DISTRICT OF
Logan Lake
Discover Our Nature

**Education and Environmental Stewardship Committee Meeting Agenda**
**Friday, June 26, 2026 at 9:30 AM in the Fire Hall Teck Room**

Page

## 1. CALL TO ORDER

## 2. LAND ACKNOWLEDGEMENT

We acknowledge that the District of Logan Lake is located on the traditional unceded territories of the Nlaka'pamux, Secwepemc and Syilx Nations on whose traditional territories, we live, we learn, we play, and we do our work. We acknowledge that the historical relationship to the land and territories of these peoples continues to this day.

## 3. ADOPTION OF AGENDA AND LATE ITEMS

(a) June 26, 2026 Education and Environmental Stewardship Committee

## 4. ADOPTION OF MINUTES

(a) Minutes of April 24, 2026 — 3 - 5
Education and Environmental Stewardship Committee - 24 Apr 2026 - Minutes - Pdf

## 5. DELEGATIONS/PRESENTATIONS

(a) Presentation from Lees and Associates regarding Proposed Wetlands Interpretive Trail. — 6 - 22
Wetland Trail Presentation

## 6. UNFINISHED BUSINESS

(a) September Projects Update.

(b) Interpretive Signage Locations within the Wetlands and Parks. — 23 - 32
Map with Interpretative Signage Locations

(c) Discussion regarding Invasive Species at Meadow Creek Golf Course. 33 - 60
Logan Lake Weed Management Program FINAL DRAFT May 23 2017

## 7. NEW BUSINESS

(a) Discussion regarding BC Parks Foundation Grant Opportunities.

## 8. CONSIDERATION OF LATE ITEMS

## 9. QUESTION PERIOD

## 10. ADJOURNMENT

# MINUTES
# Education and Environmental Stewardship Committee Meeting

**Friday, April 24, 2026 - 9:30 AM**
Fire Hall Teck Room

| | |
|---|---|
| **PRESENT:** | Councillor Martell, Councillor Chong, Marge Sidney, Jacqui Schneider (joined 9:35), Ray Town, Anayansi Cohen-Fernàndez, and Hona Healey |
| **ABSENT:** | Lower Nicola Indian Band Representative |
| **ADMINISTRATION:** | Wade Archambault, Chief Administrative Officer, and Jacqui Martell, Administrative Assistant |
| **PUBLIC:** | 2 members |

**1. CALL TO ORDER**
Councillor Martell, Chair called the meeting to order at 9:33 a.m.

**2. LAND ACKNOWLEDGEMENT**
Councillor Martell opened the meeting with a Land Acknowledgement.

**3. ADOPTION OF AGENDA AND LATE ITEMS**

a) April 24, 2026 Education and Environmental Stewardship Committee

Moved and seconded
THAT the Education and Environmental Stewardship Committee meeting agenda for April 24, 2026 be adopted.

CARRIED.

**4. ADOPTION OF MINUTES**

a) Minutes of March 27, 2026 Education and Environmental Stewardship Committee Meeting.

Moved and seconded
THAT the Minutes of the Education and Environmental Stewardship Committee meeting held on March 27, 2026 be adopted as presented and circulated.

CARRIED.

**5. UNFINISHED BUSINESS**

a) Discussion regarding Workplan for 2026 Projects.

Ms. Knezevic, Larratt Aquatic Consulting Ltd. informed the Committee that two (2) classes from the Logan Lake High School went sampling at Logan Lake with Larratt Aquatic, a biologist did a talk on fish and aquatics and Ms. Knezevic did a talk on water quality with the students.
Ms. Cohen-Fernández informed the Committee that there are two potential timeframes for the September projects, she is working on a plan for the wetland project, and they are about to submit an application for the Low Tech Process Based Restoration (LTPBR).
Ms. Sidney stated that the Kamloops Adult Learners Society was interested in attending the September projects and will confirm with them once dates are finalized.

b) Update regarding Park Naturalization and Trail Development.

Councillor Martell informed the Committee that all 2026 budget requests for the Education and Environmental Stewardship Committee had been approved by Council and the Chief Administrative Officer added that he had just received a quote for the trail plan through the wetlands.
Ms. Cohen-Fernández informed the Committee that there are a new group of students with capstone projects she will give them the options to participate in a management plan for invasive weeds or the park naturalization plan. General discussion ensued.

c) Interpretive Signage Locations within the Wetlands and Parks.

There was general discussion regarding interpretive signage in the wetlands and the parks. Councillor Martell requested that committee members review the signs and provide recommendations for locations at the next Education and Environmental Stewardship Committee meeting.

**6. NEW BUSINESS**

a) Discussion regarding Waterfront Plan.

The Chief Administrative Officer reviewed the Waterfront Plan with the Committee and stated that the plan has been adopted by Council and next steps are costing and funding. General discussion ensued.

b) Ltr. 105 from Chris Lee, AquaRealTime Canada, Inc., regarding Continuous Water Monitoring.

There was general discussion regarding the Continuous Monitoring apparatus from AquaRealTime and the Chief Administrative Officer will investigate further and provide information, including costing, at a future Education and Environmental Stewardship Committee meeting.

**7. CONSIDERATION OF LATE ITEMS**

N/A

**8. QUESTION PERIOD**

There were no questions from the gallery.

**9. ADJOURNMENT**

The Education and Environmental Stewardship Committee meeting adjourned at 10:11 a.m.

Recorded by Jacqui Martell, Administrative Assistant

CERTIFIED CORRECT

Chair (Councillor Martell)

Corporate Officer (L. Grimm)

District of Logan Lake

# Dumois Creek

## Wetland Trail

# Project Team

**Patrick Beech**
Senior Landscape Architect

**Sam Bowerman**
Landscape Designer

## Agenda

- Introduction to the Project
- Review of Alignment Opportunities
- Discussion
- Next Steps

## About the Project

This project will explore potential opportunities for a trail through the Dumois Creek Wetland.

The project aims to produce:

- A conceptual trail alignment;
- Trail cross-sections showing construction technique, and
- A Class D cost estimate

with the goal of procuring funding for trail construction.

# Goals and Concerns

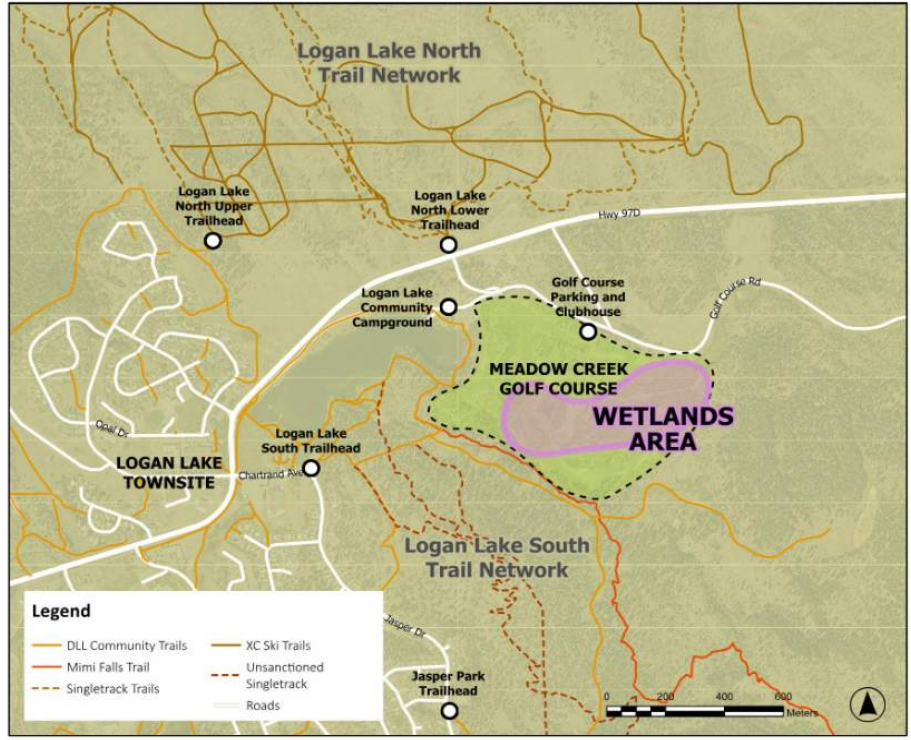
**Project Goals**

- Highlight wetland restoration work in the Dumois Creek Watershed
- Grow the Logan Lake South Trail Network and create new loops
- Promote interpretive and outdoor education opportunities

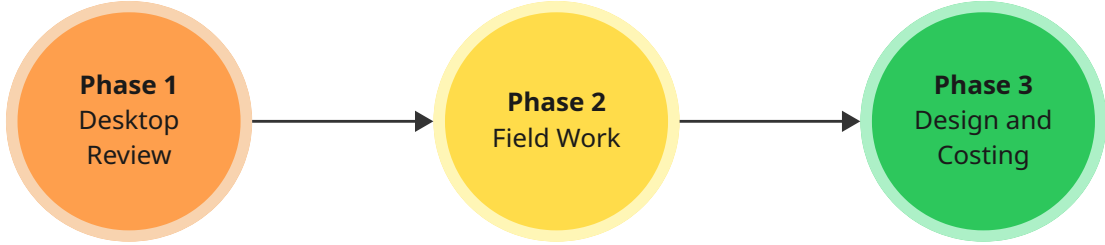
**Project Concerns**

- Avoid impacts to sensitive ecosystems
- Minimize conflict with golfers
- Minimize maintenance and replacement costs

# Project Area



# Project Process




**June 2026**

- Review
- ESSC Meeting
- Desktop Analysis

**Early July 2026**

- Site Visit
- Route-finding

**Late July 2026**

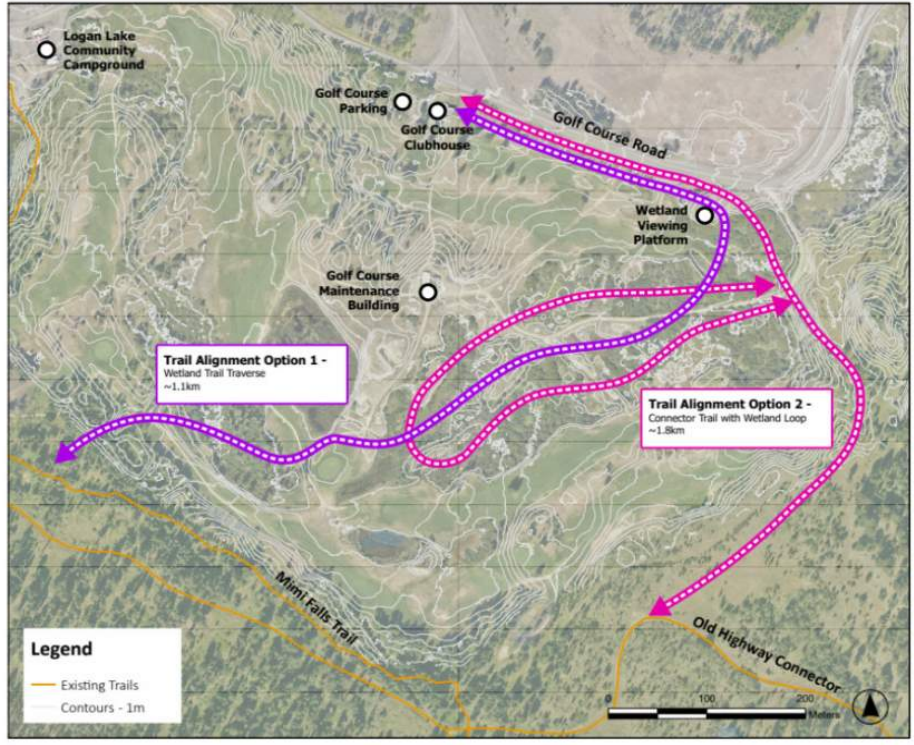
- Analysis summary
- Trail Alignment
- Trail Cross-sections
- Class D Cost Estimate

