PEST MANAGEMENT PLAN

Confirmation MOS-CSRD-2021/2026

MOSQUITO CONTROL MANAGEMENT PLAN FOR GOLDEN, REVELSTOKE & SCOTCH CREEK

COLUMBIA-SHUSWAP REGIONAL DISTRICT
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Executive Summary

This Pest Management Plan (PMP) will serve as a strategic management tool that will allow for the effective prevention and control of larval mosquitoes by the Columbia-Shuswap Regional District (CSRD) including all public and private lands by permission of the applicable owner, agent or authority.

Under this PMP, the CSRD mosquito control program includes the Town of Golden and surrounding area in Electoral Area 'A', the City of Revelstoke and surrounding area in Electoral Area 'B', and the Scotch Creek/Lee Creek First Suppression Area along Shuswap Lake.

Mosquito reduction activities will be conducted using Integrated Pest Management principles including careful monitoring to determine pest incidence and abundance. All treatments will target mosquitoes in their larval stages and the use of adulticides will not be considered under this PMP.

Adult mosquitoes are a source of annoyance for residents and visitors and can negatively affect outdoor worker performance, tourism and human activities. The objective of the CSRD mosquito control program is to minimize the annoyance caused by large populations of nuisance adult mosquitoes. As per the CSRD Mosquito Control Programs Policy (W-3), "…the Regional District's program is not directed at controlling or addressing the health impacts of mosquitoes, including in relation to the West Nile Virus. The Regional District will not be investigating, responding to or in any way addressing the potential impact of mosquitoes as part of this program."

All mosquito control activities will be undertaken in a manner that minimizes risk to the environment and human health. This PMP addresses all required elements of a PMP as outlined in Section 58 of the BC *Integrated Pest Management Regulation*.

1.0 Introduction

The goal of the Columbia-Shuswap Regional District (CSRD) mosquito control program is to reduce mosquito populations and decrease mosquito annoyance. In areas adjacent to extensive larval development habitat, mosquito populations can become extremely high. When this happens, quality of life for residents in the area can decrease because of severely limited outdoor activity. Further, high numbers of mosquitoes can cause allergic reactions in some individuals and can also impact tourism.

As per the CSRD Mosquito Control Programs Policy (W-3), "…the Regional District's program is not directed at controlling or addressing the health impacts of mosquitoes, including in relation to the West Nile Virus. The Regional District will not be investigating, responding to or in any way addressing the potential impact of mosquitoes as part of this program."

The CSRD has conducted a nuisance mosquito control program in the Town of Golden since 1987, the City of Revelstoke since 2003 and in the Scotch Creek/Lee Creek Area since 2004. The programs are based on the principles of Integrated Pest Management (IPM).

Prevention and reduction of mosquito larval development sites are the first objective of the CSRD programs because preventing a problem is always better than trying to control the problem once it occurs. However, in reality, there are few instances in which habitat prevention is possible and therefore the vast majority of the CSRD mosquito control campaigns is focused on controlling mosquitoes while they are in their larval stages, (as opposed to their adult stage) for two primary reasons. Firstly, larval control is much more efficient than adult control – it is possible to treat larval mosquitoes in high concentrations in larval development ponds, while adult mosquitoes tend to disperse soon after emerging over a much wider area. Secondly, when larvicides such as Aquabac, Vectobac, and VectoLex are applied at the label rates, they are species-specific, affecting only aquatic members of the Order Diptera (mosquitoes and black flies). These larvicides have no impact on other invertebrates, fish, amphibians, birds, and mammals.

The BC *Integrated Pest Management Act* (*IPMA*) and the *Integrated Pest Management Regulation (IPMR)* require pesticides to be applied pursuant to the principles of IPM. This in turn requires the development of a Pest Management Plan (PMP) (this document) and the use of pesticides in accordance with the terms and conditions of the *IPMR* and the commitments made in this PMP.

1.1 Geographic Boundaries of this Pest Management Plan (*IPMR* 58(1)(a))

The geographical areas covered by this PMP included:

1) Town of Golden (Golden) & Electoral Area 'A' with program boundaries extending along the Columbia River from Donald Station south to Harrogate;
2) City of Revelstoke (Revelstoke) and Electoral Area 'B' within and immediately adjacent to city boundaries; and
3) the Scotch Creek/Lee Creek First Suppression Area of Shuswap Lake (Scotch Creek) including the Tsútswecw (Roderick Haig-Brown) Provincial Park, Shuswap Lake Provincial Park, and the Little Shuswap Lake Band Reserve

Within this area, all municipal, private, First Nation reserve, crown and Regional District land are included, however, treatments will only occur with permission of the applicable owner, agency or authority. As permission may change during the term of the PMP, treatment areas may differ during each season, but will not increase outside of the above described areas.

A map of the geographic boundaries to which this PMP applies can be found in Appendix A. Maps displaying the locations of larval development sites can be provided upon request. Please contact Environmental Services at the CSRD for specific larval development site information.

1.2 Responsibility for the Columbia-Shuswap Regional District Integrated Mosquito Control Program (*IPMR* 58(1)(b)(c))

The CSRD mosquito control program is conducted by mosquito control contractor(s). Within the CSRD, the primary contact for information relating to this Pest Management Plan is:

Ben Van Nostrand
Environmental Services Coordinator
Columbia-Shuswap Regional District
PO Box 978
555 Harbourfront Dr NE
Salmon Arm, BC V1E 4P1
Phone 250-832-8194
Email: Operations@csrd.bc.ca

1.3 Term of this PMP

This PMP shall be in force for a five-year period from the date that a Pesticide Use Notice (PUN) has been submitted to the BC Ministry of Environment, and Confirmation of the plan has been received. This project will run from April, 2021 to April, 2026.

1.4 Outline of this PMP

The content of PMP's prepared in the province of British Columbia is legislated under the *IPMR* (Section 58) and the checklist provided in the *Regulation* is included in Appendix B. This PMP will

describe the CSRD's nuisance mosquito control Integrated Pest Management Program including monitoring activities, treatment decisions, treatment options, and treatment evaluations. It will also outline the operational procedures conducted by the CSRD to ensure safe methods of transporting, storing, handling, and applying the pesticides used in this program. This PMP will address the CSRD's policies for disposing of empty pesticide containers and unused pesticide, as well as for responding to pesticide spills. There will be a discussion of the CSRD's strategies for the protection of community watersheds, domestic and agricultural water sources, fish, wildlife, riparian areas, and food intended for human consumption. Finally, this PMP will outline the commitments of the CSRD with respect to maintaining pesticide records and submitting annual reports and notices.

2.0 Integrated Pest Management

A requirement of all PMP's in British Columbia is an explanation of how the applicant (in this case, the CSRD) will utilize the elements of Integrated Pest Management (IPM). The six elements of an IPM strategy that will be discussed in detail in the following sections are:

1) **a strategy to *prevent* organisms from becoming pests (Planning);**
2) **a method to *identify* pests;**
3) **a *monitoring* (surveillance) program;**
4) **a description of the *injury thresholds* used to make treatment decisions;**
5) **a discussion of *treatment options* and selection criteria; and**
6) **a method for *evaluating effectiveness* of pesticide use.**

2.1 PREVENTION (PLANNING) (*IPMR* 58(2)(A))

Prevention is one of the most important options for successful mosquito control. The CSRD actively pursues the following preventative measures in its mosquito control program:

1. Reduction and/or modification of mosquito larval development sites; and,
2. Public outreach/education.

2.1.1 Source Reduction/Modification

The CSRD encourages the reduction of mosquito larval development sites and water management as effective methods of mosquito control. The fact that mosquitoes require water to develop is the key to their effective control. Mosquitoes are unable to complete their life cycle without water.

Source reduction is simply the use of physical methods to eliminate standing water by draining or filling in mosquito larval development sites or by allowing water to flow through the site. If draining or filling is not an option, many mosquito larval development sites such as storm water retention ponds, sewage treatment ponds, farm dugouts, and ornamental ponds, can be made unsuitable for mosquito larval development through a combination of good design (*e.g.*, steeply sloped and graveled

shore lines), water level manipulation, and control of emergent vegetation. Bodies of water with sloped, graveled, rocky or sandy shorelines will usually support fewer mosquitoes, as larvae will be exposed to wave action and will have difficulty obtaining food.

Scraping of sediment from the bottom of roadside ditches every few years can make the ditches unattractive for mosquito larvae. Ditches that are slow to drain may form a series of pocket pools and support lush grasses and weeds, thereby becoming prime larval development sites. Landowners and local government will be encouraged to use the above described methods within their lands when a problem is noted.

Homeowners/residents will be encouraged to participate in habitat management. Since some species of mosquitoes (e.g. *Culex* and *Culiseta*) can readily breed in containers, the CSRD encourages residents to reduce standing water around their homes. Some examples of measures that can be undertaken by residents to help eliminate mosquito larval habitat are as follows:

- Eliminate standing water outdoors by emptying artificial containers (e.g., flower pots, wheel barrows, old tires, barrels, storage drums, abandoned equipment and tins cans) at least once a week, or by storing them in an inverted position, drilling holes in them, disposing of them or covering them.
- Cover the top of water collecting containers (e.g. rain barrels) with a screen to prevent mosquitoes from laying floating eggs.
- Drain water from swimming and wading pools when not in use or cover them so that mosquitoes cannot lay eggs.
- Keep water off swimming pool covers and ensure that the pump is circulating water.
- Change water in bird baths weekly.
- Install fountains or aerators in artificial waterbodies or ornamental ponds.
- Clear leaves and twigs from tarps, awnings, eaves troughs, storm gutters and roof gutters throughout the summer and early fall so water does not pool or collect.
- Avoid over-irrigating lawns and fields.
- Ensure proper drainage of septic tank fields.
- Drain or fill-in low areas, tire ruts or hole left during excavation.
- Ensure proper drainage of septic tank fields.

