogs" and are best suited for treating woody vegetation. The maximum brush diameter that can be cut with mowers is usually 10 cm.

8.4.2 Grubbing and Cultivating

Grubbing is also referred to as rotavating and grinding and involves the cutting and mixing of cut debris into the soil and sub-soil. Grubbing is non-selective and all existing vegetation will be impacted.

Flying debris is not usually a concern since the vegetation is ground into the soil and sub-soil. Grubbing will produce a site that will be suitable for the planting of cover crops that will decrease woody vegetation densities in future years. The site will look like a freshly tilled farm field upon completion and although the landscape will be dramatically altered, the site will be aesthetically pleasing. It is quite common following grubbing operations in agricultural areas for the landowner to start to farm a site thus reducing utility maintenance costs.

However, grubbing may also allow the establishment of invasive plants or other incompatible vegetation. Soils that are exposed following grubbing may be prone to wind and water erosion and may lead to more use of the sites by ATVs or other vehicles.

There are many types of grubbing equipment available. Tractor-pulled cultivation equipment can be used to cut and turn under herbaceous plant cover on accessible rights-of-way to control weeds and prepare a site for seeding. Herbicide application prior to cultivation will provide superior control of perennial weeds.

Photos courtesy: Bob Burke

Crushers / grinders can be mounted on a number of vehicles and will cut vegetation and mix cut debris into soil & subsoil.

8.4.3 Excavating

Excavating involves the use of bulldozers and excavators (backhoes) to dramatically change the landscape. This often includes removal of all surface vegetation, stumps, rocks and leveling of lands. Normally, sites are seeded with a cover crop following excavation. Sites that are treated in this fashion are much easier for crews to access and are level and cleared to allow mowing in future. On soft or wet soil conditions, it is possible to use blades and backhoe equipment to remove vegetation at the surface, once the ground is frozen.

Photos courtesy: Bob Burke

Bulldozers and excavators can dramatically change the landscape, removing rocks, stumps and vegetation.

Excavating is common in the construction of many types of public work lines. For example, this type of operation is commonly used during new pipeline construction as the area immediately above the pipeline is required to be level and free of debris. Disposal of excavated debris must be in accordance with local and provincial regulations.

8.4.4 Tree Cutting

There are a number of tree cutting machines such as feller bunchers and tree harvesters that allow for large scale clearing of trees. This method is more efficient and safer than rigging, cutting with chainsaws and dropping trees.

Tree cutting equipment is capable of cutting, removing limbs, and stacking trees very efficiently. Where deciduous trees are being cut, to prevent re-sprouting, stumps must be removed or followed with herbicide applications for longer term control.

Photos courtesy: Jennifer Rose

Feller buncher

Off-road lift

Untreated stump resprouting

8.4.5 Precautions

When hiring contractors to perform mechanical operations or when being completed by in-house crews, it is very important that equipment be properly maintained to avoid unnecessary breakdowns, petroleum spills or leaks into the environment, and to protect from flying debris. Ensure that all equipment operators are trained on operating the equipment and are familiar with the equipment manual. All product manuals and safety bulletins issued by the manufacturer should be read and kept in an accessible location.

Mechanical options provide immediate control of all vegetation and are often well suited for creating new rights-of-way or re-establishing sites after years of neglect. One side effect is there can be a drastic change in the landscape. To avoid landowner conflict, the vegetation manager must clearly convey what the site will look like short term and long term, explain the objectives of the operation and future responsibilities should noxious weeds become established or other problems arise.

Potential concerns with habitat, archeological sites, migratory birds and species at risk must all be considered. Additionally, the soil types and depths should be noted, as well as any slopes that may be affected once the vegetation has been eliminated and the soil texture has been altered. Streams, creeks, riparian areas and aquatic habitats all require buffer zones.

The presence of underground utilities must be looked at as it can be illegal to work in the vicinity. Fences, survey markers, septic systems, overhead power lines must all be identified and marked.

Occupational Health and Safety Act (OHSA) clearances to power lines must be known and adhered to at all time. Normally signs must also be posted warning equipment operators of restricted overhead clearances when work is being completed. Operators must consult provincial regulations prior to beginning work.

The season may affect access to areas, type of equipment to be used, the establishment of a cover crop and moving equipment during load restrictions. Road crossing needs to be considered as heavy equipment can damage roads of all textures. Adjacent land use can determine the type of equipment to be used, especially if pedestrian or vehicle traffic may be at risk from flying debris.

Sites where mechanical operations will occur must be clearly mapped out and marked out in the field to ensure work only occurs where planned. Guy wires on rights-of-way pose a very serious hazard to be avoided when operating equipment and should be clearly marked with caution tape before work begins.

Some questions to pose when implementing mechanical controls are:

- Are operators properly trained and certified?
- Is the operator aware of physical hazards of the site?
- How will you ensure flying debris does not harm other people or property?
- Has the operator done a daily circle check of the machine?

- Are all safety guards in place on the machine?

8.4.5.1 Cleaning of Equipment to Prevent Spread of Invasive Plants

Whenever equipment is being transported from a site containing invasive plant specie(s) to a new site, machinery should be thoroughly cleaned to minimize the potential of transporting invasive plant parts or seeds. Cleaning should include power washing, especially the underside of mowers, graders and any equipment used to clean out ditches. The Invasive Plant Council of Ontario has developed a "Clean Equipment Protocol for Industry" and can provide operations guides and workshops. For more information go to their website at: www.ontarioinvasiveplants.ca

8.5 Chemical Control

Chemical control treatments may use naturally-occurring or synthetic chemicals to kill or hinder the growth and development of incompatible vegetation. It is important to be aware of the different control methods being used to time pesticide applications in conjunction with other pest control methods. Issues with chemical control may include:

- landowner concerns
- very high brush densities requiring very high volumes of herbicide
- concern with brown out from herbicides
- potential off-target damage to adjacent vegetation
- public access requirements.

Equipment must be properly calibrated to ensure the correct amount of herbicide is applied to avoid wasted product, poor results and off target or environmental damage. It is imperative that only federally-approved, provincially-classified products are used for the control of plants listed on the pesticide label at the given rates. All other instructions, cautions or warnings on the product label must be heeded and proper training and/or licensing and/or certification of applicators is required for the use and handling of these products. For more information about applicator requirements in Ontario, see Section 9.2 of this manual.

8.5.1 Modes of Action

Knowing and understanding how herbicides affect and move within a plant and the environment is crucial in making the correct choice of product. The mode of action is the manner in which a pesticide acts on a pest. This will influence how the pesticide should be applied and when it will affect the pest. The Weed Science Society of America has identified 30 Classes of herbicides based on their site of action. A full list of the Classes and associated chemical families can be downloaded here.

A good explanation of the different groups can be found in a factsheet produced by the Ontario Ministry of Agriculture, Food and Rural affairs (OMAFRA) at:

http://www.omafra.gov.on.ca/english/crops/facts/00-061.htm

The OMAFRA document divides herbicides into four broader groups of herbicides that:

- cause injury to new growth and with the potential to move from leaves to roots
- cause injury to old growth and with the potential to move only upward
- are applied to the soil with the potential to injure emerging seedlings
- cause immediate injury with little or no movement

Another more simplified way of categorizing herbicides is based on their chemical activity as they relate to their use.