# Alignment Opportunties

**Route 1 - Wetland Traverse**
A single route which travels through the wetland before paralleling Golf Course Road

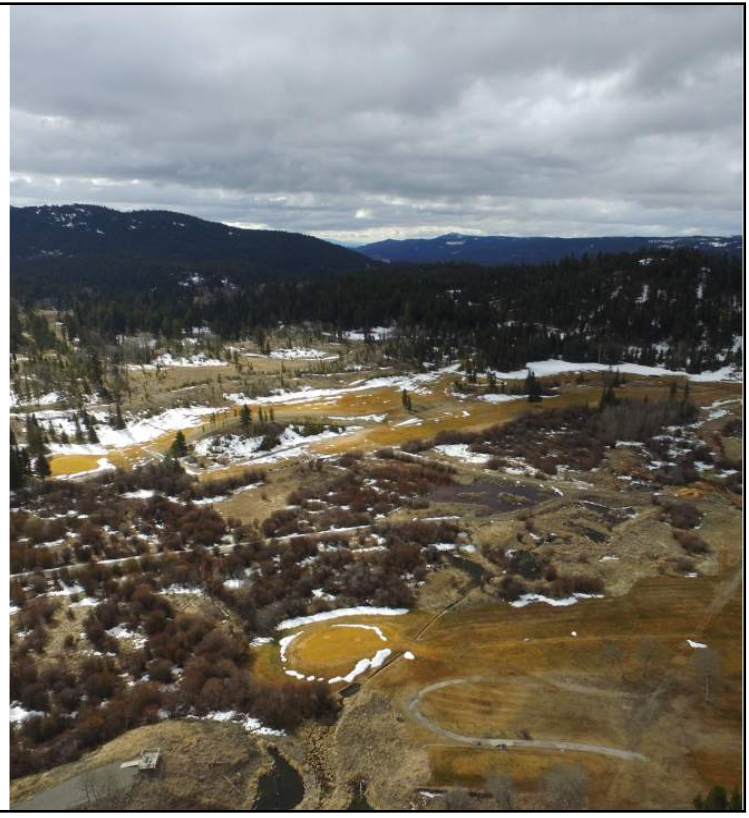
**Route 2 - Wetland Loop and Connector**
A dedicated wetland loop trail tied into the network with a short connector trail

*Note alignments are conceptual



## Questions?

Before we get into our discussion are there any questions about the project?



## Discussion

What do you value about the wetland?

What would you like people who use this trail to take away from their experience?

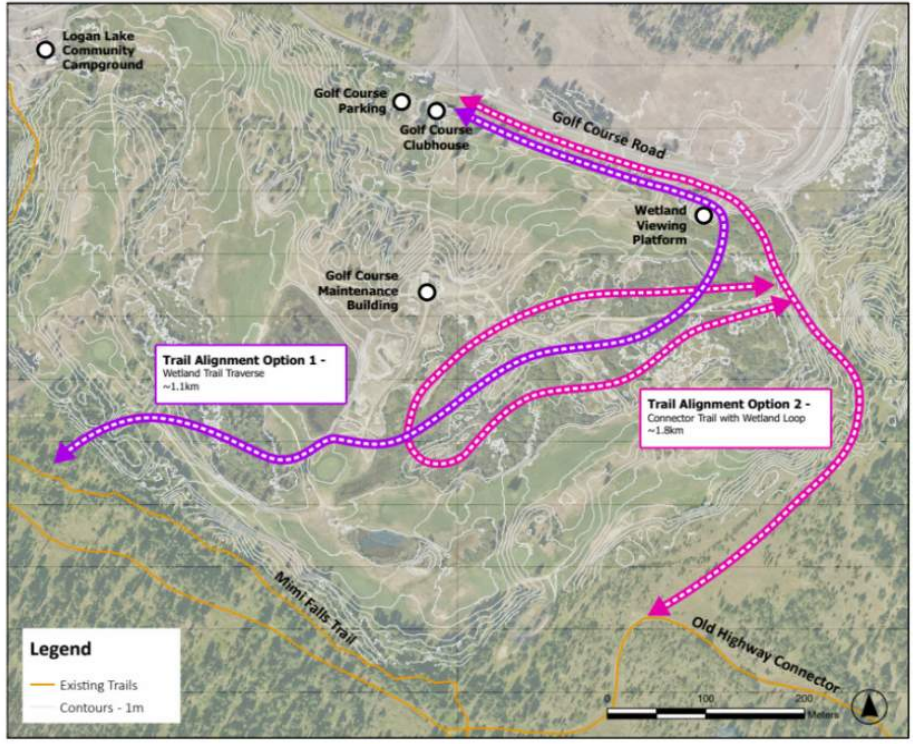
## Discussion

Are there any areas or features that the trail should highlight?

Are there any areas the trail should avoid?

## Discussion

What alignment approach would you prefer to see? Why?



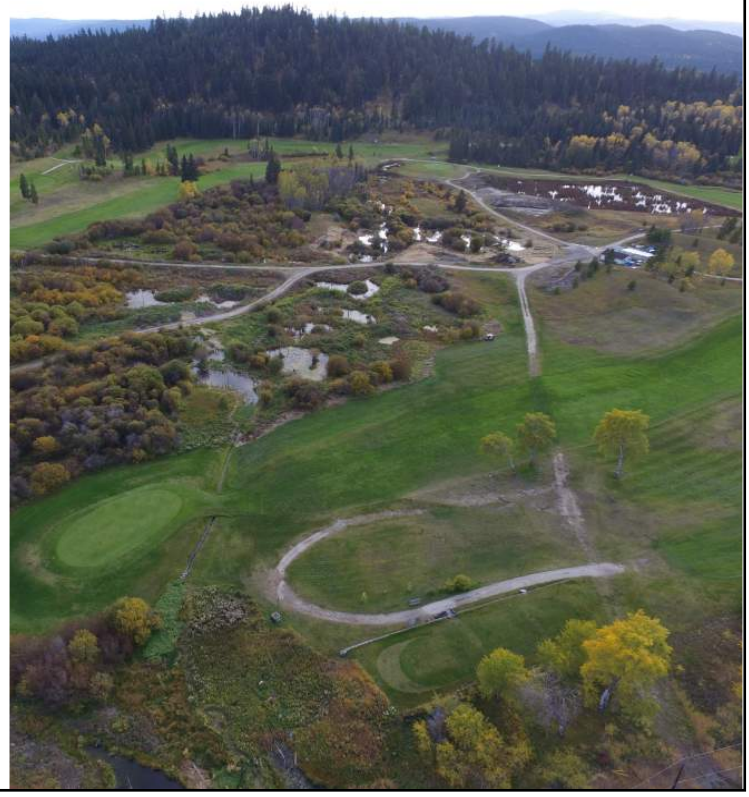
## Discussion

Is there anything we should know that may impact trail construction in the area?

## Discussion

What kinds of amenities (benches, signage, etc.) should the provide?

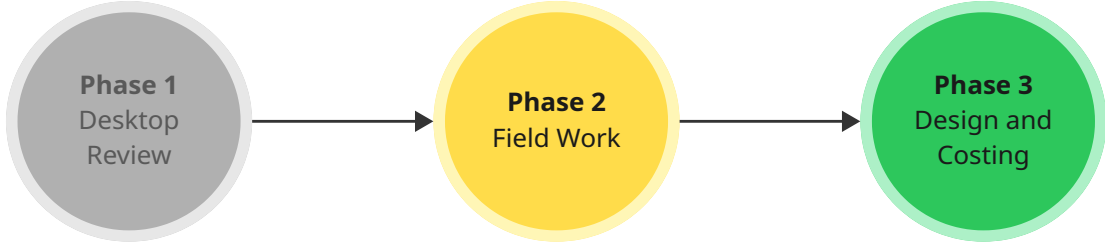
Are there opportunities for the trail to support programming?



## Discussion

Is there anything else that we should know?

# Next Steps

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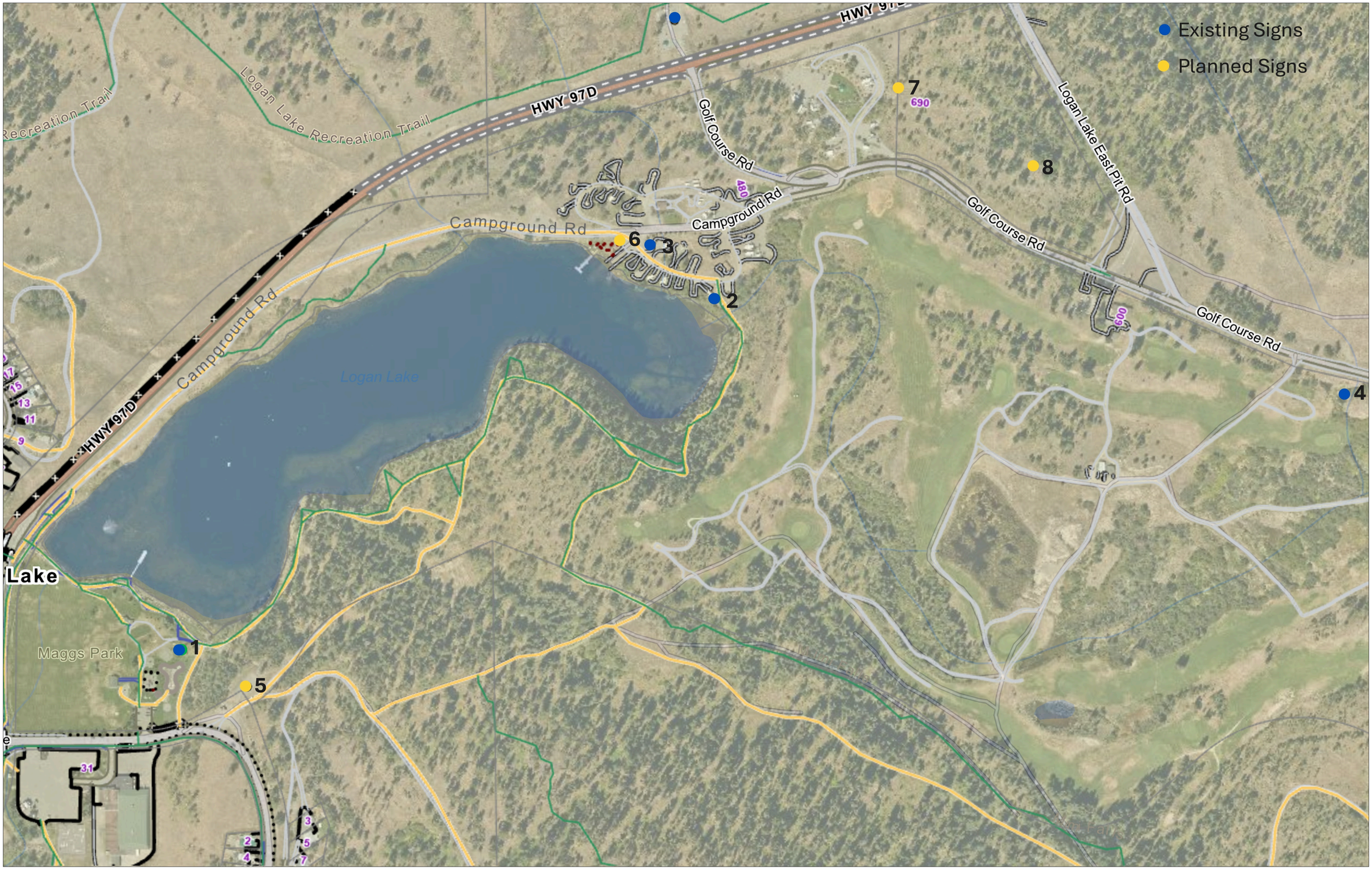
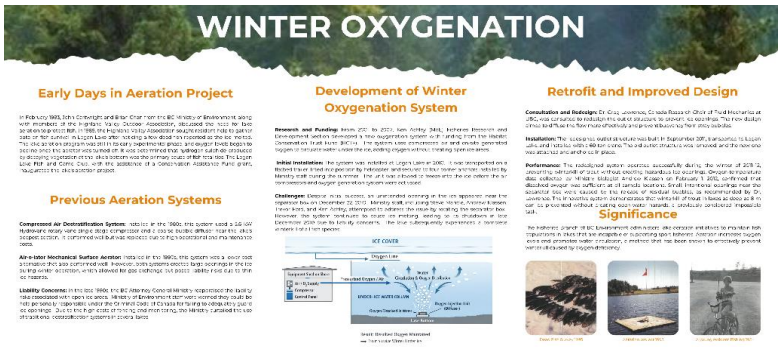
Thank you!


