

ADULT MOSQUITO CONTROL and DOMESTIC HONEYBEES

Standard Operating Procedures – Background and Rationale

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developed by

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Delaware Division of Fish and Wildlife

Delaware Dept. of Natural Resources and Environmental Control

in consultation with

Delaware State Apiarist

Delaware Plant Industries Section

Delaware Dept. of Agriculture

- **Preface.** The purpose of this document is to reflect operational arrangements and understandings among the Delaware Mosquito Control Section (MCS) [Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Fish and Wildlife], the Delaware State Apiarist [Delaware Department of Agriculture (DDA), Plant Industries Section], and DDA-registered beekeepers for protection of domestic honeybees from possible adverse effects potentially associated with exposures of honeybees to mosquito control adulticides. These Standard Operating Procedures (SOPs) represent an updating in April, 2015 of arrangements and understandings dating from November, 2003, in that not surprisingly with passage of time new developments and conditions have arisen warranting document revisions, and with some minor revisions further made in October, 2016.

The MCS wants and needs to perform its needed spray operations, which the MCS undertakes for the public's health, safety and welfare, in manner that will not jeopardize the viability of valuable beekeeping activities and all the associated environmental and economic benefits that honeybees provide; and in turn in pursuit of honeybee protection, the DDA and DDA-registered beekeepers realize the need to collaborate and cooperate with the MCS in manner that will still allow for timely, effective mosquito control important for the public's safety, health and well-being in fulfilling our statutory mandate.

- **Employing an Integrated Pest Management (IPM) approach.** Mosquito control professionals associated with most all major mosquito control programs around the country, such as those working for the Delaware Mosquito Control Section, universally practice Integrated Pest Management (IPM) in tackling the control challenges at hand.

In taking an IPM approach, there usually is a preference where possible and practicable to first employ non-insecticidal, source reduction measures for larval mosquito control, involving things like practicing good water sanitation, manipulating

or managing marsh or wetland water levels, or stocking larvivorous fishes and other mosquito larvae predators. Wherever such source reduction control measures are not possible, practicable or efficacious, it's then often necessary to use chemical or biological larvicides, with most modern larvicide products now having a biorational basis. The aquatic areas to be treated for larval control are usually much more localized than spraying large expanses of wetlands or uplands with adulticides, and insecticide exposures to humans or non-target organisms are also reduced when larviciding. The MCS performs larvicide spraying using products such as Bti, methoprene, spinosad or monomolecular surface films. Larvicide spraying for mosquito control does not have potential for conflicts with beekeeping activities, since larvicides are applied with very little spray drift to water primarily in marshes or wet woodlands, and unlike adulticides are not intended for aerosol treatments of the air column.

Unfortunately in the real world, and not infrequently in many locations, for various reasons the use of source reduction measures and/or larvicides still isn't enough to achieve the level of mosquito control that the public needs, expects and demands, and upon which their good health depends. This can be particularly problematic with some freshwater or inland mosquitoes, or for some peri-domestic mosquitoes. This can then lead to judicious use of adulticides as a third and usually last category or option for control, in the MCS somehow having to deal with adult mosquitoes that couldn't be satisfactorily controlled in their immature aquatic stages.

In practicing IPM, the MCS has an overall goal of trying to limit our use of adulticides only to whatever is truly needed, after our at least first considering possible source reduction methods or use of larvicides as control alternatives; and in many situations, our actually first trying to make best use of source reduction measures and/or larvicide applications. But for any given situation, matters of control effectiveness and practicability for treatment also come into play, often coupled with a pressing need to quickly take control actions whenever numbers of adult mosquitoes on-wing might become intolerable, thereby calling for some judicious adulticide use.

Adulticiding and adulticide products. For control of *adult* mosquitoes when needed, particularly for freshwater or inland mosquitoes or for peri-domestic mosquitoes that couldn't be satisfactorily controlled in their aquatic immature stages, adulticide use becomes necessary. The MCS currently uses an organophosphate, naled (Trumpet EC), as its primary adulticide for aerial applications by fixed-wing aircraft (and an oil-based version of naled in manner of Dibrom might also be used). Because of spray equipment application issues, naled is not used by the MCS for ground adulticiding. Effective swath widths when aerially adulticiding with naled are from 500-1000 feet wide, and downwind spray drift can occur beyond that for a few thousand feet. Such spray drift is required for effective aerial treatments.