Contact Herbicides - affect the parts of the plant on which they are applied and have minimal movement within the plant.

Systemic Herbicides - are absorbed by the treated portion and move or translocate to other areas within the plant.

Selective Herbicides – affect specific plant types (e.g. grasses vs. broadleaf) or species.

Non-Selective Herbicides – affect all plant types or species.

Residual Herbicides - break down slowly in the soil after application. They may remain active in the soil and can provide weed control for several weeks. Plants will absorb these herbicides mainly through their root system.

Non-Residual Herbicides - usually have a fairly immediate affect but become inactive in the soil fairly quickly after application. Plants will absorb much of these herbicides through their foliage.

Pre-Emergent Herbicides – are applied to the soil before weeds germinate, interrupting their ability to emerge as seedlings.

Post–Emergent Herbicides - are applied to target weeds that are just emerging or have already emerged.

8.5.2 Tank Mixtures

There are several products that have combined activities. One example is an active ingredient that provides post-emergent control of plants and also provides residual control of germinating seedlings. A similar effect can be achieved by combining more than one product to form a tank mixture. Other tank mixtures can provide two modes of action and better control than either product alone.

A tank mixture could be two or more chemicals that are sold together, but packaged separately and mixed in the sprayer tank. Registered tank mixtures will have been tested for their physical compatibility, efficacy, safety and crop residues. There will be clear instructions for use as a tank mix on the label.

The federal government does authorize the use of unlabeled tank mixtures, but before you can use such a mix there are six (6) conditions to meet such as *Each tank mix partner is applied in accordance with its registered product label (for example, Directions for Use, Precautions, Buffer Zones, etc.). In cases where information on the tank mix partner labels differs between them, the most restrictive directions must be followed.* Anyone using or recommending an unlabeled tank mixture does so at their own risk and

liability. Please use this link for the full text for the PMRA's directives on the use of unlabeled tank mixes. (please note that this document has been archived and tank mix labelling is under review).

In addition to an active ingredient mixture, there may be the need to add an *adjuvant*. An adjuvant is any substance added to a spray solution to modify and enhance the effectiveness of the herbicide. The largest class of adjuvants is called *surfactants*, also known as surface active agents. These can improve the spread, dispersal and/or wetting properties of an herbicide mixture.

8.5.3 Application Methods

The choice of herbicide application method depends on many factors. These include the time of year, proximity to sensitive sites, the degree of selectivity desired, compatible species present and the type of herbicide activity. The applicator must be aware of and comply with buffer zones around sensitive areas like water. Also, changes in wind speed or direction can affect the risk of herbicide drift. The applicator must therefore be vigilant at all times to ensure herbicide does not enter water courses or drift off the right-of-way and damage nearby plants.

Both liquid sprayers and granular spreaders must be calibrated prior to use to ensure herbicides are applied at the correct labelled rate.

8.5.3.1 Broadcast Applications – Liquid and Granular

Broadcast applications blanket spray an entire target area. Areas where control is required over the entire property such as railway ballasts, brush control on railway and roadside rights-of-way, roadside noxious weed control, and around refineries or electrical transformer sites are all suitable areas for broadcast herbicide application.

Foresters may apply herbicide a year prior to planting trees to remove competing vegetation in preparation for planting – called chemical *site preparation*. This also may be done in strips to reduce the amount of herbicide applied. Managers of newly created rights-of-way may also do a broadcast herbicide application prior to seeding with compatible species.

One type of broadcast spray unit uses nozzles mounted on the side of the spray unit that spray outward.

When only scattered patches of weeds or brush are to be controlled, a *directed foliar* application is used. The sprayer may be similar to the one used for broadcast herbicide applications with the ability to switch the application on and off. Another sprayer type is the 'hose and handgun', where the operator aims the spray handgun at the target vegetation, pulls the trigger and sprays. The operator is in a good position to observe both target and compatible species, but must still be vigilant for sensitive areas. Less total herbicide will be used in directed foliar applications than in broadcast applications.

Roadside broadcast sprayer

Handgun sprayer for more targeted applications

Photos courtesy: Gord Gallaugher

Granular Herbicide Application

Certain herbicides are formulated as ready-to-use granules which are spread over the area to be treated per the product label instructions. Granular applications are convenient for hard-to-access areas or around or under certain structures or machinery. The granules dissolve with rain or soil moisture, releasing the herbicide into the soil, where it can be picked up by the plant roots. Drift is not an issue with granules. However, heavy rainfall before herbicide adsorption to the soil may wash the granules off the target site and cause damage to adjacent vegetation. Conversely, inadequate rainfall can reduce its effectiveness, as not enough herbicide will be released into the soil.

Granular herbicides are applied using either of two spreader types. A *drop spreader* uses gravity to meter the granules out through openings at the bottom of the hopper. The openings are adjusted to regulate the flow of pesticide. A *rotary* or *cyclone spreader* has a positive metering mechanism in the form of a spinning disk that distributes the granules as the applicator or vehicle moves forward at a fixed speed. Spreaders can be hand-held or mounted on a truck or off-road vehicle. Disadvantages to granular herbicides are the need to recalibrate for each granular formulation and the spinning discs often distribute the pesticide unevenly on sloping ground.

8.5.3.2 Stem Brush Treatments

Some herbicides can be taken into a tree through the bark or applied to cut stumps to allow the chemical into the cambium layer containing the plant's plumbing system – the xylem and phloem. Once inside, the herbicide will be transported through the plant, killing it. These herbicides can significantly reduce the amount of herbicide put into the environment by targeting and treating only incompatible plants on a site. Consult product labels to determine which method is most appropriate.

Directed stem foliage applications provide more complete control than a simple foliar spray since the herbicide is also applied to the stems of the target brush. Equipment for this type of application is typically hand-held, often backpack style units, which can easily be carried into areas normally not accessible to larger equipment.

Cut stump applications are applied to the stump after cutting off the top growth to prevent the stump from re-sprouting. Some water-based herbicide formulations such as glyphosate need to be applied only to freshly cut, wet stumps. Other oil-based herbicides like triclopyr can be applied to the surface and bark of the stump up to a few months after cutting.

Photo credit: Gord Gallaugher

The **Frill** method of stem herbicide application, sometimes referred to as '*hack and squirt*', involves applying herbicide into a gash that has been cut into the bark where it can be absorbed into the tree.

Basal bark herbicide application means applying herbicide in a directed manner, generally with a low-pressure, handheld sprayer to the lower stems of brush or small trees. The herbicide is mixed with light oil instead of water to assist penetration through the bark and into the plant. There are several types of basal bark applications available, depending on the herbicide. Consult the product label to determine which method is appropriate.

Photo credit: Jennifer Rose

High volume basal bark application uses a hose and handgun to apply 1-3% herbicide in oil mixture to the bottom one meter of stems. Thorough coverage of the stem, root collar and any exposed roots is required, and a large quantity of oil is needed.

