

***Regional District of East Kootenay,  
Mosquito Control Program for  
Wasa/Ta Ta Creek/Skookumchuck  
2017 Final Report***



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## Executive Summary

The 2017 season is the 20th season that Morrow BioScience Ltd. (MBL) has conducted floodwater mosquito control operations for Wasa/Ta Ta Creek/Skookumchuck within the Regional District of East Kootenay (RDEK); 2017 also marks the beginning of a new 5-year contract to conduct mosquito control for the area. Continuing efforts include the identification of new mosquito development sites at varying regional water levels and increasing public engagement opportunities.

Heat maps were created this year based on mosquito larval Aquabac® treatment data gathered using MBL's new real-time data collection system. This data management portal enables real-time data access for program partners, field managers, and technicians. It also enabled field technicians to geo-code larval densities and to document richer site-specific information while in the field. The maps provide another tool for field managers and technicians to use when determining areas within which to increase larval mosquito operations in the future.

The 2017 season began with a higher-than-average snowpack in all three of the snow survey stations associated with East Kootenay basin. Snow accumulated in basins affecting the Kootenay River near Wasa/Ta Ta Creek/Skookumchuck through April. The freshet began in early May with a regional spike in ambient temperatures, which brought out a considerable amount of low and mid-elevation snow. The ambient temperature spike in late May brought out the rest of the mid-elevation snow along with some high-elevation snow. The late May spike in temperature led to the peak in the Kootenay River in Fort Steele on 1 June (4.2 m). Markedly low precipitation (rain) likely did not measurably augment regional river levels or prolong seepage site existence beyond normal.

Ground treatments started on 23 May. All ground treatments took place in May and June; the final ground treatment took place on 22 June. When regional Kootenay River levels increased to peak levels in early June, aerial treatments were required to treat sites that became active concurrently and challenging to access by ground. Three aerial treatment events were required to treat river-associated sites on 31 May and 6, 7 June. The extent of each mosquito development site and mosquito larval abundance were significantly increased in 2017 due to regional river levels that had not been as high in at least two years.

The total ground treatments amounted to about 126 ha (i.e. 719 kg) and the total aerial treatments amounted to approximately 1,068 ha (i.e. 6,406 kg). All new and existing sites were successfully treated in 2017, although additional treatments may have assisted with decreasing adult mosquito annoyance later in the season. There was a nation-wide shortage of Aquabac® in 2017, which resulted in an insufficient product for the Wasa/Ta Ta Creek/Skookumchuck program. To avoid this challenge in the future, MBL has acquired

a large warehouse for surplus Aquabac® inventory. Additionally, the RDEK plans to purchase more Aquabac® than in previous seasons.

MBL regularly updates our Facebook and Twitter accounts to reflect up-to-date mosquito and treatment related information for MBL's contract areas. To provide residents with a further avenue of contact, MBL has a toll-free Mosquito Hotline (888-733-2333) that is checked daily during the mosquito season. A total of three complaint calls were made to the Mosquito Hotline and no emails were received. It is believed these were a result of high water, which compounded the number of mosquito eggs able to hatch, and significantly increased potential mosquito development habitat. All calls were returned within 24 hours of receipt. MBL participated in a town hall meeting with the RDEK at the Wasa Community Hall on 27 June. Staff shared information pertaining specifically to the mosquito abatement program, addressed frequently asked questions about Aquabac®, and addressed the reasons for insufficient amount of Aquabac®. The meeting was well-attended. Future seasons may include having a booth at a local Farmer's Market event.

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**Cover photo credits**

Main photo: Mosquito development site near Wasa during the freshet (2017, Kendra Lewis)

In-set photo: Instar larvae (3<sup>rd</sup> and 4<sup>th</sup>) in a dip cup from field site (2017, Dirk Lewis)

## Introduction

Morrow BioScience Ltd. (MBL) became the mosquito control contractor for the Wasa/Ta Ta Creek/Skookumchuck area within the Regional District of East Kootenay (RDEK) in 1997. The contract was renewed for another five (5) years in 2017. This report will outline the accomplishments made to date, discuss regional environmental conditions affecting mosquito populations and monitoring efforts, review the success in fulfilling the proposed deliverables, and present all final data.

It is MBL's goal to reduce floodwater mosquito nuisance within the contract areas for each of our control programs. Throughout the last two decades, the trending reduction in floodwater mosquito annoyance is due, in large part, to the thorough monitoring and timely treatments conducted by MBL field technicians. Since 1997, MBL field technicians have gained a strong knowledge of mosquito development site locations and hatch timing within low and high-water years. As each season presents a unique combination of environmental variables, new seepage sites are still discovered. In 2017, field technicians gained valuable knowledge regarding the reach of the program in a considerably high-water year.

Residents have also provided valuable information about Wasa/Ta Ta Creek/Skookumchuck sites, which lends to MBL's abilities to conduct timely and effective mosquito control for the region. Specifically, this understanding enables field staff to appropriately time ground applications resulting in the reduced need for aerial treatments. MBL fosters the community involvement aspect to this mosquito-monitoring program and recognizes that it is an essential element to achieving the primary goal: to reduce floodwater mosquito annoyance while remaining environmentally conscious.

Integrated Pest Management (IPM) principles are a pillar of MBL's corporate philosophy and mosquito management strategy. Ultimately, the objectives of an effective floodwater mosquito control program coupled with maintaining a low environmental impact for all field activities are achieved by adhering to a strict IPM Plan. MBL employs a regular site-monitoring regime, allowing for accurate and effective ground treatments, with a reduced dependence on aerial treatments, thus reducing the environmental impact of treatment activities. The success of this program is further supported by the fact that site visits can occur with little notice, since MBL's long-time field manager resides in Cranbrook.

## Program Development

Prior to 1997, mosquito development site locations within Wasa/Ta Ta Creek/Skookumchuck were tracked solely with general addresses/location descriptions; no maps of the sites had previously been created. Since earning the contract, MBL ground-verified historical sites in low and high-water, created GPS waypoints of each site, and mapped all areas of the program. Electronic data files based on the GPS waypoints have been supplied to the RDEK.

In 2017, MBL further improved the mosquito control program by launching a real-time online data collection and management portal. This novel tool allows field technicians to update mosquito development site profiles, add larval/adult abundance data, update treatment information, take relevant photos, and create a daily site monitoring strategy in real-time. Program managers within MBL and the RDEK were also able to view detailed maps of the area and all data associated with each point in real-time. The online portal provided assurance to management that sites were treated appropriately. Additionally, the portal allowed for timely responses to residential questions regarding treatments in their area.

Mosquito development sites are continually being discovered due to the large area of this program, the complicated influences of local beaver dams, man-made culverts, and the Kootenay River freshet. Given these variables, several new sites were found in 2017. All sites were mapped and treated in a timely manner.

## Significant Regional Environmental Conditions

### Snowpack

Snowpack in basins influential to the Kootenay River near Wasa/Ta Ta Creek/Skookumchuck is an important environmental variable to track, as it can reveal how severe the freshet may be at varying points in the season. Following the real-time snowpack levels will also indicate when the freshet has ended. As the freshet is the primary factor affecting floodwater mosquito development, it is a benefit to the overall success of the program to understand the snowpack and freshet variations throughout the season.

