



## Delimiting survey guidelines

*This document is to be read in conjunction with the Section 5 of the Environmental Health Protection Manual.*

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### Delimiting survey definition and triggers

The Environmental Health Protection Manual defines a delimiting survey as a survey to establish the geographical boundary of the infestation of a pest species. The survey not only provides information on how far the species has dispersed from the point of introduction but helps define the extent of the infestation and the area where control activities will need to be implemented. With regards to exotic mosquitoes, there are a number of different events that can trigger the implementation of a delimiting survey, including (but not limited to):

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- An exotic mosquito is found in a routine surveillance sample (such as a trap collection);
- A suspected exotic mosquito larvae and/or pupae are found during inspection of imported cargo or a vessel;
- An exotic dead mosquito is found in relation to untreated imported goods; or
- A suspected exotic mosquito has been spotted, but has escaped before it could be collected

These events can occur in a Seaport, Airport, Transitional facility, or commercial or residential property. There may be many different circumstances associated with a detection that will inform the risk level and the actions that need to be undertaken.

### Steps to conduct a delimiting survey

The course of action following the suspected interception involves the immediate execution of a delimiting survey. Under some circumstances, such as a lockdown or an extreme weather event, the delimiting survey could be postponed until the conditions are safer. A comprehensive delimiting survey includes the following steps:

Check all existing traps and mitigate larval habitat

In the case of a delimiting survey undertaken in response to an exotic mosquito interception, activities also include checking all traps that are part of routine surveillance (where present), and inspecting, treating, mitigating, or eliminating potential larval habitats with larvicides (i.e., *Bti* or S-methoprene); and selecting suitable locations to deploy traps for enhanced surveillance. A delimiting survey also includes larval and adult sampling to determine what mosquito species already occur in the area.

Enter data in the online database

The information related to each sample must be recorded on a paper form (e.g. [Delimiting Survey Form example](#)) or in the Kobo app, and should include GPS coordinates, weather conditions and treatments carried out. All sampling information must be collected and recorded, positive or negative for mosquitoes, must be entered into the online database. Photographs of the breeding sites can be uploaded to the [Online National Mosquito Surveillance Database](#) and used to illustrate the Situation Report.

