BEST MANAGEMENT PRACTICES FOR

Reed Canarygrass

in the Metro Vancouver Region

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SERVICES AND SOLUTIONS FOR A LIVABLE REGION

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INVASIVE SPECIES COUNCIL OF METRO VANCOUVER

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Introduction

The impacts of invasive species on ecological, human, and economic health are of concern in the Metro Vancouver region. Successful control of invasive species requires concerted and targeted efforts by many players. This document - "**Best Management Practices for Reed Canarygrass in the Metro Vancouver Region**" - is one of a series of species-specific guides developed for use by practitioners (e.g., local government staff, crews, project managers, contractors, consultants, developers, stewardship groups, and others who have a role in invasive species management) in the region. Together, these best practices provide a compendium of guidance that has been tested locally by many researchers and operational experts.

The status of reed canarygrass[1] is complicated – there has been confusion about whether the species is entirely introduced or whether it is native to the Pacific Northwest and has expanded its range through human intervention (Pojar & MacKinnon, 1994). Cultivars from Europe and Asia have been introduced for ornamental use and erosion control (Klinkenberg, 2019). Cultivars of this species are still sold in nurseries in BC and seeds are available for purchase online (Klinkenberg, 2019). This perennial grass has also been selectively bred as a forage crop in the Pacific Northwest since the early 1900s for high rates of growth, adaptability to a wide range of ecological conditions (Klinkenberg, 2019), and for nutritional value (Aasen & Bjorge, 2009).

Introduced varieties hybridize with existing populations, producing aggressive offspring. It is generally agreed that what is abundant and invasive throughout wetlands in the Pacific Northwest, including BC's South coast, are the European cultivars of reed canarygrass that were specifically bred and introduced. Townsend and Hebda's soil seed assemblage study (2013) in Victoria, BC supports the theory that reed canarygrass is exotic in BC; their research indicates that reed canarygrass has only existed in BC since post-disturbance colonization and the agricultural conversion of wetlands common in the early 1900s (Townsend & Hebda, 2013).

1 Sometimes written as reed canary grass.

Many experts agree that reed canarygrass is a growing concern in the region. This species reproduces vegetatively and by seed and is very difficult to control or eradicate. Management is further complicated because many known control methods are damaging or not appropriate for the natural areas or wetlands in Metro Vancouver where reed canarygrass is found.

Academic institutions, government, and non-government organizations continue to study this species in British Columbia. As researchers and practitioners learn more about the biology and control of reed canarygrass it is anticipated that the recommended best management practices will change over time and this document will be updated. Please check metrovancouver.org regularly to obtain the most recent version of these best management practices.

REGULATORY STATUS

Section 2 of the Community Charter, Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation, states that "municipalities may regulate, prohibit and impose requirements in relation to control and eradication of alien invasive species", which includes reed canarygrass under Freshwater/Riparian Vascular Plants of Schedule 1.

IMPACTS

Reed canarygrass forms dense, persistent, monocultures in wetlands, ditches, floodplains, and wet meadows (Invasive Plant Species Asessment Working Group, 2007). Its creeping rhizomes form a thick sod layer that covers the ground, excluding other plants (Matthews, 2019). The Nature Conservancy (2004) observed that "a few native plants may be able to survive within reed canarygrass infestations, but wetlands without reed canarygrass tend to have a much higher diversity of native species." Reed canarygrass can out-compete native grasses within 5-6 months of introduction (Anderson, 2012).

Wetland altered over time by reed canarygrass. Invasive Himalayan blackberry is also present at the site.
CREDIT: TOWNSHIP OF LANGLEY

Reed canarygrass provides little forage value for native wildlife (King County Noxious Weed Control Program, 2015) although Matthews (2019) has observed several bird species attempting to eat the seeds at Cypress Provincial Park. Reed canarygrass limits raptor access to prey in meadows and fields (Evely, 2005).

This species can cause flooding and constrict waterways, agricultural drainage, irrigation canals, and municipal drainage systems (Invasive Plant Species Asessment Working Group, 2007). When reed canarygrass invades wetlands,

it can change drainage patterns or eventually eliminate any standing water, essentially converting the wetland into an alternate ecosystem (Matthews, 2019). It can form physical barriers that restrict salmonid migration and generally degrade riparian habitats (King County Noxious Weed Control Program, 2015). Reed canarygrass exacerbates oxygen challenges at restoration sites because it reduces oxygen levels as it biodegrades, decreasing native shrub and tree establishment, which in turn increases water temperatures and decreases oxygenation (Juteau, 2019).

Dense infestations can block or interfere with water access during recreational activities such as boating, fishing and swimming (Anderson, 2012). Although it does not pose a significant health risk to humans, reed canarygrass produces abundant pollen and is a known allergen (Invasive Plant Species Asessment Working Group, 2007).

REPRODUCTION AND SPREAD

Reed canarygrass can reproduce vegetatively via rhizomes and sexually by seed, but research suggests that it mainly relies on a vegetative propagation strategy (Gifford, Ferdy, & Molofsky, 2002). Pieces of stem, roots, and rhizomes can grow into new plants when in contact with bare soil (King County Noxious Weed Control Program, 2015). If untreated, a thick sod layer can form after three years (Aasen & Bjorge, 2009).

Each inflorescence can produce up to 600 seeds annually, although they have a low rate of germination, especially in dense infestations and dense shade (The Nature Conservancy, 2004). Reed canarygrass seeds can be spread on animal fur, human clothing, equipment and vehicles (The Nature Conservancy, 2004). All plant parts float on water and aquatic corridors can facilitate dispersal (King County Noxious Weed Control Program, 2015).

Anthropogenic activities such as drainage or vegetation maintenance and use or transport of infested materials can spread reed canarygrass.

HABITAT AND DISTRIBUTION

Reed canarygrass inhabits a wide range of elevations and sites. Its preferred habitat is low elevation wetlands, lake margins, ditches, disturbed waterways, roadsides, utility corridors, marshes, and meadows (Page, 2006). It favours seasonally or continually wet habitats, flooding (Kercher & Zedler, 2004), and poorly drained sites (The Nature Conservancy, 2004). Although it can tolerate prolonged drought conditions, it will not survive in dry uplands.

Agricultural practices can contribute to the success of reed canarygrass as it responds positively to disturbance and increased nutrients (Kercher & Zedler, 2004). Agricultural runoff and the increases in nitrogen associated with fertilizers contribute to the increasing colonization and dominance of reed canarygrass (Green & Galatowitsch, 2002). It can regenerate at riparian sites quickly after disturbance and is most likely to become invasive in disturbed or low-density plant communities (Centre for Agriculture and Bioscience International, 2020). Wetland restoration sites may be particularly vulnerable to invasion (King County Noxious Weed Control Program, 2015).

Reed canarygrass is present on every continent except Antarctica (King County Noxious Weed Control Program, 2015). It is widespread throughout Metro Vancouver and Southern BC where it has largely invaded wetlands, floodplains, wet fields, ditches, roadsides, moist forest edges, and disturbed riparian sites (Page, 2006).

CLIMATE ADAPTATION

Climate modellers predict that the Metro Vancouver region will experience warmer temperatures; a decrease in snowpack; longer dry periods in summer months; more precipitation in autumn, winter and spring; more intense extreme events; and an extended growing season. In the past, our region had an average of 252 days in the growing season. In lower elevations 45 days will be added to the growing season by the 2050s, and 56 days by the 2080s,

resulting in nearly a year-round growing season of 357 days on average. In higher elevation ecosystems the growing season length will increase by 50% to 325 days by the 2080s (Metro Vancouver, 2016). These changes will stress many sensitive ecosystems, increasing their vulnerability to invasive species.