Snow survey stations take continuous snowpack measurements and the results are reported in real-time<sup>1</sup>. Snow basin indices are then calculated from those measurements. In addition to these indices, 'percent of normal' calculations are also made. Specifically, when snow pack depths are measured, their heights are then compared to 'normal'

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<sup>1</sup> <http://bcrfc.env.gov.bc.ca/data/asp/realtime/index.htm>

heights (from comparable dates in previous seasons), revealing what ‘percent of normal’ the current levels are. These indices can aid field technicians in preparing for the freshet.

The main basin that influences the Kootenay River freshets in the Wasa/Ta Ta Creek/Skookumchuck area is the East Kootenay basin. The snowpack in the East Kootenay Basin was reported to be at 137% of normal<sup>2</sup> immediately preceding the start of the 2017 mosquito monitoring season. In April, unstable weather systems contributed large amounts of snow to high-elevation snow gauge stations. In fact, even in June<sup>3</sup>, the final snow basin indices for the East Kootenay basin were reported at 109% of normal.

More specifically, the Snow Water Equivalent (SWE) from the three snow survey stations within the East Kootenay basin can provide a closer look at when, exactly, the snow was depleted from those stations<sup>4</sup>. The northern-most snow survey station within the Basin (i.e. Floe Lake) was completely depleted of snow by early July. The two southern-most snow survey stations (i.e. Moyie Mountain and Morrissey Ridge) are at lower elevations and, as such, were depleted of snow by early June<sup>4</sup>. Given the depletion of SWE in the region’s high-elevation snow stations between June and July, it is reasonable to assume that the contribution of the freshet to the regional Kootenay River levels was insignificant by the end of July.

### Ambient Temperature Records

Regional Kootenay River levels can be indirectly affected by ambient temperature spikes occurring in snow basins associated with these river systems in the early part of the mosquito season (i.e., April – June). When ambient temperatures spike, snowmelt comes down through the regional Kootenay River, increasing river levels, and creating floodwater mosquito development sites. These events cause the ground along the Kootenay River edges to be wetted. The ground immediately adjacent to these Rivers contains floodwater mosquito eggs. These eggs remain dormant until ideal hatching conditions are present, which include water, low dissolved oxygen levels, and sufficiently high ambient temperatures. Typically, these conditions present themselves within the month of May.

Ambient temperatures more strongly influence sites that are shallow, relatively stagnant, and land-locked. Most the mosquito development sites within Wasa/Ta Ta Creek/Skookumchuck monitored by MBL technicians are shallow and relatively stagnant. Thus, as the ambient temperatures begin to rise, water temperature more quickly reflects ambient temperatures, creating an ideal environment for mosquito development. Larvae develop slower in cool water and much faster in warm water. In fact, in a laboratory study performed by Mohammad and Chadee (2011), *Aedes* mosquito eggs (i.e., floodwater

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<sup>2</sup> [http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017\\_May1.pdf](http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017_May1.pdf)

<sup>3</sup> [http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017\\_Jun15.pdf](http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017_Jun15.pdf)

<sup>4</sup> <http://bcrfc.env.gov.bc.ca/data/asp/realtime/index.htm>

mosquito eggs) were subjected to 35 °C conditions. Under this temperature, optimal feeding, and optimal spatial distribution conditions it took as little as six days for first instar larvae to emerge as adults.

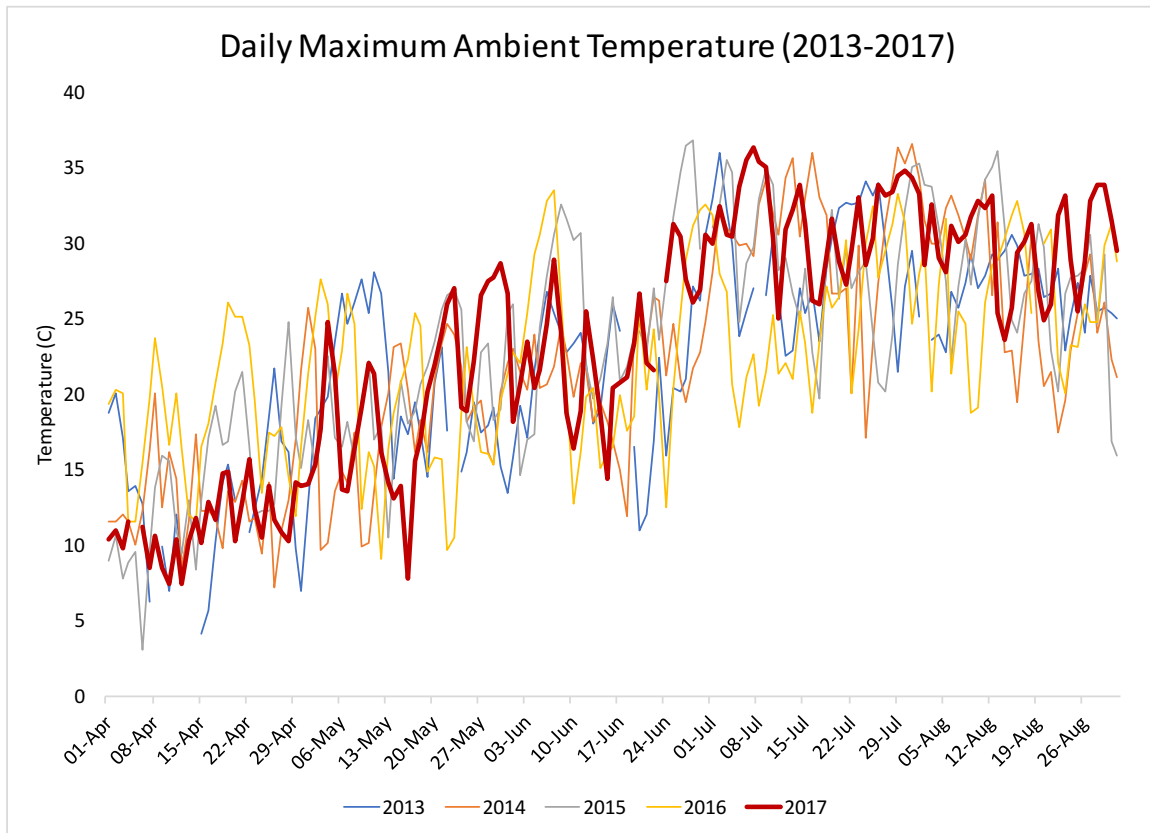
When comparing the previous four mosquito seasons (i.e. 2013-2017), the maximum ambient temperature data in 2017 are generally similar (Figure 1). However, in April of 2017 ambient temperatures appeared to be lower. This trend is consistent with the BC River Forecast Centre's 1 May report<sup>5</sup> stating that temperatures were 0.5°C – 1.5°C below normal for most of southern BC in April. As opposed to the March or April temperature spikes of the previous four seasons, 2017 ambient temperatures in much of southern BC began to increase consistently in early May (Figure 1). Accordingly, notable snowmelt began to occur at the same time, creating high regional River levels (see 'Regional Kootenay River Levels' section). The temperature spikes in late May, which were experienced throughout the southern portion of the province, led to the peak in regional Kootenay River levels in early June. In comparison to other, recent high-water years, the ambient temperature trend for 2017 appears to be well within the normal bounds, despite the slow start (Figure 1).

The highest ambient temperature recorded at the Cranbrook Airport weather station was on 7 July (36.3°C; Figure 1). Increasing temperatures experienced from May through July likely did provide an environment that allowed mosquitoes to mature more quickly than normal if they had not been controlled in previous efforts. The high ambient temperatures that occurred in late July and August (Figure 1) would have led to a more rapid adult development, which could result in a quicker die-off of adult mosquitoes.