More recently, herbicide products have been developed for **low volume basal bark** applications that are applied in a higher concentration (15-20%) herbicide and oil mixture to the lower 50 cm. of the stem, as well as the root collar.

One-sided streamline applies a 5 cm. band of concentrated herbicide/oil mixture down one side of the lower 50 cm. of stems less than 8 cm. in diameter. The mixture should slowly spread out to encircle the stem. Stems over 8 cm. in diameter require a second band applied on the opposite side to ensure the herbicide mixture completely encircles the stem.

Thin line application applies the concentrated herbicide/oil mixture in a band 5 cm. wide, completely around the stem, at a point approximately 15 cm. above the ground.

Only a few milliliters per stem are required for all of these low volume basal applications, so backpack sprayers can be used effectively. The volume of herbicide applied per hectare is substantially reduced, since only targeted stems are treated. There is a high degree of control over where the spray mixture goes, reducing risk of drift to compatible plants, water or sensitive areas.

Herbicides may be **injected** into the stem of small trees or brush. Glyphosate is available in a capsule which is injected with the use of a specially designed injection lance directly into the stems of the target species, with zero risk of drift or accidental exposure to wildlife or humans.

Injection lance places capsules containing systemic herbicide into the trunk or stems for targeted treatments. *Photos:Gord Gallaugher*

Recently, a mechanical brush cutter that also applies herbicide directly to the freshly cut stump market. This is called the **wet blade** applicator**.**

The rotating cutting blade of the brush mower receives a flow of herbicide from a reservoir mounted on top of the blade. The herbicide flows out over the blade by centrifugal force, and as the blade cuts and passes over the brush, herbicide is wiped onto the cut stump. Drift is eliminated, and one pass both cuts and applies herbicide. Product labels must be checked, as the availability of herbicide products labelled for this machine is limited.

Photos courtesy: Gord Gallaugher

Herbicide is applied to the rotary mower blade to apply to stump as it is cut in wetblade applications

8.5.4 Wood Pole Treatments

The treatment of in-ground, utility wood poles with fungicides or insecticides can greatly increase their service life. Decay from wood rot or structural damage from insects can lead to utility pole failure, cause power outages and reduce worker and public safety. Control options available for wood utility poles that are damaged from insects or rot are:
pole replacement
stubbing - the non-chemical, physical reinforcement of the wood pole by fastening a short column or stub to the pole at ground line or
wood preservative pesticide – to treat for either insect or fungal damage

Pesticide treatments of a wood utility pole to prevent decay from wood rot or structural damage from insects can be applied either externally or injected into the pole. External options are:
External insecticide treatment of liquid pesticides are applied in areas of insect activity and any visible cracks or crevices on the pole.
Bandage treatment of in-ground wood utility poles involves the application of a paste formulation of a wood preservative pesticide in the form of a bandage at the ground-line area.
Internal or injected treatments include:
Liquid pesticide injection involves drilling a specific number and depth of holes into the pole below soil level and liquid pesticide is injected into the holes, as per the label. After treatment, the excavated area is refilled.
Solid pesticide injection requires holes to be drilled into the core of the pole at the ground-line area. Rods containing a pesticide are inserted into the drilled holes as per the label rate. Rods eliminate any spill risks, but are more expensive than liquid treatments.

8.5.5 Herbicide Use Resources

Pesticide Labels contains the most complete and legally-binding information about the use of all products. Labels are affixed to each and every pesticide container, but they can also be accessed from the manufacturer, distributor or from the PMRA web site.

Safety Data Sheet (SDS), previously known as the Material Safety Data Sheet (MSDS) is available for each controlled products and provides detailed health, toxicity, safe handling and emergency response information about the product. It is more detailed than the product label and is updated at least every three years. A current SDS must be made available to all workers handling the product and employers are required to provide training to all persons handling toxic or potentially hazardous products. Employer's obligations are outlined in a guideline provided by the Ontario Ministry of Labour here.

SDS is available from the product supplier upon request and can usually be downloaded from a supplier's web site. You may also access a comprehensive SDS database, for a fee, at the Canadian Centre for Occupational Health and Safety.

OMAFRA Publication 75C, Guide to Weed Control – Chapter 18 - Roadsides & Non-crop Areas provides a list of herbicides registered for use in Ontario, by crop or use area and includes other information on herbicide regulation, application, problem pest control, control ratings. Always consult product labels for complete information on using products listed in this publication, especially whether the product is labelled for industrial vegetation management.

The print form of this publication was last updated in 2016-2017 and OMAFRA will no longer be updating this publication. All future updates to the electronic version will be managed by the Ontario Vegetation Management Association and made available on their website here.

OMAFRA website provides entry to the many information sources of OMAFRA. In particular, there is information on pest control products and sprayer calibration techniques under Pesticide Application and Safety.

In 2020, the **Ministry of Environment, Conservation & Parks (MECP)** made amendments to harmonize Ontario's classification approach with the federal product designation, i.e. manufacturing, restricted, commercial and domestic. You can access information about the classification of pesticides in Ontario in Section 9.2.2.

Manufacturer Websites will often provide additional useful information about a product.

8.5.6 Precautions

Read all Pesticide Labels before using any product. The label may have a **hazard warning symbol** indicating the type and degree of hazard. Products with a hazard symbol pose a higher risk to human health. The label will also have a list of **Precautions** when using the product and any protective clothing required when using it.

Check the label for environmental cautions or restrictions including:

- buffer zone requirements
- safe distances from compatible plants to avoid off-target damage
- soil types and potential contamination of water bodies from run-off or leaching
- potential drift

Drift should always be taken into consideration. Wind speed and direction, air temperature and nozzle type (droplet size) should always be noted prior to application and recorded.

The **First Aid** section of the label provides appropriate actions for each type of exposure – skin, eyes, oral or inhalation and **Toxicology** will provide more detailed information for medical personnel.

The **SDS** provides a more in-depth analysis of potential short-term and long-term health effects from exposure to the product, potential environmental effects and more details on protective clothing or other measures. Information on dealing with spills and the effect of fire on the product is also available on the SDS.

All persons applying pesticides must be trained and in possession of either an Industrial Vegetation Exterminators Licence issued by the MECP, or hold a Pesticide Technicians Certificate. One licenced exterminator may supervise up to 3 technicians.

Everyone must have and use personal protective equipment, as specified on the pesticide label. Having a reliable safety supply company locally is an asset for the purchase and maintenance of personal protective equipment.

Equipment should be in good repair and servicing and refueling done in a safe location. The sprayer should have been recently calibrated and everyone should know the buffer zone requirements and potential effects to off-target vegetation of the pesticide being applied.

Everyone should know the location of the onsite first aid emergency equipment, supplies and emergency telephone numbers. A supply of clean water and soap for cleanup and a spill kit to assist in controlling pesticide spills should also be onsite.

Emergency Response - No pesticide should be used near water sources or other environmentally sensitive areas. Special care should be taken to ensure petroleum products never enter water. Absorbent material should be available to contain or soak up spills and a waste drum to carry contaminated materials offsite for safe disposal.