Existing Signs
Planned Signs
HWY 97D
Logan Lake Recreation Trail
Recreation Trail
Campground Rd
Golf Course Rd
Logan Lake East Pit Rd
Logan Lake
Maggs Park
1
2
3
4
5
6
7
8
480
600
690

# Existing Signs:

**Location 1(Maggs Park 3 Sign Kiosk):**


*Figure 1: Replacement Signs (recommended changes not yet incorporated)*

**Location 2 (Campground Trailhead 3 Sign Kiosk):**

*Figure 2: Direct Replacement Signs*

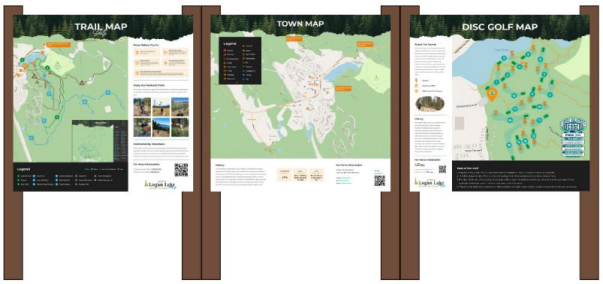


**Location 3 (Campground Near Day use area):**

**Location 4 (Wetlands Viewing Platform):**

## Planned Signs:

**Location 5 (Disc Golf Trail Head):**




**Location 6 (New Day Use Area):**

New wayfinding and regulatory signage area – move any signage from Location 3 over.

**Location 7 (New campground expansion washroom):**

New wayfinding signage related to dodecagon structure based on historical indigenous round house style.

**Location 8 (New campground expansion viewpoint):**

Nłeʔkepmx history, plants and animals in the area.

# SPECIES THAT HAVE INCREASED DUE TO WETLAND RESTORATION

## Black Cap Chickadee

The black cap and bib; white cheeks; gray back, wings, and tail; and whitish underside with buffy sides are distinctive. The more dee notes in a chickadee-dee-dee call, the higher the threat level.

## American Goldfinch

American Goldfinches are unusual among goldfinches in molting their body feathers twice a year, once in late winter and again in late summer. They are among the strictest vegetarians in the bird world.

## Dark Eyed Junco

Unique sparrow with incredible variation between populations. Generally patterned with gray, white, and shades of tan. All have pinkish bills and white outer tail feathers. Juveniles are streaky. Breeds in a variety of forested habitats, especially with conifers.

## Great Horned Owl

With its long, earlike tufts, intimidating yellow-eyed stare, and deep hooting voice, the Great Horned Owl is the quintessential owl of storybooks

## Mallard

The Mallard is the ancestor of nearly all domestic duck breeds. Mallards, like other ducks, shed all their flight feathers at the end of the breeding season and are flightless for 3–4 weeks.

## Red-breasted Nuthatch

These long-billed, short-tailed songbirds travel through tree canopies but stick to tree trunks and branches, in search of bark furrows for hidden insects.

## Orange-Crowned Warbler

Orange-Crowned birds are Nondescript warbler, generally olive-colored overall, but different populations vary from grayer to brighter yellow.

## Northern Flicker

Northern Flickers are large, brown woodpeckers with a gentle expression and handsome black-scalloped plumage. They are strongly migratory and move south for the winter.

## Ruby-crowned Kinglet

The namesake ruby crown is only present on males, and usually concealed. They are energetic, moving quickly and flicking its wings.

## Ruffed Grouse

The dappled, grayish or reddish Ruffed Grouse is hard to see, but its “drumming on air” display is a fixture of many spring forests. They can consume and digest largest and bitter vegetation, often toxic plants that many birds can’t handle.

## Song Sparrow

A rich, russet-and-gray bird with bold streaks down its white chest, the Song Sparrow is one of the most familiar North American sparrows. Males sing often, perching around eye level on exposed branches. They often come to bird feeders.

## Sandhill Crane

These tall, gray-bodied, crimson-capped birds breed in open wetlands, fields, and prairies across North America. Mates display to each other with exuberant dances that retain a gangly grace. Sandhill Crane populations are generally strong.

## Wilson’s Snipe

Wilson’s Snipes are medium-sized, pudgy shorebirds with short, stocky legs. The bill is straight and very long. The head is rounded and the tail is short Their heads move up and down somewhat like a sewing machine running at slow speed.

## Canada Goose

Canada Goose is almost always larger, longer-necked, and longer-billed than Cackling. Listen for loud honking calls, especially as flocks migrate overhead in the classic “V” formation. They are abundant and widespread in Canada.

## White-crowned Sparrow

With its boldly striped, black and white head and its bright song delivered from open perches, this large sparrow is usually conspicuous on its breeding grounds.

## Garter Snakes

The Common Garter snake is a medium-sized, diurnal snake that will grow to a mature size from 46 – 130 cm. Males are typically a fair amount smaller than females, as female fecundity increases with body size.

## Black water Rainbow Trout

Originating in the Ilgachuz Range northwest of Quesnel, Blackwater trout are tend to prefer shallow shoal areas in lakes that mimic a stream. They are powerful and often jump.

## Fraser Valley Rainbow Trout

The strain was first developed during the 1940s at a trout hatchery in Tacoma, Washington. They grow quickly and will typically have a large girth compared to other strains.

# THE HISTORY OF LOGAN LAKE

## Pre-1850-1964

**Pre-1850s:** Prehistoric Indigenous bands occupied the valley, establishing trails for hunting and fishing.
**1850s:** Explorers used the valley as a brigade trail between the Coast and the Interior.
**1871–1880s:** The first mining prospectors arrived in the area.
**1888–1890:** Dr. G.M. Dawson conducted extensive geological, botanical, and archaeological surveys of the Highland Valley.
**1896:** The first recorded mineral claim, "Last Chance," was filed by Thomas G. Patrick.
**1899:** George Novak claimed the Transvaal group of mineral rights, reportedly based on information from DuBois (a veteran Cariboo prospector) that Spence, an Indigenous individual, had discovered copper in the Highland Valley.
**Early 1900s:** Ranchers began settling in the nearby Mamette Lake and Meadow Creek areas.
**1911:** The first optimistic cries of "mining boom" in Highland Valley emerge. A Glasgow company exercised a $160,000 option on three claim groups, predicting that, with adequate capital and given the ore found, a large mining camp would develop.
**1954:** H.H. Spud Huestis formed the Bethlehem Copper Corporation, staked 112 claims, and brought in American Smelting and Refining Co. for a diamond-drilling program. This organization later amalgamated with Lornex and Highmont to form the current Highland Valley Copper (HVC) Mine.
**1962–1963:** The first copper concentrates were produced from the Bethlehem Copper Corporation
**1964:** Ergil Lorntzsen, who arrived in Canada in 1932, formed the Lornex Mining Corporation Ltd.

## 1970 - 2013

**1970:** The Village of Logan Lake was incorporated in November as an "instant town" to house mine workers and their families. The copper concentrate sale agreements were finalized, and $144 million in financing was secured.
**1971:** The first 100 families moved into the town, and the postal service was established.
**1972:** Lornex mine began full operations, shipping its first copper concentrates to Japan.
**1983:** Logan Lake was reincorporated as a District Municipality.
**1985:** The Logan Lake Golf course Meadow Creek relocation work commenced with an additional approval from the Ministry of Environment.
**1986:** Lornex and Cominco's Valley mine amalgamated to form Highland Valley Copper, now the largest open-pit copper mine in North America.
**1990:** The construction of an artificial spawning channel was kick-started and completed in 1991. The Channel is 70m long and 1-1.5m wide.
**2000:** The construction of an ornamental water fountain in the lake was commenced. The fountain operates in summer, spraying water up to 10m high at 120 GPM. Following the Ministry of Environment's recommendation, the District reduced the daily fishing limit from 2 to 1.
**2007:** Logan Lake Enhancement Working Group (LLEWG) was formed
**2013:** Highland Valley Copper mine was modernized.


Fireman's Ballroom 1976


LL Secondary School 1981


Curling Players 1976


Logan Lake Mall 1976


Mining Truck 1990


50th Anniversary Celebrations 2022


Highland Valley Lornex 1980


Highland Valley Copper Mine 2013

# THE HISTORY OF THE WETLANDS

## THE BEGINNING

Residents of Logan Lake noticed and reported a change in the lake to the Council. They saw unsightly algae and a lot more aquatic vegetation. This raised a few questions!

## LLEWG (2007)

The Logan Lake Enhancement Working Group (LLEWG) was formed to address many important issues, including the lake's deteriorating water quality. It was determined that the construction of the Meadow Creek Golf Course, the destruction of the natural wetlands along Dumois Creek, the Ministry of Highways & Transportation's salt shed (without a liner), logging, and cattle grazing in the watershed were having a major impact on the lake's water quality.

Marge Sidney, MOE

## LLEWG Members

DISTRICT OF Logan Lake

BRITISH COLUMBIA Ministry of Transportation and Infrastructure

Ducks Unlimited Canada

Highland Valley Outdoor Association Logan Lake

BRITISH COLUMBIA Ministry of Environment

LARRATT AQUATIC

Audubon Christmas Bird Count

BCLSS

Highland Valley Copper / Teck

** In 2023, LLEWG was renamed to the Education and Environmental Stewardship Committee (EESC).*

## 2010

Marge Sidney's participation in the BC Wildlife Federation's 'Wetland institute' held in Kamloops is what set the foundation for Logan Lake's Wetlands Restoration Project.

### Three Key Issues!

The historic water quality data indicated 3 key issues in the Lake :

- High pH (algae blooms and continuous drought years mostly due to climate change)
- High nitrates (cattle grazing and logging upstream in watershed)
- High salinity (Salt shed and road salt from Hwy 97C)

## 2011

### First Wetlands are Built!

In August 2011, the LLEWG brought in Tom Biebighauser, a wetland specialist from Kentucky. Together with BCIT students and staff, the first wetland restoration project was completed immediately downstream of the former salt shed site to intercept sodium and chloride. Since then, BCIT students, both Bachelor's and Master's, have been involved in every phase of the wetland project.

Tom Biebighauser

## 2012

BCIT's "Small Mammals Survey indicated a slight improvement in habitat diversity from 2010.

A viewing platform was constructed to overlook the 2011 wetlands, and educational signs were installed to inform the public about the ongoing work.

Installed a V-notch weir on Dumois Creek to measure and gauge surface flow.

## 2013

**Phase 2**: Included the creation of 2 large pools totaling 1230 $m^2$.

An Open House was introduced and held every year to promote the wetlands restoration project.

Participation including youth in grades K-12 increased over the time.

## 2014

**Phase 3:** Created four pools along the Dumois Creek drainage and 2 ephemeral wetlands measured approximately 3000 $m^2$

Project team attempted to remove Canada Thistle by hand and weed barrier with trials commencing in 2014.

## 2015

**Phase 4:** Construction of one isolated wetland and two separate wetlands along the Dumois Creek channel and a total area of 2600 $m^2$ were modified during the process.

## 2016

**Phase 5:** Work continues with two new wetland ponds within the Dumois Creek channel immediately downstream of the fourth phase and one groundwater pool upstream of the 2013 seepage side channel.

## 2017

**Phase 6:** The LLEWG are busy! In 2017 one large pond within the Dumois Creek channel upstream of phase III was built and two small groundwater ponds south of phase II.