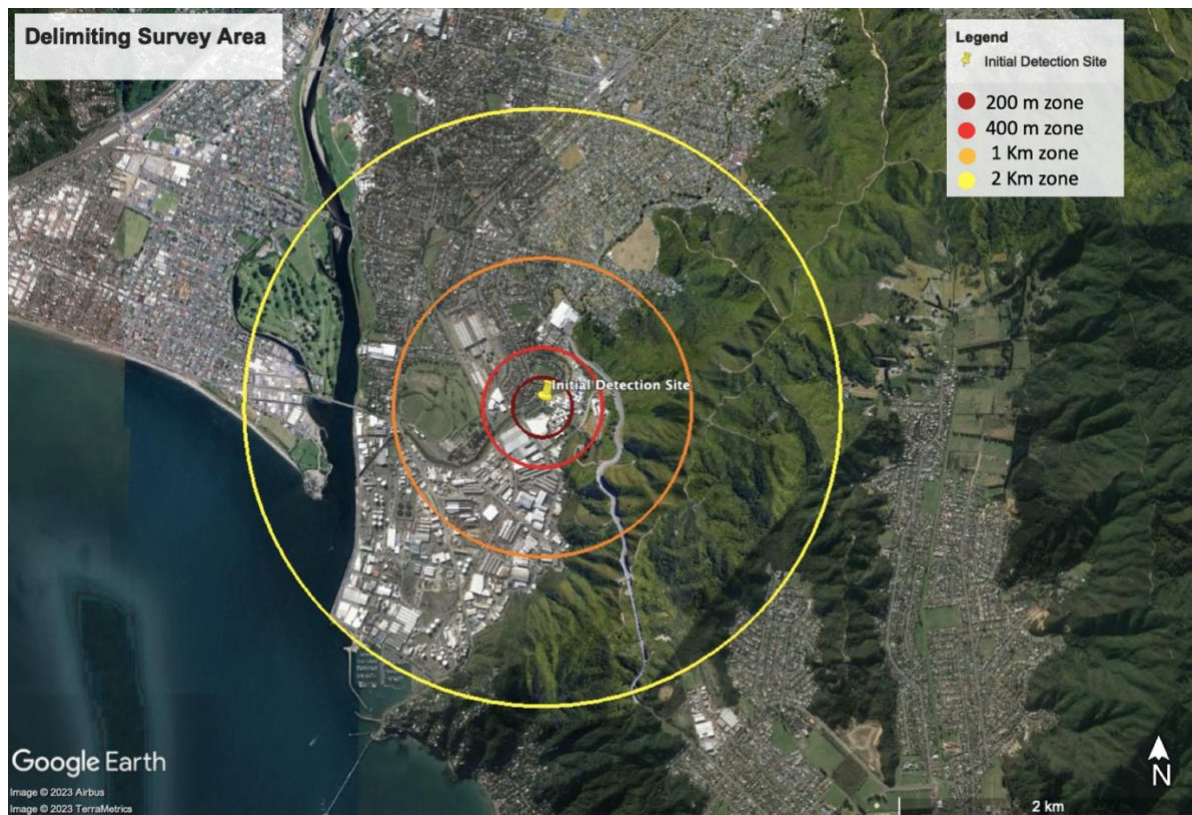
Extent of the delimiting survey area

The exact area covered and habitats to survey (e.g., ponds, saltmarshes, natural and artificial containers, etc.) will be determined by the biology of the mosquito species that has been intercepted. However, as there are over 3,000 mosquito species in the world, each with different behaviours and ecology, advice on delimiting survey area and preferred larval habitat for the intercepted species will be given by the NZBEL staff following the identification of the mosquito.

Typically, the area that will be covered from the initial detection site varies from 400 meters for container breeding mosquitoes and 1 kilometre for ground water breeding mosquitoes. A different size area may be recommended depending on the species flight range and circumstances associated with the interception (e.g. the number of specimens in the original interception).

Map the area to be surveyed

The best way to visualise the zone that needs to be surveyed is to use mapping software such as Google Earth Pro that has a measurement tool to make a circle with the desired radius from the initial detection site point (Figure 1).