Spills Action Centre telephone number 1-800-268-6060 should always be readily available to report spills that may harm persons, property, or the environment.

CANUTEC at 1-613-996-6666 or cell *666 is the contact for accidents on public roads involving products regulated under the Transportation of Dangerous Goods Act.

Pesticide Storage must be clean and secure. It is **illegal** to store pesticides under unsafe conditions. Regulation O. Reg. 63/09 gives safe storage requirements for storage facilities. There are two requirements that everyone must follow, including homeowners who store pesticides for uses other than in or around the home:

- pesticides must be stored away from food, drinks and pet food
- pesticides must be inaccessible to the public when left in an unattended parked vehicle, put pesticides in a locked compartment of the vehicle

Mixing and Loading of pesticides into the sprayer must always be done well away from water courses or other environmentally sensitive areas. Proper protective clothing is extremely important since studies have shown pesticide exposure to be the highest during this activity, especially when handling concentrated product. Backflow protection on the filling line is required to prevent contamination of the water source when filling the spray tank.

Pesticide Disposal of residual product and empty containers is subject to O. Reg. 347 under the Environmental Protection Act. Any containers larger than 23 L should be returned to the manufacturer or point of sale. Agriculture is the largest market for pesticide products and OMAFRA has good information about the disposal of surplus/unused product and containers here.

CleanFARMS is a not-for-profit organization that conducts a collection program for empty pesticide containers and every three years they also accept obsolete pesticides. For information about both these programs go to their website.

8.6 Limited-use Methods

The following control methods may be appropriate in specific circumstances.

8.6.1 Livestock

The use of goat and sheep grazing for vegetation control has been studied and used on a limited scale. Safety fencing and/or control by a shepherd would be necessary, especially where moving vehicles are involved.

Photo credit: Bob Burke

8.6.2 Heat

Burning or the use of high temperature to kill weeds has been tried in some situations. Extreme caution and an energy source is required. Heat can provide non-selective control of plants by breaking cell walls, burning plant tissues and is most effective on annuals and germinating seeds.

Commercial fire burners have been used on limited areas. Some municipalities in Ontario operate equipment applying steam for sidewalk weed control.

Hot water and steam have both been tested on railways with mixed results and were both abandoned. The steam application was discarded because of its high cost and very low productivity. Heating water to create steam is expensive and slow with only about one mile of track treated per day. Additionally, the effect of the treatment was short term (equivalent to mowing). Hot water treatment productivity was slightly better (2-3 miles a day), but still too slow, expensive and control was short-lived.

Propane flamers have also been tried on railways, but this option was also abandoned primarily due to the high risk of setting fire to the right-of-way and adjacent properties.

In nature, fires are primarily started by lightning strikes and prior to settlement, large expanses of land would burn annually. Tall grass prairie and oak savannah vegetation communities are ecologically important and provide deep-rooted native grass and forb cover that is suitable for many public work sites, including roadsides and power lines. Tall grass prairie and oak savannah

vegetation communities require periodic burning to maintain biodiversity and prevent tree invasion. Fires remove species that are not fire tolerant and promote those that are. Without periodic burns, trees and shrubs will invade these sites and the area will lose the prairie or savannah plant communities. Controlled burns can be very effective in removing many invasive species such as buckthorn.

Prescribed burns are fires that are intentionally started and conducted by professionals to mimic naturally-occurring fires. Prescribed burns are recognized as an integral management tool to control brush in public works tall grass prairie vegetation and are normally conducted in the spring of the year.

The Ontario Ministry of Natural Resources has conducted a prescribed burn on numerous occasions under a tower line operated by Hydro One to manage the tall grass prairie at Ojibway Park near Windsor, Ontario. Controlled burns are a potential tool in the IVM toolbox, but this vegetation management technique should be left to professional fire crews to plan and execute due to fire safety issues and smoke hazards affecting public work user safety (vehicles, trains). Consult local authorities for local requirements and permits related to conducting a controlled burn.

8.6.3 Precautions

Burning should only be done under the control and direction of trained and experienced fire crews.

CHAPTER 9: Legislation

Pesticide laws are in place to protect human health and the environment. Pesticides are regulated by Federal, Provincial and sometimes Municipal governments. Links to key legislation that may affect pesticide use for the maintenance of public works are provided in this chapter.

Note: The information provided in this chapter is for reference only and the final authority concerning the interpretation of all Acts, regulations and by-laws rests with the appropriate level of government.

9.1 Federal Legislation

9.1.1 Pest Control Products Act

The Pest Management Regulatory Agency (PMRA) of Health Canada registers pesticide products under the *Pest Control Products Act* (PCPA) allowing for their sale and use across Canada. The PCPA can be found here.

Once a pesticide is registered, it is given a unique registration number or Pest Control Product (PCP) number that must be present on the front panel of the pesticide label. The label is a legal document that details how to handle, store, transport, use or dispose of the pest control product. Pesticides may not be used for any other purpose or in a manner not described on the label.

A searchable database of all pesticides registered for use in Canada under this Act can be accessed through a mobile Pesticide Label App or on-line here.

The federal Pest Management Information Service provides information on federally registered pesticides. The toll free number is 1-800-267-6315. The email address is: pmra.infoserv@hc-sc.gc.ca

9.1.2 Fisheries Act

The Fisheries Act prohibits anyone from carrying on *any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery.* The Act prevents anyone from placing harmful substances in water frequented by fish.

When using or handling pesticides near bodies of water, especially in *ecologically significant areas*, attention must be given to the Fisheries Act. Fisheries and Oceans Canada administers this Act that can be found here.

9.1.3 Migratory Birds Convention Act

The purpose of the Migratory Birds Convention Act is the protection of migratory birds and their nests. Section 5.1 of the Migratory Birds legislation may pertain to Public Works. The prohibitions are listed below for your reference. The Act can be found here.

5.1 (1) *No person or vessel shall deposit a substance that is harmful to migratory birds, or permit such a substance to be deposited, in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters or such an area.*
(2) *No person or vessel shall deposit a substance or permit a substance to be deposited in any place if the substance, in combination with one or more substances, results in a substance — in waters or an area frequented by migratory birds or in a place from which it may enter such waters or such an area — that is harmful to migratory birds.*

9.1.4 Transportation of Dangerous Goods Act

The Transportation of Dangerous Goods Act and Regulations are administered by Transport Canada. It controls the handling, offering and transport of potentially hazardous goods including some pesticides.

This legislation permits the transport of potentially dangerous goods only by people who are properly trained. They must use shipping documents, special labels, vehicle placards and follow certain safety procedures. Your vendor should tell you if the pesticide products that you are transporting are considered dangerous goods and require documents, labels and placards. The Act can be found here.

9.1.5 WHMIS

The Workplace Hazardous Materials Information System (WHMIS) is a national information system intended to protect Canadian workers through the implementation of the Hazardous Products Act and associated Regulations. The key elements of the system are product classification, based on hazard; product labels that provide basic user information; safety data sheets (SDSs), and worker education programs. WHMIS is administered federally by Health Canada and provincially by the Ontario Ministry of Labour.

More information on WHMIS can be found here.

