Animal and Plant Health Inspection Service
U.S. DEPARTMENT OF AGRICULTURE

Cattle Fever Tick Eradication Program Use of Arkion Fly and Tick Spray

Final Environmental Assessment

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1 Introduction

1.1 Background

The U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) is responsible for (1) protecting and improving the health, quality, and marketability of U.S. animals by eliminating animal diseases, and (2) monitoring and promoting animal health and productivity. The Animal Health Protection Act of 2002, as amended, (7 United States Code (U.S.C.) §§ 8301-8317) provides broad authority for APHIS to prevent the introduction into or dissemination within the United States of any pest or disease of livestock (§§ 8303-8305). The Act authorizes prohibition and restriction of the importation, exportation, and interstate movement of animals moving in trade and strays, as well as exportation, inspection, disinfection, seizure, quarantine, destruction and disposal of animals and conveyances (§§ 8303-8308). This includes the ability to "carry out operations and measures to detect, control, or eradicate any pest or disease of livestock" and identifies specific cooperative programs as one way to achieve these actions (§ 8308).

Cattle fever ticks (CFTs), *Rhipicephalus annulatus* and *R. microplus*, are ectoparasites capable of carrying and spreading the protozoa, or microscopic parasites, *Babesia bovis* and *B. bigemina*, causing bovine babesiosis, commonly known as cattle fever. These are the only two tick species that can transmit the disease. *B. bovis* attacks and destroys red blood cells, resulting in acute anemia, enlargement of the liver and spleen, a high fever, and, potentially, even death for susceptible species. Health effects to cattle caused by *B. bigemina* are usually less severe but can develop very quickly. Cattle fever can cause cattle to lose weight, produce less milk, and even die. In addition, the two tick species can cause blood loss, significant damage to hides, and an overall decrease in the condition of livestock.[1]

Transmission of babesiosis requires the presence of these tick vectors (i.e., CFTs). CFTs become infected with babesia when they consume blood from infected animals. When the tick reproduces, babesia organisms are passed on to the tick larvae. The fever tick larvae will then pass on babesia to the animals on which they attach and feed. These infested animals then serve as vectors in the potential spread of CFTs to other animals and premises. CFTs are known to attach to a variety of species such as cattle, horses, white-tailed deer, Texas dall sheep, and exotic hoofstock, such as nilgai antelope and red deer (TAHC, 2024a).

Cattle fever was once a significant animal health epidemic in the United States, leading APHIS to establish the Cattle Fever Tick Eradication Program (CFTEP) in 1906 as a cooperative State-Federal cattle fever/babesiosis eradication effort, which shared program costs and cooperation

[1] Additional biological information and history of the CFTEP can be found in the "Cattle Fever Tick Eradication Program – Tick Control Barrier, Maverick, Starr, Webb, and Zapata Counties, Texas, Final Environmental Impact Statement – May 2018, which is incorporated by reference and referred to as the CFTEP EIS.

between the Federal government, States, local governments, and individual livestock producers. Before the eradication program began, direct and indirect economic losses were estimated to be $130.5 million, equating to more than $3 billion today (USDA APHIS, 2024b).

In 1938, a Permanent Quarantine Zone (PQZ) that extends more than 500 miles from Del Rio, Texas to the Gulf of Mexico (figure 1) was established at the Mexico-U.S. border in South Texas where CFTs continued to be a problem. The narrow zone formed a buffer between Mexico and the rest of the CFT-free United States. Eradication of two species of CFTs (*Rhipicephalus* (*Boophilus*) *annulatus* and *R. microplus*) from the United States occurred by 1943, except in the PQZ (Figure 1).