The synthetic pyrethroid sumithrin, with piperonyl butoxide (PBO) as a synergist (e.g. Anvil 10+10), is currently the MCS's primary adulticide for ground applications using truck-mounted sprayers ("foggers"). Sumithrin (and other synthetic pyrethroids

or pyrethrin-based products) can have mosquito control efficacy problems when aerially applied, so for effective aerial control the MCS has a strong preference for using naled. Effective swath width for ground adulticiding is about 300 feet wide, and downwind spray drift can occur beyond that for a few hundred feet. Such spray drift is needed for effective ground treatments.

Other adulticide products might be used in the future for either aerial or ground applications, as possibly deemed desirable and determined by MCS (e.g. possibly etofenprox in manner of Zenivex, or a combination of sumithrin + prallethrin in manner of Duet, or maybe deltamethrin in manner of DeltaGard), and their use and application would still adhere to what's described herein. The MCS is always on the lookout for new adulticides that might have more control efficacy or less non-target impacts.

Please note that adulticiding done by ground via truck-mounted sprayers or “foggers,” no matter what insecticide is used, is *not* in comparison to aerial adulticiding a very efficacious or cost-effective method to try to control mosquitoes *over widespread areas for longer periods of time lasting from several days to a few weeks*. Aerial adulticiding by fixed-wing aircraft or helicopter over widespread areas is often a much more efficacious, practicable application method allowing longer-term relief; and whenever this is done, an insecticide product yielding good control efficacy such as naled is the preferred product to use. Nonetheless, ground spraying with synthetic pyrethroids such as sumithrin can provide effective short-term control in localized areas needing quick relief, such as in cities, towns or subdivisions, or for isolated individual rural properties, or immediately around farm building complexes. As such, ground adulticiding is an important component of the MCS's control toolbox, especially when wide-area control is not warranted or needed, and in comparison to aerial adulticiding the costs are typically lower.

- **Times for adulticiding.** Because of mosquito behavior and typical wind or atmospheric conditions, along with spray application safety factors, almost all mosquito control aerial adulticiding occurs within 2 hours after sunrise or within 2 hours before sunset. This is consistent with EPA's product label recommendation for naled's use not to apply this product earlier than 2 hours before sunset or later than 2 hours after sunrise, in part suggested by EPA to help protect bees from adulticide exposures, since EPA apparently feels that during such times most or many honeybees are either back in their hives or not foraging far away. But in an abundance of caution to help protect bees even further, whenever practicable we try not to make our aerial adulticide applications any later than about one hour after sunrise or any earlier than about one hour before sunset. Ground adulticiding occurs too during these crepuscular periods, but can also be done throughout the night. For safety reasons, MCS does not conduct nighttime aerial adulticiding. Fortunately, the principal times for routine mosquito control adulticiding, whether done aerially or on the ground, helps to reduce most all potential conflicts with beekeeping activities, occurring at times when most or many honeybees have returned to their hives, or are not very actively foraging or far away from their hives. As operational experience has

now demonstrated over a period of many years, the MCS's application of adulticides when done in accordance with these SOPs has caused very few problems for domestic honeybees.

Regardless of what adulticide products are used, or how, when or where they are applied, all adulticide spraying will occur in manner that would not within reason be expected to adversely affect known honeybee hive or foraging locations where bees are active (which in some situations to be described later in this document might first call for beekeepers to voluntarily and cooperatively move or otherwise protect their honeybee colonies before any spraying would be done by the MCS). Limiting as much as possible aerial applications of naled to late evening or early morning time periods described above should substantially avoid adverse impacts to honeybees, with the use of sumithrin or any other synthetic pyrethroids for ground-adulticiding during these same hours or throughout the night similarly helping to avoid any adverse impacts.