In Ontario, WHMIS requirements are in:

1. *The Occupational Health and Safety Act (OHSA) generally requires employers to ensure hazardous products are identified, to obtain safety data sheets and make them available in the workplace and to provide instruction and training to workers. The OHSA also provides for the protection of confidential business information according to procedures set out in the federal HMIRA.*

2. *The Workplace Hazardous Materials Information System Regulation (R.R.O. 1990, Regulation 860) sets out in detail the employer's duties respecting labels and safety data sheets for hazardous products and prescribes the content and delivery of worker education programs. The regulation also sets out the types of confidential business information the employer may withhold from a label or safety data sheet.*

More information about the responsibilities of employers can be found in the Ministry of Labour guideline here.

9.1.6 Use of Drones

The use of drones for the application of pesticides is an emerging technology that is currently under review by Health Canada. To stay up-to-date as regulations are developed, please go here.

9.2 Ontario Regulatory Requirements

This section provides regulatory information for public works owners, operators, and licensed industrial vegetation exterminators that apply pesticides for the purposes of the public works exception under the cosmetic pesticides ban. Pesticides used on public works must be used in accordance with all relevant legislation, including requirements of the *Pesticides Act* and *Ontario Regulation 63/09* that are related to licensing, permits, posting of signs and storage and transportation of pesticides. While every effort has been made to ensure the accuracy of the information contained in this document, it should not be construed as legal advice. In the event of conflict with the legal requirements identified in the Act or Regulation, the legal requirements will apply.

9.2.1 Pesticides Act

In Ontario, pesticides are primarily regulated by the Pesticides Act and its General regulation. The Pesticides Act and its General regulation can be obtained from the Ontario e-Laws website (e-laws.gov.on.ca).

9.2.2 Classification of Pesticides

Ontario classification occurs automatically with the federal registration of a pesticide product. Classification is aligned with the federally designated classes.

Federal Pesticide Class	Ontario Pesticide Class
Manufacturing	Class A
Restricted	Class B
Commercial	Class C
Domestic	Class D

9.2.3 Licence Requirements

Appropriate licences are required to apply pesticides, operate a company that performs exterminations, or sell pesticides. Licensed exterminators can only perform exterminations as stipulated by their licence.

The Industrial Vegetation license authorizes the use of all herbicides, insecticides and fungicides, except fumigant gases in the following circumstances:

- herbicides in a land extermination to control vegetation for the benefit of public work, including:
  - roadsides
  - utility corridors
  - rail lands, and
  - oil and gas pipelines
- herbicides in a land extermination to control vegetation in areas that give access to a public work such as:
  - equipment yards
  - well sites
  - communication, and
  - transportation facilities
- herbicides in a structural extermination to control roots in sewer systems, and insecticides and fungicides on in-ground wood poles.
- herbicides in a land extermination for the purpose of maintaining rights of way or easements that are not related to a public work.
- herbicides to perform an extermination for the purpose of controlling plants under the promotion of public health and safety: other buildings, structures exception to the cosmetic pesticide ban. That is, to prevent damage to the structural integrity of a building or other structure if the damage to the building or structure by the plants would place the health or safety of a person at risk.

The following uses are not authorized by the Industrial Vegetation license:

- fumigant gases
- pesticides in a water or structural extermination
- pesticides from an aircraft
- insecticides and fungicides on turf, ornamental plants and trees, or
- rodenticides

9.2.4 Ontario's Cosmetic Pesticide Ban

Ontario's cosmetic pesticides ban is in place to reduce potential risk from the cosmetic uses of pesticides. Pesticides cannot be used for cosmetic purposes unless the only active ingredients in the pesticide are active ingredients that are on the Allowable List. It is illegal for any person to use, cause or permit the use of an unlisted pesticide in a land extermination unless under an exception to the ban. "Cosmetic" as defined in the Pesticides Act means the non-essential use of a pesticide. Pesticide products that contain only active ingredients that are on the Allowable List (i.e. biopesticide or lower risk pesticide) are allowed to be used for cosmetic purposes, such as to control weeds and other pests on lawns, gardens, and driveways. All pesticides must be federally registered and used according to label directions.

Pesticide active ingredients on the Allowable List include:

- biopesticides (microbial, pheromones or semiochemicals) as defined by the Pest Management Regulatory Agency,
- pesticides that pose a low risk to human health and the environment based on consideration of the following factors:
    - the active ingredient has a low inherent toxicity to non-target organisms.
    - the products in which the active ingredient is contained have a low potential for their use to result in significant human or environmental exposure
    - the active ingredient is not persistent in the environment
    - the active ingredient is widely available to the public and has a history of safe use for a purpose other than as a pesticide
    - the active ingredient has a mode of action that is not the result of toxicity to the target organism

Exception for Promotion of public health or safety: public works

Under the cosmetic pesticide ban, the use of pesticides with an active ingredient that is not on the Allowable List is permitted for certain excepted purposes in accordance with specific conditions. One such purpose is for the promotion of public health and safety including the destruction, prevention or control of plants, fungi or animals that affect public works and other buildings and structures, including carpenter ants and termites.

Definition for "public work"

The term "public work" means a structure that provides a benefit to the public and that is owned or operated by the Government of Ontario or Canada or by any board or commission thereof, or by any municipal corporation, public utility commission or by private enterprise and includes any railway, canal, highway, bridge, power works including all property used for the generation, transformation, transmission, distribution or supply of hydraulic or electrical power, gas works, water works, public utility or other work.

Promotion of Public Health and Safety: Public Works

Pesticides with an active ingredient that is not on the Allowable List that are used under the public works exception can only be used for an extermination that is performed to:

- prevent damage to the structural integrity of the public work, if the potential damage caused to the public work by the plant, fungus or animal would place the health or safety of a person at risk;
- facilitate essential maintenance of the public work, if the plant, fungus or animal would interfere with or prevent the maintenance;
- allow for emergency access to the public work, if the plant, fungus or animal would interfere with or prevent the access; or
- ensure the security of the public work, if the plant, fungus or animal would place the security at risk

The exception does not allow for the control of pests in gardens and landscaped areas maintained for cosmetic purposes. The exception does not allow pesticides to be used in these areas regardless of if they are under the control or ownership of the owner/operator of the public work. Unless another exception applies, the use of pesticides to maintain these areas is a cosmetic use, and only pesticides with active ingredients that are on the Allowable List can be used.

The public works exception does not allow a person to use an unlisted pesticide in, on or over land that forms part of a portion of a highway that is intended for pedestrian access or other portions where the public is invited to stop, including a rest area or picnic area.

