



Department of
Environmental
Conservation

NEW YORK STATE OAK WILT MANAGEMENT PLAN

Division of Lands and Forests
Bureau of Invasive Species and Ecosystem Health
Oak Wilt Response

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Background

Oak wilt, a disease that affects oak trees, was first identified in Wisconsin in 1942 (Wilson and Lester 2002) and has caused extensive damage in several north-central states and Texas. It is caused by *Ceratocystis fagacearum*, a fungus that develops in the xylem or water-carrying cells of trees. The fungus blocks the flow of water through the tree, causing the leaves to wilt and fall off, usually killing the tree. All oaks are susceptible to the fungus, but red group oaks (with pointed leaf tips) can die within one to six weeks while white group oaks (with rounded leaf tips) may take years to succumb.

In Texas, where oak wilt has been established for years, it has caused hundreds of millions of dollars in economic losses (Lester and Wilson, 2002). If the disease spreads throughout New York, where oaks are associated with \$55 million of income to private landowners annually (Crawford, 2016) and accounts for 20% of the state's log production (Crawford, 2014), the economic losses would be substantial. In addition, landowners, municipalities and utilities would be burdened with the costs of removing infected trees from right of ways and other areas where they would pose a hazard.

Transmission of oak wilt occurs in two ways: 1) above ground by beetles and 2) below ground through tree roots. New infection centers¹ are created when insects (mainly sap beetles) pick up fungal spores from oak wilt spore pads on infected trees or firewood and carry the spores to new trees. The insects are attracted to the sweet odor that the spore mats emit, as well as to fresh tree wounds where they can feed on the sap. Once an infection center is established, the fungus can spread to other trees through root grafts.

Eradication of the disease is possible when oak wilt is detected early and a management response is rapidly implemented (Wilson, 2005). As infection centers are detected, the New York State Department of Environmental Conservation (DEC) Division of Lands and Forests (DLF) will determine if a site is a good candidate for eradication depending on its characteristics, such as proximity to, and the number of, nearby infection centers. For best success in eradicating the disease, an integrated approach of science-based strategies including targeted removal and root graft disruption will be used. When eradication is not possible and the goal is to control oak wilt, only infected trees will be removed. Additional management activities may occur based on site conditions.

Infection Sites in New York

New York's first oak wilt infection was reported in Glenville in 2008 and again in the same area five years later. In 2016, oak wilt was confirmed in Brooklyn, Islip, Riverhead, Southold, and Canandaigua. In 2017, oak wilt was confirmed in two new locations in Glenville (See Appendix A, Figure 1).

Oak Wilt Response

The goal of DLF's Oak Wilt Response Plan is to prevent, detect, and manage oak wilt in New York to protect native habitats and rare ecosystems. The Response Plan includes the following strategies:

1. Detect symptomatic oak trees
2. Test symptomatic trees for oak wilt
3. Establish regulatory areas
4. Identify and conduct oak wilt management activities
5. Inform the public about oak wilt and how to prevent its spread
6. Conduct research to guide management decisions

¹ An infection center is an area that has had at least one sample-confirmed oak wilt infected tree within the past six years. All infected trees within a half mile of each other are included within one infection center.

To effectively manage the response to oak wilt, an Incident Command Structure was established by DLF in the affected DEC regions to apply consistent implementation of the response; delineate roles and responsibilities; and effectively disseminate information (See Appendix B, Figure 2). An additional Area Command was established in Central Office (Albany, NY) to provide financial, planning, operational and communication support.

Strategy 1 – Detect Symptomatic Oak Trees

AERIAL SURVEYS

DLF staff conduct yearly statewide aerial survey flights at 1200 feet to monitor for a variety of forest pests and invasive species, including oak wilt. Surveys specifically for oak wilt are conducted in helicopters at approximately 300 feet. These more focused aerial surveys look for expansions within two miles of known infection sites and new infections in nearby high-risk areas with large oak populations. Flights are done in mid-July and early September when oak wilt symptoms are more easily distinguished from the healthy green appearance of non-infected oaks.

