Mosquito Surveillance and Control Protocol

Vector Surveillance Coordinators

Vector Surveillance Coordinators are State DPH employees working at the regional level. Although they will work closely with local and district environmental health specialists, they are supervised by the State Environmental health office. This position has primary responsibility to conduct and improve mosquito surveillance for arboviral diseases such as West Nile Virus, Eastern Equine Encephalitis, Lacrosse Encephalitis, Zika and other arboviral diseases. Duties will include establishing surveillance locations throughout the PH Districts, setting up traps and collecting mosquitos, mosquito identification, complaint response, community assessments, and community education programs. When necessary, this position will coordinate mosquito control activities with existing city/county/contracted mosquito control agencies and assist with localized control efforts. In addition, this position supports the EH Team by assisting with surveillance for other public health pests of concern, including agents of bioterrorism (BT), tickborne diseases, rabies, bedbugs, and participates in outbreak detection and response activities.

Mosquito Surveillance

Mosquito Surveillance is the routine monitoring of both larval and adult mosquito populations over the course of an entire mosquito season. Such mosquito surveillance is critical to a successful municipal or commercial mosquito control program for several reasons. These are:

1. Monitoring changes in mosquito populations

   Monitoring changes in mosquito populations is important because it allows mosquito control to track exactly where the larval and adult mosquito populations are rising or falling. These data, when compared to previous weeks or previous years, provides the knowledge needed to identify and predict perennial, sporadic, or new problem areas, as well as to predict possible increases in the risk of mosquito-borne diseases.

2. Identifying which mosquito species are present

   Identifying which mosquito species are present provides information that can be used to locate mosquito breeding habitats, determine the severity of a nuisance mosquito outbreak, and provide knowledge about what mosquito-borne diseases may be present in a given area. Different mosquito species often display different behaviors and may require different control measures due to variations in their life histories. Many mosquitoes have different breeding habitats, activity (biting) periods, host preferences and maybe most importantly, which diseases they can transmit.

3. Detecting mosquito-borne diseases

   Detecting mosquito-borne diseases is one of the most important reasons for implementing a comprehensive mosquito surveillance program. In most cases, the diseases that mosquitoes can transmit to humans and animals can be detected in the mosquitoes themselves, weeks before they can be passed on, which provides the opportunity to take all the appropriate control actions in order to reduce the risk of human disease transmission.

4. Determining what control measures need to be conducted

Source Reduction – Source reduction of larval environments can be an effective control measure and is an important component of an integrated approach. It can often be the most effective approach since you are eliminating breeding habitat. Dumping a birdbath, bucket, or kiddie pool that have larvae present, unclogging a rain gutter that is holding water, clearing a culvert so a ditch will flow more easily, and disposing of a tire pile are all examples of source reduction techniques. Although an important component, source reduction is not always feasible, particularly for certain habitats.

Larviciding – When source reduction is not feasible, it may be necessary to use larvicide to prevent the larval mosquitoes from hatching and becoming adults. Depending on the habitat and species, either biological or chemical control methods are options for controlling mosquito larvae.

Adulticiding – It is impossible to eliminate all breeding habitat or to control all mosquitoes before they become adults. Therefore, an important component of an Integrated Mosquito Management Program is the application of adulticides in an ultra-low-volume, thermal, or barrier spray application. Different species are active at different times of night and are susceptible to different adulticides, making your surveillance data extremely important for effective control of adult mosquitoes.

The most used indicators for vector surveillance are:

Larval surveys:

- House index (HI): percentage of houses infested with larvae and/or pupae.
- Container index (CI): percentage of water-holding containers infested with larvae or pupae.
- Breteau index (BI): number of positive containers per 100 houses inspected.

Pupae surveys:

- Pupa index (PI): number of pupae per 100 houses inspected.

Adult surveys: Estimating adult population density using ovitraps, human landing collections or other surveillance traps.

How is Adult Mosquito Surveillance Done?

Mosquito surveillance is typically conducted by first dividing a program area such as a city, county or industrial facility into control zones. Within each zone a field technician collects mosquito larvae from standing water sources using standardized dipping techniques and sets adult mosquito traps. Adult mosquito traps are left out over-night, collected the following day, and taken in for counting, identification and, where possible, sent for disease testing (see appendix A & B). There are several types of adult mosquito traps used in effective mosquito

surveillance programs, each with its own advantages, depending upon what specific information is desired. Some of the traps commonly used include:

- CDC Miniature Light Traps
- Gravid Traps
- BG-Sentinel Traps

Landing Rates can also be used to establish the presence of human-biting mosquitoes.

Larval Monitoring

(http://vectorbio.rutgers.edu/outreach/dipping.htm)

Larval surveillance involves sampling a wide range of aquatic habitats, and requires trained inspectors to identify larval production sites, collect larval specimens on a regular basis from known larval habitats, and to regularly look for new sources. This information can be used to determine where and when source reduction or larval control efforts should be implemented.