Reed canarygrass may be able to adapt to our future climate in several ways:

- **Extended growing season:** Reed canarygrass is one of the first wetland plants to emerge in late winter or spring (Wisconsin Reed Canary Grass Management Working Group, 2019) allowing it to shade out native species that emerge later in the growing season. It can also continue growing into the fall (Seebacher, 2008). By taking advantage of an extended growing season and photosynthesizing for a longer period of time every year, reed canarygrass is able to successfully compete with adjacent plants (Seebacher, 2008).
- **Warmer temperatures:** This species can grow in a variety of temperatures and is heat tolerant (Aasen & Bjorge, 2009).
- **Longer summer drought periods:** Reed canarygrass is drought tolerant (Wisconsin Reed Canary Grass Management Working Group, 2019) and will not likely be impacted by extended or fluctuating annual drought periods.
- **Increased precipitation and flooding:** The species is flood tolerant (Wisconsin Reed Canary Grass Management Working Group, 2019); Kercher & Zedler (2004) discovered that floods of increasing intensity and duration increase the biomass and frequency of reed canarygrass. All plant parts float on water and aquatic corridors can facilitate dispersal, and seeds are viable for up to 4 years (King County Noxious Weed Control Program, 2015).
- **More intense extreme events:** Reed canarygrass grows well in cool conditions and is tolerant to freezing (Aasen & Bjorge, 2009). This species is more tolerant to disturbances and extreme events than other prairie grassland species (Kercher & Zedler, 2004).
- **Sea level rise:** Although reed canarygrass is documented to have poor salinity tolerance (Centre for Agriculture and Bioscience International, 2020), it has completely infiltrated a wetland in North Vancouver with brackish water suggesting it can survive some levels of salinity in the region (Matthews, 2019).

With these kinds of competitive advantages, this species is more adaptable than native species in a variety of ecosystems. Its already diverse presence worldwide, its ability to reproduce in multiple ways, and its history of spreading quickly in the region suggest that it will be able to withstand, and possibly thrive, with changing climate conditions.

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Identification

Unless otherwise noted, the following identification information was collected from Klinkenberg, 2019.

General: This perennial grass begins seasonal growth as early as January/February (Seebacher, 2008).

Stem: Hollow, round, about 1 centimetre in diameter and up to 2 metres high. During mid-summer dormancy, stems may begin growing less erect and more parallel to the ground and retain this look during the winter (Wisconsin Reed Canary Grass Management Working Group, 2019). Dead stems persist through the winter; dead straw-coloured stems are easily seen in winter when most of other grasses have died off or are dormant (King County Noxious Weed Control Program, 2015).

Leaves: Flat, wide (7-20 millimetres) pale green leaves up to 0.5 metres in length tapering to a sharp point. Leaves feel rough but are hairless (Anderson, 2012). A thin, membranous, transparent tissue (ligule) is visible on the inside of the leaf sheath where it joins the stem. The end of the leaf that attaches to the stem (the sheath) is open, which means the edges overlap and a split is visible.

Flowers: Inflorescence is a branched flowerhead, called a panicle, 7-25 centimetres long. Panicles can look quite different at various stages of development: they are compact and resemble spikes when immature, but become open and slightly spreading at maturity (May to June). Panicles also change colours from pale green to dark purplish during maturity.

Fruits: Panicles appear straw coloured when seeds are mature and disperse (The Nature Conservancy, 2004). Seeds are small (4 millimetres long), slightly flattened, smooth, shiny black to dark brown and present from spring through summer (Aasen & Bjorge, 2009). Seeds scatter easily from panicles when ripe (Aasen & Bjorge, 2009). Each inflorescence can produce 600 seeds (The Nature Conservancy, 2004). Seed viability is less than four years although most germinate within 2 years (Anderson, 2012).

Roots: Roots are large in diameter and appear pink with scales (Aasen & Bjorge, 2009). Rhizomes can grow over 3 metres per year (King County Noxious Weed Control Program, 2015). Rhizomes and dead stems and leaves form a sod layer over 0.5 metres thick (The Nature Conservancy, 2004).

The following photos show reed canarygrass plant parts.

Stems and leaves

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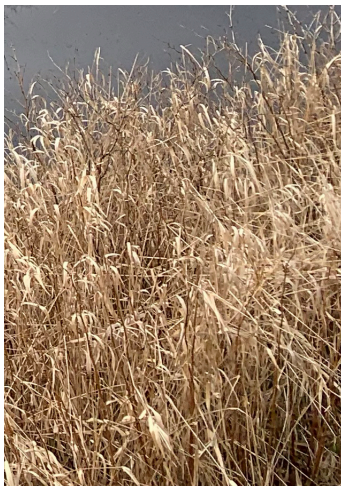

Winter foliage

CREDIT: LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Leaf and characteristic open leaf sheath and membranous ligule

CREDIT: ROB ROUTLEDGE, SAULT COLLEGE, BUGWOOD.ORG

Immature panicle

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Mature panicle

LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Roots

CREDIT: LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Seeds

CREDIT: BRUCE ACKLEY, THE OHIO STATE UNIVERSITY, BUGWOOD.ORG

SIMILAR SPECIES

Grasses can be extremely difficult to properly identify. It is estimated that more than 115 artificially-selected cultivars and subspecies of reed canarygrass exist (Wisconsin Reed Canary Grass Management Working Group, 2019). Although there is no reliable way to distinguish between the native and invasive reed canarygrasses except by genetic analysis (King County Noxious Weed Control Program, 2015), if the grass is spreading rapidly and aggressively and displacing native vegetation, it can be assumed to be the invasive variety.

Reed canarygrass has among the widest leaves of grasses, up to 20 millimetres (Aasen & Bjorge, 2009). It also has a distinctive transparent ligule (see photo above) compared to other grasses.

Some of the most common grasses that reed canarygrass can be confused with are described below.

NON NATIVE SPECIES

- A variegated ornamental form of reed canarygrass called 'ribbon grass' (*Phalaris arundinacea var. variegata*) sometimes occurs as a garden escapee.
- Orchard grass (*Dactylis glomerata*) is a tufted perennial grass only up to 150 centimetres tall (Klinkenberg, 2019). It has thinner leaves and a different shaped inflorescence compared to reed canarygrass. This species is introduced in North America and also has invasive tendencies. It is common in Southern BC and occupies similar habitats as reed canarygrass.

Foliage of variegated variety 'ribbon grass'

CREDIT: LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Orchard grass

CREDIT: OHIO STATE WEED LAB, THE OHIO STATE UNIVERSITY, BUGWOOD.ORG

NATIVE SPECIES

- Bluejoint reedgrass (*Calamagrostis canadensis*) is widespread in BC and found in similar habitats as reed canarygrass. Bluejoint reedgrass has blueish-green coloured leaves with hairs (Klinkenberg, 2019). Stems have distinct dark purple joints (Anderson, 2012).

Bluejoint reedgrass

CREDIT: LESLIE J. MEHRHOFF, UNIVERSITY OF CONNECTICUT, BUGWOOD.ORG

Tracking

The provincial government maintains the Invasive Alien Plant Program (IAPP) application (BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development 2017), which houses information pertaining to invasive plant surveys, treatments, and monitoring. Many agencies, including local governments, have their own internal invasive species inventory and mapping protocols that are used by staff, contractors and, in some cases, the public. For example, the City of North Vancouver has its own system called AlienMap. Agencies in British Columbia that do not enter data into IAPP are encouraged to check it regularly because it contains public reports and data from other agencies and it is important to consider as much data as possible when making management decisions. The Map Display module of IAPP is publicly accessible.