GROUND SURVEYS

Symptomatic trees mapped during aerial flights will be visited by ground surveyors to check for alternative causes for the symptoms identified and to determine the need for oak wilt testing.

Ground surveys will also be used to

- Monitor trees adjacent to where infected trees were removed in areas targeted for management or eradication
- Look for symptomatic trees in neighborhoods with infection sites
- Look for symptomatic trees along roads in high-risk areas within and outside of protective zones/quarantine districts (see Strategy 3)
- Check symptomatic trees reported by the public.

REPORTS FROM THE PUBLIC

The public is encouraged to report trees displaying oak wilt symptoms between June and October to DEC by calling the Forest Health Information line at 1-866-650-0652 or emailing foresthealth@dec.ny.gov. Photos of the symptomatic leaves and/or trees are requested to help DLF staff determine if a site visit and ground survey are warranted. Public meetings and stakeholder trainings will be used to provide information on the symptoms of oak wilt.

Monitoring and surveying efforts will continue in an area until no additional oak wilt infections are detected for at least five years.

Strategy 2 – Collect and Test Samples from Symptomatic Trees

DLF staff will collect samples from symptomatic trees that may be infected with oak wilt during the growing season, primarily in the summer months. Samples are sent to the Cornell Plant Disease Diagnostic Clinic in Ithaca, NY to be tested for the oak wilt fungus using culturing, PCR analysis, and DNA sequencing. Samples may be sent for testing by the public, environmental organizations, and others, but any samples that test positive for oak wilt will require a second sampling by DLF or the New York State Department of Agriculture and Markets (NYSDAM) for confirmation. If oak wilt is confirmed, DLF will implement management tactics to control or eradicate oak wilt. Both response options will include establishing a protective zone and a quarantine district.

Strategy 3 – Establish Regulatory Areas

Quarantine districts will be established in areas with confirmed oak wilt infection sites to prevent potential infected material from moving out of the regulated area, thereby limiting the chance for the disease to spread. Restrictions include:

- Oak wood and firewood (less than 29 inches long) of any species may not be moved out of a quarantine district from April 1 to July 31.
 - Non-oak wood must be in large identifiable pieces (greater than 29 inches long) to leave a quarantine district.
- Oak wood that is chipped on site and firewood of any species may be moved from August 1 to March 31 with a limited transportation permit issued by DLF.
- Oak nursery stock more than two years old may not be moved without a permit issued by NYSDAM's Division of Plant Industry

The following criteria will be used to determine the extent of a quarantine district:

- When there is only one infection center per town, a neighborhood quarantine district will be established.
- When there are two or more infection centers per town, a town quarantine district will be established.
 - Infection centers are considered separate if there is more than a half mile between infected trees.
- A county quarantine district will be established when there are four or more infection centers in three or more towns. (See Appendix C, Figure 3.)

For example, Brooklyn and Canandaigua each have only one infection center, so neighborhood quarantine districts have been established within those towns. Glenville has three infection centers, so the entire town is quarantined. There are four infection sites in Suffolk County, with one in Southold, one in Riverhead and two in Islip, so the entire county is quarantined.

Strategy 4 – Identify and Conduct Oak Wilt Management Activities

Protective zones will be established around infection centers to identify where management activities will be conducted to either eradicate or control oak wilt. In counties where there are less than four active infection centers (positive for oak wilt within the past three years), DLF will work to eradicate the disease. In counties where there are four or more infection centers, the possibility of eradication is less likely, so the goal will be control. As of January 2018, the Brooklyn, Canandaigua and Glenville infection centers will be managed for eradication, and the Suffolk County infection centers will be controlled.

SITE MANAGEMENT PLAN

Local spread of oak wilt is dependent on characteristics specific to each location, so regardless of the type of management, each infection center will have a site management plan. The site management plan identifies soil type, root graft distance, tree density, utilities and other factors that need to be considered when planning management activities. These factors help determine if a buffer of healthy trees should be removed, if root disruption will be used, and if replanting is necessary. Any trees removed for management are chipped, incinerated, or treated to prevent them from spreading oak wilt.