Trap Types

CDC Traps can be used in a variety of ways to sample different species of adult mosquitoes. The Centers for Disease Control and Prevention (CDC) has developed a portable trap that runs off a 6-volt battery or 4 "D" cell batteries. The commonly used CDC trap is fitted with a light source and a CO2 source, located at the top of the trap to attract adult mosquitoes. As the mosquitoes approach the trap, a small fan draws them into a net, which is located at the bottom of the trap. Many mosquitoes are active during the evening and into the night, so CDC traps are most often deployed at dusk and picked-up after dawn.

Gravid Traps use a dark container (plastic tray) with an organic-water mixture as the attractant. They are lightweight, portable and powered by a 6-volt battery. A fan housed above the water draws the gravid females into a box or net. These traps are very important to a mosquito control program's disease surveillance in that they collect gravid females (blood fed females ready to lay eggs). Highly organic water used as the attractant will predominately catch *Culex* species, which are important vectors of WNV.

BG Sentinel Traps are essentially a collapsible, fabric container with a white lid with holes covering its opening. In the middle of the cover, air is sucked into the trap through a black catch pipe by an electrical fan, drawing approaching mosquitoes into a catch bag. The trap is baited with the BG-Lure, a dispenser which releases a combination of non-toxic substances that are also found on human skin. The BG-Sentinel is especially attractive for *Aedes aegypti*, *Aedes albopictus*, *Culex quinquefasciatus*, and selected other species. With the addition of carbon dioxide, the BG-Sentinel is an excellent surveillance tool for mosquitoes in general.

Guidelines for setting surveillance traps:

For all traps, record date, general weather conditions (temp, humidity, sun/cloud, wind speed, etc), latitude & longitude, address, county, health district, and time of day.

CDC CO^2 Baited Light Traps - Used to capture female mosquitoes seeking a blood meal. (https://www.youtube.com/watch?v=b3_4bg95mOs)

- Depending on humidity and temperature, bait trap w/ 2 – 3 lbs. of dry ice per night of trapping.
- Placement and setup considerations
    - Protection from morning sun
    - Place trap set-up away from:
        - competing light sources (non-full moon nights best)
        - smoke / fume emitting areas (e.g., industrial plants)
        - areas of high wind
        - public view
        - livestock or pets
    - Place trap in an open area near good mosquito resting surfaces (e.g., abundant vegetation (i.e., trees, shrubs, sheds, stables, sewers/culverts, etc.) and / or areas where birds congregate (e.g., grain storage, livestock feeding areas, etc.)
    - Place light trap 5' – 6' above the ground
    - Set traps out around 4 pm
- Run traps overnight

Gravid Traps: Used to capture female container-breeding mosquitoes seeking to oviposit. (https://www.youtube.com/watch?v=5h1_WkNcMGw)

- Trap baited w/ an infusion of water and straw/hay.
    - Infusion recipe:
        - ingredients
            - a pound of straw/hay
            - 30 gallons of water
            - larvicide
        - let ferment for approx. 4 to 5 days
    - Fill trap infusion reservoir / tub to within 1" to 1.5" of bottom of vertical suction tube.
    - Drill an overflow hole into the wall of the reservoir tub at the maximum infusion level to keep the level of the infusion below the suction tube (i.e., rain).
    - Placement considerations:
        - Protection from the morning sun
        - A plastic grocery bag placed over the collection net will protect mosquitoes from rain

        - Place near mosquito resting areas (e.g., abundant vegetation, outbuildings, sheds, sewers/culverts, etc.), areas where birds congregate (e.g., grain storage, livestock feeding areas, etc.), and / or near oviposition sites, but not near enough that such sites compete (e.g., adjacent to a livestock water tank)
        - Do not place near an ant mound.
    - Set trap out around 4 pm
    - Run traps overnight

BG Sentinel Traps: Used to capture female mosquitoes seeking a blood meal. Especially attractive for the yellow fever (or dengue) mosquito, *Aedes* (Stegomyia) *aegypti*, the Asian tiger mosquito, *Aedes* (Stegomyia) *albopictus*, the southern house mosquito, *Culex quinquefasciatus*, and selected other species. (https://www.youtube.com/watch?v=_Wv693b68O0)

- Bait trap w/ BG-Lure.
- Placement and setup considerations
    - Protection from morning sun
    - Protection from rain.
    - Place trap set-up away from:
        - competing light sources (non-full moon nights best)
        - smoke / fume emitting areas (e.g., industrial plants)
        - areas of high wind
        - public view
        - livestock or pets
    - Place trap in an open area near good mosquito resting surfaces (e.g., abundant vegetation (i.e., trees, shrubs, sheds, stables, sewers/culverts, etc.) and / or areas where birds congregate (e.g., grain storage, livestock feeding areas, etc.)
    - Do not place near an ant mound.
    - Place under cover and sheltered from rain.
    - Set traps out around 4 pm
- Run traps overnight

Trap Collection:

- Collect traps late morning to minimize damage and morbidity to captured mosquitoes
- Harvest your catch by pinching off the capture net while the fan is still running and tying the lace around the top of the net securely but not tightly
- On a piece of white paper, identify the capture net with trap location / site ID and collection date (using a pencil), and place in the net for later reference (DO NOT USE POST-ITS).
- Place nets into a cooler with dry ice or in a freezer to knock them out or kill them.