2.1.2 Public Outreach

The CSRD will include public outreach as a component of their mosquito control program. Public outreach includes advising the public on personal protective measures that can be taken to reduce the incidence of mosquito bites.

NOTE: COVID-19 has impacted outreach activities. The CSRD may not attend outreach events while COVID-19 remains a threat.

Some examples of public outreach initiatives conducted by the CSRD include:

- maintenance of a 24-hour Toll-Free Mosquito Reporting Line whereby residents can leave a message for the CSRD's contractor and have the mosquito control contractor(s) return the call within 24 hours to answer any questions residents may have concerning mosquito control, mosquito biology, or current mosquito control activities;
- attendance (as funding allows) with an information booth at public events such as Farmers' Markets, outdoor festivals, etc; and
- A website for information related to the mosquito control program. This website can be accessed at https://www.csrd.bc.ca/services/mosquito-control

As part of its public education initiatives, the CSRD promotes the following:

- avoiding, where possible, being out between dusk and dawn, as mosquitoes tend to be more active between these times;
- wearing protective clothing, including long-sleeve shirts or jackets and long pants that mosquitoes cannot bite through;
- avoiding dark coloured clothing as it can attract mosquitoes;
- using mosquito netting for babies and toddlers in cribs and strollers;
- applying Health Canada approved mosquito repellents, such as those containing DEET (N,N-Diethyl-meta-toluamide), Icaridin or Lemon Eucalyptus Oil (30%); and
- reducing mosquito larval development sites and vegetation that provides harbourage on and around residences.

The CSRD does not promote the use of bug zappers, devices that give off sound waves and Citrosa plants for protection against mosquito bites as these are not shown to be affective.

2.2 Identification of the Pest (*IPMR* 58(2)(b))

One of the most important steps in mosquito control is to correctly identify the pest species and its habitat. This is particularly important because only certain mosquito species are known to be a significant human nuisance. Species identification allows CSRD mosquito control contractors to tailor their program to focus control efforts on the mosquito species that cause a human nuisance.

Mosquito surveillance allows controllers to identify when and where mosquito pests occur. The CSRD has engaged in ongoing larval surveillance and adult surveillance. At least thirty different species of mosquitoes representing all of BC's five genera of mosquitoes have been captured in adult light traps and/or as larvae in the Regional District (Table 1). Each of the species present in the CSRD

except *Culex territans* (which feeds on amphibians) and *Culex pipiens* (which feeds on birds) can be considered nuisance species.

Table 1. List of mosquito species collected within the CSRD.

Aedes campestris	*Aedes implicatus*	*Anopheles punctipennis*
Aedes canadensis	*Aedes increpitus*	*Coquillettidia perturbans*
Aedes cataphylla	*Aedes intrudens*	*Culex pipiens*
Aedes cinereus	*Aedes punctor*	*Culex tarsalis*
Aedes communis	*Aedes sierrensis*	*Culex territans*
Aedes dorsalis	*Aedes spencerii* var *idahoensis*	*Culiseta impatiens*
Aedes euedes	*Aedes sticticus*	*Culiseta incidens*
Aedes excrucians	*Aedes vexans*	*Culiseta inornata*
Aedes fitchii	*Anopheles earlei*	*Culiseta minnesotae*
Aedes hendersoni	*Anopheles freeborni*	*Culiseta morsitans*

In the field, mosquito larvae and adults can be difficult to identify to the species level. For positive identification, mosquitoes need to be examined under a microscope. In the CSRD, the determination as to whether a larva is likely to be a pest species or not, will be based on the habitat where the larvae are found and the time of year. Mosquitoes are selective with their habitats. Different species of mosquitoes tend to choose different types of habitats. The time of year can also give clues to the identity of the mosquito species.

Most mosquitoes in the CSRD are from the *Aedes* genus. Most *Aedes* species lay their eggs in moist soil near recently flooded area. Snowmelt species rely on warm temperatures and/or low oxygen levels in water to induce their eggs to hatch. Larvae of the floodwater species usually appear as soon as their eggs are wetted. Large areas of habitat often become active with rising floodwaters along creeks, rivers, and lakes and in permanent marshes as the snow melts and raises the water level in the marshes. Eggs laid by most species remain viable for several years, and therefore egg concentrations in the soil can become very dense. All the *Aedes* species can be considered human nuisance mosquitoes (although some are more aggressive than others.) *Whenever habitat along flooding creeks, rivers, lakes, ditches, fields and in permanent marshes in the spring contains mosquito larvae, it is assumed that these are pest species and treatment of the larvae will be considered*.

As the summer progresses, the occurrence of floodwater larvae tends to decrease (unless a large storm event causes flooding, or in the case of agriculture, a farmer over-irrigates, flood-irrigates, or fails to repair broken pipes). Water left standing after the spring floods can begin to colonize with species of mosquitoes from the *Anopheles, Culiseta* and *Culex* genera. *Anopheles* mosquitoes are easily

recognized in the field as the larvae are much different in appearance from all other larvae in British Columbia. They lay flat on the surface of the water and lack a siphon. *All Anopheles species in British Columbia can be considered pests and therefore whenever these species are seen, treatment will be considered.*

Culiseta and *Culex* mosquitoes lay their eggs on the surface of standing water and will produce multiple generations over the summer. Some of the species in these genera can be a nuisance to humans. *If these species are found as larvae and are present in high numbers, treatment will be considered.*

2.3 MONITORING (SURVEILLANCE) PROGRAM (*IPMR* SECTIONS 58(2)(C)(I)(II)(III))

The CSRD contractor(s) carry out the following surveillance programs:

1) environmental monitoring,
2) larval development site and larval population monitoring, and
3) adult mosquito population monitoring.

2.3.1 Environmental Monitoring

The CSRD contractor(s) monitor river levels, snowpack levels, temperature forecasts and precipitation forecasts. Water Survey Canada maintains real-time continuous flow data for many waters in the province including the Columbia River, Illecillewaet River, and Shuswap Lake, which all impact the CSRD mosquito control program. This data is monitored frequently during peak flows at http://wateroffice.ec.gc.ca/index_e.html . The contractor(s) also receive weekly updates from BC Hydro regarding current and projected water levels in the Revelstoke area.

Snow pack levels are viewed on the Ministry of Forest, Lands and Natural Resource Operation website: http://bcrfc.env.gov.bc.ca/data/asp/realtime/index.htm. Monitoring of each of these variables allows mosquito control staff to estimate the size, timing and number of larval development sites that will appear throughout the season.

Current weather conditions are monitored through Environment Canada weather forecasts as these can affect whether treatments are carried out on any given day. Ground-based treatments of granular larvicides are occasionally deferred during high precipitation events. When helicopter applications are planned, wind and precipitation monitoring is especially important. Helicopter treatments are often suspended when wind conditions make it difficult for the pilot to aim granular larvicides at the larval development sites (*i.e.* the pilot is unable to compensate for drift of the granular product due to

wind). Also, helicopter campaigns are often postponed during precipitation events because the granular larvicides can become wet and clog the application equipment which can result in improper application rates and possible damage to the application equipment.

2.3.2 Surveillance of Larval Development Sites and Mosquito Larvae

The CSRD contractor(s) will conduct larval surveillance in areas identified as known or potential larval development sites. Sampling will be undertaken as required, based on meteorological factors such as rainfall, temperature, river levels or flooding events. The results of sampling will be used to make treatment decisions.

Monitoring Methods, Frequency of Monitoring and Data Collected

Regular surveillance of larval mosquito populations will be undertaken throughout the mosquito season to determine when and if treatment is required (based on threshold levels- See Section 2.4). Larvicides have been shown to be most effective when the mosquito larvae are actively feeding and when the larvae are at the right stage (instar) of development. The results of larval surveillance will be used to:

- Define the nature and extent of the mosquito problem based on larval surveys;
- Give direction to daily mosquito control operations (priorities will be set based on the instar of the larvae);
- Determine which larval development sites can be eliminated from future surveillance;
- Generate the data needed to determine if larviciding should be commenced (i.e. the treatment threshold has been reached or surpassed); and,
- Identify the genus of mosquito present at a larval site (if possible), to evaluate whether the species are significant human pests.

"Mosquito larval dippers" are commonly used to sample mosquito larvae. With this device, a 300 ml sample of water from a suspected larval development site is checked for the presence of mosquito larvae. The number of larvae present and their development stage (instar) is recorded, and the process repeated at several locations to determine the average density. The results of this sampling are used to make a treatment decision. Following treatment, sampling is done again (on a subsample of sites) to assess effectiveness of the treatment.

The CSRD or its contractor(s) will maintain databases that enable staff and contractors to access larval development site data quickly and accurately.