ERADICATION ACTIVITIES

All infected trees will be removed, as well as any oak trees within a root graft zone (the distance within which an infected oak's roots may graft with those of nearby oaks), unless otherwise listed in the site management plan. The extent of a root graft zone varies by soil type (Table 1). All stumps will be treated with herbicide to kill the root system quickly and prevent new growth. They will be monitored for at least one growing season to verify that the roots have died, and if the stump re-sprouts, herbicide will be re-applied.

DLF may add an additional buffer to the root graft zone to ensure all trees potentially infected with oak wilt are removed. Some factors that may warrant the establishment of a buffer are: sandy soils, a high number of infected trees, and when root graft disruption isn't used.

Root graft disruption is a management technique that severs root connections between non-symptomatic oaks within the root graft zone and neighboring oaks outside of the root graft zone to further prevent underground transmission of the fungus (Figure 4, pg. 6). The use of root graft disruptions can reduce the number of trees that need to be removed but depends on site conditions, as they are difficult to install in rocky soils or urban and suburban settings where houses, roads, fences, and other structures are present. When they are installed, one or two disruption lines are cut four to five feet deep along the root graft zone boundary using trenches, cutting tools, etc. In addition to severing roots, a root graft barrier, such as heavy landscape fabric, is often installed to help prevent the severed roots from growing back into infected soils. When root graft disruption is conducted, it is done before trees are removed from the root graft zone.

Table 1. Root grafting distances, based on a 99% confidence level (Bruhn *et al.*, 1992).

Combined DBH (in.)	Inter tree root graft distances (feet) for soil types		
	Sandy soils (ft)	Loamy-sand soil (ft)	Sandy-loam/loam soil (ft)
2	5.1	4.1	2.9
4	10.2	8.1	6.0
6	15.3	12.2	8.9
8	20.4	16.3	11.8
10	25.5	20.3	14.8
12	30.6	24.4	17.7
14	35.7	28.5	20.6
16	40.8	32.5	23.7
18	46.0	36.6	26.6
20	51.1	40.6	29.5
22	56.2	44.7	32.5
24	61.3	48.8	35.5
26	66.4	52.8	38.5
28	71.5	56.9	41.4
30	76.6	61	44.3
32	81.7	65	47.4
34	86.8	69.1	50.3
36	91.9	73.2	53.2
38	97.0	77.2	56.2
40	102.1	81.3	59.1
42	107.2	85.4	62.0
44	112.3	89.4	65.1
46	117.4	93.5	68.0
48	122.5	97.5	70.9
50	127.6	101.6	74.0

Landowners that have oak trees removed from their properties will receive a two-inch diameter tree for replanting and will be able to choose from a variety of non-oak species. Any additional management activities selected by the landowner but not included in DLF’s site management plans, such as root graft disruption, will be at the landowner’s expense.

CONTROL ACTIVITIES FOR COUNTIES WITH FOUR OR MORE INFECTION CENTERS

When the goal is only to control an infection, the activities will be similar but may be conducted to a lesser extent.

All infected trees will be removed and stumps treated with herbicide. Additional activities to prevent the spread may be conducted. These include removal of non-infected oaks, establishment of a buffer, and root graft disruption on a case-by-case basis. Landowners that have oaks removed from their property will receive a two-inch diameter tree for replanting and may choose from a variety of non-oak species. Although trees are not typically removed from root graft zones in control areas, oak trees should not be replanted in these areas due to the possibility of extending the infection.