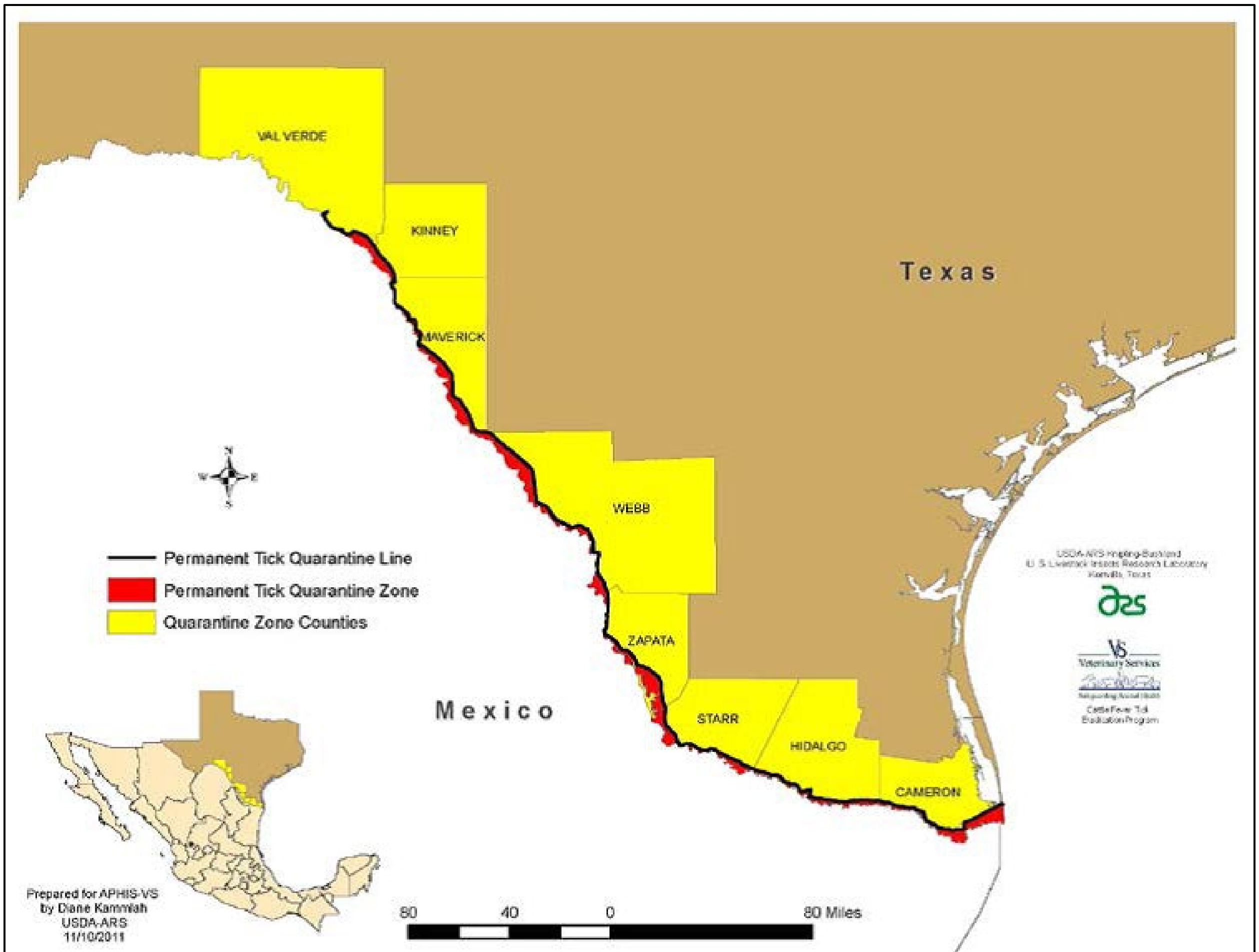

Figure 1. Map of the location of the permanent tick quarantine line, tick quarantine zone, and quarantine zone counties.

By preventing the establishment of CFTs in the United States, the CFTEP simultaneously eliminates the disease bovine babesiosis from the U.S. cattle population. Failure to control ticks on wildlife hosts greatly compromises efforts to eradicate ticks on livestock and poses a substantial threat of infestation and disease establishment throughout South Texas. In the 1930s, white-tailed deer infestation with CFTs presented a significant obstacle to cattle fever eradication in Florida (Pound et al., 2010). Both CFTs and bovine babesiosis are endemic in Mexico and therefore highly likely to travel with transported animals and associated materials as they enter this country (USDA APHIS, 2024a). With increasing U.S. trade and animal traffic, the risk of CFT entry and establishment increases. For these reasons, APHIS established and continues to maintain port-of entry inspections and the original PQZ.

1.2 Purpose and Need

Prior to September 2014, the incidence of infested premises outside of the PQZ remained at 20 or fewer. By December 2014, more than 20 premises in the tick free zone were infested, and that number has continued to rise (Figure 2). As of December 2024, there are 84 infested quarantine premises, 19 in the PQZ and 65 non-PQZ premises (TAHC, 2024b). Counties with infected premises quarantines include Cameron, Starr, Webb, Willacy, and Zapata. Additionally, there are 2,256 adjacent/check quarantine premises[2] located in these counties, Brooks County, and Val Verde County. In total, there are 2,358 quarantined premises impacting 457,366 acres in the non-permanent quarantine zone and 152,046 acres in the PQZ.

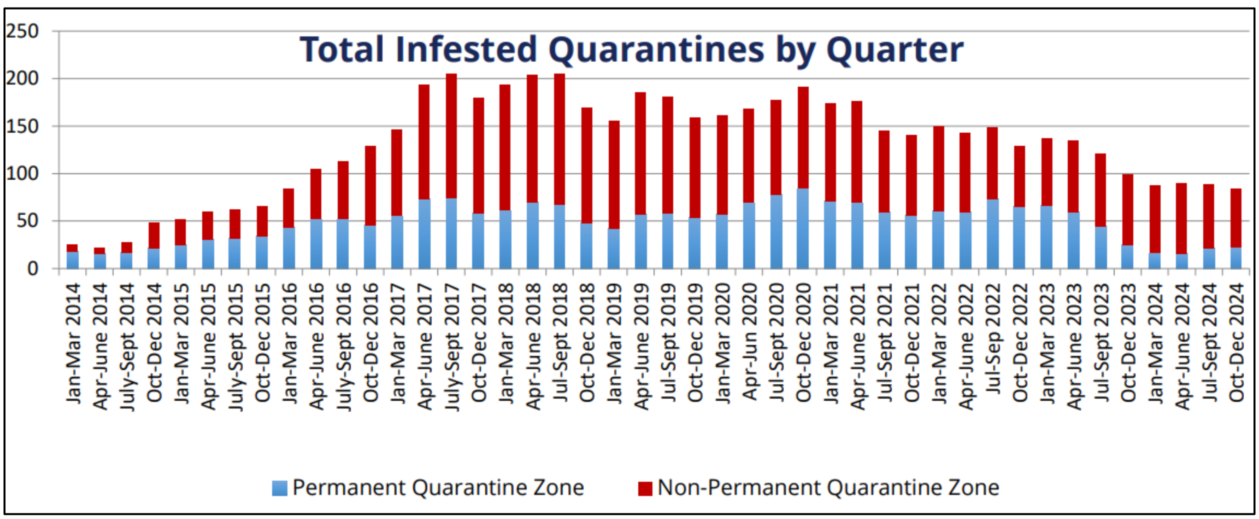

Figure 2. Total infested premises in the permanent quarantine zone and outside of the permanent tick quarantine zone (tick free area or non-permanent quarantine zone) by quarter, 2014-2024. Source: (TAHC, 2024b).

[2] Premises in the proximate area of an infested premises are designated as “adjacent, exposed or check premises.” These premises are also subject to various movement restrictions, inspections, and treatments. https://www.tahc.texas.gov/news/brochures/TAHCBrochure_FeverTickFAQ.pdf

Numerous studies have shown that white-tailed deer are suitable hosts and reservoirs for CFTs ((Graham et al., 1972), *in* (George, 1990; Pound et al., 2010)). In 1968, CFTs were discovered on white-tailed deer in ranches in Dimmit County. In the 1970s, chronic CFT infestations on ranch properties in Webb County north of Laredo, Texas, were not resolved by pasture vacation (Pound et al., 2010). In 1979, after sampling white-tailed deer in an area of Webb County, a study demonstrated that white-tailed deer sustained the existence of and spread CFTs within pastures vacated of cattle (Gray et al., 1979, *in* (Pound et al., 2010)). Since then, additional CFTs were discovered on deer in other areas, raising concern about the role of white-tailed deer in CFT outbreaks in the tick-free area. Evidence gathered supports the role of white-tailed deer as suitable CFT hosts and their importance in CFT eradication efforts.

Currently wild or feral animals, such as white-tailed deer, red deer, and nilgai antelope, and stray livestock (including cattle and horses) that can be sources of CFTs migrate from Mexico and cross the Rio Grande in areas where the river is shallow, providing easy and unimpeded access into the PQZ. CFT-infested nilgai are common in eastern Cameron and Willacy counties (Goolsby et al., 2023). This spread of CFTs by nilgai has led to extensive infestations of CFTs on cattle and white-tailed deer throughout this area.