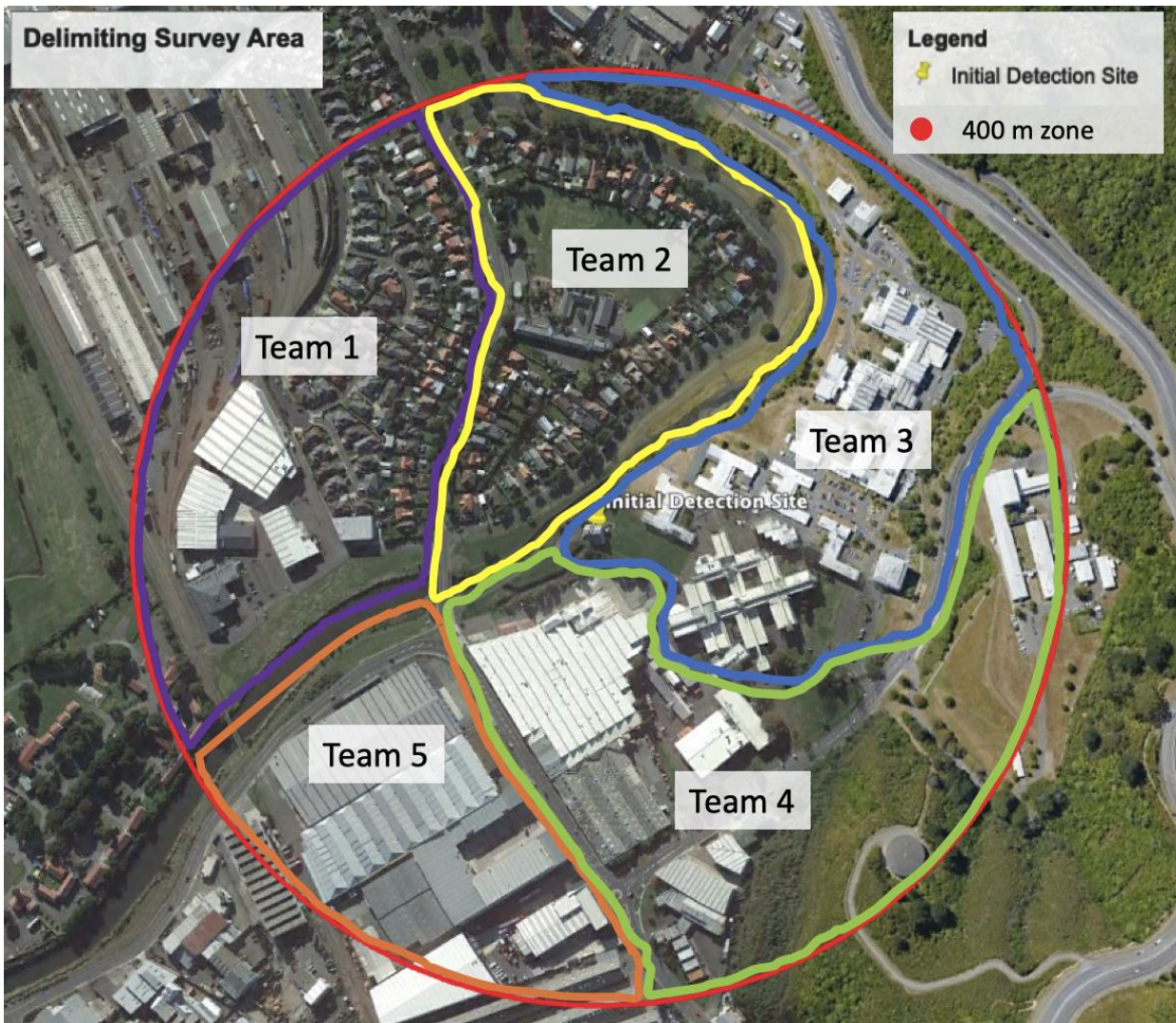


**Figure 1:** Example of a 200m, 400m, 1km and 2km zone drawn using Google Earth Pro

The area to be covered can be of considerable size. However, the approach to the delimiting survey must be systematic and thorough. This means that there may need to be several people involved. Additional resources outside your office might be required, including staff, consumables and sampling and trapping equipment.

Divide the survey zone in manageable areas

It is useful to divide the zone to be surveyed into multiple areas and work in teams of 2-3 people (Figure 2 shows an example on how to divide a zone for five teams to work on simultaneously). Small teams are ideal since it makes it easier to complete all tasks required more efficiently, including, carrying equipment, collecting samples, recording data, checking for hazards and ensuring that a thorough job is carried out. When defining the various areas that teams are covering in the 400m zone, be aware of the terrain, what businesses and buildings are in the area and any other obstacles which may be encountered.



**Figure 2:** An example of how a 400m zone could be split into areas for different teams to conduct the delimiting survey

Observe the landscape

Other relevant factors to take into account when deciding the shape and area to be surveyed are the wind direction and the landscape heterogeneity. Pay attention to the buildings, walls and streets directly facing the initial detection site, as they can work as wind tunnels carrying the mosquito away with the flow. Check the weather conditions on the site and record wind speed and direction (Figure 3). NB: remember that weather data records are a requirement from the EPA for use of the S-methoprene.

If for any reason e.g. limited human resources, unsafe circumstances, etc, the full zone can't be surveyed in one day, priority areas can be determined and worked in successive days (Figure 3).



**Figure 3:** An example of how a 400m zone could be split into priority areas.

Get in touch with stakeholders

To be able to access some properties you may require assistance or an escort and this may take some time to organise. If the interception has happened in a Point of Entry (POE) or Place of First Arrival (PoFA), ensure all appropriate authorities are contacted and informed of the situation. Authorities may wish to provide personnel to accompany and support HPOs during the delimiting survey, their knowledge of the area and potential hazards might be of value. It is important that all HPOs and Technical Officers keep their POE inductions and passes up to date.

An area covering many properties or businesses to check may take longer than an area where most of the zone is located in a single property. All these factors influence the time required to complete each area.

Check all properties in the delimit survey zone

Depending on the area covered, several stakeholders, businesses and members of the public may be involved. It is important to highlight that all properties need to be accessed to locate and treat any potential larval habitats. Any missed containers or groundwater sites can compromise the ability to fully execute the objectives of the delimiting survey.

### **Breeding habitats - What to look for**

The habitats that need to be surveyed will depend on what mosquito species was intercepted.

### Container breeding Mosquitoes

For a container breeding mosquito species, the habitats to look for and inspect might be above or underground, and can be either artificial or natural. Hidden artificial containers include sumps and drains which must also be checked (see Out of sight breeding sites below for more information). Above ground artificial containers examples include buckets, tins, jars, plastic bags, drums, guttering, tarpaulins, plastic sheeting, tyres, plant pots and bases, flower vases, and general rubbish items that hold water. Natural containers used as breeding sites include the axils of some plants, palm fronds, coconut shells or tree holes. See [overview of habitats](#) below for pictorial examples.