- **Identification of beekeeping locations -- Delaware BeeCheck.** Registration or posting by beekeepers of known beehive or identified important foraging locations can now be done via the DDA's new BeeCheck system (that's part of the DDA's DriftWatch program that was started in February, 2014), which the MCS might then also consider in advisory fashion to help plan or conduct the MCS's aerial or ground adulticide treatments. BeeCheck registration is voluntary in nature, and is intended for beekeeping operations whether commercial in scale or purpose or more "hobbyist" in nature, intended for possible awareness by myriad pesticide applicators. Delaware BeeCheck can be accessed on-line at <http://dda.delaware.gov/pesticides/Driftwatch.shtml>. However, mere registrations or postings in BeeCheck would not obviate or negate the need for beekeepers to still communicate their concerns to the MCS in timely manner regarding possible adulticide exposures, to be done in accordance with the other protocols in this document.
- **"No-spray Zones" for beekeeping?** It should also be noted that the MCS's "No-spray Zone" feature (as described in the Delaware Mosquito Control Spray Policy available on-line at <http://de.gov/mosquitospraypolicy>, and more specifically at <http://www.dnrec.delaware.gov/fw/mosquito/Pages/MC-No-Spray-Request.aspx>), applies only to individuals who might have and can demonstrate *significant human health risks or medical problems* resulting from mosquitocide exposures, including their providing evidence or documentation of such from a physician. Possible use and establishment of "No-spray Zones" does *not* apply to non-human health purposes or concerns such as domestic honeybee-keeping, or producing organically-grown crops or gardens, or dealing with endangered, threatened or other wildlife species of special concern. In regard to beekeeping, the protocols and SOPs contained in this document are designed to help protect honeybees from any adverse impacts from mosquito control adulticiding, and serve in lieu of any program involving No-spray Zones for bees. Trying to formally do the latter relative to beekeeping would create

too many operational problems and costs for the MCS, and also in many situations would not be in the public's overall best interest.

- **Advance public notice for adulticide spraying.** The MCS publicly announces in advance each planned spray event, whether for an air or ground spray, giving as much advance public notice as possible, typically from 2-24 hours before a planned spraying. The timing for preparing and releasing a public Spray Announcement depends upon when field inspection reports from many locations first become available during a workday (perhaps involving larval dip counts, or adult light trap counts and/or landing rate counts); upon findings for arbovirus indicators whenever they are reported; upon numbers and locations of public complaints that are reported daily; and upon predicted short-term weather conditions -- all of these parameters can then elicit the need for quick treatment responses. The spray announcements give information about the general location(s) where spraying will be done, when and how the spraying will occur, and what product(s) will be used.

A recorded spray announcement is put on the MCS's toll-free phone line ("hotline") that the public can access at 1-800-338-8181, with any new updates usually available by mid- to late afternoon. The spray announcement is also simultaneously posted on the MCS's website, available to anyone with Internet access, at <http://de.gov/mosquitospraycalendar>. DDA-registered beekeepers are encouraged to monitor the MCS's daily spray announcements.

On a daily basis, the MCS also sends (via e-mail) to about a dozen local radio stations its request to have public service spray announcements made in timely manner (upstate stations include WJBR, WDSD, WDEL, WRDX, and WILM; downstate stations include WAFL, WDOV, WGMD, WOSC, WSCI, and WZBH). But then as to whether any radio station will run these as Public Service Announcements (PSAs) is completely up to the stations. Advance spray notice is also simultaneously sent by e-mail via the Delaware Notification Service to the DDA (to both the Pesticide Compliance Section and the State Apiarist) and to other government agencies.

It must also be kept in mind that up until about 15 minutes before the time that a spraying has been announced to start, the spray event could readily be postponed or cancelled due to locally unfavorable weather or wind conditions (which is a reason that the MCS does not like to provide spray notice too far in advance).