Since reed canarygrass is one of the first species to emerge in the growing season in wetlands (while other species are still dormant), it will be easiest to find it at this time (Anderson, 2012). The straw-coloured dead stems and leaves persist in the winter, which is another good time to observe this species. When carrying out a reed canarygrass inventory it is useful to record the following information as it will later inform treatment plans:

- Size and density of infestation;
- Location in relation to the 10 metre Pesticide Free Zone adjacent to water courses;
- Location in relation to other water sources, such as wells.

Reed canarygrass in winter, Colony Farm Regional Park, Coquitlam/Port Coquitlam

CREDIT: ISCMV

Reporting

Since reed canarygrass is common throughout the Metro Vancouver region and does not pose an imminent health or safety risk, there is generally little value in reporting individual occurrences.

Prevention and Control Strategies

Effective invasive plant management may include a variety of control techniques ranging from prevention, chemical, manual, mechanical, biological and/or cultural methods. Each method is described below in order of effectiveness. Follow-up monitoring and treatment will be required for several years regardless of the treatment technique.

Despite decades of study, there is currently no comprehensive strategy for the effective management of reed canarygrass (Seebacher, 2008). It has proven to be a difficult species to manage and requires an integrated pest management approach using multiple treatment methods (King County Noxious Weed Control Program, 2015). The goal should be to replace reed canarygrass with a diversity of native species and therefore management plans should include shading/planting (outlined below) and focus heavily on restoration.

Some experts recommend first focusing efforts on depleting the seed bank prior to replanting the area (King County Noxious Weed Control Program, 2015). Allowing the seeds to grow and then managing the plants multiple times over several seasons may improve efficacy of many of the methods outlined below. Seeds are viable for up to 4 years (King County Noxious Weed Control Program, 2015) although most germinate within 2 years (Anderson, 2012).

Following best management practices does not guarantee control or eradication of reed canarygrass. It is unrealistic to expect control on large reed canarygrass infestations within one year, but it may be possible within 3-5 years (Wisconsin Reed Canary Grass Management Working Group, 2019).

STRATEGY COLOUR LEGEND

GREEN: RECOMMENDED

ORANGE: CAUTION

RED: NOT RECOMMENDED OR NOT AVAILABLE

PREVENTION: IMPERATIVE

Prevention is the most economical and effective way to reduce the spread of reed canarygrass over the long term.

When working in or adjacent to reed canarygrass, it is best to inspect and remove plant parts and seeds from personal gear, clothing, pets, vehicles, and equipment and ensure soil, gravel, and other fill materials are not contaminated with reed canarygrass before leaving an infested area. This is especially important along roadsides and other disturbed areas (The Nature Conservancy, 2004).

Use mulch around new plantings at restoration sites in order to prevent reed canarygrass establishment (King County Noxious Weed Control Program, 2015). Eradicate small reed canarygrass sites as soon as possible (The Nature Conservancy, 2004).

Do not buy, sell, or plant reed canarygrass plants or seeds for erosion control, landscaping, or in agricultural settings. The Invasive Species Council of BC's 'Grow Me Instead' Program or Metro Vancouver's Grow Green website provide recommendations for non-invasive, drought-tolerant plants (including some wetland species such as sedges, grasses and bulrushes), and garden design ideas. All materials (e.g., topsoil, gravel, mulch, compost) should be weed-free. Healthy green spaces are more resistant to invasion by invasive plants, so it is also important to maintain or establish healthy plant communities.

CULTURAL: RECOMMENDED

- **Shading/planting** involves establishing a diversity of native species (a mixture of native grasses, sedges, rushes, shrubs or trees). Since reed canarygrass is intolerant of year-round shade, forming a shade canopy will discourage reed canarygrass growth and seed germination (The Nature Conservancy, 2004). Most experts agree that this method will provide the best long-term control strategy.

Revegetation should focus on establishing a multi-layered shade canopy (King County Noxious Weed Control Program, 2015). King Country Noxious Weed Control Program (2015) suggests dense planting of trees with a coniferous overstory being the ultimate goal. Taller shrubs and trees may have a better chance out-competing reed canarygrass (Pinchin West Ltd., 2016).

A restoration project at the Little Campbell River in Surrey saw the greatest success densely planting native trees and shrubs (Juteau, 2019); after 6 years there is virtually no remaining reed canarygrass at the site.

Live staking is a form of planting that uses native shrub cuttings. This approach creates less soil disturbance, is easy for staff/volunteers to plant and harvest, allows for planting at higher densities (i.e. 15 centimetre spacing), is cost-effective and low maintenance (it doesn't necessarily require watering during the summer although this might help increase survivorship) (Marcoux, 2019). This method is ideal in areas where trees can't be planted, such as Hydro corridors.

Live stakes at Bear Creek Park, Surrey

CREDIT: HÉLÈNE MARCOUX, BCIT

Planting high densities of hardhack and red osier dogwood stakes can reduce reed canarygrass (Marcoux, 2019). Marcoux trialed different staking species and spacing/density at Bear Creek Park, Surrey and Boundary Bay, Delta; the sites were rototilled first, then 10 centimetres of thick mulch applied. Of the 3 spacings researched (50 centimetres, 15 centimetres, 30 centimetres), the 15 centimetre plots fared best, with significant reduction of reed canarygrass regrowth after 5 growing seasons, relative to the other spacings. Locally-harvested live cuttings of red osier dogwood and hardhack worked better than thimbleberry plugs. Continued research will focus on best practices for site preparation (Marcoux, 2019).

Others have used live willow stakes to attempt to shade reed canarygrass. King Country Noxious Weed Control Program successfully installed live willow stakes at 0.6-0.9 metres apart (2015). Pincher Ltd. (2016) had good survivorship of Scouler's willow (Salix scouleriana) and Pacific willow (Salix lasiandra) stakes planted through landscape fabric at Katzie Slough.

The shading/planting method will be more successful at sites where reed canarygrass is low in density and where there is existing native vegetation. Applying mulch or herbicide around newly planted trees and shrubs may help to suppress regrowth (Wisconsin Reed Canary Grass Management Working Group, 2019). This method cannot be used in areas that get flooded (King County Noxious Weed Control Program, 2015). Covering methods (described below) can be used with shading/planting.

A challenge of this method is that often sites (or parts of sites) where reed canarygrass invades don't naturally have a shrub or tree canopy. True wetlands often have areas of standing water or a low herbaceous cover, which reed canarygrass can take over. Some wetland restoration projects are focused on species at risk, creating amphibian habitat, or mitigating other invasive species (such as American bullfrog). Management considerations for these species (such as creating ephemeral or seasonal wetlands) may contradict best practices for reed canarygrass (Juteau, 2019). At these sites, it may not be possible or desired to use shading as a control method and control of reed canarygrass may take longer.

The Restoration section below also outlines some additional restoration guidelines including preventing damage to restoration planting from wildlife.

- **Flooding** or altering site hydrology can be an effective control if the adjusted water depth is greater than 12 inches and this level can be maintained for more than a year (Invasive Plant Species Asessment Working Group, 2007) (Wisconsin Reed Canary Grass Management Working Group, 2019). Submerged reed canarygrass rhizomes will eventually die, however established populations can survive over one year of flooding, especially where not all parts of the plant are submerged (The Nature Conservancy, 2004). Flooding also prevents seed germination (Wisconsin Reed Canary Grass Management Working Group, 2019) and may promote the growth of some native plants such as cattails. Note that regulatory permits may be required for any method altering hydrology. Other treatments may be necessary along the edges of the flooded infestation (The Nature Conservancy, 2004).

