



**Weed Control on Highways in the Calgary Area**

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**Abstract:**

The negative impacts of invasive species cost the Alberta economy thousands of dollars annually and can result in even greater ecological losses. These may come in the form of habitat loss, displacement of native plants and decreased land productivity, in addition to direct financial costs of preventing and controlling infestations. The Alberta *Weed Control Act* regulates the control of invasive species in Alberta, and recognizes three classes of weeds; restricted, noxious and nuisance. Enforcement of the *Act* is the responsibility of local municipalities. The regulatory environment is complicated by the fact that individual municipalities have the power to upgrade the status of a weed to a higher class within the municipality, resulting in unique requirements in certain areas of the province.

A number of Best Management Practices (BMPs) are currently in place to address invasive species management issues during highway construction. These include pre-disturbance weed surveys, use of native seed, cleaning of construction equipment and soil handling best practices, among others. Despite best efforts, the disturbance created during construction often provides an opportunity for invasive species to establish (or expand) a foothold. Once established, infestations can be quite difficult to control, even under ideal conditions. Proximity to sensitive areas, landowner limitations, and site stability concerns can further limit control options. Addressing the infestation often requires a multifaceted approach. In this presentation, examples of context-appropriate BMPs implemented on recent road projects in the Calgary area are described, including follow-up treatments and lessons learned.

## 1.0 INTRODUCTION

The negative impacts of invasive species cost the Alberta economy thousands of dollars annually and can result in even greater ecological losses. These may come in the form of habitat loss, displacement of native plants and decreased land productivity, in addition to direct financial costs required to prevent and control infestations.

Transportation planners in Alberta regularly encounter issues, in both urban and rural settings, related to invasive plant species and specifically, weed species as identified through provincial and/or regional regulations. In urban settings, the need for weed control is commonly linked to aesthetics, residential complaints, and public land use concerns. In rural Alberta, weed control is more often required to address concerns relating to loss of crop productivity, livestock health or degradation of wildlife habitat. A related concern is introduction of agronomic species in areas of native vegetation, with a resultant loss of native plant habitat quantity and quality.

A good understanding of the current and relevant Best Management Practices (BMPs), existing legislation and site-specific conditions is required when addressing weed issues on Alberta road projects. Examples of context-appropriate BMPs implemented on recent road projects in the Calgary area are described, including follow-up treatments and lessons learned.

## 2.0 REVIEW OF BEST MANAGEMENT PRACTICES

Key considerations in the effective management and control of weeds on a site include prevention, early detection and rapid response. Once an infestation (ie. establishment of sufficient number of weeds in an area to have a harmful effect) has been identified, management measures can become more effort-intensive and include inventory, treatment and monitoring. A review of current BMPs commonly applied on Alberta road projects is outlined below. Specific examples are provided in the context of the Northwest Stoney Trail Project, located in Calgary. Although the focus of this presentation is on weed species, BMPs can be considered generally applicable to the control of other invasive plant species as well.

### 2.1 Prevention

Preventing invasive plant introductions before they occur is the most effective means to avoid or minimize risk (Environment Canada 2004). Prevention offers the most effective and economical method as well as providing environmental and social 'savings'.

The spread of weeds occurs most commonly by the spread of weed seeds. Three of the most common sources of weed seeds contributing to infestations are:

- i) weed seeds present in the topsoil (ie. seed bank);
- ii) weed seeds present in an applied seed mix; and
- iii) introduction of weed seed from a third party or offsite source (e.g. people, animals, vehicles or equipment that have carried weed seed from another location).

BMPs to control an existing seed bank usually involve establishing alternate vegetation (such as a cover crop) that is capable of outcompeting the weeds or sterilization of the weed seed bank. Sterilization of the seed bank can be achieved either by limiting germination of the weed seed or

by controlling germinated weeds prior to establishment. Control methods are discussed further below.

Seed mix contamination can be controlled using an approved seed supplier, checking seed certificates prior to seed application, and selecting a seed grade appropriate for the project. Generally, Canada Common No. 1 seed mixes are used on Alberta Transportation projects. Environmental planners should be aware that various seed grades are available and use of a higher grade may be warranted in some situations (e.g. through areas of native grassland).

The introduction of weed seed by a third party or offsite source (e.g. construction equipment, vehicles, animals) is difficult to control during highway operations as there is normally no way to determine whether a potential source has deposited weed propagules within the road right of way. During the construction phase of projects, introduction of weed seeds can be controlled by ensuring equipment used on transportation projects is cleaned and weed-free prior to right of way entry. Construction contract documents may include a special provision specifying equipment supplied to the site is clean and weed-free, or that periodic cleanings are required.