Higher ambient temperatures in July and August can also create localized annoyance due to container mosquito emergence and dispersal. Container mosquito habitats near residential homes can be continually created throughout the summer due to local watering practices. MBL field technicians regularly inform residents that adult container-bred mosquitoes can be greatly reduced around their homes by ensuring potential container mosquito environments are either free of water or refreshed frequently.

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<sup>5</sup> [http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017\\_May1.pdf](http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017_May1.pdf)



**Figure 1. Maximum daily temperature (°C) as recorded at the Cranbrook Airport, BC (Climate ID: 1152105) between 1 April – 31 August, 2013-2017. Gaps in the data represent days wherein the monitoring station was not functioning properly.**

## Precipitation

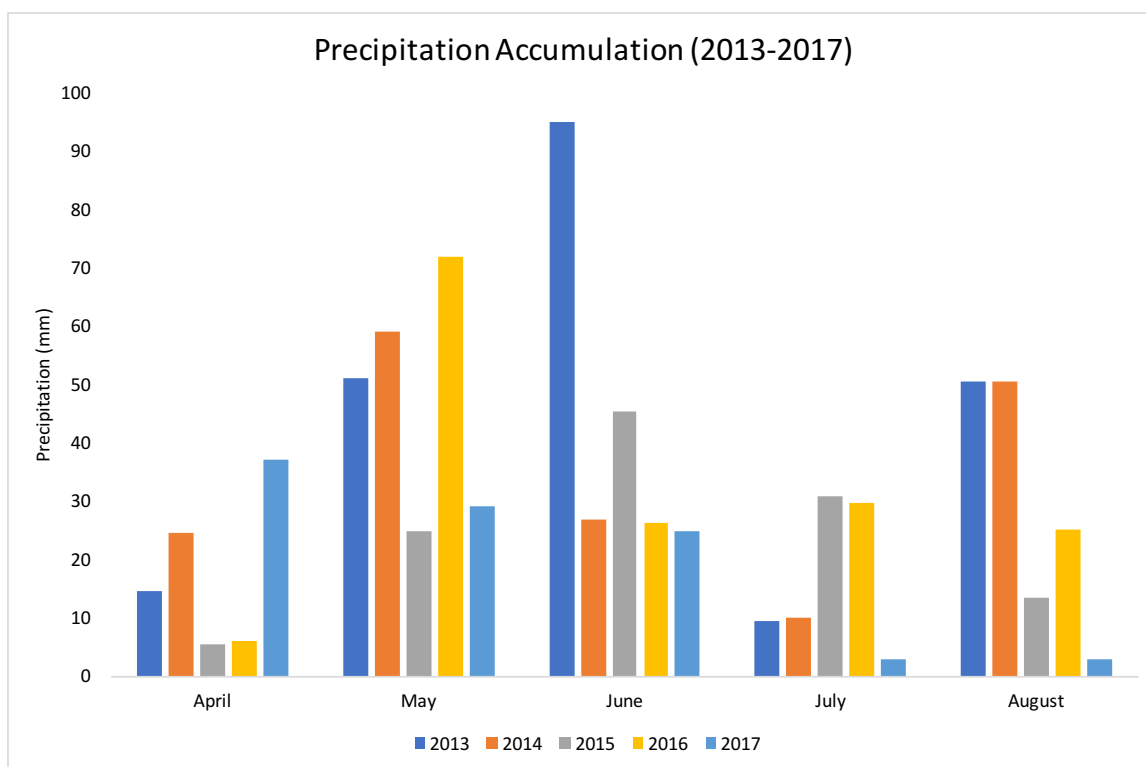
Precipitation is an important environmental parameter to monitor within a floodwater mosquito control program, along with snowmelt and ambient temperature. While not the major contributor to overall river levels in the local Kootenay River, precipitation can impact levels when the ground is saturated in influential basins or when considerable precipitation is received during the peak of the freshet. It can also affect certain sites that are not necessarily associated with the river, but that are fed by snowmelt. If a large amount of rain occurs on top of snowmelt, the rain rolls off the snowmelt and can pool in areas where mosquito development takes place.

There was a relatively low precipitation accumulation throughout the 2017 mosquito season (i.e. April – August; Figure 2). In fact, the 2017 mosquito season acquired the lowest amount of precipitation since prior to 2013. It's likely that the anomalous negative sea surface temperatures resulted in higher-than-normal temperatures (and reduced precipitation) for much of BC between April and June<sup>6</sup>.

<sup>6</sup> [http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017\\_Apr1.pdf](http://bcrfc.env.gov.bc.ca/bulletins/watersupply/archive/2017/2017_Apr1.pdf)

Of the months monitored, the greatest amount of precipitation accumulation was received in April (Figure 2; 37 mm). The maximum precipitation was received well in advance of the freshet and was relatively low. Thus, it is unlikely that precipitation in April – or any other month of the mosquito season – considerably amplified mosquito development habitat associated with the regional Kootenay River. Precipitation accumulation in the mosquito season of 2017 was likely insufficient to have measurably bolstered regional Kootenay River levels or maintained seepage sites, as it had in 2016.

Although the precipitation accumulation in the region likely didn't significantly affect floodwater mosquito habitat, it is possible that container mosquito sites may have been created due to the rain. Container mosquito species (e.g. *Culex* spp.) require sites that have stagnant, warm water for breeding and maturation. Specific sites include flat roofs, rain gutters, old tires, tree holes, birdbaths, and rain barrels, to name a few. It is possible that container mosquitoes emerged from localized sites and were a nuisance to residents into August. While MBL's mandate does not include controlling container mosquitoes, field staff help concerned residents reduce potential container mosquito breeding sites on their property by advising them to remove or replace standing water regularly.



**Figure 2. Monthly total precipitation accumulation (mm) as recorded at the Cranbrook Airport, BC (Climate ID: 1152105) between 1 April – 31 August, 2013-2017.**

## Regional Kootenay River Levels

The Kootenay River at Fort Steele primarily affects the floodwater mosquito abundance in the area around Wasa/Ta Ta Creek/Skookumchuck. The water levels of that river system are governed by two main influences: 1) local snowmelt and 2) the freshet from the East Kootenay. Frequent and large amounts of precipitation can also affect River levels, though typically to a lesser degree than the primary factors listed above.

A spike in regional ambient temperatures in early May melted snow at low and mid-elevations, resulting in a rise in regional Kootenay River levels (Figure 3). A second spike in ambient temperatures in late May led to the melting of residual mid-elevation snow and some high-elevation snow. This second large regional snowmelt gave rise to the peak in local Kootenay River levels in early June (Figure 3). Specifically, the Kootenay River at Fort Steel peaked on 1 June (4.2 m). Because the peak in the regional river occurred at a relatively warm time of the mosquito season, environmental cues were present for successful mosquito larval development, requiring treatments that started in May (see 'Larval Treatment' section).

The peak regional River levels in 2017 were considerably higher than those of 2015 and 2016 (Figure 3). The Kootenay River at Fort Steele was almost a meter higher in 2017 than in 2016 and over a 3/4 meter higher in 2017 than in 2015. The peak in the Kootenay River in recent seasons is important to note because larval mosquito abundance can be, in part, predicted by the regional rivers' peaks relative to recent seasons. For example, since the 2017 Kootenay River peak far exceeded those of 2015 and 2016, mosquito eggs that were laid above those peak levels likely remained dormant until 2017 floods triggered their hatching. Thus, 2017 larval abundance, treatment amounts – and adult abundance, to a degree – were considerably greater than that of the previous two seasons.