- **Grazing** alone cannot be used a control method for reed canarygrass. Reed canarygrass was introduced as a forage species and is actively grazed by goats, sheep, and cattle. Grazing has little to no negative impact on reed canarygrass growth and survival (The Nature Conservancy, 2004) but can be used prior to other treatment methods such as tilling, covering, or herbicide to reduce biomass and height. Seeds can adhere to animal fur and be spread further (The Nature Conservancy, 2004). In an assessment of targeted grazing feasibility in Metro Vancouver, Miller, Tarasoff & Salmon (2021) concluded that reed canarygrass is unsuitable for control by targeted grazing due to low efficacy, potential toxicity issues associated with alkaloids, and unsuitable habitat (moist soils).

Grazing opportunities are limited in urban areas due to municipal bylaws regulating agriculture animals, the high probability of interface with the public, and the damage animals could cause to riparian areas and other sensitive sites with multiple land uses. Due to these constraints, lack of effectiveness, and the risk to animal health, grazing is not recommended as a management option for this species in Metro Vancouver.

- **Burning** opportunities are limited and often not appropriate in urban areas due to fire risk, municipal bylaws and other required permits. This method should only be undertaken by qualified individuals or agencies. Spot burning with a hand-held torch can be used to kill seedlings or young reed canarygrass (The Nature Conservancy, 2004).

  Prescribed burning can be used to reduce reed canarygrass in late spring but before native grasses break dormancy (Invasive Plant Species Asessment Working Group, 2007). This method does not kill mature reed canarygrass (The Nature Conservancy, 2004) and should only be used when there are native fire-adapted species present in the seed bank which will be encouraged by fire (Community Mapping Network, 2019).

  Caution must be used as burning can stimulate growth unless the fire burns through the plants and entire sod layer down to the soil (The Nature Conservancy, 2004). Burning can be used as a pre-treatment prior to tilling, shading, or herbicide treatment to prepare large sites by removing above-ground vegetation and leaf litter (The Nature Conservancy, 2004) (King County Noxious Weed Control Program, 2015).

  The use of steam on reed canarygrass has not been documented.

CREDIT: DIAMOND HEAD CONSULTING

- **Carbon enrichment** modifies environmental conditions that allow reed canarygrass to invade and thrive. The growth of reed canarygrass can be supressed when carbon sources such as wood chips, sawdust, or sucrose are added to the soil, thereby decreasing other soil nutrients (mostly nitrogen) (Green & Galatowitsch, 2002). Adding carbon sources may be used as a supplement after covering (see below) to encourage desirable species (Seebacher, 2008). This method has been practiced as a form of weed control to promote native plant growth in prairie and grassland ecosystems and is not known to have been tried in the Metro Vancouver region for reed canarygrass management. Further research is needed.

MANUAL/MECHANICAL: RECOMMENDED

- **Digging** by shovel can be used to manage individual plants or small patches less than 10 m^2 (Matthews, 2019). This is accomplished by digging out the entire root mass, preferably in wet soil conditions (The Nature Conservancy, 2004). Digging becomes more difficult the larger the patch and the denser the sod layer (Alards-Tomalin, 2019). Care should be taken to remove all the root and rhizome fragments as these can re-sprout.

- **Covering** involves the use of cardboard, mulch, hogfuel (the by-product of the first cut of milled logs, made up of a mix of coarse bark chips and wood fibre), geotextile, black plastic, and/or another material to suppress growth (may also be called mulching or solarization). This method can be successful in dense patches of reed canarygrass (The Nature Conservancy, 2004) but is not suitable for areas where it is mixed with desired species. Covering is a non-selective control method and will kill everything underneath.

  Mowing or cutting the reed canarygrass first may ease installation of the cover material (The Nature Conservancy, 2004). When choosing the cover material, consider project length, material viability, and site use after treatment. Some materials may not be suitable for every site. Covers made of non-biodegradable material must be removed after use. Juteau (2019) found that coconut fibre mats were too porous and the reed canarygrass grew through it. When combined with other strategies (i.e. planting native shrubs/trees at high densities in tandem) and restoration (i.e. additions of new native plants), woodchip mulch covering has been shown to have positive outcomes at Bear Creek Park (Marcoux, 2019). Woodchip mulch on its own may not be a good covering material unless it is reapplied at least annually as eventually the reed canarygrass will grow through it (Johnson, 2005).

  If cardboard, mulch, or another natural cover is used, it can be left onsite following treatment as long as there are no unnatural substances attached (tape, staples, etc.). One advantage of using these materials is after decomposition starts, the site will look more aesthetically pleasing (and less conspicuous) than non-natural covers (Matthews, 2019).

  Commercially available covers should be held in place with rocks, large nails, spikes, rebar, or garden staples (King County Noxious Weed Control Program, 2015). It is critical to overlap sections of covering material by at least one foot, extending the cover over the edge of the infestation by at least two feet (King County Noxious Weed Control Program, 2015). Careful monitoring is required to watch edges and seams for rhizome growth.

  The effectiveness of this method is dependent on the coverage area and the length of time the cover is left in place (Pinchin West Ltd., 2016). Covering areas that are too small or narrow will allow the reed canarygrass to grow around the cover. Covers should be kept in place for over one year for effective control (The Nature Conservancy, 2004).

Matthews (2019) and The Nature Conservancy (2004) have both achieved good control by first cutting reed canarygrass down to the ground, covering it with 4-6 layers of clean, thick cardboard, and then a 6-inch layer of bark mulch on top. After 1 year Matthews (2019) observed no living reed canarygrass underneath the cover although some grew around the sides.

Since all vegetation underneath the cover is killed, this method should be combined with the shading/planting method to facilitate seeding or planting of native plants (Wisconsin Reed Canary Grass Management Working Group, 2019). See Planting section above for more information. Covering may also impact soil microorganisms or alter soil chemistry (Wisconsin Reed Canary Grass Management Working Group, 2019). Also note that removing the cover material can cause a resurgence of the seedbank and monitoring after this stage is essential (Wisconsin Reed Canary Grass Management Working Group, 2019).

Reed canarygrass infestation in the process of being covered with cardboard, held down by rocks. Note the preservation of native and desirable species at the site.

CREDIT: ECHO ECOLOGICAL

Reed canarygrass infestation covered with landscape fabric held in place with natural stakes.

CREDIT: ECHO ECOLOGICAL

Live stakes installed through woodchip mulch covering at Bear Creek Park, Surrey.

CREDIT: HÉLÈNE MARCOUX, BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

- **Seed head clipping** by hand can be used as a containment measure to prevent the release of seeds but it is not an effective control method on its own (Matthews, 2019). It is a faster and less expensive manual control method that can be used if no other treatments will occur at the site that season or until a more comprehensive management plan is implemented (Alards-Tomalin, 2019). This method is best employed prior to seed maturity (May to June), however if seeds are already mature, this is still possible using garbage bags to collect the seeds heads, taking great care not to disperse the seeds (Matthews, 2019). Seed head clipping can be used prior to excavation if seeds will be mature at the time of excavation. To improve efficiency, practitioners can tie reed canarygrass stems into bunches and clip multiple seed heads at once (Gasior, 2019).

- **Trampling** or stomping reed canarygrass can be used in association with planting trees and shrubs to provide competition (Community Mapping Network, 2019). Rather than a stand-alone treatment technique, this is used more as a maintenance measure during restoration activities (Juteau, 2019). The stomping should be continued until planted trees are freely growing above the reed canarygrass. It is recommended to stomp 3 times in the growing season (early June, late July, late September) (Community Mapping Network, 2019).