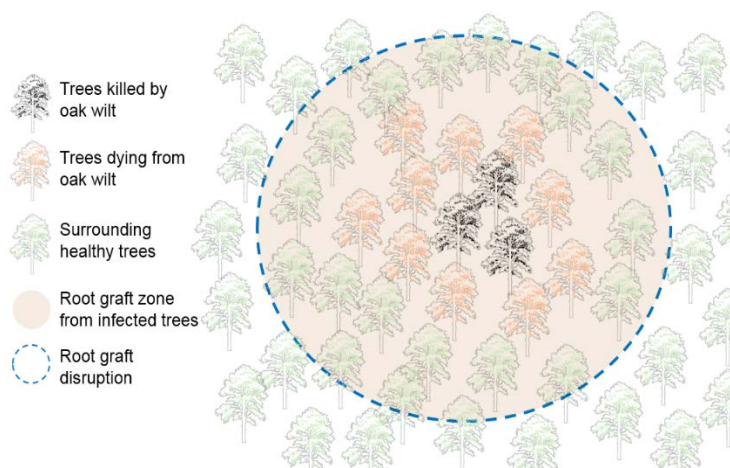


Figure 4. Diagram of root graft zone and root graft disruption in relation to infected and surrounding trees.

Strategy 5 – Inform the Public About Oak Wilt and How to Prevent Its Spread

DLF staff will conduct outreach on best management practices for pruning oak trees. Oaks should not be pruned from March through July, the period when the insects that transmit oak wilt are the most active (Table 2, from Juzwik et al., 2016). If oaks are pruned or damaged during this time, paint should immediately be applied to the damaged areas to deter sap beetles, which can spread oak wilt. Caution should also be used between August and October, when new infections are less likely, but still possible. If cutting is necessary during this time, immediately cover pruning wounds, stump surfaces of felled trees, and other wounds with paint. Staff will focus education efforts on landowners, arborists, loggers, and landscapers. To disseminate this pruning message, staff will present at professional meetings and provide trainings and workshops.

Table 2. Risk of oak wilt fungus spread by sap beetles and advisory comments by time of year (adapted from Juzwik <i>et al.</i> , 2016).		
Time of year	Risk of insect spread	Advisory notes
March – July	High	Don't wound, prune, or fell oaks in oak wilt counties during this time. Immediately cover any unavoidable wounds with paint or shellac.
August – October	Low	Depending on weather conditions and insect populations, infections are less likely. Immediately cover pruning wounds, stump surfaces of felled trees, and other wounds with paint.
November – February	Safe	Fungal pathogens and insect vectors are inactive.

Strategy 6 – Conduct Research to Guide Management Decisions

SYMPTOM MONITORING

Even though oak wilt has been discovered in several locations across New York, the progression of symptoms has not been documented. In areas marked for control, trees that have a high probability of becoming infected are being photographed through the growing season to capture the visual symptoms of the disease as they appear. Photos will be taken of the same trees from the same angles on a biweekly basis. These photos will then be combined to create a time lapse of the changes that occur, if any. This will help DLF's Oak Wilt Response Team better understand when and where (on the tree) infected oaks begin showing symptoms, which will help improve detection efforts.

SAP BEETLE TRAPPING

In the central United States, sap beetles (*Coleoptera: Nitidulidae*) have been the primary insects that transport the oak wilt fungus, however the activity of these beetles in New York has not been well documented. DLF is using insect traps to capture sap beetles between April and July to determine what species are present in New York and at what time of the year they are most active. Knowing the diversity and seasonal distribution of insects that may transport oak wilt will help guide future management decisions and education.

Alternative Management Strategies

SOIL TREATMENT

Soils from a site with oak wilt can be treated with fumigation or solarization to try to remove the oak wilt fungus. During fumigation, infected soils are treated with pesticides in a gaseous form. Soil solarization involves trapping the sun's radiant energy using clear plastic to heat infected soils to high temperatures, which kills the fungus. Both techniques result in a significant amount of soil disturbance, which is not usually preferred by urban and suburban landowners. For this reason, DLF has not implemented soil treatments and has instead prohibited the planting of oak in the root graft zone.

FUNGICIDE

The literature on oak wilt and the effectiveness of fungicides is not definitive. Some studies have shown that they may be effective in treating and preventing oak wilt in some species of oaks, while other studies have shown that fungicides only mask the symptoms. Since masking the symptoms makes detection more difficult and potentially delays treatment, DLF has chosen not to use this management technique until its effectiveness is clearer.