The date and rate at which the regional river rose can also affect mosquito hatching potential. Floodwater mosquito eggs laid on substrates at various River(s) levels have optimal environmental conditions and adequate time within which to hatch when the Rivers rise at a slower rate. Since the Kootenay River rose at a relatively steady rate in 2017 and at a time in the season which was accompanied by higher ambient temperatures, mosquito hatching cues were abundant.

After the Kootenay River at Fort Steele peaked in early June, regional river levels began slowly dropping (Figure 3). By mid/late-July, regional river levels had decreased enough to reduce the need for mosquito larval treatment. By that time, many of the known seepage and foreshores sites related to the regional Kootenay River were dry or had been successfully treated.

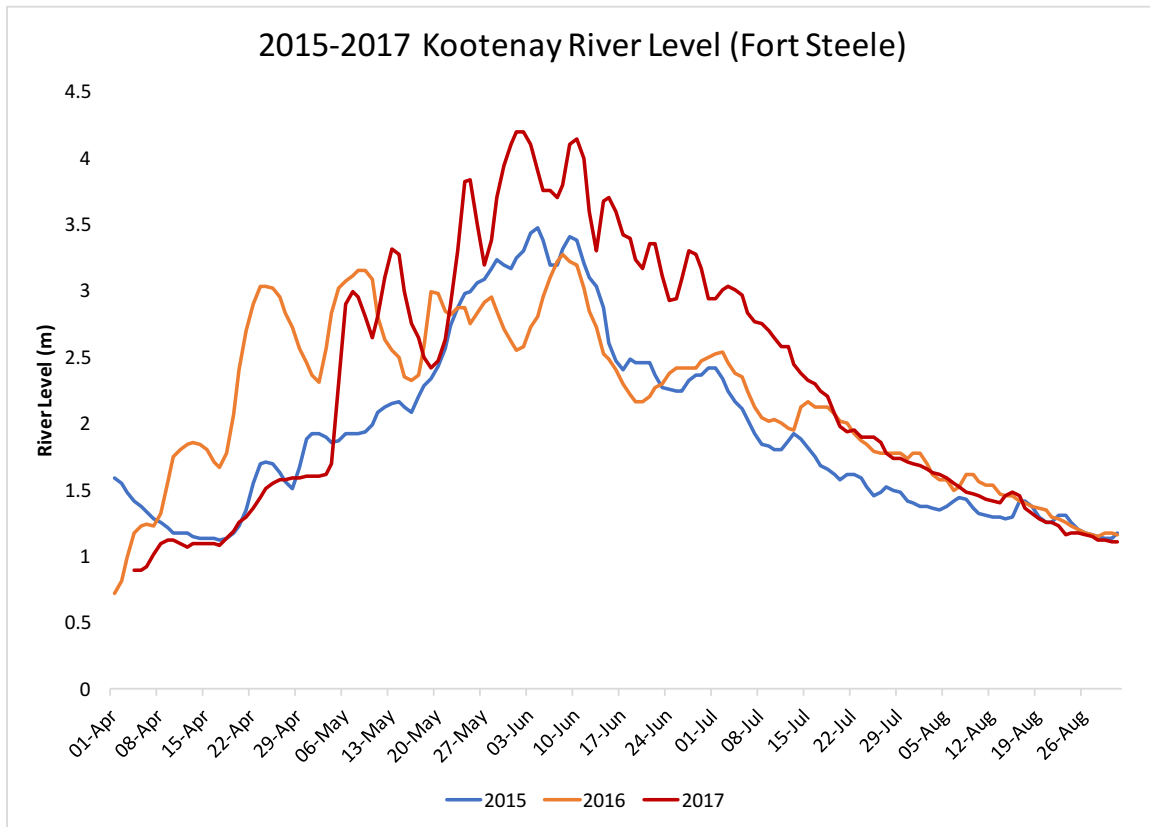


Figure 3. 2015-2017 Kootenay River levels (m), 1 April – 31 August. Kootenay River measurements were taken from the 'Kootenay River at Fort Steele' station.

## Monitoring Methodology

*Aedes. vexans* and *A. sticticus* mosquitoes are the most common floodwater nuisance mosquitoes within Wasa/Ta Ta Creek/Skookumchuck. As opposed to other mosquitoes (i.e., some *Culex*, *Culisetta*, *Anopheles spp.*), floodwater mosquitoes lay their eggs on damp substrate in areas with a high flooding potential; they are often called 'floodwater' mosquitoes for this very reason. If the water flooding the eggs is sufficiently warm, contains a low enough dissolved oxygen (DO) content, and is organically rich (which contributes to a decreased DO content), hatching will commence (Gjullin et al. 1950). If numerous seasons have passed in between high-water years, then high river levels may produce a compounded number of mosquito larvae.

The mosquito control program for Wasa/Ta Ta Creek/Skookumchuck involves monitoring mosquito development sites within regional Kootenay River floodplain areas to target floodwater mosquito hatching. At the peak of the season, high water levels occur in the Kootenay River, which means that the potential for seepage site development is also high. The low-lying farms and benches throughout the floodplain are at a greater risk for the development of seepage from both rivers. When new sites are found, they are entered into a GIS database and added to the monitoring schedule.

In 2017, there were 34 sites monitored within Wasa/Ta Ta Creek/Skookumchuck. Likely due to the higher-than-normal regional river levels, many of the original sites melded together. Additionally, the Thunderhoof Ranch culvert was removed in 2017, which added to the amalgamation of previous independent sites. Boundaries for mosquito development sites depend on either property ownership, the timing in which the area becomes active, or obvious habitat delineations.

To address early-season mosquito larval hatching, weekly monitoring began in early May. Monitoring increases to twice a week when regional ambient temperatures increase markedly and Kootenay River levels rose. Frequent monitoring takes place until seepage sites and higher-elevation foreshore sites become dry. Certain sites are monitored more frequently than others due to their propensity to either produce mosquitoes quickly (e.g. sites that are shallow will typically produce mosquito larvae earlier) or because field staff need to monitor on a shorter schedule as they become familiar with the mosquito productivity potential of a site. Monitoring typically decreases to once weekly in July, unless there is a significant precipitation event, in which case monitoring continues.

During each site visit, larval counts are made and the larval composition is distinguished between early instar (1<sup>st</sup> and 2<sup>nd</sup>) and late instar (3<sup>rd</sup> and 4<sup>th</sup>). Also at each visit, notes are made regarding pupal and adult mosquito counts, which aid in determining whether a treatment has been missed at a site. MBL treatment protocol dictates that field technicians target the late 3<sup>rd</sup> instar and early 4<sup>th</sup> instar stages to leave more biomass in the water for predators who depend on larvae as a food source. Appendix I is a map showing the relative abundance of mosquito larvae throughout the Wasa/Ta Ta Creek/Skookumchuck program area.