### Out of sight breeding sites

Be aware that there may be out of sight larval sites, such as underground pipes or drains, telecommunications pits, drainage sumps, gully traps etc. All POEs should have maps showing sumps and drainages locations and you should request a copy of them and ensure all sites are surveyed and treated.

### Ground water breeding Mosquitoes

If the species intercepted uses groundwater sites as larval habitats, the habitats that need to be inspected include ponds, marshes, drainage ditches and other bodies of water. If the species utilises brackish or saline water as larval habitats, the saltwater habitats, such as saltmarshes or mangroves will need to be sampled. Groundwater and saltwater breeding mosquitoes usually have wider flight ranges than container breeders, potentially resulting in a larger survey zone (see [overview of habitats](#) below for examples of these). If there are no ponds (or saltwater in the case of a saltmarsh species) nearby, drainage sumps and larger artificial containers should be sampled.

## Actions to undertake when a breeding site is found

When a potential larval habitat is found, it needs to be sampled, have its GPS coordinates recorded, and removed where possible. Any container habitats that cannot be removed should be sampled, treated and included in the sampling programme as part of the enhanced surveillance. Most of the time, groundwater habitats are unable to be removed, so these will also need to be sampled, and, if possible, treated. Best options for treatment are to be discussed with Te Whatu Ora and NZBEL.

When treating groundwater sites, the potential efficacy of the treatment will need to be assessed, a site may have too much organic matter for *Bti* to be effective, for example a drainage sump which has a high organic load. In some cases, the area of the larval habitat (such as a large pond) may be too large for treatment to be feasible, necessitating the application of a high number of *Bti* dunks. In these cases, the site will need to be sampled as part of any enhanced surveillance.

## Commence enhanced surveillance

Enhanced surveillance activities include setting up and regularly checking adequate traps and environmental checks.

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### Trap selection

Adult traps are chosen according to the bionomics of the intercepted mosquitoes. In general terms, ground water breeders such as *Anopheles* spp, most *Culex* spp and some *Aedes* spp mosquitoes are attracted to CO<sub>2</sub>-baited light traps, while container breeding *Aedes* spp are readily captured with BG and GAT traps. The specific traps required will be confirmed by the NZBEL once the intercepted species has been identified.

### Select suitable spots to deploy traps

Ideal trap locations should be sheltered spots adjacent to where the interception occurred. Depending on the bionomics of the intercepted mosquitoes, traps might be deployed as far as 400m away from the index site.

For information on selecting an appropriate trap location please refer to the [Where to set up traps document](#). For information on how to assemble and process traps and mosquito samples refer to the [Medical Vectors Handbook](#) Appendixes or visit the [SMSL website](#).

### Environmental checks

The breeding sites detected during the initial survey that cannot be removed or altered in a way to prevent them to collect water, are to be re-checked on a weekly basis (or fortnightly depending on the weather conditions and treatment applied). Any mosquito larvae collected is to be processed and sent to the NZBEL for identification.

### Enhanced surveillance duration

The length of the enhanced surveillance will be a minimum of three weeks or the estimated time for the mosquito to complete three breeding cycles from the last exotic specimen found. The length of the breeding cycle varies between species and is highly affected by the climatic conditions, especially by temperature. The higher the temperature the faster the cycle.

### Traps check frequency

Adult traps are to be processed three times a week (on Mondays, Wednesdays and Fridays). If the trap is positive, photographs of the specimens must be sent to NZBEL for preliminary identification. If any suspected exotic mosquito is found, the samples must be sent via urgent courier (such as Sub60) to the NZBEL.

Tyre traps should be checked once a week unless indicated otherwise by NZBEL. Tyres should be checked at the beginning of the week (from Monday to Wednesday) to ensure samples arrive in the lab before the end of the week.

A Saturday delivery must be organised for all samples collected on a Friday, unless NZBEL requests urgent delivery.

## A Brief Overview of Mosquito Habitats

The range of habitats utilised by mosquitoes is extremely diverse. With over 3000 species worldwide, almost any aquatic system has one or more species that have evolved to utilise it as a breeding site.