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Appendix A

New York State Oak Wilt Sample Locations

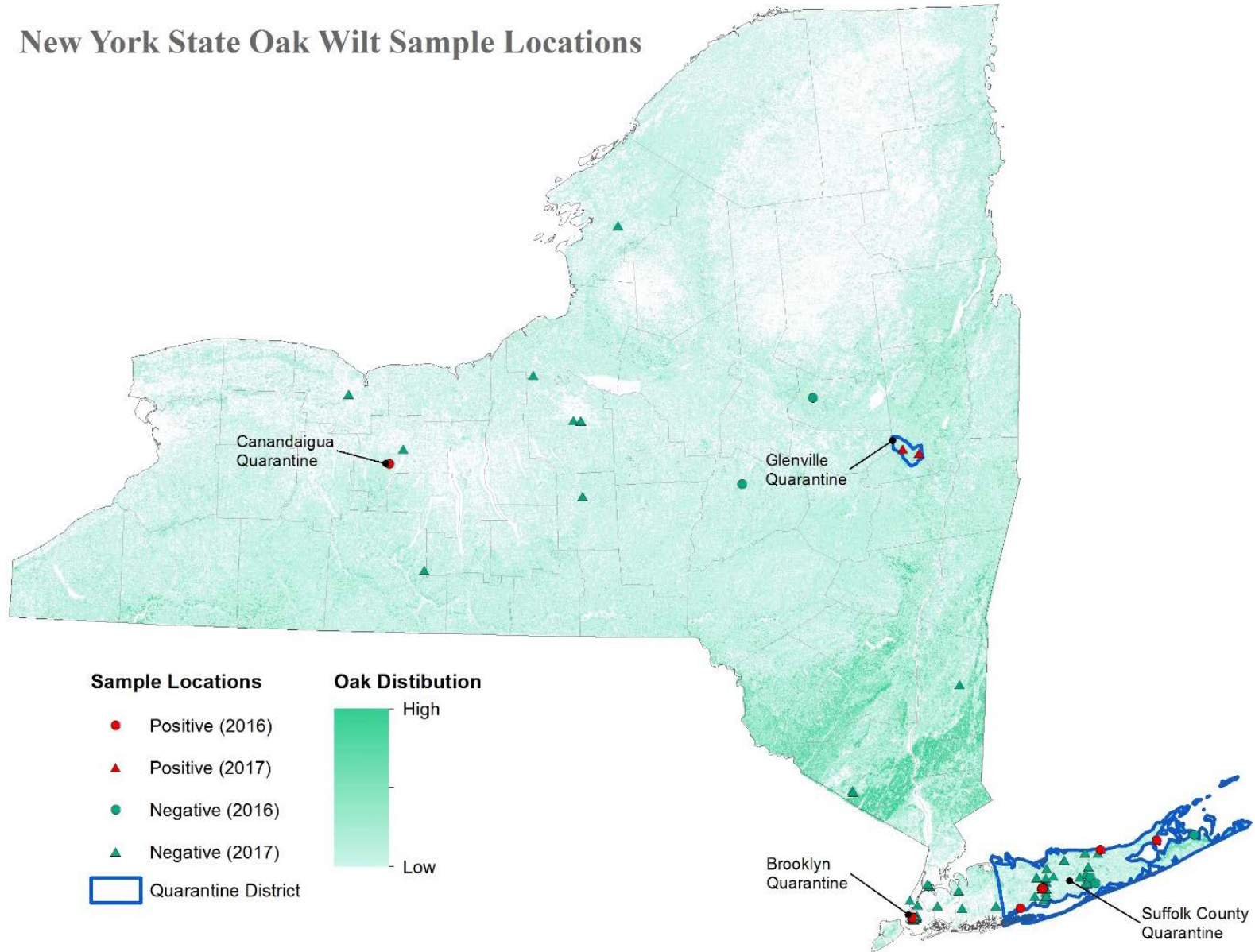


Figure 1. Map showing New York oak distribution and oak wilt sample results from 2016 and 2017.