## Larval Treatment

### Larvicide Information

Mosquitoes in the larval phase are treated with Aquabac®. Aquabac® is considered a microbial larvicide, meaning that the active ingredient is a bacterium. In this case, the bacterium, *Bacillus thuringiensis* var. *israelensis* (Bti), is soil-borne. The mode of action for has a high degree of species specificity. Receptors within the mid-gut region of the mosquito larvae are specific to the toxin proteins that are produced alongside each bacterial spore. After the mosquito larvae ingest the toxin protein, disruption of the larval mid-gut cells occurs because of cleavage of the protoxins by mid-gut proteases. An osmotic imbalance across the mid-gut epithelial cell membranes occurs due to this binding, which causes considerable damage to the wall of the gut and quickly leads to larval death (Boisvert and Boisvert, 2000).

Due to the specificity of the mosquito larval midgut receptors to the Bti endotoxins, Bti is a relatively safe treatment option when considering non-target effects potential. Besides mosquitoes, Bti also effects black fly larvae. A commonly voiced concern is whether Bti has effects on salmonids. There is a large body of evidence that suggests Bti does not directly affect salmonids. Numerous studies have demonstrated the general safety of exposing fish to Bti (Brown et al. 1998, Brown et al. 2002, Brown et al. 2004). Therefore, amounts of Bti applied in field treatments are highly unlikely to cause direct hazard to juvenile salmonids.

### Ground (Hand/Blower) Treatment Summary

Whenever possible, MBL field technicians conduct ground treatments. Early in the mosquito season, field staff access sites by foot. In addition to reducing the environmental impact of field activities, ground treatments allow for the identification of new sites and access points to sites that are commonly shrouded by canopy-cover when conducting all activities by air.

Monitoring mosquito development sites began in early May. All sites with larval densities with a moderate or greater abundance rating were treated with Aquabac®, if larvae were in the 3<sup>rd</sup> and/or 4<sup>th</sup> instar stage. In 2017, MBL field technicians applied approximately 719 kg of Aquabac® by ground (i.e. hand/blower), at a rate between 5 - 6 kg/ha in the Wasa/Ta Ta Creek/Skookumchuck area. Thus, approximately 126 ha, in total, were treated by ground, with all the ground treatments occurring in May and June (Figure 4). Appendix II shows the area and frequency of ground and aerial treatments for Wasa/Ta Ta Creek/Skookumchuck in 2017.

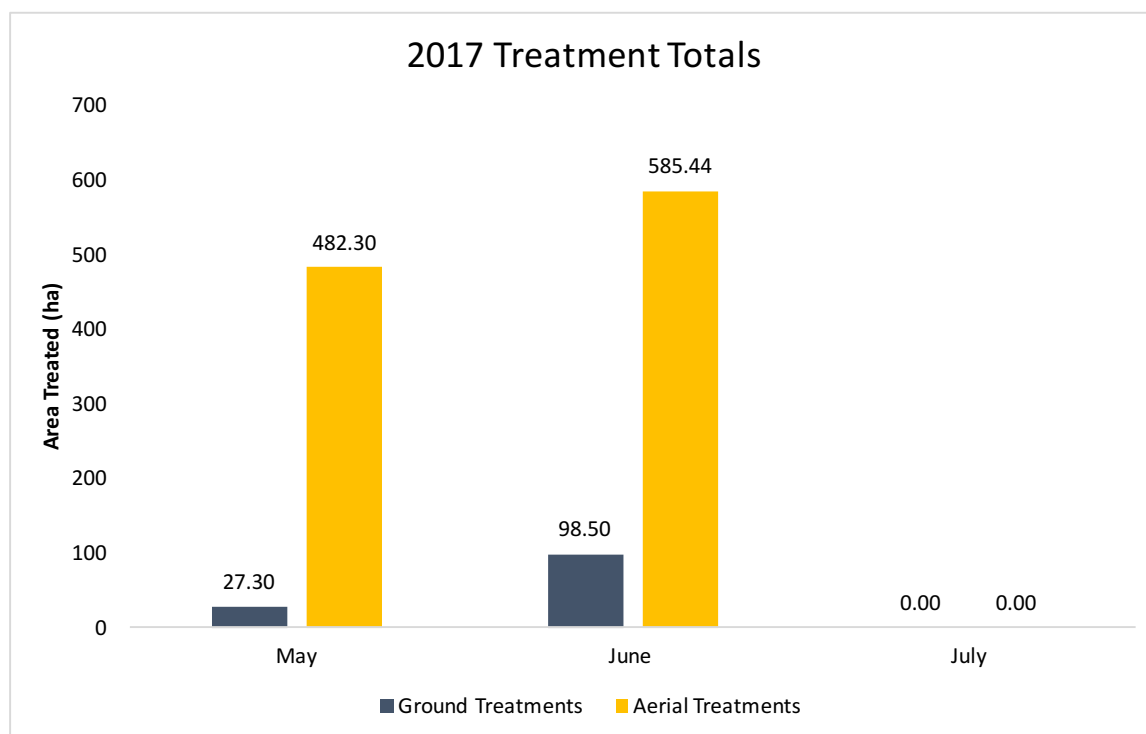
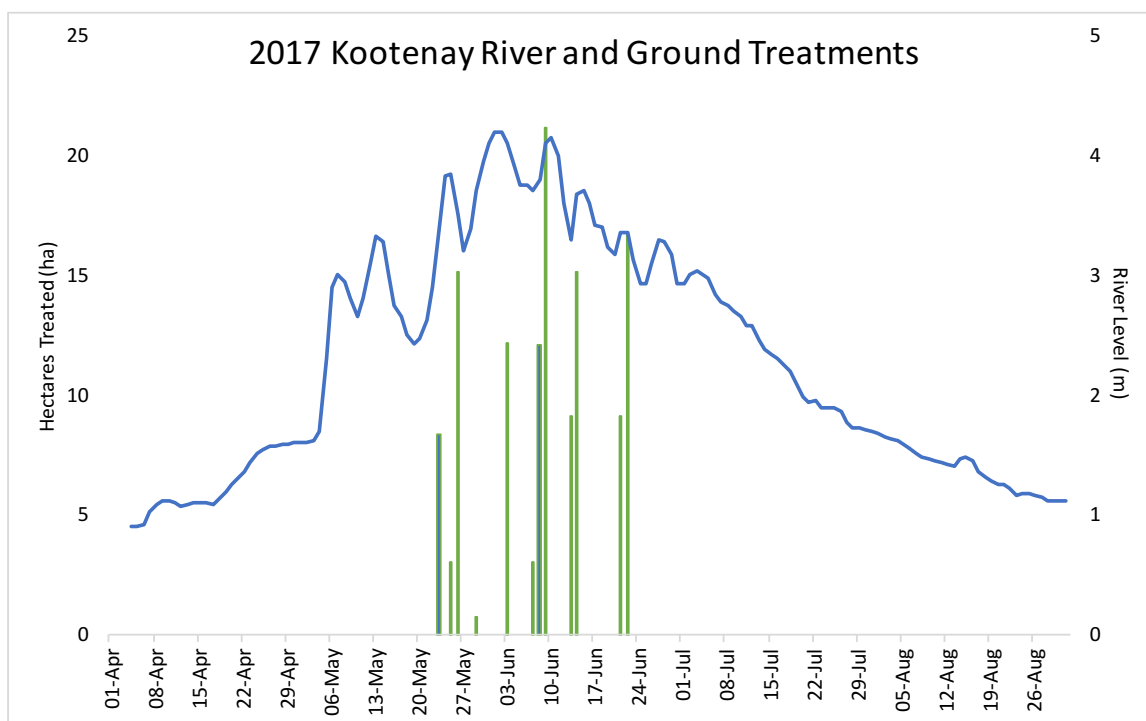


Figure 4. Wasa/Ta Ta Creek/Skookumchuck ground and aerial treatments (ha) from April – July.