## **2.2 Early Detection and Rapid Response**

It is essential to detect and identify invasive species before or immediately after they become established. General monitoring and selective monitoring around critical points of site entry, protected areas, and urban and agricultural ecosystems are important (Environment Canada 2004).

Regularly scheduled weed surveys may be required on projects with existing weed issues or with a particular sensitivity to weed infestations. Weed surveys may be particularly important in less visible locations or where adjacent landowners are especially sensitive to weed issues.

## **2.3 Management of Weed Infestations**

The management of invasive plants includes three basic components: inventory, treatment and monitoring. These were identified as BMPs through research and review of numerous invasive species management plans and strategies.

### **2.3.1 Inventory**

The first step in managing invasive species is to conduct an inventory of species present and to document their distribution. The survey information is used to prioritize areas for control in conjunction with other factors such as plant impacts, size and intensity of infestation, local or regional concerns, opportunities for cooperative control and the potential impacts of control measures (ASRD 2004).

### **2.3.2 Treatment Methods**

The three main treatment methods currently being practiced in Canada and the US include mechanical, chemical and biological control. The majority of control carried out in Alberta is either by chemical (herbicide application) or mechanical (mowing and picking) means. Biological control involves the introduction of organisms capable of destroying specific plant populations.

## Mechanical Treatment

Mechanical treatments include burning, tilling, digging, hand-pulling, mowing and cutting, mulching and grazing. For mechanical treatments it is important to thoroughly clean and inspect all equipment and clothing before moving off-site. This will reduce the probability of spreading the weeds to the next worksite (Tu *et al.*, 2001).

### *Burning*

Controlled burning is an effective strategy in weed control, especially if seed production has already occurred. Burning results in some of the seeds being destroyed, but effectiveness varies depending on the duration and intensity of the heat and the maturity and location of the seeds (BC Ministry of Forests and Range 2006).

### *Tilling*

For annual weeds, the objective of tillage is to prevent seed production and to deplete current seed reserves in the soil. Tillage encourages weed seeds to germinate, so that subsequent cultivation can bring the plant species to the surface and the roots are exposed and desiccated (BC Ministry of Agriculture, Food and Fisheries 2002).

### *Hand-Pulling and Digging*

This method is one of the more ecologically friendly treatments and can be carried out by people with variable plant knowledge, including volunteers and untrained labour under the guidance of a vegetation specialist. This involves removal of the reproductive plant structures to the point below the area of sprouting and removal of all roots, if plant is capable of asexual reproduction (rhizomes). Weeds that are hand-pulled after they have started forming seed must be carefully removed to prevent the spread of seeds. The program is ideal for small infestations, but may need to be carried out for a number of years until the seed banks have been depleted. (Mosquin 1997).

### *Mowing and cutting*

In using mowing as a control method, the timing of cuts and number of cuts per growing season is critical to satisfactory control. This strategy is acceptable for large infestations, when hand-pulling is not feasible and cultivation is impractical or impossible. Furthermore, it can be an effective way to prevent further spread of the weed, when waiting for appropriate timing or availability of other treatments. Mowing should be undertaken prior to seed production and as close to the ground as possible. This method can be very effective on certain perennial weeds (BC Ministry of Agriculture, Food and Fisheries 2002).

### *Mulching*

Mulching involves the placement of mulched plant materials (typically woody debris) on top of weed infested areas. This method prevents light from reaching the shoots of the weeds until the reserve food supply in the roots is depleted, thereby starving the plants. The timing of mulching and the depth of the mulch is critical to success. In order to be effective, mulch should be applied before or shortly after seed germination to ensure that weeds are not able to grow through the mulch. Mulch should be applied to a uniform depth normally ranging from 2 to 10 cm depending on site conditions and the type of mulch material used.

### *Chemical Treatment*

Herbicides are naturally derived or synthetic products designed to impact the growth of undesirable vegetation. The choice of herbicide depends on several factors such as (BC Ministry of Agriculture, Food and Fisheries 2002):

- the target weed species;
- the stage of growth;
- crops or other plants on the site;
- soil texture and soil depth;
- distance to commercial or residential areas; and
- distance from a water source.

Several different herbicides can be effective for a given weed species. Alberta, Agriculture and Food (2007) website provides a list of registered herbicides considered effective for various weed species.

The Alberta Pesticide Management Program oversees the administration and enforcement of provincial pesticide application including herbicides. Only pesticides registered for use in Canada by the Pest Management Regulatory Agency under the *Pest Control Products Act* can be used in Canada.

### *Biological Treatment*

Biological control methods incorporate the use of living organisms to control weeds. This method involves the introduction of specific insects or animals to feed on the weeds, or control with a plant pathogen. Biological control is best suited to large, dense infestations where other management strategies are neither cost-effective nor environmentally desirable. It is intended to weaken the target weed by decreasing seed production and reducing weed density. It normally will not eliminate the weed problem (Alberta Agriculture and Food 2000).