## 2018 - 2022

**Phase 7:** In 2017, built out one pond within the Dumois Creek channel and one large groundwater pond north of the creek.

**Phase 8:** In 2019, the construction of three ponds with a total area of 1544 $m^2$.

**Phase 9:** In 2022, the construction of two new ponds with a total area covered 341 $m^2$.

The Project paused during 2020-2021, due to Covid-19 pandemic and Tremont Creek Wildfire (2021)

## 2023 - 2024

B.C. Wildlife Federation hosted a low-tech process-based restoration training for the first of 100 Beaver Dam Analogues (BDAs), as part of the Water Everywhere project. A culvert under the maintenance road, acting like a dam, and wetlands on the south side were drying out. Dumois Creek on the north side can now overflow into the south during spring, allowing water flow.

By 2023, chloride has dropped 94.6% since 2007, with salinity declining since Phase 1. Logan Lake saw its first moderate cyanobacterial bloom that year.

In 2024, the final wetland was built on the golf course, near the 90-degree corner on the south access road. It's a small ephemeral wetland.

# WEED MANAGEMENT

## History of Weed Management

On **September 19, 2012**, the Lake Enhancement Technical Working Group discussed a volunteer weeding day in the Phase 1 Wetland to control invasive weeds

**January 16, 2013** – The Southern Interior Weed Management Committee hosted an education day on weed control. In 2013, they collaborated with TNRD and municipalities on weed management, including goats, biological control, and hand-pulling. Students from Logan Lake Secondary School, with HVC, LLEWG, School District 73, and the Southern Interior Weed Management Committee, weeded a wetland on June 12, 2013, learning about invasive plants and aquatic species. About 50 bags of weeds were collected and sent to the transfer station.

On **June 10, 2014,** two weed sessions with students from School District 73, Logan Lake, Grade 5/6 and 6/7, took place. Goat grazing was tested with partial success; it caused trampling and plant damage, as small roots could regrow, making it ineffective. The group managed to remove two loads of weeds.

Previous weed control at Logan Lake wetlands included:

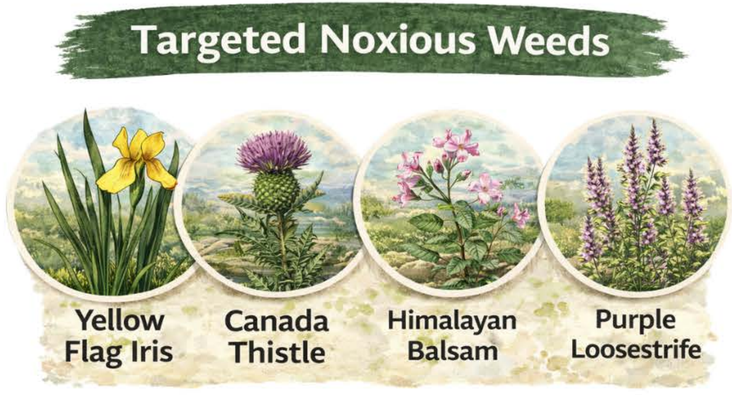
- Hand-weeding by students and volunteers removed seed heads but didn't control root systems.
- Goat grazing was ineffective, as goats ate desirable plants and trampled the shoreline.
- Barrier methods, like landscape cloth with mulch and soil (2013, 2016), suppressed weeds, but thistle stems pushed through seams; cardboard barriers failed.
- Biological controls, including seed-reducing flies, root-feeding weevils, and moths, were released in Kamloops; some agents were observed, but effectiveness was limited.

## Budget

The plan was backed by a $15,000 HVC grant over three years. Expenses include $3,000/year for herbicides like glyphosate and Milestone, contractor fees ($65–$100/hour + travel at $0.65/km), herbicides ($100/10L glyphosate, $1,800/10L Milestone), equipment ($120 backpack sprayers, $50–$100 wipe-on applicators), and $180 certification.

## Licenses and Regulations

The plan integrated the author's earlier draft and D. Ralph's (2016) submission, with a focus on noxious weed control in Logan Lake wetlands to restore habitat diversity. While nearby lands are infested, it prioritizes wetlands and seeks effective control methods for surrounding areas to minimize impacts on riparian zones and Dumois Creek.




## Scope of Work

In **2016**, the LLEWG decided to develop a Weed Management Plan and applied to the Teck Community Investment Fund for support. The plan integrates the author's earlier draft and D. Ralph's (2016) submission, focusing on noxious weed control in Logan Lake wetlands to restore habitat diversity. While nearby lands are infested, it prioritizes wetlands and seeks effective control methods for surrounding areas to minimize impacts on riparian zones and Dumois Creek.

## Two-Part Strategy of the Plan

**Prevention:**

- Ensure machinery is clean before entering the site to prevent weed introduction.
- Avoid moving machinery through heavily infested areas during construction.
- Use "weed pits" to bury uprooted plants under several meters of soil.

**Management:**

- Barrier Method: Use landscape cloth covered with clean topsoil and seeded with grass or clover to suppress weed growth.
- Chemical Method: Apply herbicides like glyphosate (Roundup) or Milestone (aminopyralid) to large weed stands. Spot spraying is preferred over broadcast spraying to minimize damage to non-target plants. Herbicide application requires a Pest Management Plan and authorization from the Ministry of Environment.
- Over-seeding: Re-seed disturbed areas with beneficial grass/forb mixes to promote native plant growth and reduce weed competition.

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# WETLAND RESTORATION

## Why Wetland Restoration is Important

Natural wetlands are finally being recognized as critically important biofilters and wildlife habitat. Although small constructed wetlands in cool climates can take over 100 years to achieve the biodiversity of their natural equivalent (Moreno-Mateos, 2012), they are still far more valuable than the disturbed sites they replace.

## Logan Lake Wetlands Restoration Goals

- Improve Logan Lake's habitat by enhancing Dumois Creek's water quality
- Enhance environmental awareness by restoring a distributed area into a functioning wetland ecosystem
- Provide educational opportunities on the Logan Lake ecological restoration to all stakeholders

## Logan Lake Bio Rafts/Islands Project

- The project, carried out from April 2014 to March 2015, built 3 Bio-rafts (8ft x 8ft Islands) and anchored them in the lake's various shallow areas by the Small Lakes Biologists.
- It was lovely to see how quickly the local birds took to the rafts, eagerly munching on all the greenery and plants. Their swift, cheerful behaviour added a charming touch to the scene.
- The Bio-rafts demonstrated a performance that was 200% higher than that of the constructed wetlands.

**In 2010, LLEWG applied for and received funding of $50,000 each from the Habitat Conservation Trust Foundation (HCTF) and Highland Valley Corporation**

**Since 2003, the Lake Enhancement Committee has been performing bird counts. Beginning with Phase 1 wetlands in 2011, annual counts increased significantly each year through 2018**

**In 2010, Dr. Ken Ashley and BCIT developed the 'Oxygen Injection Aeration System,' which was notable due to Logan Lake's high oxygen demand.**

**65 bird species were observed using the wetlands for breeding, feeding and shelter. Approximately 80% of bird species are migratory.**

**The project team obtained a section 9 license in 2013-2015 and received a water license in 2016 to carryout Wetland works until 2024.**

**The LLEWG was instrumental in bringing the problem of salt leaching from the Ministry of Transport's old salt shed to the ministry's attention.**

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## About Logan Lake

Logan Lake is in Highland Valley, Thompson Nicola Region, British Columbia. Rich in resources like mining, forestry, and outdoor recreation, it is connected by the Trans-Canada and Coquihalla Highways.

The area's scenic beauty and climate variations support activities such as hiking, mountain biking, hunting, fishing, horseback riding, golfing, cross-country skiing, and snowmobiling. It also supports passive recreation such as birdwatching and wildlife photography.

Ducks Unlimited created Logan Lake in the late 1970s by damming the outlet with a sheet pile weir to improve duck habitat. In 1980, the Fish & Wildlife Branch stocked it with Rainbow trout. Logan Slough was previously fishless due to insufficient depth. The watershed is partly drained by Dumois Creek, which flows from above Meadow Creek Golf Course to the lake. Logan Creek's flow above the lake ranges from 0.2 to 9.0 L/sec. Logan Lake covers 12.1 ha, holds about 346,000 $m^3$ of water, and is mostly less than 4 m deep, with a maximum depth of 8 m. Most flow is from subsurface sources. The lake offers an important fishery for locals and tourists.

Image: Bio Raft/ Island anchored in Logan Lake

LARRATT AQUATIC

**Combined Plan for Noxious Weed Management at Logan Lake Constructed Wetlands**

**Scope of Work**

This plan is a combination of an earlier draft by the author, and a stand-alone submission to the LLEWG from D. Ralph (2016), that is provided in its entirety in Appendix 1. This Plan is designed to address the noxious weed issue on the constructed wetland restoration project. Adjacent lands are also infested, however, this plan is focussed on the constructed wetlands, with a view that successful control on this site could then be used by other entities on adjacent lands. Of critical concern is the potential impacts and benefits to the riparian areas and adjacent stream (Dumois Creek) from noxious weed management.

This plan was reviewed by:

1. Logan Lake Enhancement Working Group LLEWG
2. Invasive Species Council of BC Gale Wallen, David Ralph
3. BCIT instructor Doug Ransome

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## 1.0 INTRODUCTION

Noxious weeds have the potential to significantly alter the habitats in which they grow Noxious and invasive weeds are opportunistic plants that grow quickly in disturbed areas and have the potential to spread into natural areas where they compete for natural resources and can displace native plants. As native plants are displaced, reliable food sources for native animal populations diminish, further disrupting the natural balance of the ecosystem.

Long-term control is important because of the wetland's adjacency to roads and susceptibility to re-introduction. This requires the establishment of a native shrub/tree canopy to create shaded environments where the thistle cannot compete. Until the time shrub/trees canopy can provide shade, a weed management program is necessary.

Existing noxious weed populations on the constructed Logan Lake wetlands site showed accelerated growth on the areas disturbed by wetland construction despite sowing commercial grass mixes (Richardson's Riparian Mix near the water and Roadside Mix upslope) and spreading a layer of straw over disturbed soils. There are several weeds species on the site and in the Logan Lake area, including Canada thistle, sow-thistle, bull thistle, wild mustard and knapweed. Complete eradication is therefore unlikely, but at this early point in the wetland restoration process, the weeds are out-competing more desirable plants and reducing habitat diversity and suitability. Of these, Canada thistle is the hardest to control.

Canada thistle (*Cirsium arvense*) has overrun the Wetland sites and is proving to be a persistent nuisance. This perennial prefers rich moist soil, reproduces quickly and mainly by the roots. The roots are highly effective at surviving and small root segments of 64 mm by 32 mm diameter store enough energy to develop a new plant. These plants can put out 6 m of root in a single year and reach depths of 5.5 m at maturity. Additionally, young plants can endure topping and will sprout back. Seed production is the secondary means of reproduction and seeds remain viable for 3-22 years.

## 2.0 HISTORY OF WEED MANAGEMENT AT WETLAND SITES

At the Logan Lake wetlands, previous attempts to control knapweed and Canada Thistle relied on student and volunteer hand-weeding in summer and fall. These efforts did little to control the stands but did remove seed heads. The use of goats was trialed in 2014 but had limited success because the goats also ate willow, grass, etc. and there was some shoreline trampling. The goats may be useful if a few animals were corralled in a portable corral on weed patches, but this has not been tested. These practices removed thistle stems but not the roots and are ineffective due to the plant's ability to regenerate from small roots segments.

A competitive control method was also trialled in 2013 that involved covering heavily thistle-infested areas with landscape cloth covered by a 10 cm mixture of mulch and

weed-free soil into which a grass mix was seeded. This provided excellent control, although thistle stems were able to push through the seams and around the periphery of the landscape cloth. Utilizing cardboard instead of the landscape fabric (2013, 2014) in this control method was completely unsuccessful. The barrier method was trialled again in 2016 during the wetland construction project. In this case, the area treated was 17.5 x 3.4 m and again, weed-free topsoil and seed were used. The results of this trial will be assessed and report in September 2017. Because of its cost, the barrier method is only appropriate in key highly infested areas.