Appendix B

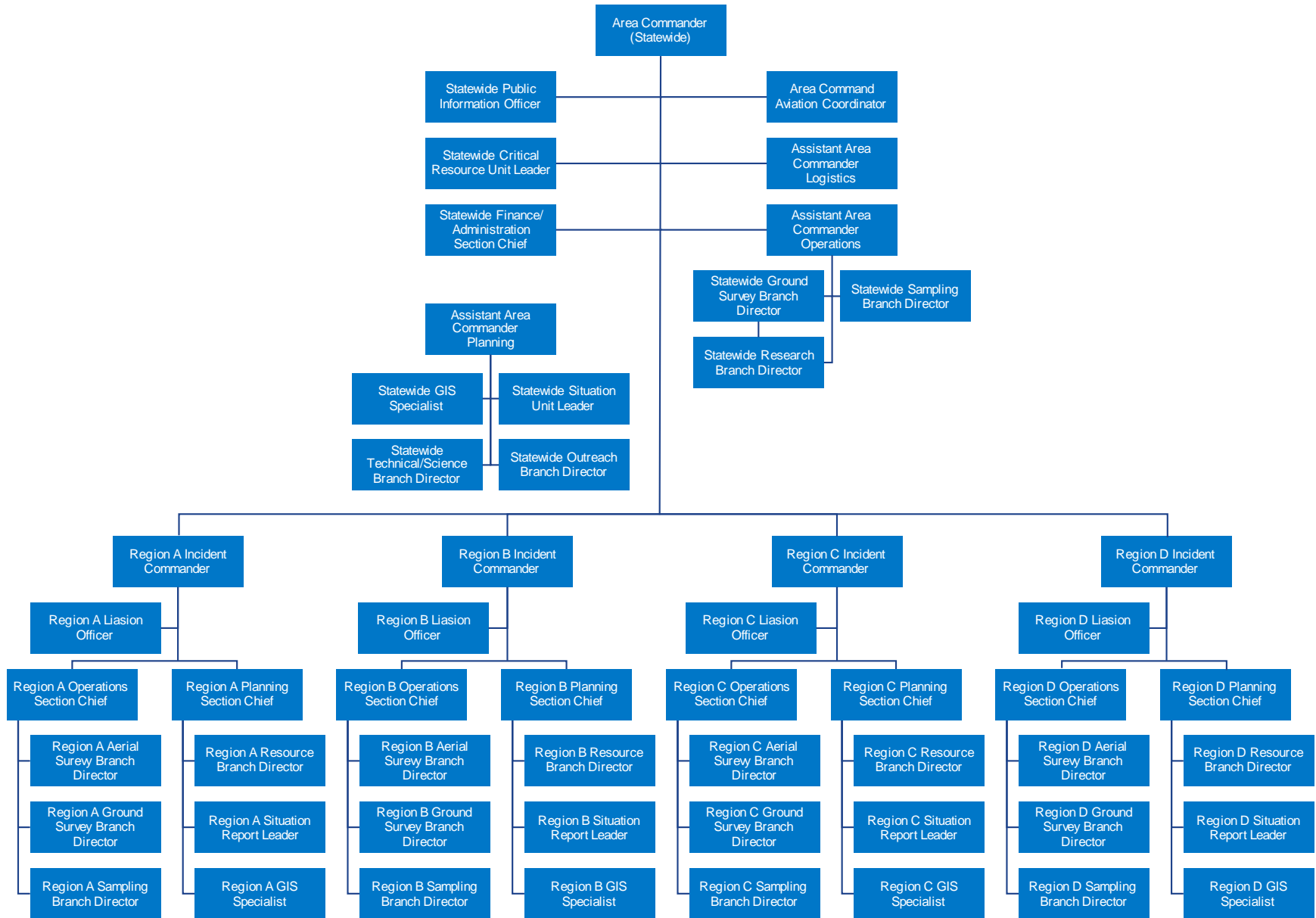


Figure 2. Generalized area command incident management structure for the oak wilt response.