- **New Spray Zone Notification System (SZNS).** In addition to the advance spray notification measures described above, beginning in 2015 Mosquito Control implemented a new Spray Zone Notification System (SZNS). This system is used to convey to the general public where and when *aerial* spraying (for adulticides or larvicides) and *ground* spraying (for adulticides applied by truck-mounted sprayers) is planned. To accomplish this, Mosquito Control has partitioned the state into numerical spray zones which are geographic blocks roughly 4.3 miles x 3.4 miles in dimension, or about 14.6 square miles in size (essentially about one-quarter of a USGS 7.5-minute quad map), and via an interactive process these spray zones can be

further queried. The SZNS consists of two key components. First, an integrative, on-line statewide map assists the public in identifying their particular zones of interest. Additionally, this statewide map is updated on a daily basis to display those zones where mosquito control spraying is planned for that day. Second, for good communication purposes, the SZNS integrates with the Delaware Notification Service (DNS) application in order to then broadcast or disseminate via e-mails, text messages or phone calls when spray activity is scheduled for or within a particular zone (the preferred mode or modes for being thus informed is selected by the SZNS subscriber). The goal of the SZNS is to provide a tool where the public can identify in advance their spray zone(s) of interest, and then be quickly notified when spray activity is planned within that zone(s). Individuals interested in signing up for this service or viewing the map can do so by visiting <http://de.gov/mosquitospray>.

The MCS hopes and urges that DDA-registered beekeepers will subscribe to the SZNS, since this will be the timeliest, most detailed way for beekeepers to know when and where mosquito control adulticiding is scheduled to occur. The SZNS now supplants the need for what used to be a special spray code system just for beekeepers, which was based upon a statewide coded spray block system for which beekeepers were provided by DDA with a copy of the statewide coded spray block map, and for which our daily spray announcements for the awareness and benefit of beekeepers used to contain the numbers (codes) for those specific spray blocks to be treated on any given day. Subscribing to the new SZNS can then eliminate the need for beekeepers to have to listen to a recorded daily spray announcements, or to hear about such on the radio, or to look for such on MCS's website.

It will be incumbent upon those beekeepers who have concerns about mosquito control adulticiding to take personal responsibility and initiative for ensuring their awareness about the "when and where" for any planned mosquito control spray operations, using any-or-all of the various awareness avenues and communication protocols that the MCS has developed and implemented as described above. Because of when daily spray announcements are typically prepared and announced or posted for the current and/or following day, which in large measure is driven by when it's first possible based upon our monitoring efforts of mosquito populations in the field to determine if any adulticiding is needed, and then for when it has to be done or is best to be done in consideration of multiple application factors, it is recommended that for any 24-hour period of interest all such inquiries be made after 2:00 pm, and for which any daily spray announcement should in most cases be made or posted by the MCS by no later than 4:00 pm.

- **Requests from DDA-registered beekeepers to delay spraying in order to move or protect bees.** If upon becoming aware that mosquito control adulticiding is about to occur in an area (in an identified spray zone) where a DDA-registered beekeeper has concerns about spray exposures to his/her bees, the beekeeper should quickly call the MCS at 302-836-2555 (MCS's upstate field office in Glasgow) for New Castle County and the northern half of Kent County, including from Dover north; and at 302-422-1512 (MCS's downstate field office in Milford) for southern Kent County

south of Dover and for all of Sussex County, to then inform the MCS of such concerns. If possible, such calls should be made before 4:00 pm on the day when concerns arise, since many daily spray announcements can call for an evening aerial or ground spray the same day, or an aerial or ground spray early the next morning. In event that a beekeeper cannot make a timely call or reach the Mosquito Control Section during the State's normal working hours (8:00 am-4:30 pm), then after-hours calls can be made to DNREC's 24-hour line at 1-800-523-3336 or 1-302-739-4357. However, there is some risk that an after-hours message might not get through to Mosquito Control personnel in time prior to their starting to spray, so it will always be better to directly contact Mosquito Control during normal State working hours, and for this particular matter before 4:00 pm if possible. *Upon receipt of such calls from beekeepers, the MCS will quickly internally review the situation, and then interact and coordinate with the beekeepers and perhaps try to postpone spraying for up to 24 hours, in order to allow time for beekeepers to move or otherwise protect their bees, or alternatively for the MCS to possibly take other actions as described below.*