In addition to local efforts, a range of biological controls have been released against spotted knapweed and are confirmed in the area; seed reducing fly (*Urophora spp*.) a root-feeding weevil *(Cyphocleonus)* and a root-feeding moth (*Agapeta) (Ralph, 2016).* Other biological control agents released in the Kamloops region include a seed weevil (*Larinus planus),* a seed head weevil (*Rhinocyllus conicus)* but these were not in evidence during a fall tour *(Ralph, 2016).*

## 3.0 GENERAL PLAN

In the interim years before shade can offer weed control, we suggest a two-part program of prevention and management.

The area to be treated would be confined to the area disturbed during wetland construction over the years and the disturbed areas immediately adjacent to the constructed wetlands.

Prevention: In future wetland construction, ensure that the machinery comes on-site with clean tracks and it avoids passing through heavily infested sites during construction. It may be possible to "bury" plants ripped out of heavy infestations with several meters of soil using "weed pits" or if hills are being created out of the excavated soil.

Control: *Barrier method*: Heavy Canada thistle stands adjacent to the pond surfaces could be controlled using the barrier method described above (heavy landscape cloth covered with 10 cm of clean topsoil and seeded with roadside grass mixture, or clover seed mix).

*Chemical method*: Application of Round-up (glyphosate) or Milestone (aminopyralid) herbicide by a certified applicator would be appropriate on the large stands of noxious weeds. Care will have to be taken to minimize the exposure of planted shrubs to avoid setting them back. A 1 m wide minimum buffer would have to be observed along water ways. Repeated applications are needed to kill all root buds with Round-up and repeated applications may be necessary for Milestone as well. Milestone may be harder to obtain.

We would suggest spot-spraying weeds rather than broadcast spraying in all years. Invasive plant management on public land can require authorization to carry out application of herbicide. A person must prepare and register a Pest Management Plan

with the Ministry of Environment if they propose to manage noxious weeds or invasive plants on more than 50 ha a year of public land, however we are proposing to treat a much smaller area (BC MoE, 2012). Herbicides would be stored in the appropriate location at the Logan Lake Works Yard.

Commented [H1]: B.C. Integrated Pest Management Regulations for Forestry, Noxious Weed and Industrial Vegetation Managers Summary of Requirements and Explanatory Notes PHASE 1: Pest Management Plan Development

Ministry of Environment Environmental Management Branch Integrated Pest Management Program March 2012

Over-seeding: If required, re-seed areas from previous year's wetland construction with beneficial grass/forb mix such as a roadside grass mix in dry areas, and a riparian seed mix in wetter areas.

## 4.0 CONTROL SCHEDULE BY NOXIOUS WEED SPECIES

### 4.1 Canada Thistle Schedule

Moist areas are most vulnerable and will be the focus of control. Canada thistle is a long-lived perennial. Pulling, dead-heading, and cutting are all ineffective at the wetland sites and elsewhere. Effect herbicides for control of Canada thistle on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage) and Milestone herbicide (aminopyralid = active ingredient) formulations. Currently biological control of Canada thistle in BC is not effective; but it will cause stress on plants and can make them less vigorous.

Year 1 - construction

- Machine scraping and burial of dense stands in a pit >1 m deep
- Volunteers/BCIT students to apply erosion control (barrier) cloth over dense stands and buried Canada thistle plants in pit. Add soil on barrier cloth and seed in roadside mix after construction is complete on all disturbed areas
- plant grass seed and shrubs for both short-term competition and long-term shade

Year 2 – post-construction

SPRING

- Weed-whack mature plants to remove seed source and delay plant maturity,
- spot spray plants when they resume active growth with herbicide in spring and repeat as needed in fall

FALL

- spot spray 2% glyphosate OR wipe-on concentrated glyphosate solution from 25% to 33% solution plants in active growth with herbicide as needed OR apply directed spray of Milestone when green basal re-growth is present
- LAC/BCIT to monitor effectiveness of control measures
- Volunteers/BCIT to collect and release *Larinus planus* weevil and *Urophora carduii* fly (collected from Kamloops area if possible)
- LAC/BCIT to determine need for over-seeding and mulching

Year 3 – post-construction

SPRING

- hand-pull or weed-whack to remove seed source and delay plant maturity

- spot spray plants when they resume active growth with herbicide in spring and repeat as needed in fall

FALL

- spot spray 2% glyphosate OR wipe-on concentrated glyphosate solution from 25% to 33% solution plants in active growth with herbicide as needed OR apply directed spray of Milestone when green basal re-growth is present
- LAC/BCIT students to monitor effectiveness of control measures
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- LAC/BCIT to determine need for over-seeding and mulching

### 4.2 Mustard Schedule

Tumble mustards are a winter annual or a biennial. Winter annuals die after flowering and setting seed, with seed germination in the autumn or winter. These mustards reproduce only by seed.

Year 1 - construction

- Volunteers + BCIT students to weed-whack dense stands and bury in weed pit.
- plant grass seed and shrubs for both short-term competition and long-term shade

Year 2 – post-construction

SPRING

- Weed digging or pulling in spring after plant growth commences works well. Mowing / weed-whacking in early summer will prevent mustard from flowering, making them unable to release seeds. For dense patches, tillage works in the control of early/young tumble mustard if it cuts the roots at a minimum depth of 10 cm below the leaf.
- If necessary, spot chemical treatment can be applied.
- Glyphosate is effective and needs to be used during active plant growth during warm weather (per label instructions)

FALL

- Application of glyphosate in late September / October will give effective control of tumble mustard and other weeds
- LAC/BCIT to determine need for over-seeding and mulching

Year 3 – post-construction

SPRING

- Weed digging or pulling in spring after plant growth commences works well. Weed-whacking in early summer will prevent seed-head formation, but care must be taken to avoid damaging planted trees and shrubs.

- If necessary, spot chemical treatment using wipe-on glyphosate concentrate as per label instructions

FALL

- LAC/BCIT to determine need for over-seeding and mulching
- If necessary, spot chemical treatment using wipe-on glyphosate concentrate as per label instructions

### 4.3 Knapweed Schedule

The spotted knapweed is a short-lived perennial, with individual plants living 3 – 5 years, but the seed can remain dormant and viable for decades. Biological control has been applied to the Logan Lake area, so any 2nd-year plants that are pulled up should be checked for the root weevil, and the percentage of plants affected noted. Applications of herbicides need to be done during active growth (June to mid-Sept).

<u>Year 1 - construction</u>

- Volunteers/BCIT students to hand-pull and weed-whack dense stands and bury in weed pit.
- plant grass seed and shrubs for both short-term competition and long-term shade
- Volunteers/BCIT students to apply barrier cloth over buried knapweed, soil and seed in roadside mix.

<u>Year 2 – post-construction</u>

SPRING

- hand-pull second-year plants
- spot spray (directed spray) emerging plants with herbicide in June. Glyphosate is effective and needs to be used during active plant growth during warm weather (per label instructions ~2% solution) Similarly, application of 2,4-D in late September / October will give effective control but should not be used near the water (observe water course set-backs on label). Milestone can be used adjacent to water due to its low toxicities (Appendix 1) and degradation in UV – sunlight.
- wipe-on application of concentrated glyphosate solution from 25% to 33% solution (see label) only to leaves of target plants – use near desired shrubs to avoid setting them back

FALL

- LAC/BCIT to determine need for over-seeding and mulching
- If necessary, spot chemical treatment using wipe-on glyphosate concentrate as per label instructions

<u>Year 3 – post-construction</u>

SPRING

- hand-pull second-year plants

- spot spray (directed spray) emerging plants with herbicide (as above)
- wipe-on application of concentrated glyphosate solution from 25% to 33% solution (see label) only to leaves of target plants – use near desired shrubs to avoid setting them back

FALL

- LAC/BCIT to determine need for over-seeding and mulching
- If necessary, spot chemical treatment using wipe-on glyphosate concentrate as per label instructions

### 4.4 Bull Thistle Schedule

Bull thistle is a biennial tap-rooted plant that is relatively easy to control. In the second year of growth the plant will produce flowers and seeds that are dispersed by wind and can remain viable for a decade. The seed-decreasing fly *Urophora stylata* was evident in each of four seed-heads examined in fall 2016 (Ralph, 2016).

Year 1 - construction

- Volunteers/BCIT students to weed-whack dense stands and bury in weed pit.
- plant grass seed and shrubs for both short-term competition and long-term shade
- BCIT students to apply barrier cloth + soil over buried weed pit, soil and seed in roadside mix.

Year 2 – post-construction

SPRING

- DO NOT hand-pull second-year plants on adjacent ground – weed whack instead due to possible hand injuries
- spot spray (directed spray) emerging plant rosettes with herbicide in June. Glyphosate is effective and needs to be used during active plant growth during warm weather (per label instructions ~2% solution) Similarly, application of 2,4-D on the new-growth rosettes in spring will give effective control but should not be used near the water (observe water course set-backs on label). Milestone can be used adjacent to water due to its low toxicities (Appendix 1) and degradation in UV – sunlight as a directed spray.
- wipe-on application of concentrated glyphosate solution from 25% to 33% solution (see label) only to leaves of target plants – use this approach near desired shrubs to avoid setting them back with over-spray.

FALL

- LAC/BCIT to monitor bull thistle persistence
- Volunteers/BCIT to clip and dispose of any seed-heads (check seed heads for *U. stylata)*

Year 3 – post-construction

SPRING

- spot spray (directed spray) emerging plant rosettes with herbicide (as above)
- wipe-on application of concentrated glyphosate solution from 25% to 33% solution (see label) only to leaves of target plants – use near desired shrubs to avoid setting them back

FALL

- LAC/BCIT to monitor bull thistle persistence
- Volunteers/BCIT students to clip and dispose of any seed-heads (check seed heads for *U. stylata)*

## 5.0 BUDGET

The Milestone purchase and the cost of the Contractor to apply the herbicide will be the most expensive budget items, followed by monitoring and reporting. The grant from HVC should last three years – the time required to fully appreciate the Plan's success. The area to be treated is approximately 3 ha around the constructed wetlands plus 2 ha along their boundaries = 5 ha (1 ha immediately adjacent to water courses + 4 ha >10m from water courses). We anticipate 3 spring applications (1/yr) plus one or two fall applications at diminishing areas to be treated for a total of 5 applications. From HVC's generous grant of 15,000, we have about 3000.00 per year to spend on herbicide applications (full spring tmt + spot-treat fall)

| COSTS: | HVC GRANT = 15,000 multi-year | |
|---|---|---|
| Herbicide Application | | |
| Contractor | 65.00 - 100.00 /hour | need an estimate from Carrie Campbell |
| Contractor travel | 0.65/km | |
| Glyphosate | 100.00/10 L | 2-4L/ha x 4 ha = 8 – 16 L per application x 5 = 800.00 max |
| Milestone | 1,800.00/10 L | 0.5L/ha x 1 ha = 2.5 L per application x 5 = 1,800.00 |
| Application equipment | 250.00 | |
| Licenses | ---------- | |
| Applicator certificate | 180.00 | |
| Plan development* | | |
| D. Ralph | 1000.00 | |
| LAC | 1485.00 | Prev. invoice (765.00 2016) + 720.00 |
| Monitoring | | |
| LAC/BCIT Report - student | student project -potential- | |
| Annual Weed Report - LAC | 850.00 | |

* paid from other grant providers

## 6.0 TIMETABLE FOR 2017

The information used to arrive at the proposed spray schedule for 2017 is provided in the following table.