Figure 3 shows the locations of the infestations occurring outside of the PQZ and in the Texas Temporary Preventative Quarantine Area. Recurring CFT infestations result in increased quarantine efforts in areas beyond the PQZ in South Texas (i.e., non-permanent quarantine zone).

The current increase in infestations combined with a high frequency of infestations occurring outside the PQZ suggests (Figure 3) current CFTEP inspection and treatment activities may be insufficient to ensure adequate protection of the U.S. livestock industry in the future. Failure to control ticks on wildlife hosts greatly compromises efforts to eradicate ticks on livestock and poses a substantial threat of infestation and disease establishment throughout South Texas. If not contained, emerging CFT populations in South Texas could spread into U.S. tick-free zones, with devastating consequences to U.S. cattle production, cattle health, and U.S. food security.

CFTs continue to be agricultural pests of concern for U.S. livestock[3] because they can cause devastating economic losses. In addition to the resulting health implications and loss of livestock, recurring CFT infestations result in increased quarantine efforts in areas beyond the

[3] USDA APHIS defines livestock as all farm-raised animals (9 Code of Federal Regulations (CFR) 71.1). As it relates to tick eradication, Texas defines "animal" as any domestic, free-range, or wild animal capable of hosting or transporting ticks capable of carrying Babesia, including (A) livestock; (B) zebras, bison, and giraffes; and (C) deer, elk, and other cervid species (4 TX ADMIN CODE § 41.1(2); 6 TX AGRIC CODE 167.001(1)). In Chapter 167, Texas' definition of "livestock" means cattle, horses, mules, jacks, or jennets (§ 167.001(4)).

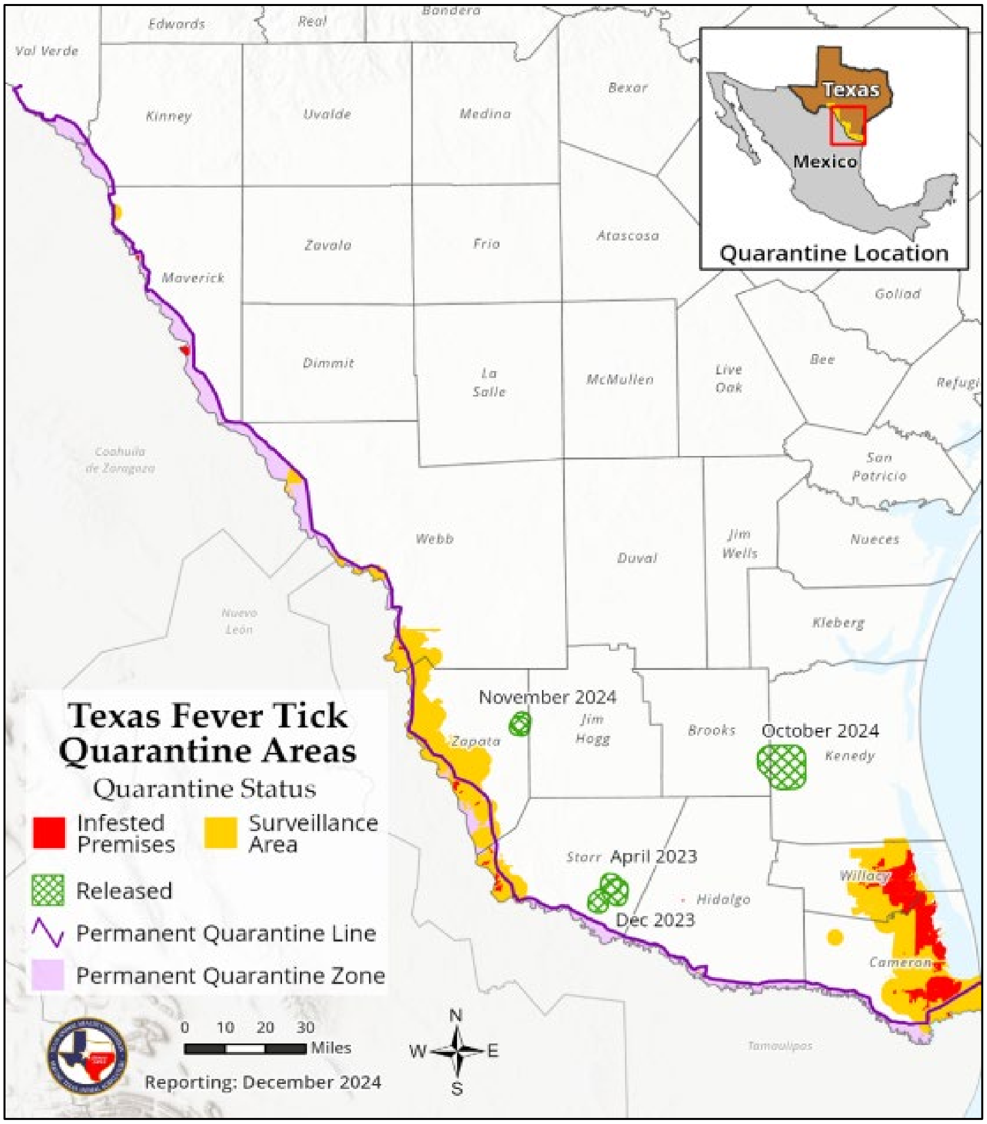

Figure 3. Map of current CFT-infested premises, surveillance areas, and released premises in South Texas counties (December 2024).

Source: (TAHC, 2024b).

Permanent Tick Quarantine Line in South Texas. As a result, producers are burdened with livestock movement restrictions and higher production costs associated with meeting requirements to eradicate these ticks. Also, increased quarantine efforts add increased workload and operational costs for the CFTEP and the Texas Animal Health Commission (TAHC). A 2010 Agriculture and Food Policy Center report estimated that the cost of a relatively small outbreak of CFTs outside the quarantine zone could total $123 million in the first year (Anderson et al., 2010). If this outbreak were to expand to the historic range CFTs once occupied across Texas and the southeastern United States, the minimum cost could be $1.2 billion in the first year alone.

Current efforts to control CFTs on wildlife include installation of fencing deterring wildlife movement, feeding ivermectin-treated corn to white-tailed deer, and population control of certain hosts such as nilgai. There is only one treatment available specifically for use on white-tailed deer. CFTEP may feed deer ivermectin treated corn, but only between the months of February through July. This allows for a 60-day withdrawal period before hunting season begins. Previously, during the hunting season, rollers with permethrin were positioned at feeders, so white-tailed deer would be dusted with the acaricide as they came to eat untreated corn. However, CFTs have increasingly become resistant to permethrin, so this treatment method has lost some of its efficacy.