The database(s) currently include the following information:

- the location and approximate size of the larval development habitat ;
- description of the habitat (floodwater, snowmelt, manmade, etc);
- maps and/or photographs associated with each development site;
- the status of the land (public or private);
- status regarding "no treatment areas" if any;
- landowners' contact information;
- larval development site data (mosquito species present, if known, and surveillance history) and;
- monitoring and treatment data including the following:
  - ✓ date and time of monitoring or treatment event
  - ✓ number of larvae present per dip
  - ✓ name of larvicide
  - ✓ active ingredient
  - ✓ PCP number
  - ✓ kilograms or litres of larvicide applied
  - ✓ number of hectares treated
  - ✓ technicians also keep a record of precipitation (if any), wind speed and temperature in a notebook

2.3.3 Surveillance of Adult Mosquitoes

Adult surveillance will be conducted in the CSRD using CDC black light traps, and/or New Jersey light traps. CDC black light traps and New Jersey traps use black light to attract adult mosquitoes which are then sucked into a collection jar. To increase these traps effectiveness, dry ice can be placed near the trap as it releases carbon dioxide, a powerful mosquito attractant. Mosquitoes captured in traps will be counted and then examined under microscope and identified to the species level.

Trap counts will be used to assess the annual effectiveness of the larval reduction program. Since adult mosquitoes are trapped in similar locations on an annual basis, year to year comparisons of adult mosquito counts will be made. This allows the CSRD to determine whether the program delivered the expected level of mosquito reduction, given the environmental conditions (e.g. one would expect a higher trap count in a higher flood year, but should be concerned if trap counts were higher than average in a dry year).

Adult trapping may also be conducted in response to specific concerns from landowners. When adult mosquito populations increase unexpectedly, mosquito collections can give a clue as to the proximity and type of larval development site in the area. Different species of mosquitoes rear in different types of development sites, and therefore, once the species of mosquito causing the nuisance is determined, crews can search for possible development sites in the area.

2.3.4 Assessing Environmental Conditions and Damage Caused by Mosquitoes Before Insecticide Use

Damage Caused by Mosquito Larvae

Unlike other types of pests, mosquito larvae do not cause direct environmental damage or affect environmental conditions. Potential damage caused by mosquito larvae is related to the potential of some species (as adults) to cause a nuisance.

Damage Caused by Mosquito Adults

Adult mosquito outbreaks can have negative economic effects. Adult mosquitoes can, and do, interfere with a variety of recreational activities by limiting the use of outdoor areas. This can have economic consequences when tourism is a significant industry such as is the case in the CSRD. Next, studies have also shown that numerous outdoor work activities (e.g., agriculture, forestry, construction) are negatively impacted by the presence of large numbers of biting mosquitoes. In the farming industry, dairy and beef cattle have been shown to have smaller weight gains when exposed to both constant annoyance and being bitten while grazing or feeding.

There can also be health concerns related to mosquito bites. Mosquito bites can cause severe reactions in some individuals and skin infections can occur when individuals scratch their bites.

2.4 Injury Thresholds (*IPMR* 58(2)(D)(I) & (II))

With respect to mosquitoes, injury thresholds are generally referred to as *treatment thresholds*. These are determined by the certified applicator after considering several variables. The applicator decides whether the numbers of larvae present are likely to cause a nuisance if allowed to develop to adults.

As a general guideline, the treatment threshold for mosquito larvae is an average of **three (3) larvae per 300ml dip**. This threshold was selected because it the standard that has been used in British Columbia and other areas of Canada and the United States. However, the CSRD will consider exceptions to this rule. In some cases, an applicator may decide that an average of three larvae per dip may not be sufficient for treatment. For example, if the larval development site is very small and a significant distance from the public, the applicator may decide that allowing the larvae to develop will not pose a nuisance problem and therefore no treatment would be necessary. Conversely, a technician may encounter a site that is very large and deep with larvae distributed throughout the water column. In this case, it may be difficult to capture three larvae in a dip, however the cumulative number of larvae in the site can be significant and treatment would be necessary. The certified

Mosquito and Biting Fly Pesticide Applicator will make the final decision as to whether to carry out larval treatment. No larviciding will be conducted on private property without the consent of the landowner.

2.5 TREATMENT OPTIONS FOR LARVAL CONTROL (*IPMR* 58(2)(E)(I-IV))

Once a technician determines that a threshold has been met, there are several treatment options available. In the case of larvicides, there are short-acting bacterial controls (*Bacillus thuringiensis* var *israelensis*) or longer-acting bacterial controls (*Bacillus sphaericus*). Of course, there is also the option to perform a physical control, requiring no pesticides at all. Each of these choices will be discussed below.

2.5.1 Non-pesticide control (source reduction & habitat modification)

Options for non-pesticide control are outlined in Section 2.1.1 and these will be considered before any pesticide application.

Rationale/Selection Criteria for Source Reduction and Habitat Modification

Mosquitoes require water to develop. Removal of standing water sources or modification of habitats, as described in Section 2.1.1, will effectively control mosquito larvae. This is always the preferred treatment option since elimination of the larval habitat is the most effective immediate and long-term control strategy.

Benefits of Source Reduction and Habitat Modification

The use of source reduction and habitat modification provides an effective, long-term solution to reducing mosquito larvae, and may reduce the need for using pesticides.

Limitations of Source Reduction and Habitat Modification

Typically, source reduction or habitat modification is conducted on small man-made habitats. Activities such as draining containers and ditching can only go so far to reduce overall mosquito numbers. The most important habitats (natural ponds and floodwaters) cannot be modified as these are protected under provincial legislation.

2.5.2 Biological Control of Larval Mosquitoes

Biological control involves the application of bacterial agents to reduce larval mosquito populations. The biological control agents proposed for use under this PMP are the bacterial agents *Bacillus thuringiensis* var *israelensis* (*Bti*) and *Bacillus sphaericus* (Table 2). The biological control products,

and their formulations, manner of application and the type of equipment required for each manner of application is detailed in Section **5.0**.

Rationale/Selection Criteria for Using Biological Agents

Mosquitoes are most efficiently and economically controlled when they are concentrated as larvae in a larval development site. The relatively low risk nature of the biological larvicides proposed under this PMP, makes them an optimal choice for use in an IPM program.

Benefits of Using Biological Agents

The benefits of using these products are that they pose little risk to the applicator and they have little or no acute toxic impact on non-target species when applied at the label rates.

Limitations of Using Biological Agents

When biological larvicides are being used, frequent larval monitoring is required to ensure that applications are made within the treatment window. Treatments must be completed before the larvae stop feeding in the late 4th instar phase of development. Also, it is most beneficial from an operational and environmental standpoint to wait until the larvae are in their 3rd or early 4th instar. Waiting for later instars allows the greatest amount of time for the highest number of mosquito larvae to hatch and be available to the larvicide. Also, it keeps the larvae in the environment longer and available to predators that benefit from the larvae as a food source. Consequently, an increased frequency of monitoring is required to ensure that applications are made within the treatment time window.

In the case of *Bti,* (Vectobac and Aquabac), the second limitation is that the products breakdown rapidly in water through exposure to sunlight and aquatic microorganisms (generally 48 to 72 hours). Treatment must be repeated if monitoring confirms the presence of newly hatched mosquito larvae. *Bacillus sphaericus* formulated as VectoLex does not have this limitation as it has a prolonged action of up to 30 or more days.

According to the *Integrated Pest Management Regulation* Section 78(2), a pesticide-free zone is not required around standing water when applying the mosquito larvicides included in this PMP. However, in accordance with Section 78 (1) of the *Integrated Pest Management Regulation*, mosquito larvicides are limited in that they may not be applied in permanent, fish-bearing bodies of water or waters that have permanent, direct, surface-water connections with fish-bearing bodies of water.

Table 2. List of larvicides that are included in this PMP, for use within the CSRD. Selection of the larvicide will be made by the applicator following assessment of the larva development habitat and consideration of available resources.

Trade Name	Formulation	Active Ingredient	PCP No.	Application Rate	Manner of Application	Application Methods*
Mosquito Dunks	13g dunk	*Bacillus thuringiensis* var *israelensis* Strain H-14 (BMP-144)	28888	1 dunk per 6 m^2 of water surface	Ground	Manual placement
Vectobac 200G	Granules	*Bacillus thuringiensis* var *israelensis* Strain H-14 (AM65-52)	18158	3-10kg/ha	Ground & Aerial	Manual placement, backpack applicator, granular spreader, helicopter, or fixed-wing aircraft. The CSRD may also use Drones for application if this method becomes listed as an option on the label.
Vectobac 1200L	Liquid	*Bacillus thuringiensis* var *israelensis* Strain H-14 (AM65-52)	21062	0.25-1.0L/ha	Ground & Aerial	Backpack sprayer, truck/ATV-mounted sprayer, helicopter or fixed-wing aircraft. The CSRD may also use Drones for application if this method becomes listed as an option on the label.
Aquabac 200G	Granules	*Bacillus thuringiensis* var *israelensis* Strain H-14 (BMP-144)	26863	2.5-20kg/ha	Ground & Aerial	Manual placement, backpack applicator, granular spreader, helicopter, or fixed-wing aircraft. The CSRD may also use Drones for application if this method becomes listed as an option on the label.
Aquabac XT	Liquid	*Bacillus thuringiensis* var *israelensis* Strain H-14 (BMP-144)	26860	300-2400mL/ha	Ground & Aerial	Backpack sprayer, truck/ATV-mounted sprayer, helicopter or fixed-wing aircraft. The CSRD may also use Drones for application if this method becomes listed as an option on the label.
VectoLex WSP*	10g water soluble pouch	*Bacillus sphaericus*	28009	1 pouch per catch basin	Ground	Manual placement
VectoLex CG	Granules	*Bacillus sphaericus*	28008	5.6-16.8 kg/ha in water bodies & 0.56-1.68 g/m^2 of water surface area in tires	Ground & Aerial	Manual placement, backpack applicator, granular spreader, helicopter, or fixed-wing aircraft. The CSRD may also use Drones for application if this method becomes listed as an option on the label.