Logan Lake Wetland Weed Control - Spray Schedule 2017

| | Canada thistle | Bull thistle | Knapweed | Mustard |
|---|---|---|---|---|
| LOCATION | wet areas | dry areas away from water | dry areas away from water | dry areas away from water |
| MATERIAL (label rates) | glyphosate 2% OR Milestone | glyphosate 2% OR Milestone OR 2,4-D not near water | glyphosate 2% OR Milestone | glyphosate 2% OR 2,4-D not near water |
| METHOD | directed spray | directed spray | directed spray | directed spray |
| TIMING | in spring and possibly warm moist Sept weather | in spring | in spring and possibly warm moist Sept weather | in spring and possibly warm moist Sept weather |

This table shows that glyphosate can be used on all the noxious weeds in spring after active growth has commenced. It is far less expensive than Milestone and both are degraded by UV (sunlight), however, Milestone is less toxic and some entities prefer it near water. Milestone has variable success on the mustards and they are not listed on the Milestone label. 2,4-D also has low toxicity, but is not effective on Canada thistle or on knapweed, and does not degrade in sunlight. We therefore recommend the use of Milestone immediately adjacent to the water (<10 m), with the use of glyphosate in the upland areas (>10m). Both herbicides would be applied in the first (2017) year in the spring (June) as a directed spray, at the label rates.

## 7.0 LABEL INFORMATION

Milestone is a systemic, post emergent herbicide designed for the management of invasive species and broad-spectrum, broadleaf weed control for roadside, rights-of-way and other non-crop vegetation control. Aminopyralid is the active ingredient in Milestone, and it is an environmentally safe, easy-to-manage molecule that provides an effective, long lasting tool for managing difficult to control weeds in any weed control program. Milestone reduces environmental impact and is safe to use, with low use rates and buffer requirements that are significantly reduced. Milestone is a lower cost alternative to other weed control programs. it has a low environmental impact. Its favorable environmental profile results in a lighter environmental footprint (lower environmental herbicide load). It has a Pest Management Regulatory Agency (PMRA) Reduced Risk status.

Glyphosate Glyphosate is a herbicide. It is applied to the leaves of plants to kill both broadleaf plants and grasses. The sodium salt form of glyphosate is used to regulate plant growth and ripen fruit. Some products containing glyphosate are

registered for use to control aquatic plants. Pure glyphosate is low in toxicity to fish and wildlife, but some products containing glyphosate may be toxic because of the other ingredients (surfactants, activators, etc.) in them. R/T 540 Liquid Herbicide is not registered for direct application to bodies of water. Therefore do not treat invasive plants over open water. Effectiveness is reduced when treating weeds heavily covered with dust or silt. Do not apply if rainfall is likely within 6 hours of application.

Prepared by: Larratt Aquatic Consulting Ltd.
Heather Larratt: Aquatic Biologist, R.P. Bio

B.C. Integrated Pest Management Regulations for Forestry, Noxious Weed and Industrial Vegetation Managers Summary of Requirements and Explanatory Notes PHASE 1: Pest Management Plan Development

Ministry of Environment Environmental Management Branch Integrated Pest Management Program March 2012

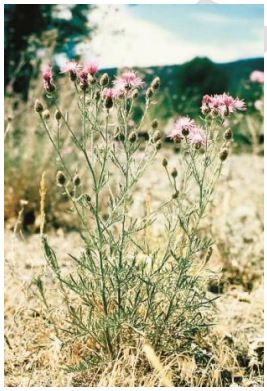
# APPENDIX 1

**Noxious and Invasive Plant Management Plan for Logan Lake Constructed Wetlands**
**Prepared by David Ralph, Project Manager, Invasive Species Council of BC**
December 15, 2016

**Overview**

I attended a morning tour of the Logan Lake Constructed Wetlands with Marge Sidney, MoE, and a group of her colleagues, on November 24th, 2016. We spent the approximately 3 hours visiting various constructed wetland sites along the creek commencing at Meadow Creek Rd, across the road from the MoTI Gravel pit and walking south east along the access road stopping at contracted wetland areas along the creek corridor and adjacent to the access road.
At this time of year many of the annual weeds have matured and been minimized into the ground litter layer, so many were unidentifiable, however, many were tall enough to be identified. Perennial weeds, typically being more robust and taller, were easier identified. The weeds species I will address herein are the noxious or invasive species found during the tour, or known to exist in the general area. For the purpose of this report invasive plants will include 'noxious weeds' which are invasive species listed on the BC Weed Control Act Regulations.
The invasive species identified on the tour and listed here will be dealt with individually. I will address management options with information on overall efficacy of treatment options. Restrictions to use certain options, such as herbicide control, will be dictated by proximity to water and the specific type and formulation of herbicide proposed for use.

## Spotted Knapweed (*Centaurea biebersteinii*)



This knapweed species is common in the Logan Lake area and in immediate areas around and within the Logan Lake Constructed Wetlands. It is a tap-rooted perennial species that

reproduces by seed. The first year of growth the plant remains a low growing seedling that does not produce seed. In subsequent years it will bolt or produce a stem and flowering structures that produce seed. It can have prolific annual production of seed that local research shows can remain 25% viable in the soil after 14 years.

The spotted knapweed infested areas, viewed on the tour, were not found directly in the constructed wetlands but mostly adjacent to them or a distance from the wetlands perimeter. Spotted knapweed was found mostly in disturbed areas: roadways, adjacent to roadways, open banks or on poorly vegetated knolls.

**Management:**
**Biological**
Inspection of 25 random spotted knapweed plant seed heads along the tour confirmed presence of the biological control agent *Urophora spp*. (*U. affinis* or *U. quadrifasciata*) seed reducing fly in all seed heads. This fly may be present in sufficient populations to reduce seed production enough reduce or minimize spread, however, to determine the rate of spread, or not, of the knapweed, establishment of transects over multiple years may be required. At the very least multiple photo points over multiple years would be required to get some indication of spread. Sampling of spotted knapweed roots in the spring would indicate the presence of any root biocontrol agents such as *Cyphocleonus achates,* a root feeding weevil, or *Agapeta zoegana*, a root feeding moth. Larvae of these two bio-agents are easily found in spring sampling.
No presence of the seed eating weevil *Larinus obtusus* and *Larinus minutus* were found on the project area. These biocontrol agents are found in the region and are effective at reducing seed production. Measuring the presence of *Urophora spp.* and closer evaluation or measurement of spread and measuring the presence or non-presence of *C. achates, A.zoegana*, *Larinus obtusus* and *Larinus minutus* may determine whether other control measures are warranted.
Biological control may, after sufficient monitoring and measurement for bio- agent presence, and release and establishment of bio-agents not present, may be an effective part of the management strategy for spotted knapweed in the project area.
"Evidence strongly points to a suite of biocontrol agents (seed feeders and root feeders) as the primary drivers of knapweed decline in British Columbia's Southern Interior." as explained in the research report by Don Gayton and Val Miller 'Impact of Biological Control on Two Knapweed Species in British Columbia'.
https://www.for.gov.bc.ca/hra/plants/publications/Gayton_Miller_knapweed.pdf

*Urophora affinis.*
https://www.for.gov.bc.ca/hra/plants/biocontrol/basic_bioagent_pages/uraf.htm
*Urophora quadrifaciata*
https://www.for.gov.bc.ca/hra/plants/biocontrol/basic_bioagent_pages/urqu.htm
*Agapeta zoegana*
https://www.for.gov.bc.ca/hra/plants/basic_bioagent_pages/agzo.htm
*Cyphocleonus achates*
https://www.for.gov.bc.ca/hra/plants/biocontrol/basic_bioagent_pages/cyac.htm
*Larinus obtusus*
https://www.for.gov.bc.ca/hra/plants/biocontrol/basic_bioagent_pages/laob.htm
*Larinus minutus*
https://www.for.gov.bc.ca/hra/plants/biocontrol/basic_bioagent_pages/lami.htm

**Manual**
Pulling spotted knapweed is only effectively done on 2nd year plants that have developed stems. Soil should be moist to effectively remove as much of the root as possible to ensure it does not regrow, as perennial can do. Removing the root to at least 2 inches below the root crown, at minimum, will likely not allow the plant to regrow , ideally removing the entire root will ensure the plant will not regrow. If the plant snaps off at the root crown, regrowth will occur. It is not always effective to long tap rooted plants as they will often snap off at the root crown. In dense stands significant soil disturbance occurs and revegetation of the areas is recommended.\

**Cutting**
Will remove the plants vegetative parts, but the plant will continue to regrow even if cut right to the root crown. This will stop plants from maturing to the seed stage and delay seed production. It must be emphasized that multiple cutting times must occur over a number of years on a site to eliminate the infestation. It is an approach that is labour intensive. It has been observed that spotted knapweed, under constant and long term cutting regimes, will begin to grow prostrate to the ground and develop flower and mature to seed stage.

**Deadheading**
Constant cutting of flowers and developing seed structures dramatically reduces or eliminates seed production. It is a very long term effort to eliminate the infestation. Deadheaded material should be bagged and disposed of in a landfill. This is very labour intensive. The long viability of seed may result in knapweed seed germinating for decades.

**Herbicide**
Invasive plant management on public land requires a 'Use Authorization' to carry out application of herbicide. Invasive plant management on lands deemed private does not need a 'Use Authorization'.
Effect herbicides for control of spotted knapweed on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage) and Milestone herbicide (aminopyralid (active ingredient)) and perhaps 2, 4-D amine herbicide formulations. There are other effective herbicides for spotted knapweed control however they may not be as suitable for invasive plant management on this project due to their persistence and leachability in soils.

***Glyphosate***: is a non-selective, non-residual herbicide and would be best used in close proximity to water. It is quickly degraded by ultra violet rays in water and has very low mammalian toxicity and moderate toxicity to fish and aquatic invertebrates. It can be applied as a directed spray or as a wipe-on application technique.



Wipe-on applicator Backpack for directed spray application Spray bottle- precise directed spray

**Wipe-on application** is a technique that requires the applicator to be brushed up and down the foliage with a concentrated glyphosate solution from 25% to 33% solution (see label). It is a directed application and properly used applies the herbicide mixture only to the target plant foliage and does not apply herbicide to adjacent non target plants and does not allow herbicide to reach the ground.
Types
http://www.redweeder.com/
http://www.oescoinc.com/sideswipe-herbicide-applicator.html

**Directed spray**: is a spray application using a pressurized backpack or spray bottle. It is a spray pattern of larger droplets applied to the foliage of the target plant. With glyphosate in small directed spray applications apply as a 1.34% to 2% solution, depending on the glyphosate formulation. Directed spray applications often result in some drift of spray droplets onto non target vegetation. Being a non-selective product this will usually result in damage or death to adjacent plants that receive spray on their foliage

***Milestone:*** is a selective, residual herbicide product that has a reduced risk classification with Health Canada. It will affect most broadleaved herbaceous plants, but it does not harm grasses at labels rates and deciduous and conifers have a level of tolerance to it as well. It is quickly degraded by ultra violet rays in water and has very low mammalian toxicity, is slightly toxic to aquatic organisms on an acute basis and practically non-toxic to birds on an acute basis. It can only be applied as a directed spray and not as a wipe-on application.

**Management Timing**
Application of either herbicide is best done during active growth. Plants are actively growing early in spring to July/August after which plants typically mature and set seed. In September warm moist conditions promote regrowth of perennial plants and germination of seeds. Later in fall a mild frost, not a killing frost, will trigger perennial species, especially creeping rooted

species, to begin movement of carbohydrates and sugars to extensive root systems for food storage over winter for use the following spring. These are good times for herbicide application

**Canada thistle** (*Cirsium arvense)*

Canada thistle could almost be considered as naturalized in BC as it is commonly found in most areas of the province except the north eastern regions. It is commonly found in the Logan Lake area, including the Wetlands project. It is a rhizomatous perennial that persists for many years in locations it establishes. It spreads by expanded root growth where it develops terminal shoots that grow into vegetative plants. This is its main mode of spread. Root pieces or fragments have the ability to re-grow if removed or transported to another location. Vegetative reproduction from the roots is much more successful than reproduction by seed. Although Canada thistle is a prolific seed producer, control efforts should be aimed mainly at vegetative reproduction, as seed is not its most effective means of spread. "Seeds that do not germinate may remain dormant for several years but most studies indicate that the majority of seeds do not remain viable after three years of burial" (Rutledge and McLendon 1998)

***Management***

**Biological**

There are a number of bio-agents in BC however most are passive. *Larinus planus* weevil has mass distribution and *Urophora carduii* fly has limited distribution, but is potentially available. Evidence of either of these two bio-agents was not found on the Wetlands sites. Currently biological of Canada thistle in BC is not visually effective but will cause stress on plants which can make them less vigorous.