There is only one tick treatment option approved for use on horses: a spray treatment with coumaphos. Horses can be treated every 14 days. Animals that move infrequently should be treated when they move out of or back into quarantine. USDA or TAHC personnel provide treatments at designated locations and times to serve multiple owners or may conduct treatment at a premises.

Synthetic acaricides are used intensely to kill *R. microplus* and *R. annulatus*, but this can eventually lead to the problem of acaricide resistance and other associated undesired effects. With the potential problems and limitations of current tick control methods, novel and safer technologies that can be integrated with existing control methods are required to sustainably continue to detect, suppress, and eradicate *R. microplus* and *R. annulatus* populations and associated diseases (Pérez de León et al., 2018).

In this environmental assessment (EA), APHIS analyzes the potential impacts on the human environment associated with including use of Arkion Fly and Tick Spray (AFTS) as an additional CFT treatment method to the CFTEP. APHIS is proposing to treat wildlife, including white-tailed deer and nilgai, cattle, and horses with AFTS to control tick vectors of cattle fever. AFTS is an all-natural soap-based insecticide for control of flies, ticks, mosquitoes, and other insects labeled for use on horses, dairy and beef cattle, areas where livestock are kept, and areas where pests may congregate (e.g., manure piles). The CFTEP is proposing to use AFTS in Brooks, Cameron, Dimmit, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kinney, Kleberg, La Salle, Live Oak, Maverick, McMullen, Starr, Val Verde, Webb, Willacy, and Zapata counties in South Texas (Figure 4).

White-tailed deer would be treated with AFTS by motion-activated sprayers as they consume untreated corn at supplemental feeders during the hunting season when ivermectin-treated corn is withdrawn. The tick treatment also would be applied by motion-activated sprayers onto nilgai and deer at fence crossings and areas where wildlife may congregate. Additionally, AFTS would be applied directly with sprayers onto cattle and horses in tick-infested areas of these Texas counties. The ability to use AFTS to control CFTs gives the CFTEP a much-needed additional treatment method or, in the case of nilgai, a treatment method where there currently is none available. Section 2 presents details of the proposed action.

Figure 4**.** The 19 South Texas counties included in the proposed action area.

The information presented in this EA is consistent with requirements in the National Environmental Policy Act of 1969 (NEPA) as amended (42 U.S.C. §§ 4321 *et seq.*) and USDA NEPA implementing procedures (7 Code of Federal Regulations (CFR) 1b).

2 Alternatives

This EA considers two possible alternatives for further analysis: (1) No Action - CFTEP will not use AFTS, representing the baseline or the current situation in the absence of the proposed action, and (2) the Proposed Action - CFTEP would use AFTS on wildlife (i.e., white-tailed deer and nilgai), cattle, horses, livestock structures and areas, and locations where ticks may congregate or emerge for CFT control. These alternatives are discussed in this chapter and are the basis for further analyzing potential environmental effects addressed in Section 4 of this EA.

2.1 No Action

Under the No Action alternative, APHIS would not use AFTS as part of the CFTEP for tick control on wildlife (white-tailed deer and nilgai), cattle, or horses. APHIS would continue to carry out current activities that help prevent the spread of CFTs and potential exposure of cattle to babesiosis. These activities include inspection of livestock at selected South Texas markets handling livestock originating from the PQZ, surveillance patrols for stray or smuggled livestock in the PQZ along the Rio Grande, inspection and pesticide treatment of tick-host livestock (mostly cattle and horses) on quarantined premises, installation of fencing to deter the movement of wildlife tick hosts.

The current CFT treatments available for livestock and wildlife under this alternative are summarized as follows:

2.1.1 Wildlife Treatments

Wildlife is more difficult to treat for CFTs than cattle, as wildlife move freely across the landscape and cannot be gathered and moved for treatment like livestock. To help control ticks on deer, the CFTEP uses ivermectin-treated whole kernel corn bait in feeding stations to deliver the systemically active acaricide. Treated corn is placed in gravity flow feeding stations after the white-tailed deer hunting season ends in February and refilled until July (USDA APHIS, 2017). It is necessary to stop feeding medicated corn in July to have a 60-day withdrawal period during which ivermectin concentrations in the blood and tissues of white-tailed deer drop to low levels before hunting season starts in November.

Ivermectin-treated corn is used by the CFTEP in locations where CFTs have been detected along the permanent quarantine line, or in adjacent areas of those counties that are determined to be at risk of incurring an infestation due to movements of tick-infested deer. In 2021, the CFTEP used 2,218 supplemental corn feeders, dispensing 681,000 kilograms (1.5 million pounds (lbs)) of ivermectin-treated corn on 193 premises with 1,004 sites (J. Picanso, USDA APHIS, personal communication (Goolsby et al., 2022)). The white-tailed deer must consume enough treated corn to get a therapeutic dose of the ivermectin for it to be effective against CFTs. Other challenges with using this method include competition among deer for bait, social dominance behavior, and the availability of other food sources (Thomas & Duhaime, 2022). The potential environmental impacts associated with the use of ivermectin-treated corn by the CFTEP were evaluated by APHIS in the 2017 environmental assessment, *Cattle Fever Tick Eradication Program Use of Ivermectin Corn*, which is incorporated here by reference (USDA APHIS, 2017).

The CFTEP may treat deer with topical applications of the acaricide permethrin, an insecticide in the pyrethroid family. Four-poster dust rollers with permethrin are mounted on either side of corn-filled feeders so that the acaricide is passively applied to the deer's head, ears, and neck when it eats corn from the feeder (Pound et al., 2010). When the deer grooms itself later, it spreads the pesticide over its entire body. However, as southern Texas populations of CFTs have developed resistance to pyrethroids, including permethrin, this treatment method has decreased in efficacy and limited its use (Thomas & Duhaime, 2022).

Nilgai do not feed on corn, so they will not eat at the feeder devices designed to treat white-tailed deer with ivermectin. As these wild animals are highly difficult to contain, currently, the only option for controlling ticks on nilgai is direct population control. As an exotic species, nilgai may be harvested by hunters year-round in South Texas (Goolsby et al., 2023). For this reason, nilgai cannot be treated with pesticides that have a required withdrawal period prior to consumption. Similarly, if necessary, culling or hunting may also be used to help control white-tailed deer populations.