2.5.3 Selection of a Treatment Method

Once a decision has been made to conduct a treatment, the applicator must decide which product they will use, the application rate and how it will be applied. The decision will be based on a combination of the following considerations:

- the advantages and disadvantages of each pesticide as discussed in Section 2.5.2 and the properties of the pesticide and its method of application as will be discussed in Section 5.0 ;
- the life stage (instar) and species of the larvae (single generation mosquito, or multi-generational mosquito);
- the density of the larvae present;
- the characteristics of the larval habitat (high organics, intermittently dry, size and location of site);
- the availability of the larvicide;
- the cost of the larvicide; and
- the proximity to fish-bearing water and the likelihood of intermittent connection to fish-bearing water.

2.6 Evaluating the Effectiveness of the Pesticide Treatment (*IPMR* Section 58(2)(F)(I-III)

The final component of an Integrated Pest Management approach is that of treatment evaluation. Post-treatment evaluation can help to improve a program over time as applicators learn which pesticides, application rates, methods and timing work best at each application site. Constant evaluation of a program and its results will allow CSRD contractors to improve and refine the nuisance mosquito control program.

2.6.1 Evaluation the Effectiveness of the Pesticide Use on Pest Populations

The *Integrated Pest Management Regulation* section 78(4b) specifies that the efficacy of a mosquito larvicide be assessed by conducting pre-treatment and post-treatment larval sampling. Certified pesticide applicators will conduct and record all pre-treatment monitoring as described in Section 2.3.2. Within 14 days following treatment, certified applicators will return to a sampling of larval development sites to conduct post-treatment monitoring using the same methods of assessing larvae as described in Section 2.3.2 for pre-treatment monitoring. This information will be used to determine if the rate and type of pesticide application chosen for the location was suitable, and if the application failed, it will allow the applicator to plan for alternate methods of control.

2.6.2 Post -Treatment Monitoring of the Environment and Non-Target Organisms

As was discussed earlier, larvicides containing biological bacterial agents belonging to the genus *Bacillus* have been shown to have no adverse environmental impacts when applied according to label directions. The larvicides are not known to affect other insect species, amphibians, mammals, bird nor fish; however, technicians are always instructed to report any observations that may cause them

concern. For example, if they were to notice dead or injured non-target organisms, they would be expected to record and report this.

3.0 Operational Information [*IPMR* Section 58(3)(a)]

The transportation, storage, handling, mixing, loading, application, and disposal of pesticides are governed by federal and provincial legislation. All persons working with pesticides will follow safe handling practices including workplace requirements for Workplace Hazardous Materials Information System (WHMIS) labelling and worker education. The required practices for pesticide applicators are detailed in:

- B.C Ministry of Environment (2005 or current edition) Handbook for Pesticide Applicators and Dispensers; and,
- Worker's Compensation Board of British Columbia (2009) Standard Practices for Pesticide Applicators. https://www.worksafebc.com/en/resources/health-safety/books-guides/standard-practices-for-pesticide-applicators?lang=en .

3.1 Procedures for Safely Transporting Pesticides [IPRM Section 58(3)(a)(i)

The following procedures for safely transporting pesticides will be practiced by all CSRD staff or contractors working under this PMP. The *Integrated Pest Management Regulation* (Section 65(1)) legislates that pesticides must be kept, handled, stored and transported in the container in which they were originally packaged and with the labels originally affixed by the manufacturer, or in a container designed for containing the pesticide and labeled accordingly. Also, Section 33(2) of the *Regulation* states that a "person who transports or causes or allows the transport of a pesticide must ensure that the pesticide is secured and transported … in a manner that prevents the escape, discharge or unauthorized removal of the pesticide from the transport vehicle, and prevents the contamination of food or drink intended for animal or human consumption, household furnishings, toiletries, clothing, bedding or similar items that are transported with the pesticide."

Further, the Handbook for Pesticide Applicators and Dispensers, 5th Ed. (Ministry of Environment, 2005) outlines several general precautions to be taken during transport of pesticides and the CSRD and its contractors will adhere to the following practices:

1) all pesticide containers will be inspected for defects prior to transporting and pesticide will be in transported in original container with original labels;
2) pesticides will never be transported along with food, feed or consumer goods;
3) all pesticide containers will be secured to prevent spillage;
4) the driver of any vehicle transporting pesticides will be trained in spill clean-up and will carry, along with the pesticides, necessary equipment to contain and/or neutralize a spill;

5) limited amounts of pesticides shall be carried in any one vehicle (the quantity shall be no more than what is necessary for the project, except where transportation occurs between storage facilities);
6) pesticides shall be carried in a secure lockable compartment such as a locked storage box or a canopy; and
7) pesticides shall be transported separately from food and drinking water, and people.

3.2 Procedures for Safely Storing Pesticides [*IPMR* Section 58(3)(a)(ii)]

The CSRD and/or their contractors will adhere to the following standards of the *Integrated Pest Management Regulation* with respect to the safe storing of pesticides:

1) a person who stores a pesticide will store it in a manner that minimizes hazards to human health and the environment (*IPMR* Section 33 (1));
2) all pesticides will be stored in the container in which they were originally packaged and with the labels originally affixed by the manufacturer, or in a container designed for containing the pesticide and labeled with the trade name, chemical name, concentration of active ingredient and Pest Control Product number (*IPMR* Section 65 (1));
3) all pesticides will be stored separately from food intended for human or animal consumption (*IPMR* Section 66 (1a));
4) according to *IPMR* Section 66 (1b) all pesticides will be stored in a facility that is:
   (i) ventilated so that pesticide vapors are vented to the outside (not applicable to granular larvicides),
   (ii) not used for the storage of food intended for human or animal consumption,
   (iii) locked when unattended, and
   (iv) accessible only to persons authorized by the person storing the pesticide.
5) according to *IPMR* Section 66 (2), each door providing access to a storage facility will clearly bear the words “WARNING: CHEMICAL STORAGE — AUTHORIZED PERSONS ONLY" written in block letters”,
6) vehicle canopies are considered mobile storage units and must adhere to the rules in item numbers 4 and 5 above;

3.3 Procedures for Safely Mixing, Loading and Applying Pesticides [*IPMR* Section 58(3)(a)(iii)]

None of the pesticides listed in this PMP require mixing prior to use. When loading bags of the granular larvicides, care will be taken to handle the bags carefully to prevent tears in the bags. Personal protective equipment may include waders, rubber boots, eye protection, dust masks and/or gloves.

3.4 Procedures for the Safe Disposal of Empty Pesticide Containers and Unused Pesticides [*IPMR* Section 58(3)(a)(iv)]

CSRD staff or its contractors will dispose of empty bags as described on the manufacturer's product label. The bags will be torn to prevent reuse and then taken to an approved landfill.

In the unlikely event that the CSRD or its contractors has pesticide that will not be used, the disposal of unused or residual pesticides will be managed at CSRD hazardous waste disposal facilities.

3.5 Procedures for Responding to Pesticide Spills [*IPMR* Section 58(3)(a)(v)]

Spill containment equipment will be ready and available at the storage site (including mobile storage), loading sites, and during all pesticide applications. All persons authorized and trained to work with the pesticides will be familiar with the protocol for containing spilled larvicide. The spill equipment will include:

1) a broom,
2) a shovel, and
3) water proof waste-receiving container (such as a bucket).

When any of the products used under this PMP are spilled, they should be swept up and placed in a bucket for application to an active mosquito habitat during regular monitoring and treatment activities.

If a spill occurs, CSRD staff and/or their contractors will follow the recommendations as described in the Handbook for Pesticide Applicators and Dispensers, 6th Ed. (Ministry of Environment, 2005):

1) the source of the spill will be contained (find the torn bag);
2) people and animals will be kept away from the spill site and people will be prevented from walking through, or driving through the spill;
3) if the spill is small enough to be handled without assistance, clean-up will begin immediately;
4) personal protective gear will be worn during clean up;
5) when more than 5 kg of insecticide is spilled, the person responsible for the project shall immediately report to the BC Provincial Emergency Program by telephoning 1-800-663-3456 or, where that is not practical, to the local police or nearest detachment of the RCMP, and to the appropriate regional office of the BC Ministry of Environment & Climate Change Strategy- Integrated Pest Management Program.

4.0 Environmental Protection Strategies & Procedures [*IPMR* 58(3)(b)]

The following sections describe the CSRD's policies for protecting the environment. Much of the information included in the following sections is drawn directly from the *Integrated Pest Management Regulation* and the Handbook for Pesticide Applicators and Dispensers, 6th Ed. (Ministry of Environment, 2005). It should be noted that only the strategies that apply to the application of the larvicides (all granular formulations) listed in this PMP are discussed.