- **Pulling** is not effective except for small seedlings in wet soil because this will not remove the roots and rhizomes of mature plants, which can easily resprout (King County Noxious Weed Control Program, 2015). Pulling must be done 2-3 times a year for several years (Anderson, 2012).

- **Excavation** via machinery is a possible control method suited for large sites that are dominated by reed canarygrass and when other control methods are not feasible but management is a high priority (e.g. a high value wetland site). Use of this method is a major undertaking, requires a considerable amount of resources, and can be extremely disruptive; therefore, it is best suited in large-scale wetland restoration design that will implement a number of different control methods under a long-term restoration plan.

In 2019, Matthews (2019) trialed a wetland restoration project in MacKay Marsh, North Vancouver that involved an excavator digging out large clumps of reed canarygrass, flipping them over and depositing them along the sides of the wetland. Fibre matting was placed around the site and staked with willow cuttings. Long-term study results to be determined. Trials are also ongoing at Boundary Bay using this method (Marcoux, 2019).

The type and size of excavator should be chosen based on site characteristics. Excavator operators should be fully briefed on the goals of the project and supervised at all times by an environmental professional. This control method will likely trigger regulatory permitting for works in and around a watercourse.

Practitioners in Metro Vancouver who have trialed this method at various sites caution that there are many challenges to be expected. Care must be taken to thoroughly remove and bury all of the roots and that the capped soil does not have any roots or the reed canarygrass will grow back over a period of years (Crosby, 2018). The footprint of the excavated site must be large enough to ensure all reed canarygrass is captured in the excavation so that no plants are left that can grow back into the treated area (Crosby, 2018). In 2006, the Township of Langley began a multi-phased/year drainage restoration project (North Creek Right-of-Way - Drainage Improvement Project) to restore drainage function through low-lying agricultural properties. Reed canarygrass (including roots) and top layers of soil were excavated from riparian banks following by revegetation with native shrub species. After relative success in initial years, the project experienced many challenges and continues to require extensive resources. Challenges include extensive beaver damage and flooding, vole damage, reed canarygrass outcompeting the restoration (requiring several replanting phases), budgetary restrictions, and property access issues. (St.Andrassy, 2020).

- **Mowing and cutting** can be used to remove reed canarygrass biomass and to stress and reduce its spread (Invasive Plant Species Asessment Working Group, 2007), but it will not kill plants or eradicate infestations. This method must involve multiple passes per year (up to 5) (Anderson, 2012) and could involve use of a machine such as a mower, brush cutter, weed eater, etc. or a hand tool such as clippers or machete. If mowing occurs only 1-2 times/year, it may stimulate additional stem production (The Nature Conservancy, 2004) so caution and long-term planning must be involved.

  Mowing prior to flowering can eliminate the seed bank for the current year (The Nature Conservancy, 2004). Since seeds are viable for up to 4 years, this method can be used for several years in a row to eliminate the seed bank and followed up with another treatment method such as shading/planting, tilling or herbicide application. (The Nature Conservancy, 2004). This method should always occur before seed set (The Nature Conservancy, 2004).

  Mowing of reed canarygrass has been suggested as a method to increase habitat value for wildlife (such as raptors) at large infestations, but will not eradicate it (Evely, 2005). The City of Surrey mows large reed canarygrass meadows as part of its meadow management program; in October, random patches of 1000 square metres connected by corridors are mowed allowing opportunity for raptors and coyotes to access prey in the winter (Crosby, 2018).

- **Tilling** is the use of machinery to turn over and break up soil (also called disking). Tilling reed canarygrass breaks up and exposes the rhizomes. Tilling is often done with large equipment that may be difficult and expensive to source. Also, since tilling is not a selective method, it can only be used at sites with little to no desirable species. Tilling is most effective when combined with another control method such as covering or flooding (see sections above). Seebacher (2008) recommends tilling and then covering the infestation with a thick, dense cover and leaving it undisturbed for at least one year.

  Tilling followed by flooding can successfully eliminate reed canarygrass but also requires the ability to manipulate water levels (The Nature Conservancy, 2004). To use this technique, first the sod layer of the reed canarygrass should be tilled through as soon as possible (as soon in the year as the equipment can safety work at the site or when the site is dry enough). This may take a few passes during the growing season in order to dry out and break up the roots, with the final result being broken clumps of soil and no viable plant material. Next, when winter flooding begins, floodgates can be managed so that the entire area is inundated at least 50 centimetres until late May/June the following year

APPLYING MANUAL/MECHANICAL CONTROL METHODS IN RIPARIAN AREAS

Reed canarygrass often grows in large contiguous patches right up to the edge of water courses. Consider the impact of control techniques and the resulting bare soil on the adjacent aquatic environment. Schedule removal works during a period of least risk to fish species, outside of the fish window. Adhere to Provincial and Federal riparian regulations. It is recommended to consult with a qualified environmental professional when working around water bodies.

CHEMICAL: CAUTION

When alternative methods to prevent or control invasive plants are unsuccessful, professionals often turn to herbicides. Chemical control may be used to control large reed canarygrass infestations that are not feasible to control manually/mechanically. This method should be used with caution for the following reasons (Crosby, 2018):

1. Weather conditions greatly influence treatment efficacy;
2. Reed canarygrass often grows in riparian areas where pesticide use is restricted; and
3. Native vegetation is often integrated with reed canarygrass infestations. Mortality of non-target plants is possible. Sites with well established native shrub and herbaceous layers are not suitable for chemical treatment.

Ministry of Transportation and Infrastructure contractors have used chemical control on reed canarygrass at the Katzie Slough Blind Channel compensation habitat in Pitt Meadows. One-month following glyphosate treatment of invasive plants at the site (including reed canarygrass) saw a 70-79% efficacy (Pinchin, 2018).

With the exception of substances listed on Schedule 2 of the BC Integrated Pest Management Regulation, the use of herbicides is highly regulated in British Columbia. Site characteristics must be considered with the herbicide prescribed, based on site goals and objectives and in accordance with legal requirements. This summary of BC's *Integrated Pest Management Act* provides an overview of the provincial legislation.

PESTICIDE LICENCE AND CERTIFICATION

A valid pesticide licence is required to:

- offer a service to apply most pesticides;
- apply most pesticides on public land including local government lands[2]; and
- apply pesticides to landscaped areas on private land, including outside office buildings and other facilities.

Pesticides (e.g., herbicides, insecticides, fungicides) are regulated by the federal and provincial government, and municipal governments often have pesticide bylaws.

- Health Canada evaluates and approves chemical pest control products as per the *Pest Control Products Act*.
- The BC *Integrated Pest Management Act* sets out the requirements for the use and sale of pesticides in British Columbia. This Act is administered by the Ministry of Environment and Climate Change Strategy.
- Several municipalities have adopted bylaws that prohibit the use of certain pesticides.

Everyone who uses pesticides must be familiar with all relevant laws.

2 on up to 50 ha/year by a single organization. Organizations looking to treat over 50 hectares of land per year are also required to submit a Pest Management Plan and obtain a Pesticide Use Notice confirmation.

ONLY companies or practitioners with a valid Pesticide Licence and staff who are certified applicators (or trained assistant applicators working under a certified applicator) may apply herbicide on invasive plants located on public lands in British Columbia. Applicators must be either the land manager/owner or have permission from the land manager/owner prior to herbicide application.