At the office:

- Transfer the dead mosquitoes from the collection nets to petri dishes
  - It is recommended that contents of collection net be emptied into a white tray where mosquitoes are separated from non-mosquito captures then placed into the petri dish.
- ID and count *Aedes aegypti* and *Aedes albopictus*
- Count all other mosquitoes – save these in vials for later ID
- Fill out the mosquito ID form

Landing Counts

A landing count is done by an individual who records the number of mosquitoes that land on the observer over a designated period. It is suggested that they be taken over either a 1 or 5 min period. If the landing rates exceed 50 in 30 sec, the interval can be shortened to protect observers that are expected to conduct numerous counts. Landing rates may involve identification, if desired, but they are normally employed in areas where a single, known species is the sole cause of annoyance.

Guidelines for landing counts:

- Wear solid color clothing whenever possible. Mosquitoes are more easily seen on a solid vs. patterned background.
- Maintain a consistent clothing color among the counters within a county to keep the results comparable. Mosquitoes do exhibit color preferences and wide variation in the background color of the clothing could cause variation within the data set.
- No repellents, after-shaves or perfumes should be worn.
- Take all landing counts from a standing position with arms away from sides.
- Disturb the surrounding vegetation before starting the counts.
- Count only those mosquitoes that land within view.
- If work is conducted after sunset, use a light source with a red filter. Red light is less repelling than white light.
- Use a standardized form to facilitate the recording and filing of information (see attached).
- Use real numbers on all forms. One hundred plus (100+) tells the foreman or director there are a lot of mosquitoes but for mathematical analysis 100+ is useless. One hundred twenty (120) or two hundred (200) are much more meaningful. BE SURE TO KEEP GOOD RECORDS.
- When collecting mosquitoes for identification, use some type of aspirator, either electric or lung powered.

- Be aware of the behavior of the species that is being monitored when interpreting data from landing rates and bite counts. Landing rates taken at mid-day for a mosquito species that host-seeks at twilight may require adjustment to assess the magnitude of the problem. The timing of the landing rate or bite count should coincide with the period of greatest activity whenever possible.

To use the datasheet (see appendix C):

1. Stand and count landing mosquitoes for 15, 30, or 60 seconds.
2. After the specific time period, move slightly and count again.
3. This should be done 5 times at one site. Take an average of the 5 landing counts at the one site.
4. Data should be collected at a minimum of 5 sites.
5. Data can be entered into the spreadsheet and the average number of mosquitoes landing per minute will be calculated.

Thresholds for Landing Counts -

- Excessive Landing Rate Counts:
    - In populated areas >25 mosquitoes/minute
    - In relatively unpopulated areas >50 mosquitoes/minute

Working in a neighborhood

It is important to always be courteous and respectful when talking with people; you are representing the GDPH. When conducting door-to-door inquiries, remember that public education is an important component of homeowner backyard source reduction. To be successful, community-based strategies must be flexible and adapted to the local setting because of ecologic, cultural, and social differences between localities. A usual overview of door-to-door survey techniques can be found at http://www.socialresearchmethods.net/kb/intrview.php.

Vector Surveillance and Control Recommendations

Risk Level 0 – Preparation: Before mosquito season

- Conduct public mosquito education campaigns focusing on reducing or eliminating larval habitats for *Ae aegypti* and *Ae albopictus*
- Conduct surveys to determine abundance, distribution, and type of containers; large numbers of containers may translate into high mosquito abundance and high risk

- Initiate a community wide source reduction campaign – the goal of the campaign is to motivate the community to remove and dispose of any water holding containers
- Cover, dump, modify or treat large water-holding containers with long-lasting larvicide

Risk Level 1: Beginning of mosquito season

- Continue public education campaigns focusing on reducing or eliminating larval habitats *Ae aegypti* and *Ae albopictus*
- Develop and distribute mosquito education materials about *Ae aegypti* and *Ae albopictus* and personal protection measures
- Initiate *Ae aegypti* and *Ae albopictus* community-wide surveys to:
    - determine presence or absence
    - estimate relative abundance
    - determine distribution
    - develop detailed vector distribution maps
    - evaluate the efficacy of source reduction and larvicide treatment
- Continue/maintain community source reduction efforts.
- Initiate adult sampling to identify or confirm areas of high adult mosquito abundance
- Initiate preventive adult control to reduce adult populations targeting areas of high mosquito abundance
- Concentrate control efforts around places with high mosquito density

Risk Level 2: Single locally acquired case or cases clustered in a single household or nearby houses.

Vector Surveillance & Control Protocols

Aedes albopictus are present throughout Georgia and *Aedes aegypti* have also been found in Georgia, although the extent of their habitat is unknown. Begin public mosquito containment education campaigns aimed at preventing or minimizing contact between vectors and suspected or confirmed human cases, especially during the first week of illness when an infected person is viremic and can infect mosquitoes, thereby possibly triggering a local outbreak.