Penned white-tailed deer or exotics may be treated for CFTs using the same methods as for cattle or free-ranging wildlife. Deer can be treated with approved sprays in a chute before being moved from a premises (Swiger, 2017).

2.1.2 Livestock Treatments

APHIS or TAHC annually inspects all livestock within the permanent quarantine zone for CFTs. USDA or TAHC inspectors must also treat, inspect, and certify all cattle as tick-free before they can move out of the quarantine zone to prevent ticks from spreading. In addition, USDA and TAHC set up temporary quarantines as needed if the ticks are found outside of the permanent quarantine zone. These animals must also be treated and inspected before leaving quarantine (USDA APHIS, 2023).

CFTEP uses an integrated pest management approach for CFT control including chemical treatments, vacating pastures, anti-tick vaccines, and injectable pharmaceutical products. When CFTs are found on livestock or wildlife on a property, the premises is quarantined and all livestock, including horses, are required to be treated. The treatment options vary based on what animals are on the quarantined premises and the planned use or movement of the animals. Treatments currently used by the CFTEP on cattle and horses to control CFTs include the following:

Coumaphos

Tick-killing pesticides, called acaricides, cannot cure an animal of diseases; yet they are the most effective way to eliminate ticks on infested animals. Acaricides require frequent application because they cannot prevent future tick infestations over the long-term. The organophosphate acaricide coumaphos is the only acaricide currently available for use in the eradication of CFT outbreaks and in the treatment of cattle bound for exportation to the United States. The CFTEP uses Co-Ral® Flowable Insecticide (42% coumaphos) (EPA Registration Number 11556-98; (Bayer, 2009) as registered for direct application in dip-vats, spray-dip machines, and hand-held sprayers.

Vat dipping is the preferred method for treating cattle with tick infestations as it is the only treatment method providing complete coverage of the animal (George et al., 2004) which prevents ticks from surviving treatment. CFT-infested cattle are run through a dipping vat every 7 to 14 days (based on the CFT life cycle) until the mandatory quarantine period of six to nine months is completed. There is no withdrawal period for coumaphos. Public dipping vats overseen by the CFTEP are located throughout the permanent quarantine area for ranchers to use. Portable dipping vats may be available for onsite use on large herds (more than 100 cattle). Cattle may also be treated using a spray-dip machine. These portable treatment options save producers the cost of transporting animals to dipping vats. Hand-held sprayers also may be used on animals that are unable to enter spray boxes due to size or physical condition (USDA APHIS, 2014).

Spray treatment with coumaphos is the only CFT treatment option approved for use on horses. Horses on quarantined premises are treated every 7 to 14 days with coumaphos applied by a hand-held sprayer. USDA or TAHC personnel provide treatments at designated locations and times to serve multiple owners or may bring sprayers to premises. The horses used by CFTEP Mounted Patrol Inspectors also are sprayed with coumaphos.

Doramectin Injections

Another treatment available for CFT-infested cattle is ready-to-use, injectable doramectin. Doramectin injections are given to cattle every 25 to 28 days for 6 to 9 months. Injections can be done on-premises, eliminating the stress on cattle being dipped and/or the need to be moved offsite. Doramectin injections cost much less than dipping but have a 35-day pre-slaughter withdrawal period during which cattle may not be moved outside the quarantined area (Swiger, 2017; USDA APHIS, 2023).

Vaccination
Adult cattle within the PQZ must be vaccinated annually with an anti-tick vaccine. The BM86 vaccine by Zoetis is approved for use in the CFTEP. BM86 works against a protein found in tick gut cells of the CFT and targets and kills both species of CFTs (TAHC, 2024a; TAHC & USDA, 2016). The vaccine is not 100 percent effective and is more effective against *R. annulatus* than *R. microplus*. By adding immunization with BM86 to systemic treatments, all or many ticks on an animal can be killed (TAHC & USDA, 2016). Vaccines are only administered by APHIS Veterinary Services, TAHC employees or authorized agents. The vaccine is currently approved for cattle but is still being studied in horses.

Ivermectin-treated Molasses
The CFTEP distributes ivermectin-treated molasses tubs as a preventative treatment to aid in CFT eradication. Molasses tubs are commonly utilized as supplemental protein, vitamin, and mineral sources for cattle. When cattle eat the liquid molasses feed supplement treated with ivermectin, it will kill ticks on them. Only CFTEP and TAHC employees can utilize the ivermectin-treated molasses tubs on high-risk premises where essentially continuous exposure to CFT occurs as infested nilgai and/or white-tailed deer travel onto the property (USDA APHIS, 2024b).

2.2 Proposed Alternative: Treatment with Arkion Fly and Tick Spray
The current CFTEP surveillance, population reduction, and eradication activities described under the No Action Alternative would continue under the Proposed Alternative. Additionally, under this alternative, white-tailed deer, nilgai, cattle, horses, structures and areas where livestock are housed or maintained, and locations where ticks may congregate or emerge, such as manure piles, would be treated with AFTS. These treatments would serve as an additional tool for the CFTEP to help prevent CFT infestations in the PQZ along the border of Texas and Mexico and areas in southern Texas where CFT outbreaks may occur. The proposed program area includes Brooks, Cameron, Dimmit, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kinney, Kleberg, La Salle, Live Oak, Maverick, McMullen, Starr, Val Verde, Webb, Willacy, and Zapata Counties.

AFTS is an all-natural soap-based insecticide for control of flies and ticks labeled for use on horses, dairy and beef cattle, and areas where livestock are kept. The product is composed of natural plant oils (Table 1) that strip the exoskeleton of the insect leading to immediate respiratory distress and soon eventually death (Arkion, 2024). The two main ingredients responsible for tick mortality and repellence are castor oil, which reduces the production of eggs, and leads to the mortality of ticks (Arnosti et al. 2011, Ghosh et al. 2013, as cited in (Maestas & Goolsby, 2024)); and geraniol, which in various forms is a repellant and significantly reduces the tick burden on cattle (Khallaayoune et al. 2009, Singh et al. 2018, Ibrahium et al. 2022, as cited in (Maestas & Goolsby, 2024)).

Per the criteria set by the U.S. Environmental Protection Agency (EPA)[4], AFTS qualifies as an exempt minimum risk pesticide product under section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and, as such, is exempt from regulation under FIFRA. Pesticides exempt under FIFRA section 25(b) are also exempt from pesticide registration in Texas.[5] The inert ingredients, mineral oil and potassium cocoate, are natural substances and safe to use. This product is available for purchase and use by the general public.