On private property the owner may obtain a Residential Applicators Certificate (for Domestic class products only) or use a qualified company. Residents do not require a Residential Applicator Certificate for certain uses of domestic class glyphosate including treatment of plants that are poisonous for people to touch, invasive plants and noxious weeds listed in legislation, and weeds growing through cracks in hard surfaces such as asphalt or concrete. Refer to the 'Pesticides & Pest Management' and 'Home Pesticide Use' webpages listed in the Additional Resources section for more information.

Questions? Contact the BC Integrated Pest Management Program: Telephone: (250) 387-9537

Email: bc.ipm@gov.bc.ca

Pesticide applicator certificates can be obtained under the category 'Industrial Vegetation Management' to manage noxious weeds on industrial land, roads, power lines, railways, and pipeline rights-of-way for control of noxious weeds on private or public land. However, since reed canarygrass is not a regulated noxious weed, the 'Landscape' certification category is needed for herbicide use on public and private lands. Assistant applicator training is also available and the online course and exam are free

It is best practice for personnel supervising or monitoring pesticide contracts to also maintain a pesticide applicator licence so they are familiar with certification requirements.

For more information on how to obtain a licence and the requirements when working under the provincial *Integrated Pest Management Act and Regulation*, please review the Noxious Weed & Vegetation Management section on this webpage: gov.bc.ca/PestManagement.

Reed canarygrass in Colony Farm Regional Park, Coquitlam/Port Coquitlam

CREDIT: ISCMV

HERBICIDE LABELS

Individual herbicide labels must always be reviewed thoroughly prior to use to ensure precautions, application rates, and all use directions, specific site and application directions are strictly followed. Under the federal *Pest Control Products Act* and the BC Integrated Pest Management Regulation, **persons are legally required to use pesticides (including herbicides) only for the use described on the label** and in accordance with the instructions on that label. Failure to follow label directions could cause damage to the environment, poor control results, or danger to health. Contravention of laws and regulations may lead to cancellation or suspension of a licence or certification, requirement to obtain a qualified monitor to assess work, additional reporting requirements, a stop work order, or prohibition from acquiring authorization in the future. A conviction of an offence under legislation may also carry a fine or imprisonment.

Herbicide labels include information on both the front and back. The front typically includes trade or product name, formulation, class, purpose, registration number, and precautionary symbols. Instructions on how to use the pesticide and what to do in order to protect the health and safety of both the applicator and public are provided on the back (BC Ministry of Environment, 2011).

Labels are also available from the Pest Management Regulatory Agency's online pesticide label search or mobile application as a separate document. These label documents may include booklets or material safety data sheets (MSDS) that provide additional information about a pesticide product. Restrictions on site conditions, soil types, and proximity to water may be listed. If the herbicide label is more restrictive than provincial legislation, the label must be followed.

HERBICIDE OPTIONS

As reed canarygrass is a grass and often grows in aquatic habitat areas, there are limited herbicides available for this species (see Apply Pesticide in Riparian Areas section below).

Although not specifically listed on the labels of the following herbicides, reed canarygrass may be treated under the general application provision for grasses. Note that the aquatic forms of these herbicides will be more effective; however, most require a special pesticide use permit prior to use. The addition of surfactants may also improve efficacy.

ACTIVE INGREDIENT (EXAMPLE BRAND NAMES)+	APPLICATION	PERSISTENCE	GROWTH STAGE	TYPE++	COMMENTS
Glyphosate (many products)*	foliar application	non-residual	actively growing, prior to reseeding	non-selective	
Imazapyr	foliar application	residual	actively growing	non-selective	Remains active in soil after treatment and therefore recommended only on reed canarygrass monocultures and if the site will not be replanted or seeded until the following growing season or later (King County Noxious Weed Control Program, 2015)

+ The mention of a specific product or brand name of pesticide in this document is not, and should not be construed as, an endorsement or recommendation for the use of that product.

++ Herbicides that control all vegetation are non-selective, while those that control certain types of vegetation (e.g. only grasses or only broadleaf plants) are termed selective.

APPLYING PESTICIDE IN RIPARIAN AREAS

Provincial legislation prohibits the use of herbicides within 10 metres of natural water courses and 30 metres of domestic or agricultural water sources on public lands. On private lands herbicide labels need to be followed (which means for glyphosate products treatment can happen up to the water's edge) and other restrictions may apply (e.g. industrial sites, forestry sites, golf courses, etc.). On public lands, glyphosate is the only active ingredient that can be applied within the 10 metre Pesticide-Free Zone (PFZ)[3] in British Columbia in accordance with the BC *Integrated Pest Management Act* and Regulation and all public land Pesticide Management Plans (PMPs), but not within 1 meter of the high water mark (HWM)[4]. A plant must be either a listed Noxious Weed (under the BC *Weed Control Act*) or appear in the *Forest and Range Practices Act* Invasive Plants Regulation to be treated within the 10 metre PFZ. **Reed canarygrass is not listed and therefore glyphosate and other herbicides can only be applied on reed canarygrass up to 10 metres away from the high water mark (HWM).** The 30 metre no-treatment zone around a water supply intake or well used for domestic or agricultural purposes may be reduced if the licencee or PMP holder is "reasonably satisfied" that a smaller no-treatment zone is sufficient to ensure that pesticide from the use will not enter the intake or well.

When managing reed canarygrass with herbicide in riparian areas:

- Observe and mark all PFZs while on site.
- The HWM should be determined by careful evaluation by the applicator.
- Distances in PFZs should be measured as horizontal distance.
- Herbicides restricted in a PFZ must not enter these zones by leaching (lateral mobility) through soil or by drift of spray mist or droplets.
- Treatments should be conducted when water levels are low (e.g. summer months) to reduce risk.
- Note that efficacy may be dependent on site conditions, including moisture in the soil.

APPLICATION METHODS

- **Foliar application** by backpack, hand sprayer, or wicking tool is possible for reed canarygrass. For rhizomatous species such as reed canarygrass herbicide should be applied during the growing season at mid-summer (The Nature Conservancy, 2004) or late in the fall (Invasive Plant Species Asessment Working Group, 2007) for maximum translocation of the herbicide into the roots. Large infestations will require multiple treatments over several years (The Nature Conservancy, 2004).

3 The Pesticide-Free Zone (PFZ) is an area of land that must not be treated with pesticide and must be protected from pesticide moving into it, under the *Integrated Pest Management Act* and Regulation.

4 The High Water Mark (HWM) is defined as the visible high water mark of any lake, stream, wetland or other body of water where the presence and action of the water are so common and usual and so long continued in all ordinary years as to mark upon the soil of the bed of the lake, river stream, or other body of water a character distinct from that of the banks, both in vegetation and in the nature of the soil itself. Typical features may include, a natural line or "mark" impressed on the bank or shore, indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or other distinctive physical characteristics. The area below the high water mark includes the active floodplain (BC Ministry of Environment, 2011).

Small patches can be tied in a bunch (with flagging tape or another material), cut above the tie, and then treated with herbicide (King County Noxious Weed Control Program, 2015). This method allows for a more targeted application and makes it easier for applicators to keep track of treated stems (Gasior, 2019).

Mowing or cutting can be used prior to herbicide treatment (Page, 2006) (The Nature Conservancy, 2004). If using this method, allow the reed canarygrass to re-grow back to boot height and then apply the herbicide. Herbicide can be used prior to covering methods to increase efficacy; allow time for herbicide to take effect (King County Noxious Weed Control Program, 2015).

BIOLOGICAL: NOT AVAILABLE

There are no known biological control agents for reed canarygrass.

CONTROL SUMMARY

The following table provides a summary and comparison of control methods for reed canarygrass.