4.1 Strategies to Protect Community Watersheds and Domestic and Agricultural Water Sources [*IPMR* Section 58(3)(b)(i)(ii)]

The CSRD and their contractors will follow the guidelines contained in the *Forest Practices Code of British Columbia Act* to protect community watersheds, and will ensure that each of the steps listed below are conducted:

1) the location of community watersheds will be determined by accessing the Ministry of Environment Community Watershed website: http://www.env.gov.bc.ca/wsd/data_searches/comm_watersheds/index.html
2) an adequate buffer zone will be maintained around no-treatment areas such as landowners who do not want treatment;
3) insecticides will not be stored within a community watershed for more than 24 hours prior to their use, and removed from the community watershed within 7 days of their use, unless they are stored in a permanent structure;
4) insecticide applications will be stopped if insecticide residues or insecticide breakdown products are detected at a community watershed water intake, and there will be no further insecticide applications until the local Medical Health Officer has been satisfied that all required measures have been implemented to preserve water quality.

To protect domestic drinking water and water for agricultural use, Applicators will follow all standards for pesticide-free zones (PFZs) and no-treatment zones (NTZs) as specified in the *Integrated Pest Management Act and Regulations*. Table 3 lists the PFZ's and NTZs for mosquito control applications.

Table 3. Standards as described in the *Integrated Pest Management Regulation* (*IPMR*) for Pesticide Free Zones (PFZ) and No Treatment Zones (NTZ) to protect water during mosquito control activities.

Insecticide	Water Source	Regulation	Applicable Section from *IPMR*
Bacterial Larvicides	Water supply intake or well used for domestic or agricultural purposes, including water for livestock or for irrigation of crops.	Exempted from PFZ	71(12)
	Bodies of water and streams	Exempted from PFZ however no treatment allowed in permanent, fish bearing bodies of water or waters that have permanent, direct, surface-water connections with fish bearing bodies of water	78(2); 78(1)

4.2 Strategies to Protect Fish and Wildlife, Riparian Areas and Wildlife Habitat [*IPMR* Section 58(3)(b)(ii)]

Riparian areas are defined as the areas around bodies of water. These areas usually contain lush vegetation and high biodiversity (birds, insects, reptiles, amphibians, plants and mammals). They are often critical habitats, home ranges and travel corridors for wildlife. Riparian areas are essential for stream, lake and marsh health as they support vegetation that maintains bank stability and provide cover for water bodies to help maintain cooler water temperatures. With respect to pesticide applications, herbicides and chemical adulticides are generally considered the most dangerous pesticides in these ecosystems and none of these are included in this PMP.

Due to the low toxicity of the bacterial larvicides, applications may be conducted within riparian areas, and sensitive wildlife habitat, however the following will be undertaken to keep impacts to riparian, wildlife habitat and fish bearing waters to a minimum:

- Care will be taken to ensure minimal impacts on vegetation and soil (*e.g.* attempt will be made to stay on paths and avoid trampling vegetation).
- There will be no fuelling of machinery/application equipment or mosquito larvicide mixing within 15 meters of riparian areas, or sensitive wildlife habitat.
- There will be no cleaning or disposal of larvicides or their containers within 15 meters of riparian areas, sensitive wildlife habitat, or permanent, fish bearing bodies of water or waters that have permanent, direct, surface-water connections with fish bearing bodies of water.

Also, as per the Integrated Pest Management Regulation, fish habitat will be further protected as no larviciding will take place in permanent, fish-bearing bodies of water or waters that have permanent, direct, surface-water connections with fish-bearing bodies of water.

4.3 Strategies to Prevent Contamination of Food Intended for Human Consumption [*IPMR* Section 58(3)(b)(iii)]

The larvicides proposed for use in this PMP will not cause contamination of food intended for human consumption. This is due to their physical properties and their use only in aquatic areas. However, general guidelines for safety will be followed by applicators (*e.g.* applicator will wash hands before eating and food will be stored separately from pesticides and equipment used for larviciding).

4.4 Pre-Treatment Inspection Procedures for Identifying Treatment Area Boundaries [*IPMR* 58(3)(b)(iv) & 71(1)(a)(c)]

Section 58(3)(b)(iv) of the *IPMR* requires that a PMP include a description of the pre-treatment inspection procedures for identifying treatment area boundaries. Section 71(1)(a)(c) of the *IPMR* requires that a confirmation holder to do all of the following before the pesticide use:

- ensure that each individual who will be using the pesticide is informed of the boundaries of the proposed treatment area, the requirements for personal protection, and the pesticide use procedures required to protect human health and the environment;
- carry out an inspection of the treatment area to ensure that the applicable regulatory requirements and standards can be met in carrying out the use, and
- if the pesticide is to be applied aerially, ensure that the pilot conducts an inspection of the proposed treatment area to ensure that they are familiar with the boundaries and other critical features of the treatment area.

To ensure that the above regulatory requirements are met, the CSRD will establish and implement the following strategies and procedures prior to the application of mosquito larvicides.

Prior to *ground-based larviciding*, the applicator will ensure that he or she has permission to treat the site, and the applicator will ensure that he or she is not treating in a permanent, fish bearing body of water or waters that have permanent, direct, surface-water connections with fish bearing bodies of water.

When the *larviciding* application is to be done by *air*, the pilot will be guided on a reconnaissance flight prior to the treatment and will be shown the habitats to be treated. Ground crews will have completed pre-treatment monitoring and will have determined the boundaries of the habitat to be treated. During the application, the pilot will remain in direct radio contact with the ground crew in case of any questions or concerns related to the treatment

4.5 Procedures for Maintaining and Calibrating Pesticide Application Equipment [IPRM Section 58(3)(b)(v)]

All pesticide application equipment used by the CSRD and its contractors shall be safe, clean, in good repair, compatible and calibrated appropriately for the larvicide being applied

Calibration of backpack blowers and aerial application equipment used to apply granular formulations of larvicides will be conducted daily prior to larviciding treatments being undertaken. As these products broadcast spread the larviciding granules, the applicators must be aware of the spread pattern and its correlation to application rate. Spread-pattern "posters" will be used to teach applicators to visualize appropriate application rates. Applicators will be trained on the appropriate use of backpack granular applicators prior to use so that they are able to adjust their calibration as they walk through and around standing water (i.e. to walk slower or faster with a higher or lower throttle and flow rate).

4.6 Procedures for Monitoring Weather Conditions and Strategies for Modifying Pesticide Application Methods for Different Weather Conditions [*IPMR* Section 58(3)(b)(vi)]

As currently required by Section 35(1)(i) of the *IPMR*, prior to, and periodically during larviciding applications, measurements will be made to record weather conditions including:

- Wind speed and direction;
- Precipitation; and,
- Air temperature.

During larviciding activities, if wind speeds are too high, granules can be blown off course and miss the treatment areas, both during ground and aerial applications. Precipitation rarely interferes with ground application of larvicides, however during heavy rain, aerial applications may be interrupted as water can cause the granules to clump in the application equipment and therefore application rates can be affected. During high wind and/or precipitation events, ground and aerial application of larvicide will be postponed if wind is making granular application difficult (blowing granules off target or altering the application rate) or precipitation is affecting the working of the application equipment.

It should be noted that amendments are currently being considered to Section 35(1)(i) of the *IPMR* that would eliminate the requirement for recording wind speed, temperature, and precipitation during the granular application of larvicides for mosquito control. If this amendment shall come into force during the term of this PMP, the CSRD shall comply with all amended regulations.

5.0 Insecticides Proposed for Use, Their Properties, Manner of Application and Equipment Required for Application (*IPMR* 58(3)(c))

The following sections will provide an overview of the mosquito control products, their modes of action, manners of application (ground and/or air), and the equipment required for their application.

5.1 Bacterial Larvicides

The bacterial pesticides proposed in this PMP are safe for both humans and the environment, while being highly effective at controlling mosquito larvae. The CSRD will consider the use of any of the registered biological mosquito larvicides listed in Table 2, and this PMP may be updated with any new biological larvicides that become registered in Canada during the term of this PMP.

5.1.1 *Bacillus thuringiensis* var *israelensis* Strain H-14(AM65-52) or H-14(BMP-144)

Most of the larval treatment within the CSRD will be with larvicides containing strains of the active ingredient *Bacillus thuringiensis* var *israelensis* (*Bti*) (trade names Vectobac and Aquabac). During its spore-forming stage, *Bti* produces an endotoxin that contains five different proteins that can be digested in the alkaline gut of mosquito larvae. The toxin is attached to crushed corncob that serves as a carrier. Once digested, the proteins become toxic to the larvae and work to destroy the larvae's gut.

The granular larvicide formulations may be applied by manual placement, backpack applicator, granular spreader, or helicopter or fixed-wing aircraft. Application rates for the granular formulations vary from 2.5 to 20 kilograms per hectare (with the higher rates applied to polluted or highly organic water), although most sites are treated at about 5 to 10 kilograms per hectare. *Bti* Mosquito Dunks, another formulation, are always applied by manual placement.

The liquid formulations of the bacterial larvicides may be applied by truck or ATV mounted sprayer, backpack sprayer, helicopter, or fixed-wing aircraft at rates between 250 ml and 2400 ml per hectare (depending on the product).