Table 1. Ingredients in Arkion Fly and Tick Spray.

Chemical Name	CAS Number	Weight %
Active ingredients		**30**
Castor oil	8001-79-4	12
Geraniol	106-24-1	8
Oil, peppermint	8006-90-4	5
Oil, clove	8000-34-8	5
Inert ingredients		**70**
Oils, mineral	8012-95-1	Trade secret
Potassium cocoate (soap base)	61789-30-8	Trade secret

Source: (Arkion, nd).

Under this alternative, sprayers would be strategically placed near corn feeders and at openings in fence crossings and areas where wildlife may congregate on private and public lands to treat CFT-infested wildlife (e.g., white-tailed deer and nilgai). AFTS would be applied directly onto white-tailed deer and nilgai by remotely activated sprayers, substantially reducing the tick burden on these important alternative hosts of CFTs. As part of the CFTEP under this alternative, cattle and horses also may be treated directly with AFTS. AFTS is effective for up to 14 days. Livestock structures and areas and other locations where ticks may be found could be treated with AFTS. Under all application scenarios, per the product label, AFTS would not be sprayed on feed, food or water sources (Arkion, nd). Additionally, under all use scenarios, AFTS will not be used within a minimum of 50 feet from any water bodies.

The proposed use concentrations for all application scenarios are shown in Table 2. The CFTEP consulted with Arkion, the manufacturer, regarding the proposed use of the product, particularly on white-tailed deer and nilgai as these applications are not on the current label. The CFTEP intends to use the current maximum concentration on the label for wildlife treatments but may decrease the concentration based on efficacy testing. AFTS is an exempt minimum risk pesticide product, so its uses are not regulated or need to be approved by EPA. It is safe to apply AFTS to

[4] See U.S. Environmental Protection Agency's Conditions for Minimum Risk Pesticides located at the following website: Conditions for Minimum Risk Pesticides | US EPA.
[5] Pesticide Product Registration, Texas Department of Agriculture website: Pesticide Product Registration (texasagriculture.gov)

animals that will be consumed, as castor oil and geraniol have food tolerance exemptions and clove and peppermint oil are ingredients that are exempt by EPA from the requirements under the edible fats and oil exemption found under 40 CFR 180.950(c).

Table 2. AFTS tick control uses and concentrations.

Use	AFTS Concentration
White-tailed deer, nilgai, direct	12 fl oz AFTS per gallon
Cattle, direct application	3-4 fl oz AFTS per quart 10–12 fl oz AFTS per gallon
Horses, direct application	6 fl oz AFTS per gallon, depending on horse size
Livestock structures and areas	3-4 fl oz AFTS per quart (375 sq ft per quart) 10-12 fl oz AFTS per gallon (1,500 sq ft per gallon)

fl oz – fluid ounces; sq ft – square feet
Source: (Arkion, nd)

The ATFS application scenarios under the preferred alternative are described, as follows:

Direct spray treatment of white-tailed deer at corn feeders

AFTS would be applied directly onto white-tailed deer by remotely activated sprayers at corn feeders. The sprayers would be the same as those described in Goolsby et al. (2019) but without the need for aerators (Figure 5). AFTS would be mixed in each 57-liter (15.1-gal) spray tank for direct application at the label rate of 10 to 12 fluid ounces concentrate per gallon (fl oz/gal) of water (Arkion, nd). Ultra-sonic sensors would set off the sprayers when triggered by deer approaching the corn feed tubes, applying AFTS from the rear of the animal to avoid eye contact. The pump is set to spray 180 to 250 milliliters (ml) (6.1-8.5 fl oz or 0.05-0.07 gal) of AFTS solution through 8 m (26.2 ft) of tubing on the ground to 3 spray nozzles. The Wylie 8005-VS spray nozzles emit a fine mist of solution for 15 seconds covering an area of approximately 9 m^2 (97 ft^2) (Goolsby et al., 2019; Goolsby & Shapiro Ilan, 2020).

The commercially produced 3-D Quik Hand™ cattle sprayer is a commercially available application device designed to funnel and slow animals as they pass through a sprayer (Figure 6) applying a low volume of pesticide solution that provides near-full coverage of the animal (Maestas & Goolsby, 2024). The 3-D Quik Hand sprayer could be used as an alternative to the remotely activated sprayers (described, above) to apply AFTS to wildlife and cattle. The sprayer is equipped with a 15-gallon tank and the spray is delivered through three nozzles. The 3-D Quik Hand cattle sprayer has an application rate of approximately 250 ml per animal each time they cross through the gate (Maestas & Goolsby, 2024). In order for the device to be used on white-tailed deer near treated corn feeders, the gate would need to be positioned such that deer have to pass through the spray box; this may be difficult in an open area where deer can't be directed through a discrete opening such as at fence crossings.

Whereas ivermectin-treated corn can only be used from February to July due to hunting season, treatments with AFTS could be conducted year-round as it is safe to apply AFTS to animals that will be consumed.

Figure 5. Sprayers with ground nozzles to treat white-tailed deer at corn feeders.
Source: (Goolsby et al., 2022)

<u>Remotely activated spray treatment of wildlife at fence crossings</u>

AFTS would directly be applied on wildlife, including nilgai and white-tailed deer, by remotely activated sprayers located at fence crossings and areas where wildlife may congregate to control CFTs (Figure 7) (Goolsby et al., 2019). Wildlife would also be passively treated as they contact wet foliage and soil around the crossing. The battery powered sprayer is activated by sonic sensors that detect movement of nilgai passing by (Goolsby et al., 2019). These sprayers would be the same as those described for use on white-tailed deer at corn feeders. AFTS at a concentration of 12 fl oz/gal of water would be mixed in each spray tank (Arkion, nd). Treatments could be conducted year-round as it is safe to apply AFTS to animals that will be consumed.

Figure 6. 3-D Quik Hand™ sprayer.

Source: (Maestas & Goolsby, 2024).

<u>Direct application on cattle and horses</u>

AFTS would be applied directly to cattle and horses by CFTEP and TAHC employees by pressure sprayer, sponge (horses), or tank dipping (cattle). Cattle could also be treated through use of motion-activated sprayers, such as the 3-D Quik Hand™ sprayer (Figure 6). Use of AFTS would be particularly valuable where tick resistance to permethrin or other synthetic pesticides is observed and on horses with coumaphos sensitivity. A solution of 10 to 12 fl oz AFTS per gal would be applied to thoroughly wet the coat of cattle. For horses, 6 fl oz AFTS per gal of water would be applied, particularly to the topline, underline, flanks, withers and other infested areas while avoiding the face or genitalia. The AFTS label recommends that approximately 8 fl oz of solution should be used per horse, depending on size. Treatments may be repeated at intervals of 5 to 12 days or as reinfestation warrants. Per the product label, cattle and horse feed, food, or water sources would not be sprayed.