CONTROL STRATEGY	TECHNIQUES	APPLICABLE SITE TYPE	PROS	CONS
Cultural	**Shading/Planting**	All sites	The method with the highest long-term efficacy, can be used with other methods	Long-term commitment, labour intensive, not suitable for sites that flood or for sites where plant or tree canopy is not desired
Manual	**Digging**	Small sites (<10m2)	Selective, can be done by volunteers	Labour intensive, must remove all rhizome fragments
	Covering	Environmentally sensitive areas in places with minimal native vegetation or other obstacles	Low risk to environment, can be used with other methods	Challenging to implement around existing vegetation, access constraints
Cultural	**Flooding**	High density infestations where altering hydrology is an option	Can kill all part of the plant and prevent seed germination, may promote growth of some native plants (e.g. cattail)	Takes at least one year, may not be suitable for sites with desirable vegetation that cannot withstand flooding
Manual	**Seed head clipping, trampling/ stomping, pulling**	Small sites, diffuse patches (e.g. after other forms of control)	Selective, can be done with volunteers, effective maintenance strategy	Can cause disturbance, low efficacy long-term, labour intensive

CONTROL STRATEGY	TECHNIQUES	APPLICABLE SITE TYPE	PROS	CONS
Mechanical	**Excavation, mowing/cutting, tilling**	Highly disturbed sites, large sites with major restoration plans	Appropriate for infestations that cannot be managed other ways, can be used with other methods, non-chemical	Expensive, requires trained staff and specialty equipment, high impact to ecosystems, likely requires regulatory permits
Chemical	**Foliar application**	Large, dense infestations except in environmentally sensitive areas and/or where herbicide use is restricted	Appropriate for infestations that cannot be managed other ways, less labour intensive	Unintended environmental/health impacts, high public concerns, requires trained staff, manual control may be necessary for plants within the PFZ adjacent to chemical treatments
Cultural	**Grazing**	Sites accessible to grazing herds, can be used prior to other treatment methods	Non-chemical, this species has been used as a forage species and it is actively grazed by various livestock	Requires specially trained herds and special permits, non-selective, complex logistical considerations, unintended environmental impacts, seeds can be spread by grazing animals
	Burning	Use in late spring at sites where native fire-adpated species are present	Non-chemical	Labour intensive, has little impact on the plants, burning may be restricted in some municipalities and/or require permits, requires trained staff
	Carbon enrichment		Non-chemical, if used after covering methods carbon sources may encourage desirable species	Labour intensive, unknown environmental impacts
Biological	**No biological control agents are currently available for distribution in British Columbia**			

CONTROL SUMMARY COLOUR LEGEND

GREEN: RECOMMENDED

ORANGE: CAUTION

RED: NOT RECOMMENDED OR NOT AVAILABLE

Disposal

ON SITE DISPOSAL

Onsite composting of reed canarygrass is not recommended since the rhizomes and stems can propagate new roots if exposed to moist ground or water (The Nature Conservancy, 2004). If onsite composting is necessary, it is important to dry the plants thoroughly on a tarp or similar first (King County Noxious Weed Control Program, 2015). After drying, plants can also be burned (Anderson, 2012), but consult your local fire department beforehand, as this may require a burning permit.

All plant parts, sod and soil can also be buried at least 60 centimetres deep, but must remain undisturbed for at least four years (King County Noxious Weed Control Program, 2015).

OFF SITE DISPOSAL

Plants, plant parts, and seeds should be placed in tarps, bagged, or otherwise contained before transport to an appropriate disposal site.

Reed canarygrass can be included with other yard waste in municipal green bins or larger bins that are used for invasive plant disposal. When disposed off site, it is best to transport plant parts on tarps or in thick plastic bags to an appropriate disposal or compost facility. In the Metro Vancouver region, several facilities accept reed canarygrass plants and/or infested soil. Please consult this disposal facility list for current details. Note that there are limits to how much soil can be included in biomass for disposal.

PLEASE CONTACT ALL FACILITIES BEFOREHAND TO CONFIRM THEY CAN PROPERLY HANDLE THE MATERIAL.

CLEANING AND DISINFECTION[5]

Before leaving a site, all visible plant parts and soil from vehicles, equipment, and gear should be removed and rinsed if possible. When back at a works yard or wash station, vehicles should be cleaned and disinfected using the following steps:

- Wash with 180 °F water at 6 gpm, 2000 psi*, with a contact time of ≥ 10 seconds on all surfaces to remove dirt and organic matter such as vegetation parts or seeds. Pay special attention to undercarriages, chassis, wheel-wells, radiators, grills, tracks, buckets, chip-boxes, blades, and flail-mowing chains.
- Use compressed air to remove vegetation from grills and radiators.
- Sweep/vacuum interior of vehicles paying special attention to floor mats, pedals, and seats.
- Steam clean poor access areas (e.g., inside trailer tubes) – 200 psi @ 300 °F.
- Fully rinse detergent residue from equipment prior to leaving facility.

* Appropriate self-serve and mobile hot power-wash companies in the Metro Vancouver area include: Omega Power Washing, Eco Klean Truck Wash, RG Truck Wash, Ravens Mobile Pressure Washing, Hydrotech Powerwashing, Platinum Pressure Washing Inc, and Alblaster Pressure Washing. Wash stations should be monitored regularly for reed canarygrass growth.

5 Adapted from Metro Vancouver 2017 Water Services Equipment Cleaning Procedures and Inspection Protocols.

Follow-up Monitoring

Whatever control method is used, follow-up monitoring and maintenance treatments are components of an integrated management plan or approach. The Nature Conservancy (2004) recommends continued monitoring and follow-up treatments for 5-10 years after initial management to treat any recurring or invading reed canarygrass.

When using the shading/covering method, it is important to manage regrowth for years after planting in order for the native plants to establish and grow large enough to compete with the reed canarygrass. This is especially important within the first 2 years of plant or stake installation, when greater mortality may be seen (Pinchin West Ltd., 2016). Replacement of dead plants may be warranted if the underlying cause of death is known and is likely not to recur (or perhaps a new management strategy should be implemented).

The covering method can cause a resurgence of the seedbank and monitoring after this stage is essential (Wisconsin Reed Canary Grass Management Working Group, 2019).

Restoration

Since reed canarygrass shows lower establishment rates and seedling viability under low light conditions, the goal of restoration is to establish native plant cover, ideally a complex, multi-species herbaceous canopy with diverse vertical layers and plant species of different shapes, ages, and forms (Wisconsin Reed Canary Grass Management Working Group, 2019). Restoration creates competition that will help control reed canarygrass regrowth and replace lost habitat. Replanting or reseeding is essential if a seed bank is eliminated after treatment (e.g. after the flooding or tilling) (The Nature Conservancy, 2004).

Mulch can be used to avoid leaving bare soil and reduce colonization from other invasive plant species. The International Society of Arboriculture and relevant municipal Parks or arboriculture departments offer guidelines for mulch application. Specific mulch depths can be used to control invasive weeds and encourage plant growth (International Society of Arboriculture, August).

Reed canarygrass establishes best on flat ground; during restoration activities, consider creating furrows or humps to diversify the substrate to help discourage reed canarygrass regrowth (Anderson, 2012).

When possible, restoration should aim to reestablish the pre-introduction diversity of the site (Townsend & Hebda, 2013). To compete effectively with reed canarygrass, Seebacher (2008) recommends choosing fast growing plant species with early emergence/leaf out and a high leaf area index. Examples of common competitive native species prescribed in Metro Vancouver sites are summarized in the table below based on site moisture.