There have been recent trials of granular and liquid *Bti* applications by drone. The CSRD may use drones for treatment if, during the term of this PMP, the use of drones is approved and added to any of the larvicide labels.

Bti can be applied to virtually any standing water except finished, treated drinking water, or permanent, fish-bearing bodies of water or waters that have a permanent, direct, surface-water connections with fish bearing bodies of water.

***Benefits of* Bacillus thuringiensis *var* israelensis**

There are many benefits to using *Bti* larvicides. When applied at label rates, *Bti* larvicides are specific to mosquito larvae and non-toxic to fish, amphibians, reptiles, mammals and most other insects. They are easy to apply and have no residual effect. They are the most economical of the larval controls.

Bti larvicides work best when applied to larvae in their 2nd and 3rd instars, however control can be achieved when applied to 1st and early 4th instar larvae as well. Death of the larvae usually occurs within 24 hours. This allows for technicians to be able to assess effectiveness soon after application.

***Limitations of* Bacillus thuringiensis *var* israelensis**

There are few disadvantages associated with the use of *Bti*. One limitation is that the *Bti* products have no residual effect, and therefore only the larvae present at the time of application are affected. In habitats where multiple generations of larvae appear, more than one application of larvicide may be necessary. Another possible disadvantage is the short window for treatment with optimum control of the larvae in the 2nd and 3rd instars.

5.1.2 Bacillus sphaericus

Bacillus sphaericus is a naturally occurring bacterium that acts as an endotoxin to mosquito larvae. *Bacillus sphaericus* formations contain living sporulated bacteria and a crystal protoxin that is released by alkaline conditions in the gut. The toxin destroys the lining of the intestine of the mosquito larvae that then releases lethal chemicals into the larvae's haemocoel. The bacteria recycle, and spores from dead larvae can remain suspended for extended periods of time. The duration of activity depends on many biotic and abiotic factors. Products containing *Bacillus sphaericus* are registered for larval mosquito control under the trade name VectoLex and the manner of application and the application methods are detailed in Table 2.

When VectoLex products are used at label rates, these will control several species of mosquito larvae in freshwater marshes, salt marshes, flood plains, flooded fields and pastures, wetlands, ponds, storm water detention/retention and seepage ponds, wastewater sewage effluent, sewage lagoons, oxidation ponds, log ponds, impounded waste water, septic ditches, drainage ditches including open storm

sewers, catch basins, and irrigation ditches, although applicators must read each label carefully as the different formulations are registered for use in different habitats. *Bacillus sphaericus* will not be applied to any water sites that serve as a source of treated finished drinking water.

***Benefits of* Bacillus sphaericus**

The benefits of *Bacillus sphaericus* are similar to those of *Bti* in that it is virtually non-toxic to non-target organisms while being very effective at reducing mosquito larval numbers. This product works better than *Bti* when applied to highly organic larval habitats and it has the added benefit of maintaining its effectiveness for up to 28 days and thus can control multiple generations of larvae with a single application. The *Bacillus sphaericus* formulated as VectoLex WSP is the larvicide of choice in catch basins due to its low toxicity to non-target organisms, easy manual application, and extended action of up to 28 days.

***Limitations of* Bacillus sphaericus**

The greatest disadvantage of *Bacillus sphaericus* is its cost, and therefore it will only be considered in larval development sites where multiple generations of larvae are known to occur. In these cases, the increased cost of the larvicide may be warranted as fewer applications would be required over the course of the summer.

6.0 Records and Reporting

Under the *Integrated Pest Management Regulation,* the CSRD and its contractors are required to maintain records of all pesticide applications and submit an Annual Record of Pesticide Use and an annual Notice of Intent to Treat.

6.1 Treatment Records (*IPMR* 37(1), 83(2)(a))

The CSRD will maintain, for three years from the date of treatment, operation records of all pesticide applications including:

1) treatment location;
2) pre-treatment monitoring results (larval dips);
3) treatment date and time;
4) type of pest targeted (mosquito larvae);
5) trade name of pesticide used and its PCP number;
6) method of application;
7) rate of application;
8) total quantity of pesticide used;
9) relevant meteorological conditions (*i.e*. wind, precipitation, temperature);
10) result of post-treatment monitoring and evaluation;

11) if the applicator decides that the 30 m non-treatment zone around a water supply intake or well used for domestic or agricultural purposes may be reduced, the information upon which the decision was based.

6.2 Records of Larval Development Sites

The CSRD will maintain updated records of all larval development sites, including:

1) GPS location or description of the location of the site;
2) name and address of owner or manager of the treatment site; and
3) information concerning no-treatment areas or areas where permission has not been granted by the landowner.

6.3 Annual Report of Pesticide Use (*IPMR* 39 (1)(2))

The CSRD will submit an Annual Report of Pesticide Use for Confirmation Holders to the Administrator of the *Integrated Pest Management Regulation* by January 31. The Report will be a summary of the previous calendar year's pesticide use including:

1) The name and address of the CSRD and the Confirmation number;
2) the trade name, PCP registration number, active ingredient name(s) and amount of pesticide product used in kilograms;
3) an estimate of the area treated with non-pesticide controls; and
4) maps of treated areas.

6.4 Annual Notice of Intent to Treat

The CSRD will provide a Notice of Intent to Treat to the Administrator *Integrated Pest Management Regulation* at least 21 days prior to the commencement of the project in each calendar year of the PMP Confirmation. The Notice of Intent to Treat will contain the following information:

1) the name and business location of the confirmation holder;
2) a description of the proposed treatment locations for the calendar year and a map or diagram that clearly identifies those locations;
3) a description of the proposed treatment for each area, including the pesticide to be used and its method of application; and
4) the total area of the treatment areas in the proposed treatment locations for the calendar year.

7.0 Engagement (*IPMR* 61(1))

The *Integrated Pest Management Regulation* specifies that persons preparing a PMP must conduct public engagement activites. The *Integrated Pest Management Regulation* specifies that the engagement must include newspaper notices and "reasonable" efforts to contact and consult with individuals who have the potential to be impacted by a proposed pesticide use under the PMP.

7.1 PUBLIC ENGAGEMENT

Prior to submitting a Pesticide Use Notice to the Ministry of Environment and Climate Change Strategy, the plan holder will carry out an engagement process with the public.

The objectives of engagement when this PMP is at the draft stage are:

- To increase public awareness of the PMP process and of the principles of Integrated Pest Management which are embodied in the PMP;
- To ensure that the public have an opportunity to identify concerns, and for the plan holder(s) to address those concerns before the PMP is finalized and a Pesticide Use Notice submitted for Confirmation;
- To ensure a transparent and accountable review process for the PMP;
- To introduce the public to the need for managing the larval stage; and,
- To explain how the planning process that is described in the PMP recognizes the need to protect human health and the environment.

The public will be consulted via notices in local community newspapers within the geographic boundaries of the mosquito control area. As per Section 61(1) of the *IPMR*, at least 45 days before submitting a Pesticide Use Notice, the first of two notices, at least 40 cm^2 in size, will be published in newspapers circulated in the various communities. Then, within a two-week period a second notice will be published (Table 4). The published advertisements will be placed in the main or legal sections of the newspapers with the heading "DEVELOPMENT OF A PEST MANAGEMENT PLAN". A copy of the advertisement that will be placed in newspapers within the mosquito treatment areas can be found in Appendix C.

During the public engagement process, the draft PMP will be accessible on the CSRD website.

Table 4. Names and location of newspapers and date of publishing of Plan Development advertisement.

Newspaper	Community	Date of 1st Publishing	Date of 2nd Publishing
Shuswap Market News	**Scotch Creek/Lee Creek**		
North Shuswap Kicker	**Scotch Creek/Lee Creek**		
Revelstoke Review	**Revelstoke & Area 'B'**		
Revelstoke Mountaineer	**Revelstoke & Area 'B'**		
Golden Star	**Golden & Area 'A'**		

7.1.1 Summary of Public Engagement

SECTION TO BE COMPLETED FOLLOWING ENGAGEMENT PERIOD

7.2 FIRST NATIONS ENGAGEMENT

First Nations engagement will be conducted in compliance with Section 61(2) of the *IPMR*. This legislation requires that:

> *"If a proposed pesticide use under a pest management plan has the potential to **significantly impact** an individual or a member of an organization or community, the confirmation holder must make reasonable efforts, starting at least 45 days before submitting a pesticide use notice to the administrator, to contact and consult these individuals"*

Apart from meeting this legislative requirement, the objectives of engaging First Nations are:

- To ensure that First Nations have an opportunity to identify concerns, and for the plan holder(s) to address those concerns before the PMP is finalized and a Pesticide Use Notice submitted for Confirmation;
- To ensure a transparent and accountable review process for the PMP; and
- To explain how the planning process that is described in the PMP recognizes the need to protect human health and the environment.

7.2.1 Guidelines for First Nations Engagement

When the *Integrated Pest Management Act (IPMA)* and Regulation (*IPMR*) was introduced in December 2004, the provincial government made a commitment to develop and implement procedures for First Nations engagement. Appropriate engagement is necessary when industry or government agencies develop plans for pest management activities that may potentially adversely impact First Nations' rights or title interests.