Monitoring in late spring to early summer will determine presence of *Larinus planus*. This would be an appropriate time to collect and release. Due to limited distribution of *Urophora carduii*, is unlikely that it is present. The type of vegetative cover and water features present on the Project site are very suitable for *U. carduii* establishment. Fall is the time to collect and release this bio-agent.

The collection and release of both bio-agents in the Project area would be a recommended for 2017.

**Manual**
Pulling Canada thistle is very ineffective because the plant will break off at the root crown and the rhizomatous or creeping root will continue to grow by sending up new shoots. Seed production is reduced or perhaps eliminated if pulling is continuous, but the rooting system is persistent and will continue to grow. Canada thistle with its' spiny leaves is also difficult and may be injurious to pull. Due to this and it's relatively ineffective results, pulling is not recommended except for small, newly established infestations, digging may be effective but care should be taken to dig out the entire root system

**Cutting**
Repeated mowing or cutting down to the root crown when the plant has tight flower buds can help decrease the number of plants. "Mowing can be effective if plants are mowed each month during the growing season over a period of several years. The goal is to minimize photosynthesis and eventually "starve out" the roots. This method takes time and persistence. If mowing is not done regularly, it can increase the spread of Canada thistle by stimulating new growth from the rhizomatous root systems and reducing grass competition." (Jefferson County Noxious Weed Board Canada Thistle BMP)

**Deadheading**
Due to the fact that most reproduction and spread of Canada thistle is through roots, cutting of flower buds or flowers can have little effect on vigour of the plant or its' population reduction. This technique, when done at an appropriate stage of development (bud to late flower stage), can reduce or eliminate the spread of viable seed from the Canada thistle infestation.

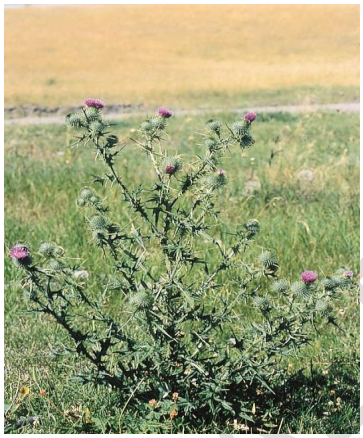
**Herbicide**
Effect herbicides for control of Canada thistle on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage) and Milestone herbicide (aminopyralid (active ingredient)) formulations. There are other effective herbicides for Canada thistle control; however they may not be as suitable for invasive plant management on this project.

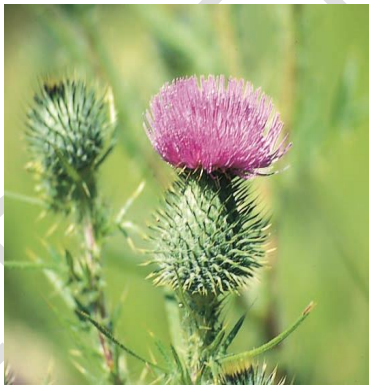
***Glyphosate***: Can be applied as a directed spray or as a wipe-on application technique. As with spotted knapweed wipe-on application is a technique that requires the applicator to be brushed up and down the foliage with a concentrated glyphosate solution from 25% to 33% solution. It is a directed application and properly used applies the herbicide mixture only to the target plant foliage and does not apply herbicide to adjacent non target plants and does not allow herbicide to reach the ground.
Ideally there is a height differential between the Canada thistle and other non-target plants so the tops of the Canada thistle foliage can be adequately wiped without touching non target foliage

**Directed spray** with glyphosate in small directed spray applications apply as a 1.34% to 2% solution, depending on the glyphosate formulation. Directed spray applications often result in some drift of spray droplets onto non target vegetation. Being a non-selective product this will usually result in damage or death to adjacent plants that receive spray on their foliage. With a larger tall growing invasive plant such as Canada thistle that has more foliage to cover with spray, non-target damage can increase with the increase in spray mixture being applied.

***Milestone*** is effective for control of Canada thistle and can only be applied as a directed spray and not as a wipe-on application. Research shows "… the optimal application time is after Canada thistle plants are fully emerged and actively growing plants just prior to flowering (bud stage), or early to mid-flowering. For fall applications, the optimal application time for Canada thistle control with Milestone is September when green basal re-growth is present." (Deneke, Moechnig, 2012). Applications to re-growth in the fall, (before freezing occurs) are very effective because the chemical is readily moved with sugars being sent to the roots for winter storage.

**Bull thistle** (*Cirsium* vulgare)





Bull thistle is a biennial tap rooted plant. Although it is a large robust thistle that often forms large infestations, it is not a challenging species to control. It is mainly a problem in hay fields and pastures. Bull thistle is also commonly found along trails, roads, vacant fields, cut-blocks and disturbed areas and sites. Bull thistle spreads only by seed. The first year of growth plants will remain a low growing rosette or seedling plant that does not produce seed structures. In the second year of growth the plant will produce a stem that will develops flowers and seed producing structures. Bull thistle seeds are dispersed by wind and can remain viable for a decade.

**Management**
**Biological**
There are three bio-agents in BC that are commonly found on bull thistle. *Larinus planus* is a seed feeding weevil; *Urophora stylata* is seed deceasing fly and *Rhinocyllus conicus* is a weevil which occupies the seed head displacing seed production or causing seed to be non-viable. *R. conicus* has limited distribution, but is potentially available. No evidence of *L. planus* or *R.*

*conicus* was found on the Wetlands sites, but *U. stylata* was present in each of 4 seed heads randomly sampled from 4 bull thistle plants.
Monitoring in late spring to early summer will determine presence of *Larinus planus*. This would be an appropriate time to collect and release. Due to limited distribution of *Urophora* carduii, is unlikely that it is present. The type of vegetative cover and water features present on the project site are very suitable for *U. carduii* establishment. Fall is the time to collect and release this bio-agent.
The collection and release of both bio-agents in the project area would be a recommended for 2017.
Monitoring and sampling of bull thistle infested areas will likely yield the widespread presence of *U. stylata* in the wetlands area. However, some sampling should be done to determine if collection from infested areas and redistribution should be done. The bio-agent fly is very effective at redistribution on its' own.

**Manual**
Pulling bull thistle is very difficult because the plant will usually break off at the root crown and the root will continue to grow. Bull thistle with its' spiny leaves also makes it difficult and may be injurious to pull. Digging may be effective but care should be taken to dig out as much of the root as possible.

**Cutting**
Repeated mowing or cutting down to the root crown in the second year of growth when the plant has tight flower buds can eliminate seed production that year. Typically with biennials if they are prevented from maturing in the second year of growth they may continue growing into the 3rd year in an effort to complete their life cycle. Subsequent years cutting may force continued growth but the plants will perish eventually. Cutting should be very low to the crown as plants may feign vertical growth and develop lateral stems that can produce flowers that mature to seed.

**Deadheading**
Cutting of flower buds or flowers can have some effect on vigour of the plant and will eliminate development of viable seed. This technique, when done at an appropriate stage of development (bud to late flower stage), can reduce or eliminate the spread of viable seed from the thistle infestations

**Herbicide**
Effect herbicides for control of bull thistle on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage), Milestone herbicide (aminopyralid (active ingredient)) formulations and phenoxy products like 2, 4-D amine formulations. Application of these products is best in the very early stages of bull thistle growth at the 2- 4 leaf to early bud stage, depending on herbicide used. There are other effective herbicides for bull thistle control; however they may not be as suitable for invasive plant management on this project.

***Glyphosate***: Can be applied as a directed spray or as a wipe-on application technique. Wipe-on application technique would require the applicator to be brushed on the wide leaves of rosette or seedling plants with a concentrated glyphosate solution from 25% to 33% solution. It is a

directed application and properly applying the herbicide mixture to the target plant foliage will reduce damage to adjacent non target plants.

**Directed spray** with glyphosate in small directed applications can be applied as a 1.34% to 2% solution, depending on the glyphosate formulation. Directed spray applications often result in some drift of spray droplets onto non target vegetation. Being a non-selective product this will usually result in damage or death to adjacent plants that receive spray on their foliage. Spray applications to only low growing foliage on bull thistle non-target damage may be decreased as a result of less drift.

***Milestone*** is effective for control of bull thistle and can only be applied as a directed spray and not as a wipe-on application. Optimal application time to spray bull thistle plants are fully emerged leaves on actively growing rosette plants to just prior to bud development. Fall applications to bull thistle are not effective, or necessary, on second year biennials as it is typically the last growth year.

***2,4-D amine*** yields best control results when applied to bull thistle plants with 2-4 fully emerged leaves on actively growing rosette plants. Application to more mature plants results in decreased effectiveness as the plant matures.

**Management Timing**
Application of any of these 3 herbicides is best done during active growth. Early season application when the plants are less robust and spray applications result in less drift will give effective control. The more mature the bull thistle plants become the more herbicide is required to achieve complete spray coverage of all foliage.

**Mustard spp.** Peppergrass (*Lepidium densiflorum*) and tumble mustard (*Sisymbrium spp (perhaps altissimum, no specific identification)*) are two Mustard species identified on the tour. Both are tap-rooted plants, with peppergrass being an annual, biennial or perennial, whereas, tumble mustard is typically an annual. Both reproduce only by seed.

**Peppergrass**

**Tumble Mustard**


**Management**
**Biological**
No biological control available

**Manual**
Pulling mustards is very effective because the plant only reproduces by seed and pulling at or before flowering stage will eliminate maturing and dissemination of viable seed. These species are easily pulled and under moist soil conditions the entire or most of the root is dislodged and come out of the ground cleanly. Digging is effective but care should be taken to dig out as much of the root as possible.

**Cutting**
Peppergrass mowing or cutting down to the root crown is required repeatedly as it may re-grow in subsequent years being a biennial to perennial. Typically with biennials if they are prevented from maturing in the second year of growth they may continue growing into the 3rd year in an effort to complete their life cycle. Subsequent years cutting may force continued growth but the plants will perish eventually. Cutting should be very low to the crown, as plants may feign vertical growth and develop lateral stems that can produce flowers that mature to seed.
Tumble Mustards mowing or cutting only need take place once in the year prior to seeding seed in the bud to early flower stage. Plants left to late into flower stage before cut and left on the ground may still have enough energy in the plant to produce some viable seeds.

**Deadheading**
Cutting of flower buds or flowers can have some effect on vigour of the plant and eliminate development of viable seed after flowering. This technique, when done at an appropriate stage of development (bud to late flower stage), can reduce or eliminate the spread of viable seed from the mustard infestations

**Herbicide**
Effect herbicides for control Mustards on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage) and phenoxy products like 2, 4-D amine formulations. Application of phenoxy products would best be done in the very early stages of Mustard growth at the 2- 4 leaf stage. There are other effective herbicides for Mustard control; however they may not be as suitable for invasive plant management on this project. Milestone is not effective on Mustard species.

***Glyphosate***: Can be applied as a directed spray or as a wipe-on application technique. Wipe-on application technique would require the applicator to be brushed on the wide leaves of rosette or seedling plants with a concentrated glyphosate solution from 25% to 33% solution. It is a directed application and properly applying the herbicide mixture to the target plant foliage will reduce damage to adjacent non target plants and not allow herbicide to reach the ground. Apply when the plant is taller and has sufficient foliage to accept enough herbicide into the plant for effective control.