When notified by State Environmental Health of a positive case of an arbovirus, **VSC and/or vector control agencies** should:

- Conduct mosquito surveillance and testing:
    - Obtain permission and conduct surveillance at the home or in vicinity (1/2 mile) of the case as soon as possible.
    - Coordinate with local mosquito control if available. Provide mosquito control as soon as possible. This includes:

- Door to door neighborhood inspections for larval habitat.
- Eliminate larval habitats within 100-200 yards/meters around a case's home.
- Treat with long-lasting larvicide any water-holding containers that cannot be dumped, covered, discarded or otherwise modified.
- Leave door hangers where no one is home
- Possibly adult control (barrier spraying)

- Educate the public about reported cases of disease and urge them to use:
  - Insect repellents containing DEET or picaridin
  - Window and door screens to prevent mosquitoes from entering the house
  - Air conditioning
  - Tip-n-Toss: continually dispose of water holding containers to eliminate larval habitats.
  - If funding allows, work with other local agencies to host community source reduction, adult mosquito, and case containment initiatives to minimize the spread of infected mosquitoes and to help facilitate removal of larval habitats.

<u>Adult Vector Control</u>

- Possibly treat the outdoors around a case's home with adulticide
- Provide outdoor residual and spatial insecticide treatments; repeat as necessary to reduce vector abundance
- Initiate/maintain adult sampling to estimate adult mosquito abundance and evaluate effectiveness of insecticide treatments
- Send mosquito pools to SCWDS for testing if possible and send a copy of the data and results to Rosmarie Kelly at DPH.

<u>Risk Level 3: Widespread Local Transmission Outbreak; clusters of suspected or confirmed cases</u>

- VSCs will be notified by DPH EH and assemble at area of outbreak. Coordinate with local MC agency if available
  - Divide the outbreak area into operational management areas where control measures can be effectively applied to all buildings and public areas within a few days; repeat as needed to reduce mosquito density
  - Conduct door-to-door inspections and mosquito control in an area-wide fashion (reach >90% coverage of the control area within a week)
  - Identify and treat, modify, or remove mosquito-producing containers
  - Organize area/community clean-up campaigns targeting disposable containers (source reduction), including large junk objects that accumulate water (broken washing machines, refrigerators, toilets) in buildings, public areas, etc.
  - Combine outdoor spatial or residual spraying with source reduction and larviciding (including residual spraying of container surfaces and adjacent

mosquito resting areas). Don't forget to treat storm drains, roof gutters and other often overlooked cryptic water source

- Collect mosquitoes for viral testing and ship to UGA
- DPH may deploy private mosquito control contractor based on needs assessment

Risk Level 4: Widespread transmission within multiple counties or the state

- Activate Incident Command
- Expand vector control efforts for regional or state coverage.
  - If available, activate emergency mosquito control contingency plan
    - Clarke Mosquito Control
    - Mosquito Control Services
  - Regional VSC will work with contracted mosquito services to provide education, larviciding, and adulticiding.
- Collect mosquitoes for viral testing and ship to UGA

Mosquito Control

Safety procedures

- READ THE LABEL
  - The label is the law!
  - (http://pesticidestewardship.org/HowToReadTheLabel/Pages/default.aspx)
- Wear a dust mask and goggles as indicated on the label
- Wear rubber gloves when handling pesticide

Larviciding

Altosid (methoprene): read and follow label

- Briquets
  - 150 day
  - 30 day
- Pellets WSP
- XRG (apply using Stihl mister/blower)

Barrier Spray (https://www.youtube.com/watch?v=shhafQNvq0A)

- Obtain a residual insecticide labeled for elimination of mosquitoes in outdoor areas.
- Mix the residual spray insecticide in water or oil according to the manufacturer's instructions if it is a concentrate product.
- Pour the residual spray into the Stihl mist blower.
- Apply the residual spray during hot days to areas where mosquitoes rest. These are:

  - Cool, shaded, and damp sites
  - Overgrown grass under a tree, under a deck or around an air conditioner
  - Shrubbery (flowers need to be avoided)
- The residual spray usually remains effective for about 3-4 weeks.

The scope of the job: Education, surveillance, support, mosquito control

- Meet the local and District Environmental Health Specialists
  - You are their support for mosquito and mosquito-borne disease issues
  - You are working within their territory. Always ask before reaching out to local officials and agencies.
  - Things you can do -
    - Help field mosquito-related phone calls
    - Follow up on mosquito complaints
  - Things to get help on –
    - Where are the mosquito problems
    - Who are the other agencies in the area
- Meet local mosquito control - http://www.gamosquito.org/resources/GA_Mosquito_Control_Programs2017.pdf
- Other agencies and groups
  - Code Enforcement
  - Educational programs
    - schools
    - nursing homes
    - senior and recreation centers
    - day care
  - Neighborhoods
    - neighborhood associations
    - housing authority
    - local churches
  - Parks & Recreation
  - Keep "County or City" Beautiful programs
  - Any other agencies in the area – you never know until you try

Additional duties

- Reporting data
  - Reports of surveillance and control activities should go to the State Environmental Health office
  - Reports should also be made in writing or verbally to the local and District EHS as required by the local office
  - See appendix D for an example of a surveillance report
- Insecticide Resistance Testing
  - Collection

        - Collect a sample of larvae and pupae in the field
        - Label with site location and date
        - Rear in the lab to adult stage
        - Hold unfed for 2-5 days before
    - http://www.cdc.gov/parasites/education_training/lab/bottlebioassay.html

Media Talking Points

Do not talk to the media unless specifically requested to do so by the local health department and given approval by DPH.