## **2.3.3 Monitoring**

Monitoring is the collection, analysis and interpretation of information in order to evaluate results of weed control treatments. Following monitoring, an evaluation of the data will aid in determining the success of the weed management strategy or determine if modifications to the weed management plan are required. An excellent monitoring aid is the use of photographs to document changes in invasive species over time.

### 3.0 LEGISLATION

#### 3.1 Federal

Federal weed legislation consists of the Plant Protection Act, the Seeds Act, and the Weed Seeds Order. The federal government has also developed an Action Plan for Invasive Alien Terrestrial Plants and Plant Pests and An Invasive Species Strategy for Canada.

The *Seeds Act* and associated regulations, among other things, determines how seeds are graded in Canada. It is important to note that the weed seeds prohibited in the *Act* are identified in the *Weed Seeds Order*, and may not include species regulated under provincial or municipal legislation.

#### 3.2 Provincial

##### **Alberta Weed Control Act and Regulations**

In Alberta, weed control is legislated under the *Weed Control Act* and associated regulations. Under the Act a land occupant or owner must:

- destroy all restricted weeds located on the land to prevent the spread, growth, ripening or scattering of the restricted weeds;
- control in accordance with the Act and the regulations all noxious weeds located on the land to prevent the spread, growth, ripening or scattering of the noxious weeds; and
- prevent the spread or scattering of nuisance weeds.

*Restricted weeds* are designated as restricted in order to prevent their establishment. Restricted weeds are non-native species that pose a serious threat because of their ability to spread rapidly and out-compete natural vegetation (ASRD 2004). Only seven species in Alberta are classified as restricted.

*Noxious weeds* are generally more abundant than restricted weeds, but have the ability to spread rapidly (ASRD 2004). Twenty-two species are listed as noxious weeds.

*Nuisance weeds* are common throughout the Province and include native species. Due to their abundance and biological suitability; it is difficult to eradicate nuisance weeds (ASRD 2004). Thirty-six species are categorized as nuisance weeds.

Section 31 of the *Weed Control Act* states that the occupant or owner of the land must destroy all restricted weeds, control noxious weeds and prevent the spread or scattering of nuisance weeds.

Pesticide and herbicide handling, storing and application in the province are governed by the *Alberta Environmental Protection and Enhancement Act* and the *Environmental Code of Practice for Pesticides*.

### 3.3 Municipal

The City of Calgary bylaws that relate to invasive plants and their management include the *Community Standards Bylaw 5M2004*, which empowers the City to meet the requirements of the *Alberta Weed Control Act*, the *Drainage Bylaw 37M2005* which relates to the release of prohibited materials including pesticides, herbicides and fertilizers and the *Agricultural Pest Bylaw 5M94* which addresses the responsibility of the landowner to prevent the establishment of pests on or in their land, property or livestock.

## 4.0 EXAMPLES FROM THE NW STONEY TRAIL EXTENSION

### Setting

The NW Stoney Trail Extension is an ultimate 8-lane freeway currently under construction, and forms the northwest leg of AT's Ring Road for the City of Calgary. The Calgary ring road was originally planned in the 1970's, with land purchased in 1980's and 1990's and includes a right-of-way (ROW) for the highway as well as a utility corridor for pipelines, powerlines and municipal utilities. Although most of the ring road is located inside the urban boundaries of the City of Calgary, it is considered provincial property and is not subject to municipal legislation. Off site impacts, including noise, drainage and waste disposal, may however be subject to municipal by-laws in urban areas.

Stoney Trail Extension has been under construction since 2006, with detailed design beginning in 2003. This portion of the ring road is 15 km in length, with major interchanges at the TransCanada Highway (Hwy 1) and the Queen Elizabeth Highway (Hwy 2) as well as several additional interchanges at major municipal arteries..

In the intervening time since the purchase of the ROW, the land has been under various states of management. While the eastern portion of the ROW was leased mainly to agricultural use, the western portion of the ROW was largely vacant or used for commercial purposes. As a result, the standards for weed control varied across the project. A pre-disturbance survey was conducted to identify problem weed areas. Minor infestations of Canada thistle, dandelion and sow thistle were identified at various locations throughout the project. A review of the BMPs proposed to control for three weed species (Nodding thistle, scentless chamomile and foxtail barley) and the success of these BMPs on the Stoney Trail Project are described below.