WET SITES	MOIST SITES	DRY SITES
SHRUBS		
Salmonberry	Salmonberry	Thimbleberry
Hardhack	Willow	Nootka rose
Willow	Red osier dogwood	Red flowering currant
Red osier dogwood	Red elderberry	Snowberry
Pacific ninebark	Vine maple	Tall Oregon grape
	Indian plum	Oceanspray
TREES		
Western red cedar	Western red cedar	Douglas-fir
Red alder	Red alder	Red alder
Sitka spruce		

Replacement species should be chosen based on the ecology of the site by a qualified environmental professional. Local biologists, environmental professionals, agronomists, agrologists, native and domestic forage specialists, seed companies, and plant nurseries are all good sources for localized recommendations for regional native species and regionally adapted domestic species, based on site usage. There are several science-based resources available to guide restoration efforts, such as the South Coast Conservation Program's Diversity by Design restoration planning toolkit.

Native grass seed mixes are also available. Noted in the Similar Species section, the native Bluejoint reedgrass would also be a suitable restoration species for reed canarygrass management sites.

It may be difficult to find and source native plants that can withstand water inundation at wetland sites, but working from the 'wet sites' species list above provides a good start (Juteau, 2019).

Reed canarygrass sites are often found in areas with existing, or potential, wildlife populations that can damage restoration plantings (deer, beaver, muskrat, vole, etc.). Therefore, any revegetation plan must consider impacts from wildlife and utilize appropriate mitigation measures to protect the restoration and existing native plantings (tree wrapping, exclusion caging/fencing, vole guards, etc.).

Restored wetland

CREDIT: ECHO ECOLOGICAL

References

Aasen, A., & Bjorge, M. (2009). Grasses. In Alberta Forage Manual, 2nd Edition (pp. 55-136). Edmonton: Alberta Agriculture and Rural Development.

Alards-Tomalin, J. (2019, November 27). Echo Ecological. (T. Murray, Interviewer)

Anderson, H. (2012). Invasive Reed Canary Grass (Phalaris arundinacea subsp. arundinacea) Best Management Practices in Ontario. Peterborough: Ontario Invasive Plant Council.

BC Ministry of Environment. (2011). Canadian Pesticide Education Program: Applicator Core Manual. Federal, Provincial, Territorial Working Group on Pesticide Education, Training and Certification.

Centre for Agriculture and Bioscience International. (2020). Invasive Species Compendium. Retrieved from Phalaris arundinaceae (reed canary grass): https://www.cabi.org/isc/datasheet/55423

Community Mapping Network. (2019, December 2). Invasive Plants of Southwestern BC: Reed Canary Grass. Retrieved from http://www.cmnmaps.ca/shim/atlases/invasivespecies/_private/ReedCanary.htm

Crosby, K. (2018, December). Natural Areas Coordinator, City of Surrey. (F. Steele, Interviewer)

Evely, A. (2005, July 28). GVRD. e-mail communication.

Gasior, I. (2019, November 27). Project Manager, Invasive Species Council of Metro Vancouver. (T. Murray, Interviewer)

Gifford, A., Ferdy, J.-B., & Molofsky, J. (2002). Genetic composition and morphological variation among populations of the invasive grass, Phalaris arundinacea. Canadian Journal of Botany, 779-785.

Green, E., & Galatowitsch, S. (2002). Effects of Phalaris arundinaceae and nitrate-N addition on the establishment of wetland plant communities. Journal of Applied Ecology, 134-144.

International Society of Arboriculture. (August, 2018). Proper Mulching Techniques. Retrieved from http://www.treesaregood.org/portals/0/docs/treecare/ProperMulching.pdf

Invasive Plant Species Asessment Working Group. (2007). Invasive Plant Species Fact Sheet: Reed Canarygrass.

Johnson, M. (2005). Investigating Alternatives for Control of Phalaris arundinacea (Reed Canarygrass) in Urban Wetlands (Master's Thesis). Portland: Portland State University.

Juteau, C. (2019, December 3). Conservation Science Director, A Rocha Canada. (T. Murray, Interviewer)

Kercher, S. M., & Zedler, J. B. (2004). Multiple disturbances accelerate invasion of reed canary grass (Phalaris arundinacea L.) in a mesocosm study. Oecologia, 455-464.

King County Noxious Weed Control Program. (2015). Best Management Practices: Reed Canarygrass. King County.

Klinkenberg, B. (2019). E-Flora BC: Electronic Atlas of the Plants of British Columbia [eflora.bc.ca]. Retrieved from http://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Phalaris%20arundinacea

Marcoux, H. (2019, December 6). BCIT, Forest & Natural Areas Management. (T. Murray, Interviewer)

Matthews, T. (2019, November 27). CEO, Echo Ecologicial. (T. Murray, Interviewer)

Metro Vancouver. (2016). Climate Projections for Metro Vancouver. Burnaby, BC. http://www.metrovancouver.org/services/air-quality/AirQualityPublications/ClimateProjectionsForMetroVancouver.pdf

Miller, A. J., Tarasoff, C. & Salmon, T. (2021). Feasibility of Targeted Invasive Plant Grazing in Metro Vancouver. Retrieved from http://www.metrovancouver.org/services/regional-planning/PlanningPublications/FeasibilityTargetedInvasivePlantGrazingMV.pdf

Page, N. (2006). Framework for Invasive Plant Management in GVRD Parks. Burnaby: GVRD Regional Parks Department .

Pinchin. (2018). Katzie Slough Blind Channel – Year 2 Post Planting Inspection.

Pinchin West Ltd. (2016). 2016 Post-planting Report for Remedial Works Associated with the Katzie Slough Blind Channel Compensation Habitat, Airport Way, Pitt Meadows, BC. Abbotsford: Pinchin West Ltd.

Pojar, J., & MacKinnon, A. (1994). Plants of Coastal British Columbia including Washington, Oregon & Alaska. Vancouver: Lone Pine Publishing.

Seebacher, L. (2008). Phalaris arundinacea Control and Riparian Restoration within Agricultural Watercourses in King County, Washington (Doctor of Philosophy Dissertation). University of Washington.

St.Andrassy, J. (2020, February). Environmental Coordinator II, Township of Langley. (T. Murray, Interviewer)

The Nature Conservancy. (2004). Reed Canary Grass: Control & Management in the Pacific Northwest.

Townsend, L., & Hebda, R. (2013). Pollen and Macro-Fossil Assemblages in Dusturbed Urban Wetlands on South Vancouver Island Reveal Recent Invasion of Reed Canarygrass (Phalaris arundinacea) and Guide Restoration. Restoration Ecology, 114-123.

Wisconsin Reed Canary Grass Management Working Group. (2019, December). Reed Canary Grass (Phalaris arundinacea) Management Guide: Recommendations for Landowners and Restoration Professionals . Retrieved from https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_035064.pdf

Additional Resources

For more information please refer to the following resources.

- BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development, Invasive Alien Plant Program (IAPP). www.gov.bc.ca/invasive-species
- E-Flora BC, an Electronic Atlas of the Plants of BC www.eflora.bc.ca/
- Grow Green Guide. www.growgreenguide.ca
- Grow Me Instead. https://bcinvasives.ca/play-your-part/plantwise/
- King County Noxious Weed Control Program Best Management Practices: Reed Canarygrass. https://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/Reed-Canarygrass-Control.pdf
- Pesticides and Pest Management. Province of British Columbia https://www2.gov.bc.ca/gov/content/environment/pesticides-pest-management
- The Nature Conservancy. Reed Canarygrass: Control & Management in the Pacific Northwest. https://www.invasive.org/gist/moredocs/phaaru01.pdf

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