Ground treatments at snowmelt mosquito development sites started on 23 May (Figure 5). Ground treatments focused on the Kootenay River foreshore mosquito development sites and started, in earnest, immediately following the first spikes in river levels (Figure 5). Despite the high water, certain foreshore sites were accessible throughout the mosquito season. After mid-June, ground treatments began to taper off after local Kootenay River levels were consistently receding; the final ground treatment took place on 22 June (Figure 5).



**Figure 5. Ground (hand/blower) treatments (ha) with respect to the daily peak of the Kootenay River at Fort Steele (08NG065) for the 2017 mosquito season.**

Peak regional river levels required a shift toward aerial treatments due to drastically increased and concurrent mosquito development site productivity. An increase in both ground and aerial treatments occurred in 2017 due to the higher-than-normal regional river levels and a compounded number of mosquito eggs that hatched in 2017 (Figure 5). Appendix III provides more specific information about site, treatment timing, and the extent of treatment.

## Aerial Treatments

Aerial treatments are necessary whenever access to mosquito development sites is not possible by foot, when there is a significant amount of mosquito larval activity, and when larval development is occurring too quickly to treat all sites by ground. Thus, the total number of aerial treatments conducted within a given year is dependent upon the amount of water moving through or adding to the system and the larval mosquito development rate.

In 2017, MBL field technicians applied a total of approximately 6,406 kg. Aerial treatments were applied at a rate of about 6 kg/ha, thus, the total area treated by helicopter was approximately 1,068 ha (Figures 4, 6; Appendix II). This amount is considerably more than that treated in recent years, due to the considerably high water table and water input. Despite the large amount of Bti applied, additional applications would have been useful to further reduce adult mosquito annoyance. High water was experienced throughout

much of BC and Canada. As a result, there was a nation-wide shortage of Aquabac® and insufficient product for the Wasa/Ta Ta Creek/Skookumchuck program. To avoid this challenge in the future, MBL has acquired a large warehouse for surplus Aquabac® inventory. Additionally, the RDEK will pre-purchase more Aquabac® than in previous seasons.

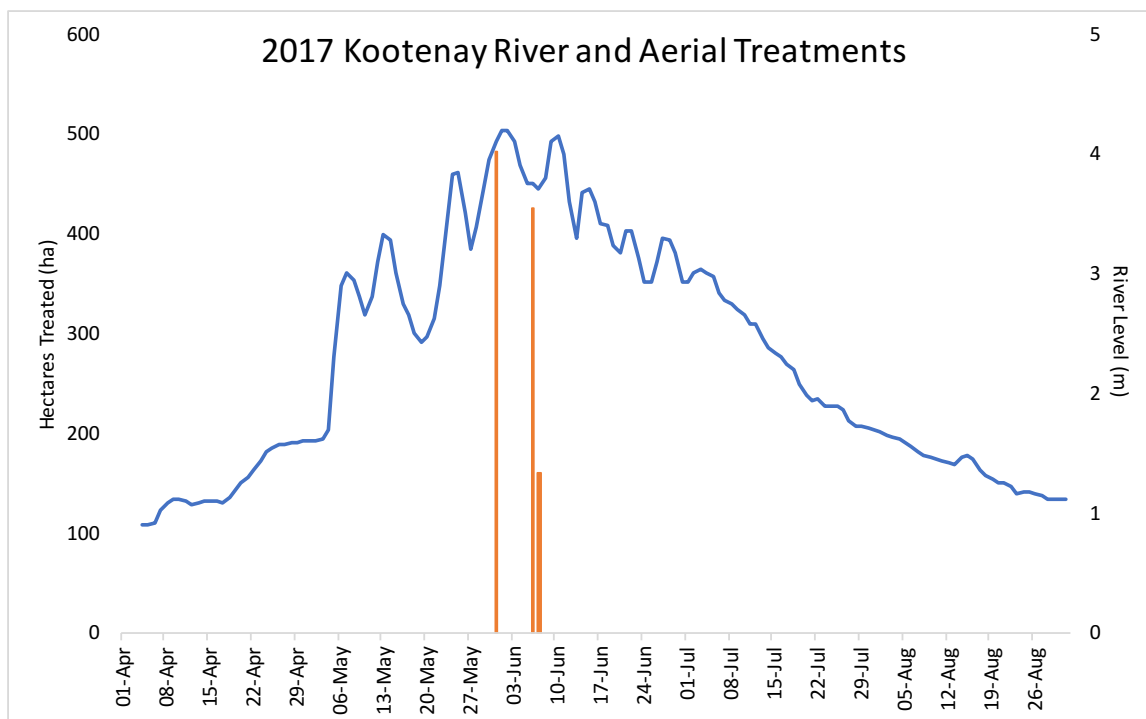


Figure 6. Aerial treatments (ha) with respect to the daily peak of the Kootenay River at Fort Steele (08NG065) for the 2017 mosquito season.

The Wasa/Ta Ta Creek/Skookumchuck aerals were conducted on 31 May, and on 6, 7 June (Figure 6). The three aerial events were necessary due to the rise in the Kootenay River. Post-treatment monitoring revealed high control rates. Appendix II provides more specific information about treatments.

## Public Engagement

Direct communication between MBL staff and the public can occur in many circumstances. The most common direct interfacing with the public occurs when technicians are in the field. MBL technicians, while conducting site visits, are often asked questions by landowners or nearby residents. These encounters provide an excellent opportunity for public relations. The fact that technicians are visibly monitoring and treating lets residents know that attention is being given to mosquito abatement efforts.

An important outcome of these interactions can be the identification of new sites and larval mosquito activity by involved residents.

MBL contact information is disseminated when field technicians have direct communication with the public. Contact information for MBL includes an email, phone number, and social media sites (Twitter, Facebook). Another resource for public queries is the new MBL website ([morrowbioscience.com](http://morrowbioscience.com)). By providing the public with these resources and avenues of communication, it enables community members to follow-up with questions.

MBL staff was invited to present to a town hall meeting at the Wasa Community Hall on 27 June. Staff shared information pertaining specifically to the mosquito abatement program, addressed frequently asked questions about Aquabac®, and addressed the reasons for insufficient amount of Aquabac®. The mid-season summary presentation was well-attended, with high resident participation during the Q&A portion. Future seasons may include having a booth at a local Farmer's Market event.

### Hotline Calls and Emails

Maintaining positive public relations remains a high priority for MBL. Public relations occur on several levels: in-person communication with members of the public, returning calls made to the mosquito hotline, presenting program data to staff and politicians, responding to e-mails, and continuing our social media presence. MBL remains committed to look for new areas to expand this aspect of our program and to improve our communication techniques.

A total of three calls were received by the regional field manager in 2017. All calls were considered complaint calls, where residents stated that adult mosquito abundance was high in their area. All calls were received approximately two weeks post-regional Kootenay River peak, which is consistent with the expected adult mosquito dispersal timeframe following peak flows. Calls were returned promptly, within 24 hours. No emails were received.

In addition to the calls received, field technicians regularly encountered residents during monitoring/treating. Residents would commonly inquire about what the outlook was for the mosquito season and whether their properties were slated for monitoring again. Field technicians also provide residents with information about how to reduce mosquito development sites on their own property and about personal protection measures against adult mosquitoes.