### Nodding thistle.

Nodding thistle (*Carduus nutans L.*) is listed as a restricted weed in Alberta (Figure 1). An infestation of nodding thistle was identified in the northwest quadrant of the Stoney Trail/Shaganappi Trail interchange (Figure 2). As excess topsoil was anticipated from this area, the infested topsoil was salvaged, with only the necessary amount of affected material used for reclamation. Based on soil balance requirements, some of the material was used for reclamation and monitored for weed growth. Excess material was stockpiled within the TUC and will be stored adjacent to the road corridor until such time as it is required for reclamation of the ROW or an alternate use of the material is identified. Areas reclaimed with infested topsoil as well as the stockpiled topsoil material will be monitored as part of routine environmental inspection during construction of the project. Approximately 40 plants were identified following the growing season in a limited (30 m X 100 m) area and subsequently hand controlled in the fall of 2007. Chemical control supplemented by mowing and hand control is proposed for summer 2008.





Figure 1: Nodding thistle plant found on Stoney Trail project in 2007



Figure 1: Nodding thistle infested backslope along Stoney Trail in 2007

### **Scentless chamomile**

An infestation of scentless chamomile (*Matricaria maritima L.*) was identified at the Inland Gravel pit (Figure 3). Scentless chamomile is listed as a noxious weed in Alberta (Figure 4). During reclamation of the gravel pit and in advance of road construction, the rough subgrade for Stoney trail was prepared and the steep side and back slopes were reclaimed. The infestation in this area consisted mainly of several mature plants located on the existing subgrade. As the area of infestation was located on the proposed roadbed and minimal disturbance of the backslopes and sideslopes was anticipated, encapsulation of the infested fill material and monitoring of the surrounding area was recommended as the BMP.



Figure 3: Disturbed backslopes and sideslopes in scentless chamomile infestation area along Stoney Trail project.



Figure 4: Scentless chamomile plant found on Stoney Trail project in 2007

During construction, additional disturbance of the back and sideslopes was undertaken to accommodate stormwater treatment and slope stability issues. In the summer of 2007, an infestation was identified on newly reclaimed backslopes and sideslopes. As most plants were in bud and flower stage, mechanical control (mowing and hand-picking) was undertaken at this location. In order to ensure eradication of existing plants, a herbicide application was applied to control newly sprouted weeds, and the area re-seeded with a seed mix containing agronomic species expected to demonstrate vigorous growth. The infested areas will continue to be monitored as part of routine environmental inspection during construction of the project.

A second infestation of scentless chamomile was identified during routine monitoring in the summer of 2007 adjacent to a realigned portion of Nose Creek and Pond 3B. No pre-existing infestation had been identified in this area, and the source of this infestation is unclear. Due to proximity to the WNC watercourse and the constructed wetland, no chemical control is permitted. Mechanical control (hand picking followed by mowing) was undertaken in the summer of 2007 and will continue through the summer of 2008.

### **Foxtail barley**

Prior to construction, an infestation of foxtail barley (*Hordeum jubatum* L.) was identified on the Hidden Valley berm adjacent to City residences. In this case, although foxtail barley is not listed as a weed under Alberta's *Weed Control Act*, it has been elevated to the status of noxious weed by the City of Calgary. As no disturbance of the area in question (within the provincial ROW) was anticipated during construction, no treatment to control the foxtail barley infestation was initially required. However, following a late summer mowing in August 2007, the foxtail barley seed heads were blown outside the TUC boundary and deposited in residential yards adjacent to the utility corridor.

In order to address resident's complaints and ensure off-site impacts will be prevented in the future, chemical control was undertaken in the fall of 2007. Due to the heavy buildup of thatch in this area, the area was tilled in the spring of 2008 the area was re-seeded with a seed mix containing agronomic species. The cultivation undertaken earlier to break up the thatch will allow improved seed to soil contact and promote germination of the seed mix applied to this area. This area will be monitored through to the end of construction as a component of the routine environmental inspection undertaken for the project.



Figure 5: Foxtail barley infestation on berm inside the TUC boundary on the Stoney Trail project



Figure 6: Foxtail barley seeds in yard of resident adjacent to Stoney Trail



Figure 7: Foxtail barley plants found on Stoney Trail project in 2007

## 5.0 CONCLUSION

Carrying out weed control on highway projects can be a complex and challenging task requiring a comprehensive understanding of the relevant legislation and current Best Management Practices (BMPs) in addition to time and money. Once established, weed infestations can be difficult to eradicate or even control. Normally a multifaceted approach involving multiple BMPs will be required to achieve control. These often include chemical control (i.e. herbicide application) or mechanical control such as hand-pulling, mowing or tilling.

The key to effective and economical weed control is through prevention of weed infestations. Projects should consider implementing site management practices to limit the potential for contamination of the site with weed seeds. Provisions that could be incorporated into construction contracts include reviewing seed certificates prior to seed application, controlling access to construction sites and requiring pre-access and periodic cleaning of equipment used on construction sites.

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