Mosquito Surveillance and Control Following a Flood or Hurricane

If a major disaster declaration is declared, be sure to work with the local emergency response service to include a request for reimbursement for mosquito control activities in their request to FEMA. Vector control falls under the removal of health and safety hazards. Documentation needed for vector control includes:

- Surveillance Data - Current data and past 3 years covering same time period
- Operational Data - Including all info that supports the Project Worksheet
    - equipment
    - personnel
    - pesticide
- Post Surveillance Data – Desired but not necessary

Include complaint info and larvicide handed out to citizens.

Everything you do as far as surveillance and control must be part of the process. The process includes:

- Coordination through the County Emergency Operations Center (EOC)
- Involve Joint Field Office
- Have County EMA contact GEMA SOC
- Work with District EH Director to draft request (Appendix E)
    - NEED ASSISTANCE
    - NEED RESOURCES – list **everything** so that expenses and insurance are covered

Safety is the number one concern. Depending on the scope of the problem, it may not be possible to safely access many areas. Once it is safe to enter the area of concern, it is important to set out CDC light traps near population centers. Supplies in the emergency mosquito trailers can be used to aid with both surveillance and control. Mosquitoes should be counted and identified quickly. If there is local mosquito control, work with them when providing mosquito control for the area. If the scope is very large, the GDPH has a contingency contract for mosquito control that can be invoked, or the local government can choose to hire an

emergency mosquito control agency. The role of the VSCs and Public Health is to safely provide data and, potentially, assist with control efforts.

APPENDIX A: Guidelines for Submitting Mosquito Pools

(Last updated 11 May 2012)

1. If you are using light traps, do not send nulliparous mosquitoes for testing. They have never had a blood meal and will not be positive. Wait to collect at least a week after a large emergence before shipping mosquitoes for testing.
2. Sort mosquitoes by sex, species, and collection site into pools of 1-25 mosquitoes/pool. Unless you have been asked to provide blood-fed mosquitoes to SCWDS, put NO in the column labeled "Blood Fed?" on the submission sheet.
3. Vials and a cardboard box for vials will be provided by SCWDS. Place vials in order in the cardboard box, place each box in a baggie, and ship the box(es) of vials and a **copy of the submission form(s)** in an insulated shipping container with dry ice via "priority" overnight courier.
4. If you would like SCWDS to ship your containers back to you, please provide them with an accurate shipping label with your address on it and instructions to that effect. This returning of shipping boxes is a courtesy only and will not be done if a correct return address label is not supplied. PLEASE DO NOT CALL THE LAB ASKING FOR YOUR BOXES.
5. Label vials using a water/smear resistant Sharpie with the following information and in this order; county (3 letter abbreviation), year, and pool number (i.e. - the first pool from Chatham County in 2012 will be labeled CHC-12-001) - **do not deviate from this protocol or get too creative with abbreviations**. If sense cannot be made from your labeling scheme, the sample will not be tested. Please check with Dr. Mead before deciding on an abbreviation so that counties do not use the same abbreviation.
6. **DO NOT DUPLICATE NUMBERS.** Keep records for yourself so that you do not duplicate numbers. ***This is important***. Duplicate numbers cause everyone a lot of problems and can invalidate test results.
7. **Notify SCWDS that you are sending mosquitoes *24 hours* prior to shipping** (dmead@uga.edu) - try to give an estimate of the number of pools you will be sending (a ball park guess will be fine). If this is not done the lab will not be prepared for your samples and they may not be tested in a timely manner.
8. E-mail the completed submission sheets (Font - Times New Roman 10 pt type) to dmead@uga.edu when you ship the samples.
9. **Positive results will be reported to the submitting district or county health department ASAP. Please give UGA permission to send mosquito pool results to the GDPH**. Be aware that it may take up to two weeks to obtain results, although positive results are generally received from the lab in less than a week. **Please do not contact SCWDS for bird or mosquito test results**. Negative results will not be reported, but you may call Rosmarie Kelly at the GDPH (404-657-2912) if you have questions about any specific submission. If you do not get positive results for a mosquito pool within two weeks after submission, it is likely that it is negative for any of the common arboviruses.
10. Individual mosquito pool test results will not be provided to the public except at the discretion of the district or county health department.

11. If you are trapping mosquitoes at someone's home, please let that person know if the mosquito pools are positive and give them information on personal protection and source reduction measures.