Some examples of pesticide use authorized under the public works exception include:

- use of a herbicide with an active ingredient that is not on the Allowable List to control vegetation that is penetrating a public work, such as a dam if the vegetation is damaging or will damage the structural integrity of the dam
- use of a herbicide to control vegetation on a highway to facilitate maintenance of that highway such as:
    - ensure clear sight lines including signs and intersections;
    - promote water flow, drainage and drying, and prevent road flooding;
    - allow motorists to see animals at the roadside;
    - facilitate winter snow removal maintenance; or
    - reduce snow accumulation
- use of a herbicide with an active ingredient that is not on the Allowable List to control vegetation on a utility right-of-way to allow emergency access to electrical power lines)
- use of a herbicide with an active ingredient that is not on the Allowable List to control vegetation around a federal prison if the vegetation were placing the security of the public works at risk, or

- the use of a fungicide with an unlisted pesticide to control fungus in an inground wooden pole that is a public work to prevent damage, if the potential damage could cause the wooden pole to fall and thereby place the health or safety of a person at risk

IPM Certification requirements

The exception to the cosmetic pesticide ban for public works sets out certain requirements related to IPM certification. The person using the pesticide must be certified by an integrated pest management body approved by the Director or working under written instructions of a person so certified. The IPM Council of Canada is an approved IPM body.

If the person using the pesticide is certified by an integrated pest management body, the person shall carry (or have readily available at the extermination site) the certificate or a copy of the certificate. Alternatively, if the person using the pesticide is working under the written instructions of a person who is certified by an integrated pest management body, the person shall carry (or have readily available at the extermination site) a copy of the following:

1. The certificate issued to the certified person
2. The written instructions

Annual Report

The owner or operator of a public work that used unlisted pesticides must prepare an annual report each year. The annual report covers the period from January 1 to December 31 in a year and shall be prepared before January 31 in the following year.

The form that must be used for the Annual Report can be found on the University of Guelph Ridgetown campus webpage for Ontario IPM (https://www.ontarioipm.com/). The annual report must include the following information:

- name of each active ingredient used
- quantity in kilograms of each active ingredient used
- reason for using each active ingredient
- method of use for each active ingredient
- map or plan showing the location of all application areas
- explanation of how future use of each active ingredient used will be minimized
- signature of the person who is certified by an integrated pest management body approved by the Director and who used, supervised the use of or provided any written instructions on the use of unlisted pesticides

A copy of the annual report must be kept at the head office of the owner or operator of the public work for at least five years and given to a provincial officer or the Director immediately on request or to any person free of charge within seven days.

Notification

Public concerns related to the use of pesticides have largely focused on their application to publicly accessible areas such as residential lawns, playing fields, golf courses, rights-of-way, cemeteries, and parks where the activity of children, adults and pets may result in the exposure to pesticides. Increasingly, the public wants to know where and when pesticides will be used, so that they may take personal precautions if they so wish.

To address public concerns, the General regulation under the Pesticides Act requires notification of pesticide use in Ontario on non-residential land areas and on residential land areas where pesticides are applied in, on or over land by any person (unless exempt under the General regulation). The notification requirements provide specific information regarding the application of a pesticide and allow the public the opportunity to make an informed decision as to whether to enter the treated area.

A licensed exterminator shall give public notice as required by the legislation and is responsible for:

- obtaining and displaying suitable rain resistant signs in accordance with the legislation as available on the Ministry of the Environment, Conservation and Parks website at: https://files.ontario.ca/moecc_179_pesticides_notice_warning_signs. pdf;
- using signs that are rain-resistant, sturdy and reusable;
- completing the signs legibly for the extermination;
- posting and removal of the sign(s) where and when required by the legislation; and
- providing written notice to the occupants of neighbouring residential area properties that abut the application area (for example a tree that abuts the neighbouring residential area property by roots, branches or trunk etc.)

Permits

In addition to a licence, a permit may be required for some pesticide applications. For example, a permit is required for any extermination using a Class B or C pesticide with a label that indicates that it contains picloram in a land extermination. Picloram is a herbicide used for brush control along rights-of-way. Refer to the General regulation under the Pesticides Act and the nearest Ministry of the Environment, Conservation and Parks Regional Pesticides Specialist to determine if a permit is required.

9.2.5 Environmental Protection Act

The purpose of the *Environmental Protection Act*, *R.S.O. 1990, Chapter E.19* and its Regulations is to protect and conserve the natural environment. This Act is administered by the Ministry of the Environment Conservation and Parks. Section 14 of the Environmental Protection Act applies to pesticides if they contaminate the natural environment in any way.

R.R.O. 1990, Regulation 347: General – Waste Management, under the Environmental Protection Act, applies to pesticide container depots and deals with the handling and storage of empty pesticide containers for eventual recycling.

9.2.6 Ontario Water Resources Act

The *Ontario Water Resources Act, R.S.O. 1990*, states that it is illegal to deposit in any body of water in Ontario any material that may impair the quality of the water. This Act is administered by the Ministry of the Environment, Conservation and Parks.

9.2.7 Endangered Species Act 2007

The *Endangered Species Act 2007, S.O. 2007, Chapter 6* provides for the conservation, protection, restoration and propagation of species of fauna and flora that are endangered or threatened with extinction in the Province of Ontario. The Act provides legal protection for both a species and its habitat that is classified endangered or threatened. This Act is administered by the Ontario Ministry of Natural Resources.

9.2.8 Weed Control Act, R.S.O. 1990, c. W.5

The Weed Control Act protects agricultural lands from plants considered noxious weeds. It is administered by the Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and empowers municipalities to designate any plant, in addition to provincially listed noxious weeds for removal. Both the municipality and the province can require landowners to remove or control plants listed as noxious weeds. A list of all weeds designated as noxious can be found on the Ministry's website here.

9.2.9 Invasive Species Act, 2015

The Invasive Species Act, 2015 is administered by the Ministry of Natural Resources and Forestry and is concerned with controlling the spread of species not native to Ontario that may pose a threat to the natural environment. It restricts the propagation, transport or sale of prohibited invasive species and provides the Minister with the ability to require land owners to remove invasive species to mitigate its spread. For more details, the Act may be found here.

9.2.10 Clean Water Act, 2006

The *Clean Water Act, 2006. S.O. 2006, Chapter 22* ensures communities protect their drinking water supplies through prevention – by developing collaborative, watershed-based source water protection plans that are locally driven and based on science. The plans may include restrictions on activities within municipal wellhead protection areas and surface water intake protection zones where municipal drinking water sources may be impacted. Consult with your local conservation authority for your local plan. You can access the Clean Water Act here.

9.3 Municipal Bylaws

Public works managers need to be aware of local bylaws that may affect the use of pesticides in maintaining public works. Managers should also consider local tree cutting bylaws, property standards bylaws and source water protection plans.