### Social Media

This year, 2017, is the 6<sup>th</sup> consecutive year in which MBL had a social media presence online. There are five main goals for MBL's social media presence: 1) provide timely and

up-to-date information regarding conditions pertinent to mosquito production, 2) relay MBL's current efforts to control mosquitoes, 3) inform the public about MBL's efforts at social sustainability, 4) provide the community with opportunities to get involved with related public events, and 5) offer a platform for mosquito-related discussion amongst involved citizens and the MBL team.

Facebook ([facebook.com/morrowmosquito](https://facebook.com/morrowmosquito)) remains the primary avenue for MBL to disseminate mosquito-related information. Regular updates on mosquito abundance began in early April noting the kick-off of the freshet around British Columbia. In addition to field updates, post topics also included volunteer, outreach efforts conducted by MBL staff members (i.e. Farmer's Market booths). Whenever possible, photos of staff working within the Wasa/Ta Ta Creek/Skookumchuck vicinity were also posted.

The total number of followers on the MBL Facebook page is currently 182. This number has increased by 104 since the end of MBL's first season on Facebook (2012). Another way to gauge how many people are looking at or responding to MBL's posts is by considering MBL's post "reach". Specifically, each time a follower interacts with the MBL page a subset of their "friends" is exposed to the information that the original follower commented on or "liked". In this way, the maximum reach was 1,004 on June 26, 27 and included a re-post of an article from a different regional district website entitled 'Mosquito Control Continues Throughout the Region'. This is the highest reach recorded on MBL's Facebook page and it encourages the future dissemination of local mosquito control articles from the RDEK or other regional districts on this site.

Another aspect to MBL's social media outreach strategy is the use of Twitter (@morrowmosquito). Utilizing Twitter allows the opportunity for community members to follow, in real-time, our activities and updates relating to mosquito control issues. An average of one "tweet" a week is sent out throughout the mosquito season. Some of these "tweets" were forwarded from other sources if those messages were mosquito-related.

To date, the maximum number of followers on Twitter is 137. This is an increase of 49 followers from 2014. Part of the reason for the increase in followers is the link between the Twitter account and the Facebook account. Each time a "tweet" was sent out via Twitter, it was also posted to the Facebook page. This way the Twitter feeds reached as many people per day as did the Facebook posts. Twitter and Facebook accounts are also linked to the new Morrow BioScience website, enabling visitors to easily connect with each account. Notable Twitter followers include local municipalities and media.

### MBL Website

The MBL website ([www.morrowbioscience.com](http://www.morrowbioscience.com)) was launched on March 26, 2015. This site was developed to allow clients and the public to have access to information about

MBL's background, activities, outreach, and staff members. The website is continually being refined as MBL further develops our programs.

Currently, the site contains information about MBL's philosophy, staff background, and current projects. The site outlines MBL's services and relevant news, including a blog updated throughout the mosquito season. Of importance is the 'Contact' tab which allows a person to directly send a message to MBL. Additionally, there are links to MBL's Facebook account and Twitter feed, so interested individuals may have real-time updates on MBL's activities.

## Future Work

Future work within the Wasa/Ta Ta Creek/Skookumchuck areas will continue to include reconnaissance efforts for new sites. Additionally, MBL would like to continue the current community engagement strategy by visiting a Farmer's Market event in 2018. The 2018 Farmer's Market event should target earlier times of the mosquito season (ca. May) to better equip residents with pro-active mosquito control efforts around their properties.

MBL will continue to improve the recently launched real-time online data collection and management portal. It has aided in improved management of the program and allowed for real-time data summaries. Capabilities to be added may include georeferenced flight paths for aerial treatments and aerial footage of treatments.

MBL provides each of our programs with the best floodwater mosquito control possible. Within that commitment is the focus on consistent communication and to continually pursuing areas in which to improve. Improving MBL's visibility and direct accountability to program residents is a goal for 2018.

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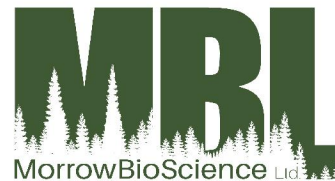
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# 2017 Mosquito Larval Densities at Sample Locations



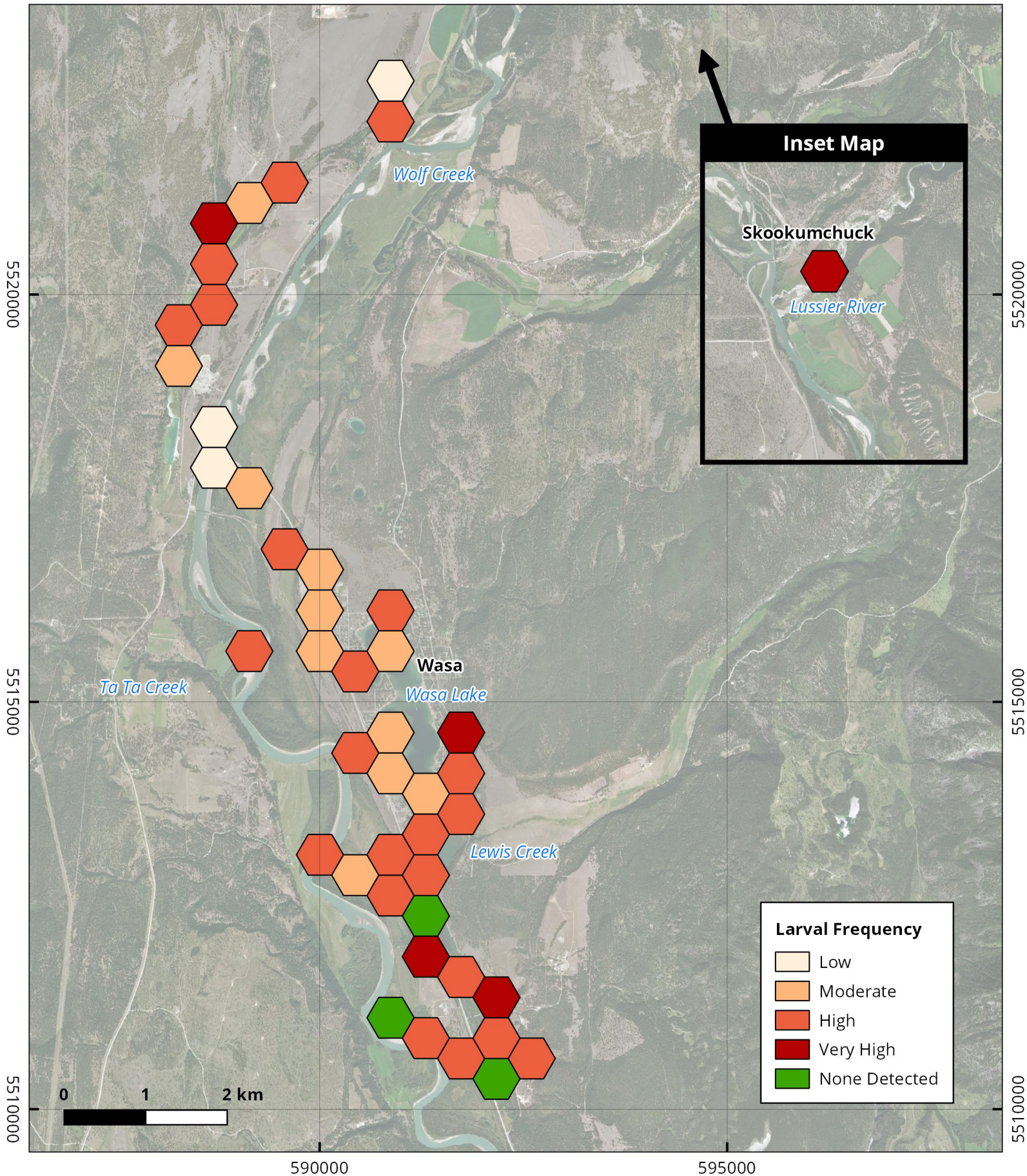
**Morrow BioScience Ltd**

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## Appendix I

Scale = 1 : 60,000 CRS = NAD83 UTM Zone 11N  
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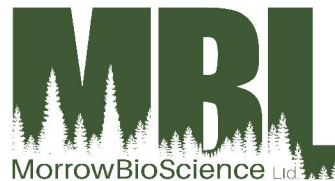