***** Do not ship mosquitoes on Fridays!! *****

Shipping Address:

Dr. Daniel Mead voice: (706) 542-1741

589 D.W. Brooks Drive fax: (706) 542-5865

Wildlife Health Building

Athens, GA 30602-4393

APPENDIX B: Mosquito Testing Spreadsheet

Collection Date	VIAL ID	Address	City	Zip Code	Latitude (Y)	Longitude (X)	County	District	Species	Total per Pool	Trap Type

APPENDIX C: Landing Count Datasheet

							Mosquitoes Collected in One Minute					average landing rate per
Collector's Name	Site	County	District	Date	Time	Location on Body	1	2	3	4	5	minute
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APPENDIX D: Example of a Report (see attached PDF)

APPENDIX E: Example of a request for mosquito control

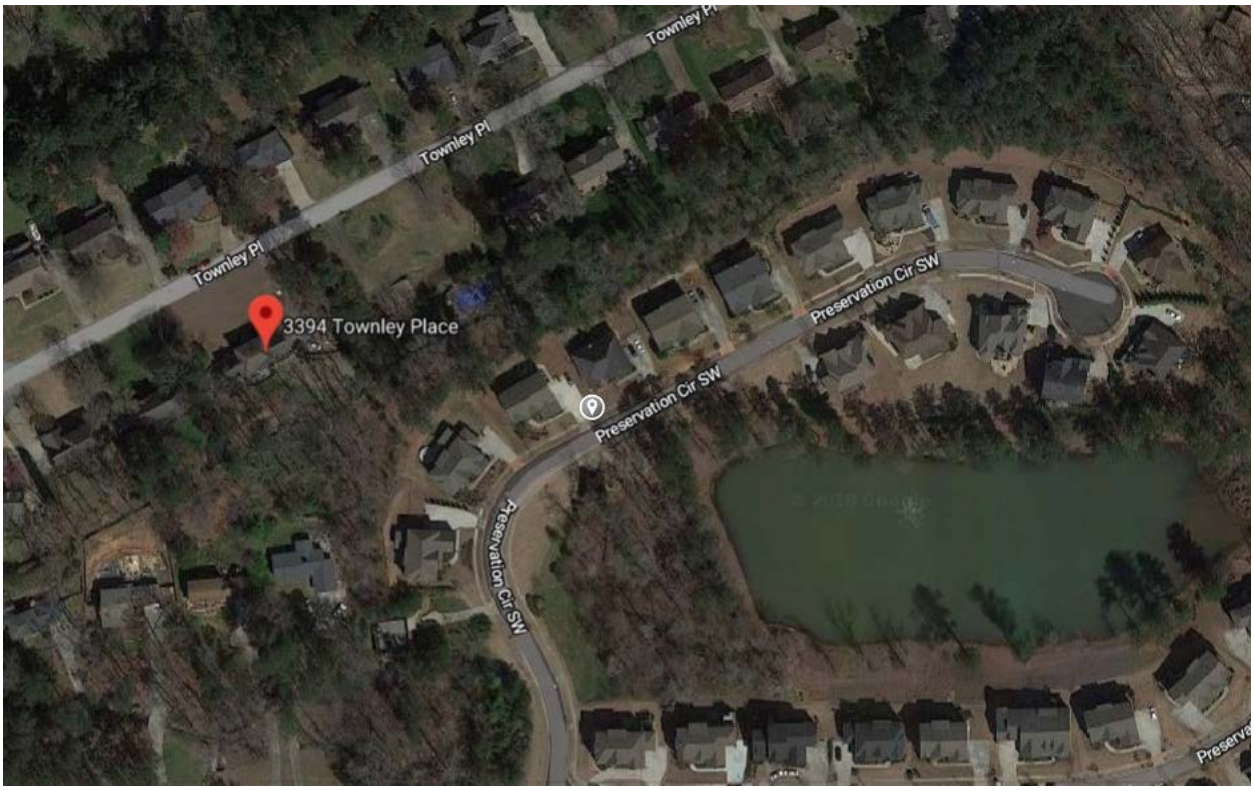
To County EM Director:

Mosquito surveillance efforts following (high levels of rainfall and resultant flooding (associated with tropical storm/ hurricane z)), indicate that the mosquito population in X County has greatly increased. Recovery personnel have reported that their efforts are hindered by the insect pest. Recovery activities such as X and Y are delayed/ postponed. The day-to-day outdoor activities of the general public are also impacted. (Consider adding examples such as waiting for the school bus, walking and biking to work). As Director/ Administrator of X County Health Department, I am requesting that appropriate mosquito control efforts be implemented.

WNV/ EEE activity is endemic in the impacted area and the greatly increased mosquito populations and increased exposure to residents increases the potential for disease transmission if amplification in bird populations was to occur. Due to the time lag between infection and the onset of clinical symptoms, high rates of infection will not be evident until several weeks after exposure.

In summary, adult and larval mosquito control efforts in X County are necessary to resume recovery efforts and return to normal operations.