- **Response from the MCS to beekeepers' concerns.** In responding to a beekeeper's concerns about possible mosquito control aerial or ground adulticiding conflicts within an announced "spray zone" block, the MCS will evaluate where the specific area of beekeeping concern is actually located in relation to the needed adulticiding, based upon information that the beekeeper provides when he/she phones in to request a delay in aerial spraying. The MCS might then choose or enact one of three responses:

1) Possibly determine that no overlap exists between areas to be aerially or ground adulticided for mosquito control purposes vs. an area having beekeeping concerns. The specific areas needing mosquito control aerial adulticiding within a "spray zone" block, or for ground adulticiding within a block, might not overlap with any area(s) having concerns for honeybee safety. In many cases given site-specific distance factors and local settings, it might still be possible to spray those areas needing mosquito control treatment within a spray zone, done without posing any unacceptable risks to honeybees in the spray zone. It might be possible on a case-by-case basis to design or redirect planned aerial spray swaths or ground "fog routes" in order to eliminate or reduce any concerns for honeybee impacts. *But all of this depends upon beekeepers communicating as needed to the MCS in timely manner on a case-by-case basis any concerns they might have relative to planned and announced mosquito control adulticiding.*

2) Simply not aerially or ground adulticide for mosquito control purposes in an area having beekeeping concerns. Depending upon the type, extent, severity and specific locations of mosquito problems, then even if an area in a "spray zone" block has a mosquito problem warranting aerial adulticiding, or where some ground fogging is called for, it still might be possible to forgo such spraying on the MCS's part and at the MCS's discretion in a location where bee safety is a significant issue, as long as other nearby mosquito-problem areas can still be

treated, such that most of the local mosquito problems are still successfully addressed. This type of “no spray” determination will be solely made by the MCS, in consideration of what could then also be some detrimental local impacts for public health, safety, comfort, and well-being in perhaps not treating.

3) Delay or postpone aerial or ground spraying until bees can be moved or otherwise protected. Even if there are beekeeping issues at-hand for a given area, there will still be occasions when it’s very desirable or necessary to aerially or ground adulticide for mosquito control purposes. If the proposed mosquito control spraying is primarily to address intolerable quality-of-life (nuisance) problems, but which can nonetheless also regularly have human health implications and medical complications, it should be possible for the MCS to postpone spraying for 24 hours, in order to allow enough time for beekeepers to move or protect their bees. However, it will be desirable or sometimes necessary to treat mosquito problems earlier than this if arbovirus disease is also a potential or actual part of the problem at-hand. For example, the MCS might need to aerially or ground adulticide certain areas where beekeeping activities occur in order to reduce abundant populations of “bridge vector” mosquito species capable of transmitting West Nile Virus (WNV) or Eastern Equine Encephalitis (EEE), perhaps in response to a sentinel chicken that seroconverted for WNV or EEE; or in response to a presumed or confirmed equine case of WNV or EEE; or in reaction to a suspect or confirmed human case of WNV or EEE. Possible future need to do this to contend with chikungunya or Zika, which potentially are newly emerging mosquito-borne diseases in Delaware affecting people, could also prompt such need for adulticiding.

Depending upon the driving forces behind the need to perform adulticiding, the MCS will work with beekeepers and the DDA to the extent practicable in order to allow enough time for the beekeepers to move or otherwise protect their honeybees and hives. Once a beekeeper has taken actions to move or protect his/her honeybees, the MCS should be immediately informed by the beekeeper of such actions and status, so that the MCS can then proceed with any planned adulticiding.

- **If a beekeeper says that his/her bees cannot be moved or protected.** If the MCS needs to adulticide in an area where *for whatever reason(s)* a beekeeper says that his/her bee colonies cannot be moved or otherwise protected in timely manner, and as such the colonies will accordingly not be moved or protected, then such situations can become somewhat problematic to deal with.