# 2017 Mosquito Larvicide Treatment Locations



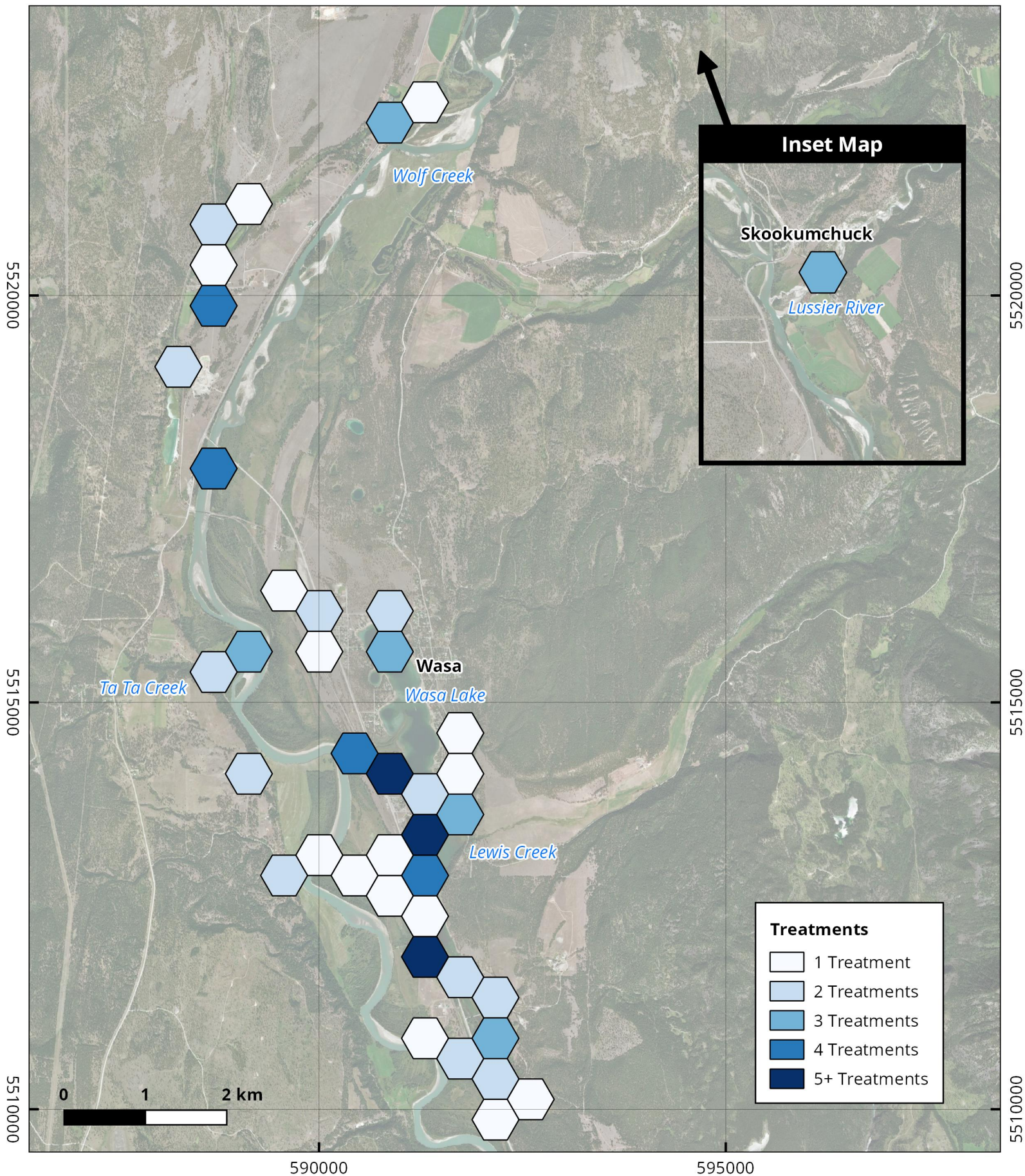
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## Appendix II

Scale = 1 : 60,000 CRS = NAD83 UTM Zone 11N  
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**Appendix III. 2017 treatment data (kg, ha) by site and date for all ground (A) and aerial (B) treatments.**

**A. Ground Treatments**

Date	Site	Treatment Amount (Kg)	Treatment Area (Ha)
5/23/2017	RDEK-006	36.40	6.07
5/23/2017	RDEK-015	4.55	0.76
5/23/2017	RDEK-018	4.55	0.76
5/23/2017	RDEK-058	4.55	0.76
5/25/2017	RDEK-044	18.20	3.03
5/26/2017	RDEK-005	36.40	6.07
5/26/2017	RDEK-050	54.60	9.10
5/29/2017	RDEK-018	4.55	0.76
6/3/2017	RDEK-021	4.55	0.76
6/3/2017	RDEK-022	18.20	3.03
6/3/2017	RDEK-025	4.55	0.76
6/3/2017	RDEK-026	9.10	1.52
6/3/2017	RDEK-027	36.40	6.07
6/7/2017	RDEK-003	18.20	3.03
6/8/2017	RDEK-042	72.60	12.10
6/9/2017	RDEK-050	90.80	21.18
6/13/2017	RDEK-043	9.10	1.52
6/13/2017	RDEK-047	27.30	4.55
6/13/2017	RDEK-062	18.20	3.03
6/14/2017	RDEK-019	27.30	4.55
6/14/2017	RDEK-025	18.20	3.03
6/14/2017	RDEK-027	27.30	4.55
6/14/2017	RDEK-045	18.20	3.03
6/20/2017	Unknown	4.55	0.76
6/20/2017	RDEK-019	27.30	4.55
6/20/2017	RDEK-021	4.55	0.76
6/20/2017	RDEK-022	18.20	3.03
6/21/2017	RDEK-020	4.55	0.76
6/21/2017	RDEK-024	27.30	4.55
6/21/2017	RDEK-027	18.20	3.03
6/21/2017	RDEK-042	18.20	3.03
6/21/2017	RDEK-043	22.75	3.79
6/21/2017	RDEK-045	9.10	1.52

**B. Aerial Treatments**

<b>Date</b>	<b>Site</b>	<b>Treatment Amount (Kg)</b>	<b>Treatment Area (Ha)</b>
05/31/2017	Program Area	2893.80	482.30
06/06/2017	Program Area	2548.00	424.67
06/07/2017	Program Area	964.60	160.77