CHAPTER 10: Integrated Vegetation Management References

10.1 Plant identification

A Guide to Identifying Trees and Shrubs in Ontario: http://ontariotrees.com/id/howtoid.php -
Agriculture and Agri-Food Canada Weed Database: http://www.weedinfo.ca/
Canadian Poisonous Plants Information System: http://www.cbif.gc.ca/pls/pp/poison?p_x=px
Committee on the Status of Endangered Wildlife in Canada (COSEWIC):
http://www.cosewic.gc.ca/
E-Flora BC: https://ibis.geog.ubc.ca/biodiversity/eflora/identification.html
Global Compendium of Weeds: http://www.hear.org/gcw
Michigan State University Extension Publications for the Landscape and Nursery Professional
http://msue.anr.msu.edu/uploads/234/40581/msu.pdf
Northern Ontario Plant Database: http://www.northernontarioflora.ca/
Northern Ontario Plant Database – Rare Plants:
http://www.northernontarioflora.ca/links.cfm?val=rare_plants
OMAFRA Publication 505 – Ontario Weeds:
http://www.omafra.gov.on.ca/english/crops/facts/ontweeds/weedgal.htm
Ontario Wildflowers – Poisonous Species: http://ontariowildflowers.com/main/poisonous.php
Plants and Lichens at Risk in Ontario:
https://www.ontario.ca/environment-and-energy/species-risk-type?name=Plants+and+Lichens
Royal Botanical Gardens Rare Plants Database: http://www.rbg.ca/archive/rare/epo_plant.htm
United States Department of Agriculture – Plants Database: http://plants.usda.gov

10. 2 Industry Specific Vegetation Management References

Review of Integrated Weed Management for Ontario Roadsides
Canadian Pacific Integrated Vegetation Management Plan, 2010
Pest Management Plan for Integrated Vegetation Control PMP Confirmation #: CN-0128-12/17
Canadian National Railways May 3, 2012 – May 3, 2017

CHAPTER 11: Glossary of Useful Terms

action threshold - the point at which treatment should take place to prevent a pest from causing harm. Timing depends on the type of treatment selected

active ingredient (a.i.) - the portion of a pesticide formulation which is the actual toxicant.

adjuvant - a substance added to a pesticide to improve the pesticide's physical qualities, hence its effectiveness, e.g., wetting or spreading agents, stickers, penetrants, emulsifiers and synergists

adsorption - the adherence of a pesticide to the surface of a plant or soil particle

aerosol (pressurized can) - a small amount of pesticide or combination of pesticides that is driven through a fine opening (orifice) by an inactive gas under pressure (propellant) when the nozzle is triggered

agitation - the movement of a liquid pesticide to keep the chemical contents mixed so as to prevent them from separating or settling in the spray tank

allelopathy - the inhibition on the growth and germination of other plants due to chemical products released from roots, other plant parts and plant debris of certain plants. Examples of allelopathic species are black walnut, Canada goldenrod.

antidote - a substance used to counteract the effect of a poison

application rate - the amount of pesticide product or active ingredient applied to a unit area or in a unit volume of water

bacteria - one-celled microorganisms, some of which cause diseases in plants or animals. They can be seen with a microscope

beneficial - useful or helpful to people (as in 'a beneficial insect', e.g., an insect which feeds on aphids)

biological control - the use of living things such as predators, parasites or disease organisms to control pests

botanical pesticide - naturally-occurring compounds which are derived from plant parts and are toxic to pests, e.g., pyrethrum. Synthetic botanical pesticides are man-made pesticides which are similar to those found in nature

broad spectrum pesticide - a pesticide that controls or is toxic to a wide range of pests when applied correctly, See non-selective pesticide

buffer zone - areas or strips of land left untreated to protect a nearby area, e.g., a sensitive water body, habitation

calibrate - (1) to determine the amount of pesticide being applied through a nozzle of a sprayer, duster or granular applicator over a given area; (2) to mark a container or tank to indicate the volume at certain levels

calibrated sprayer rate - the amount of spray mix applied per unit area. This is determined from calibration procedure in field conditions (L/ha)

carrier - an inert material mixed with active ingredients to make a pesticide formulation, e.g., finely ground clay, talc, volcanic ashes, water, oil, solvent, air and gas propellants

caustic - a corrosive, low pH chemical that may burn the skin

chemical name - the name of the chemical structure of the active ingredient

compatible - materials in a spray or dust mixture are compatible if one does not reduce the effectiveness of the other and if crop injury does not result from the use of the combination

compatible vegetation – vegetation that does not interfere with the public work, pose a safety hazard, cause interruption of service or impede access to the public work for service or maintenance

c**oncentrate** - opposite of dilute. Concentrated formulations are diluted with water or oil before use

concentration - refers to the weight of active ingredient in a given weight or volume of a formulation or spray mixture

coverage - the degree of uniformity of a pesticide application over a surface

crop - useful plants growing where desired

dermal toxicity - the degree of toxicity of a compound when it is absorbed through the skin of mammals.

detergent - any liquid normally used as a cleansing substance. Some may also be used as wetting agents due to their ability to reduce the surface tension of water droplets

diluent - any liquid or solid material used to weaken (dilute) or carry an active ingredient

dilute - to make a pesticide concentration thinner or weaker by adding water, oil or solids (dusts)

disease - an abnormal condition of an organism resulting from an infectious (parasitic) or non-infectious (non-parasitic) agent

dissolve - usually refers to getting solids into solutions

ditching - road maintenance activity where plants, gravel and other debris is dug out of the ditch to re-establish adequate drainage to protect the road structure

drift - the movement of pesticide droplets, vapour or dust, by wind or air currents, away from the target area onto areas not being treated. Drift constitutes one of the major hazards of pesticide application

dust - a dry, finely divided carrier (diluent) containing an active ingredient, usually of low concentration, to be used without dilution

ecosystem - a community of organisms interacting with one another and the specific habitat (environment) in which they live

efficacy - a term used in pest control to mean the degree to which a pesticide or procedure will control a specified target pest

emulsifier - synonymous with emulsifying agent

emulsifying agent - a material which helps to suspend one liquid in another, such as oil in water

environment - the surroundings, including water, air, soil, plants and animals

exposure - when contact occurs with a pesticide orally, ocularly, dermally or through inhalation

exterminator - a person carrying out control of a pest

flowable or suspension concentrate - pesticide formulation which consists of a thick suspension of finely ground particles. The formulation is diluted with water and the spray mix should be kept well agitated

forb - broad-leaved herbaceous plant that is not a grass

formulation - a mixture of active ingredient with carriers, diluents or other materials, to make it safe and easy to store, transport, dilute and/or apply

frass – powdery refuse of wood-boring insect or excrement from insect larvae

fumigation - the use of chemicals in gaseous form to destroy pests. Fumigation may be carried out in storage areas, under tents in the field or by direct application to the soil and covering with a tarpaulin.

fungi - small, often microscopic, plant organisms which cause rots, moulds and plant diseases; they lack chlorophyll (green colouring). Fungi grow from microscopic-size spores and produce tiny threadlike growths. Some fungi can cause the deterioration of structures (singular: fungus).

fungicide - a pesticide used to control fungi

germination - the beginning of vegetative growth, usually refers to the beginning of growth from seed

ground-line – line drawn to signify the surface of the ground

habitat - a particular environment in which organisms live

herbicide - a pesticide used to control or manage weeds

host - the living plant or animal a pest depends on for survival

humidity - refers to moisture or dampness in the air

incompatible - cannot be mixed or used together. When two or more pesticides that are not compatible are mixed together, one or more may precipitate from the mixture, or the effectiveness of one or more may be reduced, or injury to plants or animals may result

inhalation - to breathe air into the lungs

insect - small animals with adults characterized by having the body divided into three parts: head, thorax and abdomen; and the thorax divided into three segments, each bearing a pair of segmented legs

insecticide - a pesticide used to control or manage insects

Integrated Pest Management (IPM) - a decision-making process that uses a combination of techniques to suppress pests and that include: pest prevention, pest identification, monitoring pests & environmental conditions, establishing pest thresholds, selecting appropriate control practices and evaluating the program results.