Sometimes in such situations, the MCS will work directly with the beekeeper to determine a modified course of action. If a solution does not present itself, the MCS might then determine at its discretion not to treat at all, rather than jeopardize the viability of valuable honeybee colonies that for some reason(s) cannot be moved or otherwise protected by a beekeeper in timely manner. If elected officials, residents or other members of the public inquire of MCS as to why mosquito relief via

adulticiding cannot be delivered, the MCS will respond by informing inquiring parties about an intractable problem that a beekeeper might have in moving or protecting his/her colonies from adulticide exposures, and that the protection and maintenance of valuable beekeeping operations are important economic and environmental goals for the State. If this is not a satisfactory answer for any inquiring party as to why the MCS cannot or will not treat a local area for what might still be a pretty severe mosquito infestation and/or public health threat, the MCS will then refer them to the DDA's State Apiarist for additional information and explanation relative to beekeeping concerns. And then in trying to address what might still be the public's untended and pressing need for mosquito relief for the situation at hand, it might then become incumbent for the State Apiarist to directly work with the affected beekeeper to see whatever remedy might still be possible, with the State Apiarist taking the lead for what to do.

The need for the MCS to adulticide can be driven by several public health concerns, including human health problems and medical complications from people simply receiving too many mosquito bites per se without any disease or pathogen transmissions; from a specter for EEE or WNV transmissions to horses or humans, possibly indicated by findings of these viruses in the MCS's sentinel chickens, or in wild bird populations or mosquito collections; and from actual recent equine or human cases of EEE or WNV (and that now might also include possible chikungunya or Zika transmission to people). If any of these indicators point to potential or actual public health problems, the MCS will consult with the DDA's State Apiarist in resolving any potential conflicts involving beekeepers needing to quickly take actions to protect their honeybees from possible adulticiding impacts, such that the MCS can then protect horses or humans from contracting mosquito-borne diseases, and to allow for the MCS's protecting people from adverse health impacts and medical complications from simply receiving too many mosquito bites per se without any disease or pathogen transmissions.

It is anticipated that by selection of appropriate adulticides, and by carefully performing spray applications in regard to treatment locations or timing, that most such beekeeper conflicts can be resolved. If this is not possible, then to the extent practicable additional examination of somehow moving or protecting bee colonies might need to be explored, with the State Apiarist taking the lead for what to do. But if due to local situations and conditions the MCS determines that aerial or ground adulticiding must still occur even when beekeepers will not or cannot move to protect their beehives, and as such some spray damages to bee colonies might then occur as a corollary of the MCS needing to act to protect the public's health and well-being in fulfilling its statutory mandate, this unfortunately might then come to pass.

- **Need for good cooperation.** Working with the DDA's registered beekeepers and the DDA State Apiarist, the MCS will do all that it practicably can to help ensure that the honeybee colonies very important to the State's agriculture base and economy are not adversely affected by mosquito control adulticiding. But this effort also has to be balanced with the MCS's statutory mandate to protect the public's health, safety,

comfort and welfare from mosquito infestations and mosquito-borne medical complications or diseases. The MCS is quite sensitive not to perform spray operations that will jeopardize the viability of valuable beekeeping activities; and in turn the DDA's registered beekeepers and the DDA State Apiarist are quite sensitive to the need for their cooperation in accommodating effective mosquito control so important to the public's health, safety, comfort and well-being.

For more than a decade since these types of communication/response protocols have been in effect in Delaware, there seemingly have been no significant incidents regarding bee kills and mosquito control adulticiding. In large measure this seems to be due to the timing (within a 24-hour period) for when most all adulticide applications are made, the areas or locations where most spraying is done, and the types of products used by the MCS at ULV rates. Add to this prompt and effective communications coming from beekeepers to help alert the MCS in timely and site-specific manner about any bee exposure concerns relative to adulticide use, followed by the MCS then responding to such the best they can, then things have seemingly worked pretty well to date and hopefully will continue this way.

A concise 2-page set of Standard Operating Procedures of interest to beekeepers relative to mosquito control adulticiding can be found at www.dnrec.delaware.gov/fw/mosquito/Documents/MC-Honeybees-SOP-Oct-2016.pdf