Figure 7. (A) Nilgai transiting fence crossings. (B) Night-time transit of nilgai across wetted grass. (C) Fence crossing showing set up of sprayer adjacent to fence crossing. (D) Sprayer nozzle strip applicating solution (Goolsby & Shapiro Ilan, 2020).

<u>Livestock structures and areas and other locations</u>

AFTS would be applied directly to livestock structures and areas and other areas where ticks may congregate or emerge. Per the AFTS label, the product can be used on structures and areas where livestock are kept, such as stalls, barns and other structural areas, dairy areas, areas around cattle, as well as manure piles and other places where flies and ticks may congregate or emerge. Under the preferred alternative, CFTEP and TAHC employees would use a backpack or mechanical sprayer to apply AFTS solution mixed at the label-specified rates (Table 2), 3-4 fl oz AFTS per quart (covering 375 sq ft per quart) or 10-12 fl oz AFTS per gallon (covering 1,500 sq ft per gallon), on these locations. Following the label instructions, feed, food or water sources would not be sprayed directly. Treatments would be repeated as necessary.

3 Affected Environment

The “affected environment” is considered the environment of the area(s) to be affected or created by the alternatives under consideration. This chapter describes the existing physical and social conditions in the proposed program area. To make an informed decision about which actions to take, it is necessary for a federal agency to understand who and what may be affected.

In this section, APHIS summarizes the potentially affected environment, including the physical, biological, and human environment, of the counties in the proposed program area in South Texas: Brooks, Cameron, Dimmit, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kinney, Kleberg, La Salle, Live Oak, Maverick, McMullen, Starr, Val Verde, Webb, Willacy, and Zapata Counties.

3.1 Soil

According to the Texas State Historical Association, Jim Wells, Kinney, Maverick, Webb, and Zapata counties lie within an area designated as the Rio Grande Plain, located within the Gulf Coastal Plains region of Texas. The Rio Grande Valley includes Cameron, Hidalgo, Starr, and Willacy Counties, while Val Verde is part of the Edwards Plateau (Figure 8; (TSHA, 2015)).

As part of the Coastal Plain Physiographic Province in Texas, this region’s mean annual soil temperature regime is hyperthermic, and the soil moisture regime is aridic and ustic. Alfisols, Inceptisol, Mollisol, and Vertisol soil orders dominate the proposed program area (TAMU, 2024). Soils of the Rio Grande Plain are typically deep, fine- to coarse-textured, and well drained, with limited soil moisture available for use by vegetation during the growing season (McNab & Avers, 1994). Soils range from alkaline to slightly acidic clays and clay loams. Table 3 summarizes the soil characteristics of each county (TSHA, 2015).

3.2 Vegetation

Throughout the proposed action area, the vegetation is relatively consistent except near the coast. Grasslands and temperate deciduous shrublands generally are associated with the average annual rainfall levels occurring in the proposed action area. Vegetation in the South Texas Plains area is primarily live oak, mesquite, brush, cacti, and grasses. The Edwards Plateau is predominantly short grasses, mesquite, and cacti. Val Verde County has desert shrubs or juniper, oak, and mesquite savanna. Along the Gulf Coast, in Willacy County, the vegetation shifts to cordgrasses, seashore saltgrass, and marsh millet. In Cameron County, Gulf Prairie and Marsh vegetation consists of predominantly marsh grasses, bluestems, and grama grasses (TSHA, 2015). The general types of vegetation found in each county are described in Table 3.

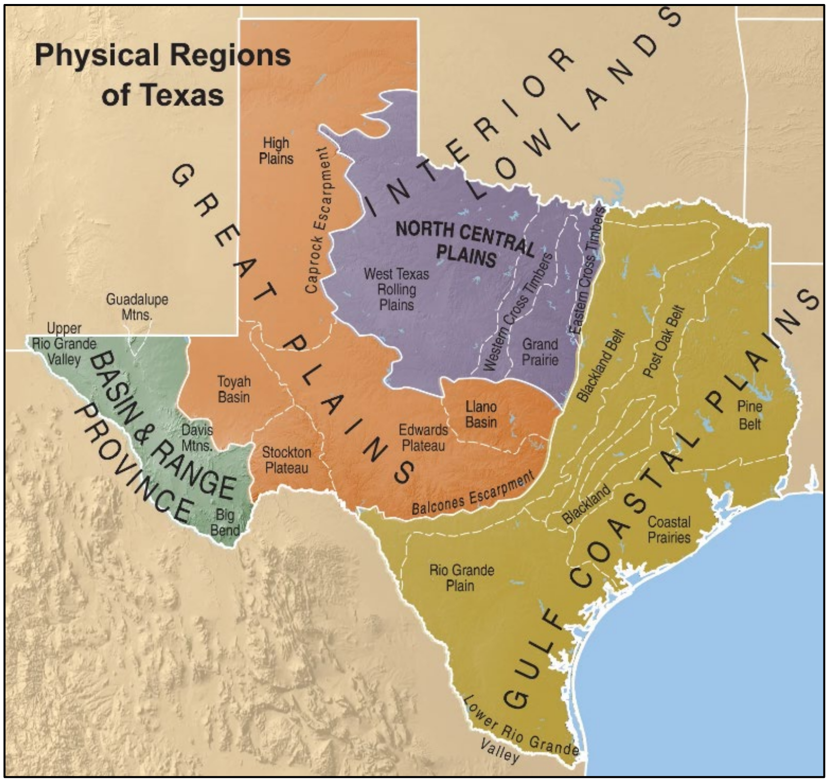

Figure 8. Physical regions of Texas.

Source: (Texas Almanac, nd; TSHA, 2015)

Table 3. Summary of land characteristics in the proposed action area.