**Directed spray** with glyphosate in small directed applications can be applied as a 0.6 % to 1% annuals or a 1.34% to 2% solution for perennials, depending on the glyphosate formulation. Directed spray applications often result in some drift of spray droplets onto non target vegetation. Being a non-selective product this will usually result in damage or death to adjacent plants that receive spray on their foliage. With application to only low growing foliage on Mustards non-target damage may be decreased as a result of less drift.

***Milestone*** is effective for control of Mustard species.

***2, 4-D amine*** yields best control results when applied to Mustard plants with 2-4 fully emerged leaves on actively growing rosette plants. Application to more mature plants results in a decreased effectiveness as the plant matures.

**Management Timing**
Application of any of these herbicides is best done during active growth. Early season application when the plants are less robust and spray applications result in less drift will give effective control. The more mature the Mustard plants become the more herbicide is required to achieve complete spray coverage of all foliage.

## Other Weed Species

### Blueweed (*Echium vulgare*)

Blueweed was not found on the tour of the Wetlands area proper, but it is in the immediate area in the MoTI Logan Lake East Gravel Pit #0591on the north side of Meadow Creek Rd across the road from the head of the Wetlands Creek.

This is a very invasive and persistent biennial to short lived perennial tap-rooted weed species. It is not easily controlled by any method including with most herbicides. Glyphosate offers good control, but not residual activity. Common residual herbicides that provide long control on other invasive species, do not provide long term management beyond 2 years of blueweed.

**Management:**

**Biological**

No biological control

**Manual**

Pulling blueweed is only effectively done on 2nd year plants that have developed stems. Soil should be moist to effectively remove as much of the root as possible to ensure it does not regrow, as perennials can do. Removing the root to at least 2 inches below the root crown, at minimum, will likely not allow the plant to regrow , ideally removing the entire root will ensure the plant will not regrow. If the plant snaps off at the root crown, regrowth will occur. It is not typically effective to pull seedling plants as they will usually snap of at the root crown. In dense stands significant soil disturbance occurs and revegetation of the areas is recommended. Blueweed has tiny stiff hairs covering leaves and stem so it is advisable, as with most plant pulling, to wear gloves and avoid skin irritation from this plant.

**Cutting**
Will remove the plants vegetative parts, but the plant will continue to regrow even if cut right to the root crown. This will stop plants from maturing to the seed stage and delay seed production. It must be emphasized that multiple cutting times must occur over a number of years on a site to eliminate the infestation. It is an approach that is very labour intensive.

**Deadheading**
Constant cutting of flowers and developing seed structures dramatically reduces or eliminates seed production. It is a very long term process to eliminate the infestation. Deadheaded material should be bagged and disposed of in a landfill. This is very labour intensive. The longevity of seed is not well known but can be up to three years. Seed are buoyant so seeds entering the Wetlands water course have the ability to drift down stream and establish along the shoreline

**Herbicide**
Effective herbicides for control of blueweed on this project would be glyphosate active ingredient herbicide products (Roundup, Vantage) and Milestone herbicide (aminopyralid (active ingredient)). Milestone applied alone does not offer acceptable control (70% or higher). Milestone mixed with 2,4-D amine herbicide does offer adequate shorter term control. Note: MoTI does not allow use of 2,4-D on MoTI rights of ways or pits.

***Glyphosate***: is a non-selective, no residual herbicide and would be best used in close proximity to water. It can be applied as a directed spray or as a wipe-on application technique.

**Wipe-on application** is a technique that requires the applicator to be brushed up and down the foliage with a concentrated glyphosate solution from 25% to 33% solution. It is a directed application and properly used applies the herbicide mixture only to the target plant foliage and does not apply herbicide to adjacent non target plants and does not allow herbicide to reach the ground. There has been effective control resulting from wipe-on applications, but it is only effectively done to 2$^{nd}$ and subsequent year bolting plants, so multiple years treatment is required for acceptable long term management

**Directed spray**: is a spray application using a pressurized backpack or spray bottle. It is a spray pattern of larger droplets applied to the foliage of the target plant. With glyphosate in small directed applications applied as a 1.34% to 2% solution, depending on the glyphosate formulation. Directed spray applications often result in some drift of spray droplets onto non target vegetation. Being a non-selective product this will usually result in damage or death to adjacent plants that receive spray on their foliage

**Management Timing**
Application of herbicide is best done during active growth. Plants are actively growing early in spring to July/August when plants typically mature and set seed. In September, warm moist conditions promote regrowth of perennial plants and germination of seeds and this is a good treatment time. Later in fall a mild frost, not a killing frost, will trigger perennial species to begin movement of carbohydrates and sugars to root systems for food storage over winter for use the following spring. These are good times for herbicide application

**Licenses and Regulations for Herbicide Application**

Marge Sidney, MoE has confirmed that the property where the Wetlands Project is currently. The Golf Course has a lease with the District of Logan Lake and the CAO has confirmed public classification.

**Use Licenses**
Public lands in BC require a 'Use Authorization' (Pesticide Use License, Pesticide User Service License) to carry out herbicide application of noxious and invasive species on public lands.
If the project was to hire an invasive plant Contractor to carry out herbicide application as part of the invasive plant management plan, that Contractor would be required to have a 'Use Authorization' permit and have an Industrial Vegetation and Noxious Weed Applicators certification from the BC Ministry of Environment as per the Integrated Pest Management Regulations. That Contractor would be able to supervise up to 4 Assistant Applicators (an on-line, but limited in ability to treat, course for free) who may be volunteers.
If the project did not hire a contractor with a 'Use Authorization' the project would have to use herbicide under the Village of Logan Lake (if they have one and proper category) or have the Project (MoE, Village of Logan Lake) obtain one themselves. This would likely be a minimum of $250 per year. If a 'Use Authorization' was obtained by the project or partner, a Certified Pesticide Applicator would be required to oversee the herbicide application. As with the Contractor scenario, the Certified Applicator could supervise up to 4 Assistant Applicators
There may be some other options that could possible, depending on the potential land tenure. Jon Mullan, Pesticide Officer, Integrated Pest Management Unit, Victoria would be the contact to determine the authorization.

**Regulations**
As this is public land the following primary regulations apply. The following list is primary regulations. (For specific regulations, see *Integrated Pest Management Act,* INTEGRATED PEST MANAGEMENT REGULATION, HTTP://WWW.BCLAWS.CA/CIVIX/DOCUMENT/ID/LOO91/LOO91/604_2004)

Adherence to all Regulations
Adherence to all Pesticide Free Zones (PFZ's)

- Signage at treated areas
- Perhaps a notice of intent to treat (NIT) to public and MoE on dates to commence and duration of treatment (will be determined by 'Use Authorization' used)
- No herbicide application or entry (drift or leaching) of herbicide below 1 m above high water mark (AHW)
- Only glyphosate formulations may be applied as a directed application from 1 m AHW to 10 m AHW
- No application or entry of any other herbicide below the 10 m AHW
- One Certified Applicator overseeing project herbicide application
- Four Assistant Applicators may be supervised by a Certified Applicator

**Costs:**
**Contractor** – there are limited invasive plant contractor in the region. Hourly rates range from $65.hr to $140/hr depending on the size and scope of infested area to be treated and what kind of equipment is necessary for the job. Additionally travel costs can range from $0.60 to

$1.00/km, depending on the equipment required for the job. Contractors will often supply herbicide and that would be an added cost.

**Herbicide** – Glyphosate is approximately $100/10 L container. It can be bought in 1 L containers as well. Application rate per hectare for glyphosate formulations is 2-4 L/ha
**Milestone –** is approximately $1,800 per 10 L container and is only available in that size. Contractor hired for Milestone treatment would be beneficial for cost and use
**Application Equipment** (if the project purchased application equipment for use by volunteers)

- Backpack sprayer – approximately $120 each
- Wipe-on applicator – approximately $50 - $100 each

**Applicator Certification** –

- Pesticide Applicator Certification (Industrial Vegetation and Noxious Weeds) $90 for self-study kit (2 manuals) and $90 fee to write exam = approximately $180.
- Assistant Applicator Certification – free of charge – on-line study course and exam

**Management Recommendations:**

1. Cutting, digging and deadheading - should take place before the seed stage of invasive species. The optimum time is prior to seed set in the bud to early flowering stage of weed growth. Plants in this later stage of growth should be bagged and removed for disposal, preferably burial. Plants left on the ground in the late stages of flowering can have enough energy in the plant to continue maturing of some seeds. Poisonous plants should always be bagged and removed as their toxicity may still occur in deteriorating plants. Often deteriorating plants turn to silage and are more palatable or desirable to grazing animals

2. Herbicide treatment - should occur during periods of active growth of the invasive plants. This will occur in the spring to early summer and in some invasive plants there is an active period of regrowth in the fall. All herbicide applications should follow the BC IPM Regulations and the label instructions of each herbicide. The herbicide applicator(s) should **read, and understand, the label** of any herbicide planned for use prior to the application of any herbicide product.

3. Biological Control -Survey and monitoring of the biological control agents available or present for the invasive species on the project should place. If there is sufficient evidence or promise of effective biological control of any of the invasive species on the project site, consideration and evaluation should take place to determine;
   - Whether populations of existing agents should be augmented or left to increase on their own
   - What other bio-agents should be collected off-site and introduced to the project area infestations
   - Where these other agents are found and how or who will obtain them for release.

   Note: Due to the high population of birds in the project and surrounding areas, it may be that bird predation on existing or future bio-agent insect populations may be a

limiting factor to required population build ups for the most effective biological control possible. It may be recommended that a biological control specialist be contacted for consultation on this point.

4. Areas where soil disturbance has occurred due to digging, pulling or other operations should be seeded with a desirable mix of domestic or native to occupy the bare soil created. Weeds are usually the first species to develop and grow on disturbed sites, so seeding the area to a competitive, desirable and perennial seed mix will assist in reducing the re-growth or re-invasion of invasive species. Species selection should be done by a local land manager with knowledge of the local environmental and site conditions. Seeding in the fall is typically the best time for seeding in the interior, but local expertise and conditions may dictate other timing.

5. Nitrogen enhances growth of grass species, but nitrate levels have been measured at high levels in the lake. Nitrogen fertilizer application may result in excess runoff during a high precipitation even or run off. Perhaps investigation into the use of native or domestic legume species may offer addition nitrogen to desirable plants yet not be available to move off site. A forage specialist may answer this question.

6. Management activities should likely commence from the headlands along the creek or headwaters of the creek along through the wetlands project. Beginning from the top of the project, so to speak, will reduce or eliminate seeds or propagules from moving down stream in the creek flow and landing on shore areas and establishing new sites. Starting in mid-area of the project may allow re-infestation from invasive plants upstream that will go to seed and float down.

7. Overall, the approach to invasive plant management on the Logan Lake Constructed Wetlands is to use an Integrated Pest (Plant) Management (IPM) approach. The development of goals (general direction) and objectives (specific aims) will be required to achieve long term effective management of the invasive plants present on site and in adjacent lands.

    a. Prevent new invasives from being introduced and prevent existing invasive from spreading
    b. Become knowledgeable about existing and potential species
    c. Inventory the area for invasives so you have good knowledge of what species is where
    d. Identify the control options that are available for use
    e. Select the appropriate and effective control methods and tools to implement
    f. Monitor the effectiveness and impact of the control efforts implemented
    g. Evaluate the efficacy of control and adjust as required

8. The use of more than one effective control method or technique, when possible, is a primary consideration and component in an integrated vegetation management approach. Use as many of the tools in the 'tool box' as is effective. Timing of treatments is also critical. Pick the best time to treat species for effective control to get the most benefit from your efforts in the future.

9. All sites treated require maintenance or follow-up visits later in the year of treatment if possible, definitely the year following treatment. Invasives are very persistent and rarely will one treatment application of a species at a site give 100% control with one visit. Follow-up visits are required to manage remaining plants.

10. Herbicide use should be done judiciously. Be cognizant of the areas geographic features, non-target species, weather and other factors that may influence your decision on their use. Always READ THE LABEL prior to use of any herbicide.

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