Mosquito Surveillance
Townley Place, Lawrenceville, Gwinnett County, District 3-4



Address	City	Latitude (Y)	Longitude (X)
3394 Townley Place	Lawrenceville	33.88090	-84.07295

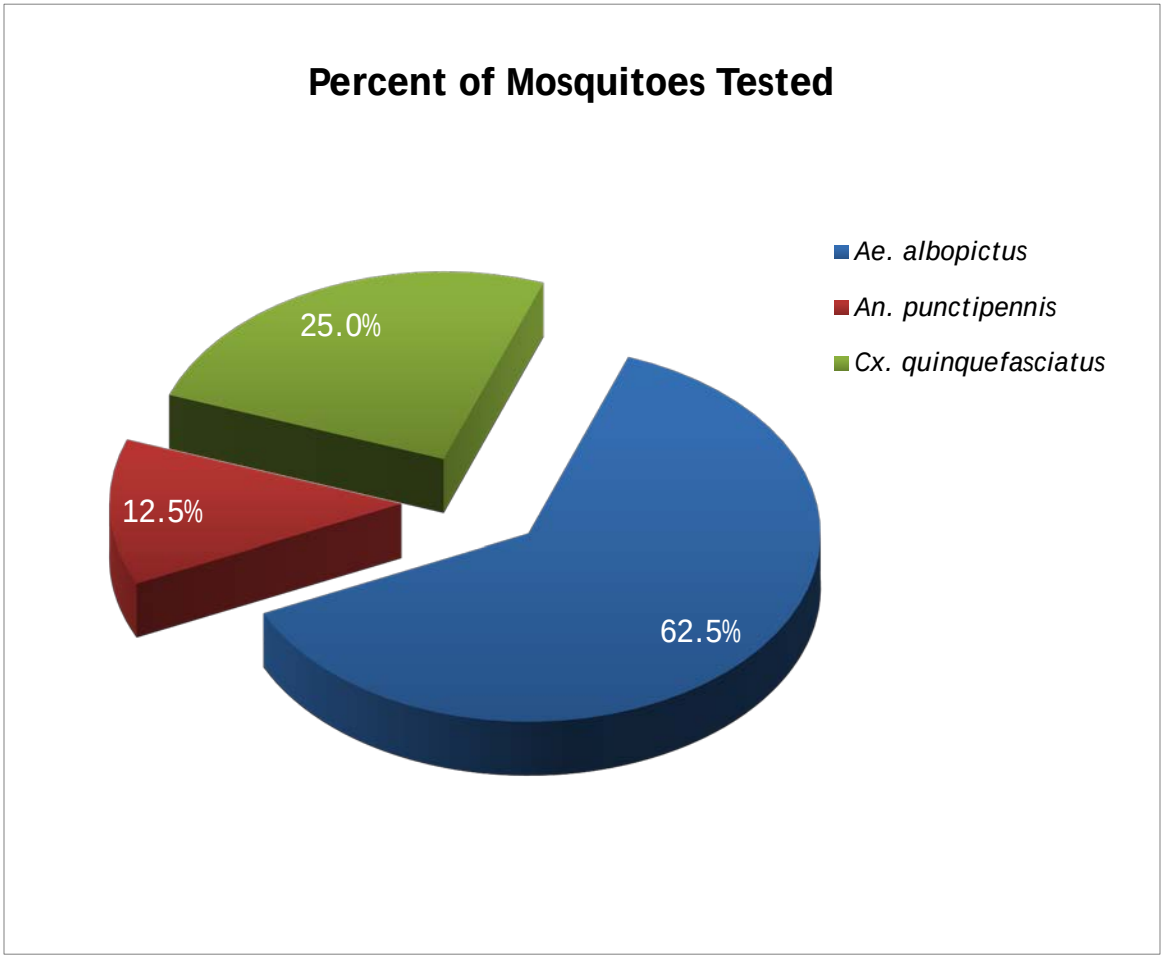
Address	City	Species	Total per Pool	Trap Type
3394 Townley Place	Lawrenceville	*Ae. albopictus*	5	Gravid
		An. punctipennis	1	CDC
		Cx. quinquefasciatus	2	Gravid

Mosquito Species from Cross Gate Dr

Percent (%) Of Total Collected	Number of Mosquitoes Collected	Mosquito Species	Characteristic Breeding Habitat	Human Biter?
62.5%	5	*Aedes albopictus*	containers	Yes
12.5%	1	*Anopheles punctipennis*	cold, clear water in ponds, temporary pools, springs, borrow pits, roadside puddles, wheel ruts, hog wallows, eddies of streams, rain-water barrels and other artificial containers	Yes
25.0%	2	*Culex quinquefasciatus*	nutrient-rich standing water	Yes

Two traps, one gravid and one light, were set on 9 July at the complaint site. The temperature was in the high 80s, there was moderate humidity, and there was a slight breeze. The traps were picked up on 10 July. The temperature was in the high 80s, it was humid, and still.

The site was well maintained, with open areas and wooded, shady areas. No mosquitoes were biting in the yard when the traps were set. Given how few mosquitoes were found in the trap, and the recent rainy weather, it is likely that there was an emergence of floodwater species that have now mostly died off.



GRAVID TRAP

This trap selectively attracts container-breeding mosquitoes that lay eggs in stagnant organically rich water. These mosquitoes will have had at least one blood meal, so may possibly have picked up an infected blood meal if there are WNV+ birds in the area.