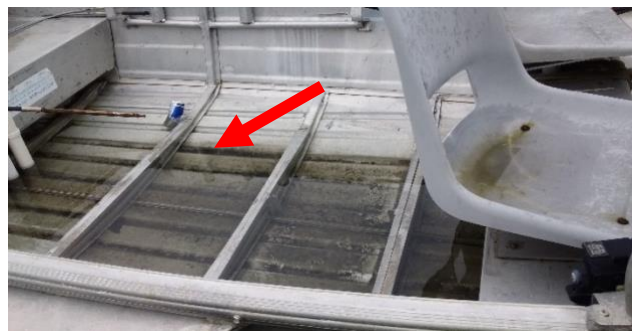
Most mosquito species can be classified as either container breeders or groundwater breeders, though some species may be found in both.

- Container breeders utilize artificial containers and/or natural containers. Artificial container breeders are commonly associated with populated areas, as these generally provide more habitats and therefore more opportunity for breeding. These habitats can be found above ground and underground.
- Groundwater breeders utilise more expansive habitats, such as swamps, marshes, lake edges, field drains and mangroves, usually with emergent vegetation.

	Mosquito Classification	
	Container Breeders	Groundwater Breeders
<b>Habitats</b>	<p><u>Natural containers</u></p> <ul style="list-style-type: none"> <li>• Tree holes</li> <li>• Leaf axils</li> <li>• Coconut shells</li> <li>• Rock pools</li> <li>• Palm fronds</li> </ul> <p><u>Artificial containers</u></p> <ul style="list-style-type: none"> <li>• Discarded rubbish</li> <li>• Tyres</li> <li>• Tin cans</li> <li>• Plastic sheeting</li> <li>• Oil drums</li> <li>• Buckets</li> <li>• Building fixtures, such as drain sumps and guttering</li> </ul>	<ul style="list-style-type: none"> <li>• Swamps</li> <li>• Marshes</li> <li>• Lake edges</li> <li>• Field drains</li> <li>• Mangroves</li> <li>• Temporary ponds</li> <li>• Rock pools</li> </ul>
<b>Local species</b>	<p><i>Aedes notoscriptus</i>  <i>Culex pervigilans</i>  <i>Culex quinquefasciatus</i>  <b>Rock pool:</b>  <i>Opifex fuscus</i></p>	<p><i>Culex pervigilans</i>  <i>Culex quinquefasciatus</i>  <i>Aedes antipodeus</i>  <b>Rock pool:</b>  <i>Opifex fuscus</i></p>
<b>Exotic species</b>	<p><i>Aedes aegypti</i>  <i>Aedes albopictus</i>  <i>Aedes japonicus</i>  <i>Anopheles stephensi</i></p>	<p><b>Fresh groundwater:</b>  <i>Anopheles</i> spp.  <i>Culex annulirostris</i>  <i>Culex tritaeniorhynchus</i>  <i>Culex gelidus</i>  <b>Saltmarsh species:</b>  <i>Aedes vigilax</i>  <i>Aedes camptorhynchus</i>  <i>Culex sitiens</i></p>



Artificial container breeding sites:



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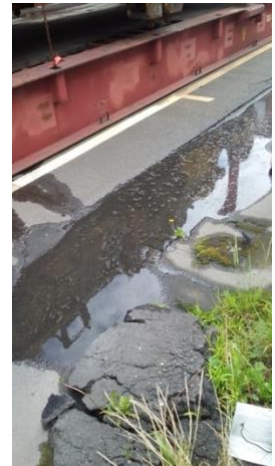
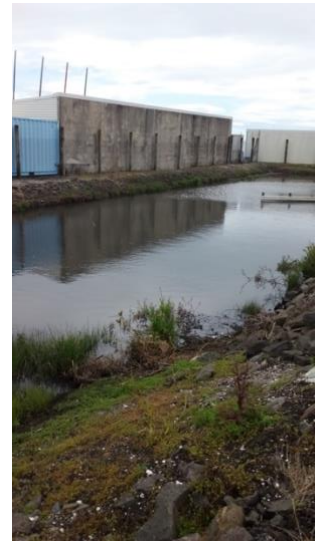
Natural container breeding sites:



Groundwater Breeding sites:



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**Delimiting Survey Form**

Date:     /     /                    Location:

Sampling Officers:

**Weather Conditions**

- Wind:     Km/h   Direction:            Temp:     °C
- Heavy rain/Moderate rain/Light rain/No rain/Snow
- Overcast/Moderate cloud/Light cloud/Clear

Start Time:                                End Time:

Time	Site Reference	Habitat Category	GPS Coordinates	Dips (+ve/Total)	Treatment applied	Sample	Unique Sample number	Site Photo	Comments
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			
			E: S:			Pos +/-Neg-			