IPM Certified Applicator - the designated licensed industrial vegetation exterminator responsible for ensuring pesticides are used in accordance with IPM principles. It is also the person who passes the IPM examination, ensures their registration is up-to-date with the IPM Council of Canada and completes the required continuing education credits (CEC) annually.

leaching - refers to the movement of chemicals through a soil by water

mammals - warm-blooded animals that nourish their young with milk; their skin is more or less covered with hair

Safety Data Sheet (SDS) - Legislated under Workplace Hazardous Materials Information System (WHMIS). Provides information on health hazards, personal safety, and environmental protection for hazardous products. SDS is not a legal document. It may not be available for all pesticides

microorganism - A living organism, including a fungus, virus and bacterium that can only be seen with a microscope

mites - small to minute animals having eight legs in the adult stage. There are harmful and beneficial species

mode of action - the way in which a pesticide affects a living organism, e.g., disrupts the nervous system or inhibits cell division

mollusc - A soft-bodied animal, which usually, but not always lives in water and has a shell, such as a clam, oyster or mussel. Some (snails and slugs) live on land, and move by means of a single "foot." Slugs are molluscs with no shells

nematodes - microscopic roundworms (thread worms, eelworms) which may do considerable crop damage. Nematodes may be animal or plant parasites, some are free living. Generally found in the soil feeding on plant root systems. Not all nematodes are harmful.

non-selective pesticide - a pesticide that is toxic to a wide range of pests, or toxic to more than one plant or animal, e.g., a nonselective herbicide is one which kills many plant species.

nozzles - devices which control droplet size, application rate and uniformity of a pesticide application.

parasite - an organism that lives in or on the body of another organism obtaining nourishment from it

penstock - gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydro turbines and sewer systems

persistence - the time during which a pesticide retains its toxic properties

personal protective equipment - any clothing, material or device that offers protection from pesticides; especially important when handling or applying toxic pesticides, e.g., gloves, apron, boots, coveralls, hat, respirator and goggles

pest - Any harmful, noxious, or troubling organism that may cause an undesirable effect. Pests include some: fungi, bacteria, viruses, plants, insects, mites, rodents, birds and wildlife

Pest Control Products Act - a Federal Act administered by the Pest Management Regulatory Agency of Health Canada to register and regulate pesticides sold or used in Canada

Pest Control Product Act Registration Number (PCP #) - the number which is assigned to a specific pesticide when registration is approved. It must be displayed on every pesticide container label sold or used in Canada

pesticide - a product designed to kill, control, repel, attract or manage pests

pesticide buffer zone - an area between the non-target area and the pesticide treatment area that is not treated with pesticides in order to prevent entry of pesticides or pesticide residues by drift, runoff or leachate into the non-target area. The width of the pesticide buffer zone is up to the discretion of the pesticide applicator, who must take the type of pesticide application equipment, speed of travel, terrain topography, soil conditions and weather conditions into account

pesticide label - As defined in the PCP Act: "Any legend, word, mark, symbol, or design applied or attached to, included in, belonging to, or accompanying any control product." A pesticide label is a legal document

pesticide resistance - Occurs when a pest population is exposed to the same, or a similar, pesticide for a number of times. A few individuals may have a genetic difference that enables them to survive a pesticide application. These reproduce and generate a new population that is resistant to the pesticide

pH - an expression of the degree of acidity or alkalinity. The pH scale of numbers 0 to 14 expresses the intensity of acidity or alkalinity. Materials with a pH of 7 are neutral. Those below 7 are acid. Those above 7 are caustic (alkaline)

phloem – plant vascular tissue that transports sugars and other organic materials produced in the leaves down to the rest of the plant

ppb - parts per billion
ppm - parts per million
product - the pesticide as it is packaged and sold
propellant - the compressed or liquefied gas used in pesticide aerosols to disperse the pesticide
purpose - describes the group of pests that are controlled by the pesticide product, e.g., insecticide, fungicide
registered pesticide - a pesticide accepted under the Pest Control Products Act for the uses and purposes claimed. The Pest Control Products Act Registration Number must be displayed on the label of each pesticide container sold or used in Canada.
residual - to continue to remain over a period of time after application
resistance - the ability of an organism to resist or suppress the injurious effects of a pesticide
risk - The chance that someone or something will be harmed by the toxicity of a pesticide and one's exposure to it
rodent - small mammals of the order Rodentia. Includes such pest species as rats, mice and pocket gophers
R.S.O. – revised statutes of Ontario
runoff - movement of water (including any contaminants) down a sloping surface
safety data sheet (SDS) - previously known as the Material Safety Data Sheet (MSDS) provides detailed health, toxicity, safe handling and emergency response information about the product. It is more detailed than the product label and is updated at least every three years.
selective pesticide - a pesticide which is more toxic to some types of organisms than others. Usually used to describe a particular type of pesticide, such as a selective herbicide, e.g., a selective herbicide may kill broadleaf weeds in a cornfield without injury to the corn
solvent - a liquid which will dissolve one or more substances to form a solution
sounding - tapping a wooden utility pole with a mallet to listen for hollow sections that have been damaged by pests such as insects or fungi
spore - a small, usually single-celled asexual or sexual reproductive body capable of growing into a new organism
spot treatment - an application of spray to localized or restricted areas as differentiated from broadcast or complete coverage
spray - a pesticidal formulation dissolved or suspended in a liquid (usually water or oil) so that it can be applied in fine droplets.
spreading agent - a substance used to improve the wetting and spreading properties of a spray mixture
spreader sticker - a substance used to improve the wetting, spreading and sticking properties of a spray mixture, e.g., facilitates the spreading of a liquid over leaf surfaces, and enhances
surfactant - a chemical or agent used in a pesticide to make mixing easier and to assist in the spreading of a chemical and the wetting of and adherence to the surface to be treated, e.g., emulsifiers, soaps, wetting agents, detergents and spreader stickers
suspension - a liquid or gas in which very fine solid particles are dispersed but not dissolved. Constant agitation is essential
target pest - the pest at which a pesticide application or other control method is directed

tolerant - ability to withstand effect, e.g., grasses are tolerant to 2, 4-D to a degree that it can be used selectively on lawns to control some broadleaved weeds

toxicant - poison

toxicity - the degree to which a substance is poisonous or injurious to a plant or animal. Toxicity is one consideration in assessing the hazard in handling a particular pesticide

vapour - the gas produced by a substance which is generally a solid or liquid at room temperature. A gas or vapour is not the same as an aerosol or mist which are composed of tiny droplets of liquid suspended in air

virus - infectious agent of plant or animal, too small to be seen except with an electron microscope. They are protein bodies capable of multiplying and acting like living organisms within the host organism

weed - any plant growing where it is not wanted

WHMIS - Workplace Hazardous Materials Information System

xylem – plant vascular tissue that transports water and nutrients upward from the roots