LIGHT TRAP

Light traps attract mosquitoes looking for a blood meal. The attractants used are light and CO_2, in the form of dry ice or as compressed gas in canisters. These traps are useful for providing information about the mosquito species found in the area under surveillance. Because they attract mosquitoes looking for a blood meal that may have just emerged and never had a blood meal previously, the likelihood of finding virus in these mosquitoes is much reduced.

MOSQUITO BREEDING HABITAT TYPES

There are two general categories within which mosquito breeding habitats exist: natural mosquito breeding habitats and man-made mosquito breeding habitats. Female mosquitoes lay their eggs either on water or on soils that are periodically flooded. These breeding areas can be found in habitats that exist naturally, such as within a pond or flood plain, or in habitats that have been created by humans, such as bird baths, water-filled tires, or catch basins. Mosquitoes can breed in a wide variety of locations, and the discussion below provides a description of the general types of habitats where mosquitoes are known to breed.

NATURAL MOSQUITO BREEDING HABITATS

Temporary Woodland Pools:
Shallow, temporary pools are common in woodland areas during the spring and wet summers in low lying areas or in small depressions where a variety of mosquito species will breed, most commonly *Ochlerotatus canadensis* and *Aedes vexans*. These mosquitoes lay their eggs along the edges of the pool and when rainwater or melting snow fills these pools the larvae hatch.

Freshwater Ponds:
The larvae of Anopheles are found primarily in small ponds among the emergent vegetation. Ponds clogged with vegetation can breed large numbers of mosquitoes because of the vast amounts of organic matter available to mosquito larvae for feeding and because fish and other aquatic predators cannot readily feed on the larval mosquitoes.

Streams and Floodplains:
Streams with running water rarely produce mosquitoes. However, mosquitoes need to be near water in order to lay their eggs. Anopheles and Culex mosquitoes are two types of species that can sometimes be found in isolated pockets adjacent streams or within floodplain areas that undergo only periodic flooding.

Tree Holes and Other Natural Containers:
Tree holes and other natural containers, such as pitcher plants or water trapped in or on plant leaves, can also serve as breeding habitats for mosquitoes, such as *Ochlerotatus triseriatus*. Frequent rainfalls maintain standing water within these types of microhabitats and can breed mosquitoes throughout the summer.

Freshwater Marshes and Swamps:

Mosquitoes, such as *Coquillettidia perturbans*, breed in freshwater marshes and swamps consisting of emergent vegetation. These types of habitats can occur in both woodland and open field habitats. Larvae attach themselves to the stems and roots of the vegetation to obtain oxygen, and do not need to swim up and down in the water column to feed and to breath. Due to this adaptation, these larvae can avoid exposure to predatory fish.

MAN-MADE MOSQUITO BREEDING HABITATS

Stormwater/Wastewater Detention:
A catch basin typically includes a curb inlet where storm water enters the basin to capture sediment, debris and associated pollutants. Similarly, detention/retention basins that perform similar functions for other types of wastewaters, such as waste treatment settlement ponds, provide a similar type of breeding habitat to that of the storm water catch basin. These detention basins provide breeding habitat for urban mosquito species, such as *Culex quinquefasciatus*. Moisture and organic debris captured within the detention basin can aid in development and provide nutrients for growing larvae.

Roadside Ditches:
Roadside ditches are the suitable habitat for many species of Culex mosquitoes. The larvae of *Culex quinquefasciatus* and *Culex restuans*, for example, can survive in waters with high organic content. Culex mosquitoes will lay their eggs directly on the water's surface; therefore, ditches that hold water for extended periods of time can breed large numbers of mosquitoes.

Artificial Containers:
Artificial containers left out to collect rainwater such as tires, bottles, buckets, and birdbaths can provide an excellent mosquito-breeding habitat free from any predators. Many tree-hole mosquitoes have learned to adapt to using these man made mosquito nurseries. *Aedes albopictus*, our most common pest species, also breeds readily in these artificial containers. The abundance of organic debris, which can also collect in these containers, allows for the proliferation of mosquito breeding during a season.

Control – A Message for the Public
The mosquitoes of most importance to public health at these sites were *Culex quinquefasciatus*, the Southern house mosquito, and *Aedes albopictus*, the Asian tiger mosquito. Both these species lay eggs in such artificial containers as birdbaths, gutters, tires, flowerpots, and any other container that holds water for at least a week. The Southern house mosquito bites at dusk. It feeds primarily on birds, but will bite mammals, and is our primary vector for WNV. The Asian tiger mosquito bites during the day. It feeds primarily on mammals. It has been found positive for WNV in Georgia and is a vector of ZIKV. The best way to control these species is to dump out or treat standing water, treat catch basins with larvicide, and to cut back heavy vegetation where the mosquito will rest when not out biting. These mosquitoes will shelter in abandoned houses. Thermal fogging or barrier spray around these houses can help to reduce resting and overwintering mosquitoes.

Two larvicides are available to the public for treating standing water, Mosquito Torpedoes (methoprene) and Mosquito Dunks (Bti). Both are available from stores such as Lowes and Home Depot and possibly others. Hand-held foggers can also be used to reduce biting populations of mosquitoes, but this solution is temporary and needs to be followed up with good source reduction (removing breeding sites) and larviciding.