The Ministry of Environment has prepared guidelines that are to be used by pest managers as guidance when First Nations engagement is required. These guidelines are largely based on previous requirements for First Nations engagement under the former *Pesticide Control Act*. The Ministry asks that proponents (persons who prepare Pest Management Plans) to use the guidelines when pest management activities are in areas where a First Nation asserts aboriginal interests or has treaty rights. The Ministry will monitor industry use of the guidelines. In instances where aboriginal interests or treaty rights might be adversely impacted by pest management activities under the *IPMA*, the Ministry will assess the proponent's conduct and fulfillment of the engagement steps in the guidelines.

There are fourteen First Nations communities who have asserted aboriginal interested within the proposed treatment areas. Each of these will be consulted to determine whether there are any concerns of adverse effects on their land and resource use. Appendix D contains a sample of the

letter that will be sent along with a complete copy of the Draft PMP to each of the following First Nations governments.

- Adams Lake Indian Band
- Akisqnik First Nation (Ktunaxa Nation Council)
- Little Shuswap Lake Band
- Lower Kootenay Band (Ktunaxa Nation Council)
- Lower Similkameen Indian Band
- Neskonlith Indian Band
- Okanagan Indian Band
- Okanagan Nation Alliance
- Penticton Indian Band
- Qwelminte Secwepemc
- Shuswap Indian Band
- Splats'in First Nation
- St. Mary's Indian Band (Ktunaxa Nation Council)
- Tobacco Plains Indian Band (Ktunaxa Nation Council)
- Upper Nicola Band

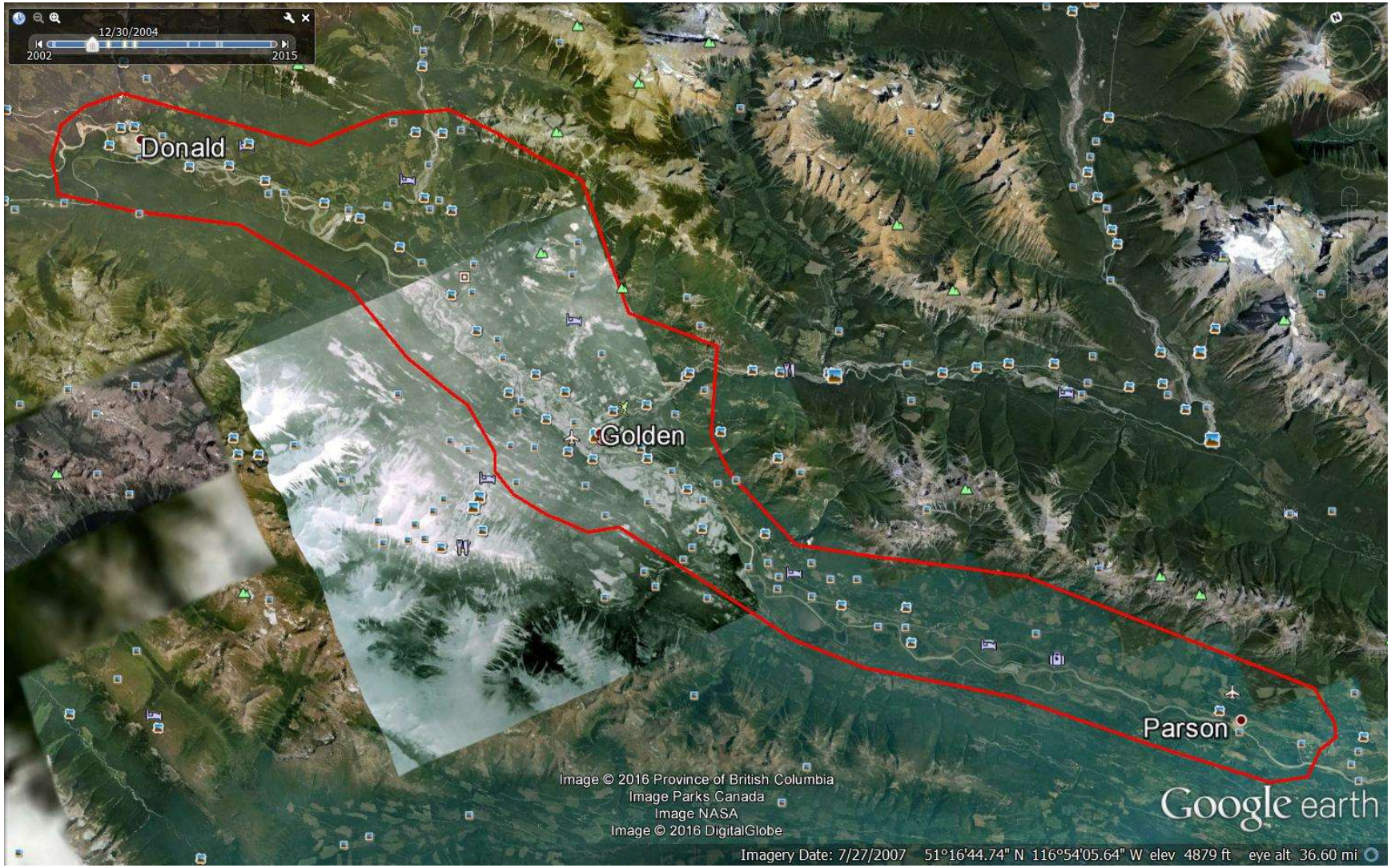
7.2.2 First Nations Engagement Summary

To facilitate Ministry consideration of the adequacy of First Nations engagement and of the plan holder response to any issues raised, the plan holder will prepare a report that described the engagement process and outcomes. This report will be submitted to the Administrator, IPMA, in conjunction with the submission of the Pesticide Use Notice application.

SECTION TO BE COMPLETED FOLLOWING ENGAGEMENT PERIOD

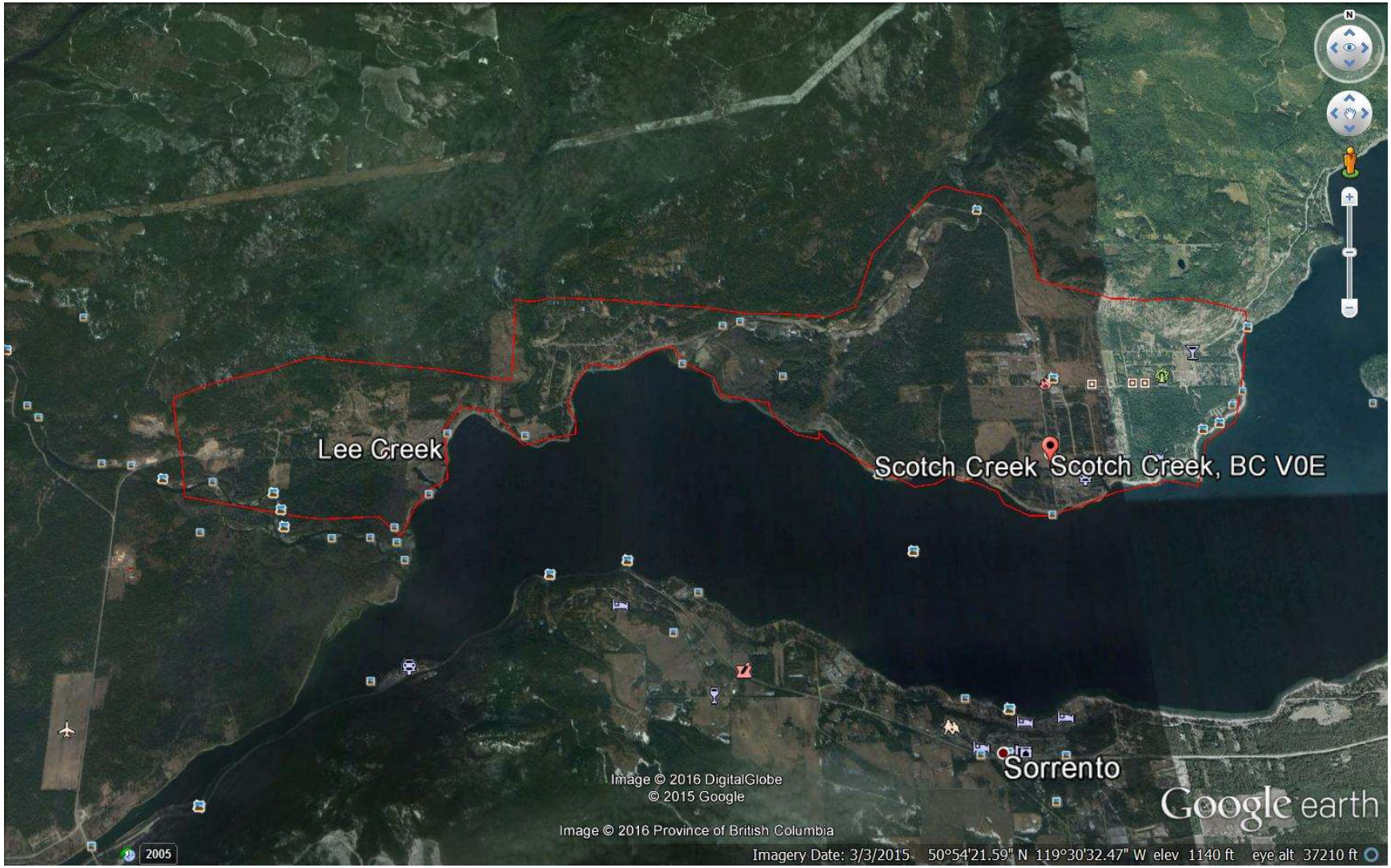
Appendix A: Map of the Geographic Boundaries Described within this PMP

Map showing approximate boundaries of the Golden & Electoral Area 'A' mosquito control program.