Appendix C

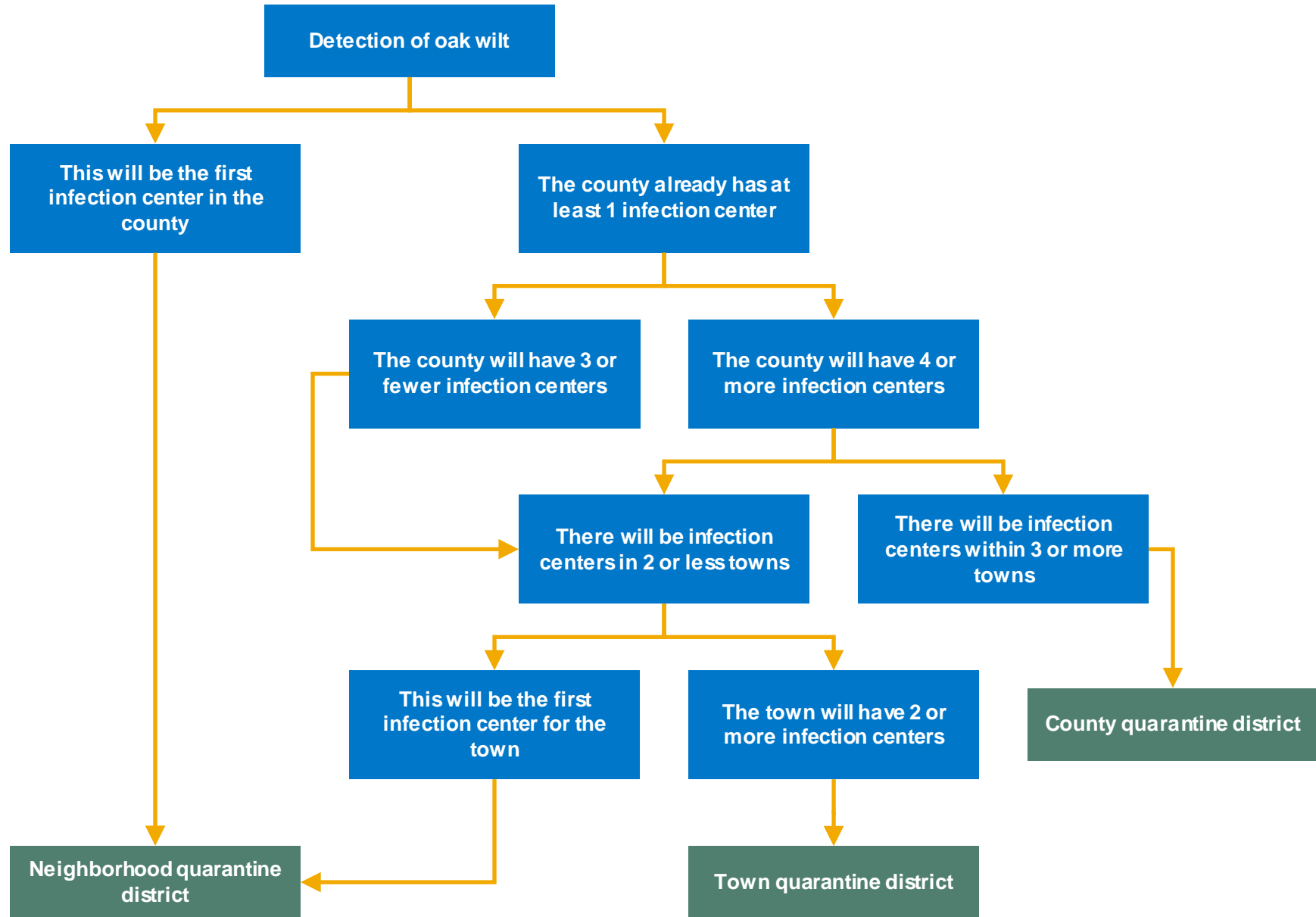


Figure 3. Flow chart used to help determine the type of Quarantine District that is established from a new oak wilt infection center.



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