Map showing approximate boundaries of the Revelstoke & Electoral Area 'B' mosquito control program.

Map showing approximate boundaries of the Scotch Creek/Lee Creek mosquito control program.



Appendix B: Checklist of Required Information for the Development of a Pest Management Plan (from Section 58 of the *Integrated Pest Management Regulation*)

Checklist for required contents of a Pest Management Plan (from Section 58 of the *Integrated Pest Management Regulation*).

	Section of *IPMR*	Task	Associated Section Within this PMP
☒	58 1(a)	Description of geographic boundaries with maps etc	Section 1.1 Appendix A
☒	58 1(b)	Person responsible for managing pests in relation to land described above	Section 1.2
☒	58 1(c)	Name & phone number of individual who is the principal contact for information relating to the PMP	Section 1.2
☒	58 2(a)	Description of the program to prevent organisms from becoming pests	Section 2.1
☒	58 2(b)	(i) a description of the program that will be employed to identify pests targeted by the plan, or (ii) identification of the pests targeted by the plan	Section 2.2
☒	58 2(c)i	Description of the monitoring methods that will be used to assess pest populations, environmental conditions and damage caused by pests	Section 2.3
☒	58 2(c)ii	Description of monitoring frequency of above before and during pesticide use	Section 2.3
☒	58 2(c)iii	Description of the data that will collected before and during pesticide use	Section 2.3
☒	58 2(d)i	Description of the treatment threshold and how it was chosen	Section 2.4
☒	58 2(d)ii	Description of how treatment threshold will be applied	Section 2.4
☒	58 2(e)i	Description of the pesticide & non-pesticide treatment methods	Section 2.5
☒	58 2(e)ii	Rational for selecting a specific treatment method	Sections 2.5
☒	58 2(e)iii	Benefits and limitations for each possible method under sec 2(e)i	Sections 2.5
☒	58 2(e)iv	Description of how treatment method will be chosen	Section 2.5.3
☒	58 2(f)i	Description of post-treatment monitoring methods used to determine pesticide efficacy and any environmental effects	Section 2.6
☒	58 2(f)ii	Description of frequency of post-treatment monitoring	Section 2.6
☒	58 2(f)iii	Description of data collected during post-treatment monitoring	Section 2.6
☒	58 3(a)i	Procedures for safely transporting pesticides	Section 3.1
☒	58 3(a)ii	Procedures for safely storing pesticides	Section 3.2
☒	58 3(a)iii	Procedures for safely mixing, loading, and applying pesticides	Section 3.3
☒	58 3(a)iv	Procedures for the safe disposal of empty pesticide containers and unused pesticides	Section 3.4
☒	58 3(a)v	Procedures for responding to pesticide spills	Section 3.5

☒	58 3(b)i	Strategies to protect community watersheds & other domestic & agricultural water sources	Section 4.1
☒	58 3(b)ii	Strategies to protect fish, wildlife, riparian areas & wildlife habitat	Section 4.2
☒	58 3(b)iii	Strategies to prevent human food contamination	Section 4.3
☒	58 3(b)iv	Pre-treatment procedures for identifying treatment area boundaries	Section 4.4
☒	58 3(b)v	Procedures for calibrating & maintaining application equipment	Section 4.5
☒	58 3(b)vi	Procedures for monitoring weather conditions and strategies for modifying pesticide application methods for different weather conditions	Section 4.6
☒	58 3 (c)	Identification of each pesticide that will be used under the plan, the manner of its application and the type of equipment required for each manner of application	Section 5.0

Appendix C: Copy of the advertisement published in newspapers of participating communities.

DEVELOPMENT OF A PEST MANAGEMENT PLAN

Pest Management Plan Number: CSRD~MOS~PMP~2021-2026

Applicant: Columbia-Shuswap Regional District, 555 Harbourfront Dr NE, Box 978, Salmon Arm, BC V1E 4P1 Tel: (250) 832-8194 Attention: Ben Van Nostrand, Operations@csrd.bc.ca

Location: The Pest Management Plan covers three distinct programs. 1) Scotch Creek/Lee Creek Fire Suppression Area including parts of Roderick Haig-Brown and Shuswap Provincial Park; 2) City of Revelstoke & immediate surround area of Electoral Area 'B'; and 3) Town of Golden & surrounding area of Electoral Area 'A' extending north to Donald Station & south to Harrogate.

Pesticides: The active ingredients and trade names of the Pesticides (including bacterial agent(s) proposed for use under this plan include: *Bacillus thuringiensis* var *israelensis* Strain H-14 (AM65-52) (Vectobac 200G & Vectobac 1200L); *Bacillus thuringiensis* var *israelensis* Strain H-14 (BMP-144) (Mosquito Dunks, Aquabac 200G & Aquabac XT); & *Bacillus sphaericus* (VectoLex WSP & VectoLex CG).

Application Methods: Backpack applicator, granular spreader, & manual placement for Vectobac 200G & Aquabac 200G. Manual placement only for Mosquito Dunks & VectoLex WSP. Backpack sprayer & truck/ATV mounted sprayer for Vectobac 1200L and Aquabac XT. Helicopter or fixed wing aircraft for Vectobac 200G, Vectobac 1200L, Aquabac 200G, Aquabac XT & VectoLex CG. If the use of drones is approved and added to any larvicide label during the term of the PMP, they may also be used for treatments.

The selection of insecticides has been chosen to target mosquito populations in the most environmentally responsible manner and will be applied within the area outlined in the PMP.

The proposed duration of the PMP is from April 1, 2021 to March 31, 2026.

A draft copy of the PMP including maps of the proposed treatment areas may be examined at the CSRD address listed above or by contacting Cheryl Phippen at the address below. The draft PMP can be viewed online at www.csrd.bc.ca

A person wishing to contribute information about a proposed treatment site, relevant to the development of the Pest Management Plan, may send copies of the information to the consultant at the address above within 30 days of the publication of this notice.

BWP Consulting Inc
Attention: Cheryl Phippen
6211 Meadowland Cres S
Kamloops, BC V2C 6X3
Email: BWP@shaw.ca
Phone: 250-819-1750

Appendix D: Letter sent to the First Nations with traditional territories that fall within the treatment area, requesting input regarding this PMP.

BWP Consulting Inc.
6211 Meadowland Cres S
Kamloops, BC V2C 6X3

DATE

Address

Attention "Contact"

Our company, BWP Consulting Inc., has been contracted by the Columbia-Shuswap Regional District to update and renew their current Pest Management Plan (PMP) for the control of nuisance mosquitoes within the District. The Proposed Plan (No. CSRD~MOS~PMP~2021-2026) is now complete and is in the Public and First Nations Engagement phase of development.

Please be advised that this letter forms part of the Crown's engagement process for the following proposed pesticide use:

The complete list of active ingredients and trade names of the proposed larvicides for use under this Plan include: *Bacillus thuringiensis* var *israelensis* (Vectobac200G, Vectobac 1200L, Mosquito Dunks, Aquabac XT, and Aquabac 200G) and *Bacillus sphaericus* (VectoLex WSP & VectoLex CG).

Mosquito control activities will begin in April of each year and may extend as late as September each year.

The Pest Management Plan covers three distinct programs. 1) Scotch Creek/Lee Creek Fire Suppression Area including parts of Tsútswecw Provincial Park and Shuswap Lake Provincial Park; 2) the City of Revelstoke and immediate surround area of Electoral Area 'B'; and 3) the Town of Golden & surrounding area of Electoral Area 'A' extending north to Donald Station and south to Harrogate.

In accordance with the requirements of the British Columbia *Integrated Pest Management Act* and Regulation, we are required to ask you following questions;

a. What traditional activities have been or are being practiced within the proposed area and where have they taken place?
b. Do you have any technical or traditional knowledge of the area under application which would assist us in assessing the impact of this application on your traditional interests or treaty rights?
c. Do you have any concerns regarding potential impacts of our proposed activities on your asserted aboriginal interests or treaty rights, and if so, can you provide proposals on how we may address those concerns?

We would welcome an opportunity to meet with a representative of your Nation with the intent being to carry out meaningful engagement as needed. Alternately, we welcome you to submit information pertaining to the enclosed plan in writing or by calling Cheryl Phippen of BWP

Consulting Inc at (250) 819-1750 by January 25, 2021. If you prefer to respond in writing, please send response by mail to Cheryl Phippen at 6211 Meadowland Cres S, Kamloops, BC V2C 6X3 or by email to bwp@shaw.ca

If you would like to speak to a Ministry representative directly about the proposed pesticide use outlined in this letter, please contact the following Ministry of Environment Regional Office at 102 Industrial Place, Penticton, BC V2A 7C8, phone 250-490-8200.

Sincerely,

Cheryl Phippen, BSc, RN
President, BWP Consulting Inc.

c.c. Integrated Pest Management Program, Ministry of Environment, Surrey, BC.