County	Land area (square miles)	Elevation above sea level (feet)	Predominant soil types	Vegetation
Brooks	942	100-400	Poorly drained, dark and loamy or sandy soils, with isolated dunes. Northeast corner of the county: soils are light-colored and loamy at the surface and clayey beneath	South Texas Plains - live oaks, mesquite, brush, weeds, cacti, and grasses.
Cameron	905	0-60	Brownish to reddish soils, with loamy to clayey surface layers, and clayey subsoils. Eastern edge: soils sandy and saline, with some cracking clay	Gulf Prairie - small trees, brush, weeds, and grasses found in abundance, also, mesquite, live oak, post oak, and shrubs; and Marsh - marsh grasses, bluestems, and grama grasses
Dimmit	1,307	500-800	Nearly level area soils are loamy and sometimes poorly drained; rolling south central soils are loamy to clayey	Mesquite, small trees, scrub brush, cacti, grasses

County	Land area (square miles)	Elevation above sea level (feet)	Predominant soil types	Vegetation
Duval	1,795	250-800	In the North: loamy cracking or crumbly clayey soils, deep to moderately deep, that overlie indurated caliche. In the West: deep soils with loamy surface layers and loamy or clayey subsoils, and loamy soils with indurated caliche at shallow to moderate depths. In the East: poorly drained loamy soils and well-drained dark soils with loamy surface layers and clayey subsoils	Small trees, brush, shrubs, cacti
Hidalgo	1,596	40-200	In the North: sandy and light loamy soils over deep reddish or mottled clayey subsoils. Limestone may lie within 40 inches of the surface. In the South, soils moderately deep to deep loamy surfaces over clayey subsoils. Along the Rio Grande: brown to red clays	South Texas Plains - live oaks, mesquite, brush, weeds, cacti, and grasses.
Jim Hogg	1,136	200-800	Mostly loamy surfaces over deep reddish or mottled clayey subsoils, with limestone near the surface. In the East: many soils sandy with areas of light color	Mesquite, scrub brush, grasses, chaparral
Jim Wells	845	200-400	Generally light to dark, with loamy surfaces over reddish, clayey subsoils and limestone forty inches below the surface. Gray to black, cracking, clayey soils in some areas	South Texas Plains - live oaks, mesquite, brush, weeds, cacti, and grasses.
Kenedy	1,389	0-100	Generally sandy with areas of light-colored loamy surfaces over very deep reddish or mottled clayey subsoils. Gulf Coast soils sandy and salty, with areas of gray to black, cracking clay	Brush and scrubby mesquite; some huisache, acacia, post oak, and live oak. Along the coast: seacoast bluestem, cordgrasses, saltgrass, and marsh millet
Kinney	1,359	1,000-2,000	In the North: rocky and hilly with some loamy soils. Northeastern corner: dark, loamy soils over limestone. In the South: gray to black, crackling, clayey soils over limestone with some light-colored loamy soils	In northeast, Edwards Plateau - short grasses, mesquite, and cacti predominating; or South Texas Plains - short to mid-height grasses, thorny

County	Land area (square miles)	Elevation above sea level (feet)	Predominant soil types	Vegetation
				shrubs, cacti, and mesquite
Kleberg	853	0-150	Clay and loam soils	Brush as huisache, mesquite, and ebony
La Salle	1,517	400-600	In the Northwest: deep to moderately deep, often light-colored loams that overlie clayey subsoils, in places, limestone only forty inches beneath the surface. In the Southeast: cracking, clayey soils vary from light to black in color	Mesquite, small live oak, and post oak trees, scrub brush, cacti, and grasses
Live Oak	1,057	70-400	In the East: light and dark loamy soils overlie cracking, clayey subsoils. In the Northwest: gray to black clayey soils cover a layer of limestone. Other areas: light to dark loamy soils covering reddish subsoils	Grasses, mesquite, blackbrush, prickly pear, post oak, and small live oak
Maverick	1,287	540-960	Gray to black, cracking and clayey with high shrink-swell potential. Some areas are light colored and loamy soils with limestone bedrock	Short to mid-height native grasses, mesquite, live oak, cat's claw, huajilla, cenizo, and prickly pear are the predominate flora.
McMullen	1,159	150-450	Some areas light to dark loamy soils cover reddish, clayey subsoils, with limestone within forty inches of the surface. Other areas cracking, grey to black clayey soils	Mesquite, scrub brush, cacti, chaparral, and grasses
Starr	1,226	200-400	In the Northeast: sandy or light-colored and loamy soils over very deep, reddish or mottled clayey subsoils. Central region: light-colored, deep to moderately deep, and well drained. In the Southwest: gray to black cracking clay, limestone within forty inches of the surface. Along the Rio Grande: brown to red loams cover cracking clayey soils	South Texas Plains-live oak, mesquite, brush, cacti, and grasses
Val Verde	3,150	2,248-2,925	Dark, calcareous stony clays and clay loams	Desert shrub savanna. In the East: juniper, oak, and mesquite savanna
Webb	3,363	400-700	Primarily clayey and loamy	Grasses, mesquite, thorny shrubs, and cacti

County	Land area (square miles)	Elevation above sea level (feet)	Predominant soil types	Vegetation
Willacy	589	0-50	Dark brown to red loam over deep clayey subsoils. Along the Gulf Coast: sandy and saline (cracking)	Mesquite grasses, thorny shrubs, and cacti
Zapata	999	200-700	light-colored loamy soils over reddish or mottled clayey subsoils; in places, limestone is within forty inches of the surface	Thorny shrubs, grasses, mesquite, and cacti

Source: (TSHA, 2015).

3.3 Water Resources

The overall project area includes reservoirs, streams, rivers, and ephemeral (short-lived), intermittent, and perennial drainage features that are considered jurisdictional waters of the United States subject to Clean Water Act regulations (40 CFR §§ 136, 230-233). The Texas Surface Water Quality Standards developed by the Texas Commission on Environmental Quality (TCEQ) set State regulations to enforce the Clean Water Act.[6] The standards specify criteria for evaluating the quality of surface water, including dissolved oxygen, temperature, pH, dissolved minerals, toxic substances, and bacteria (TCEQ, nd).

A watershed is an area of land that water flows across, through or under on its way to a stream, river, lake, estuary, or ocean. A river basin encompasses the area where a river and all its tributaries drain. River basins are made up of a number of interconnected watersheds. The proposed action area is located in these river basins: (a) Rio Grande Basin, (b) Neuces River Basin, and (c) Nueces-Rio Grande Coastal Basin (Figure 9) (TWDB, 2024a). These three river basins drain all or parts of the following counties included in the proposed action area (TSHA, 2021):

- Rio Grande Basin: Dimmit, Hidalgo, Jim Hogg, Kenny, Maverick, Starr, Val Verde, Webb, and Zapata;
- Nueces River Basin: Dimmit, Duval, Kenney, La Salle, Live Oak, Maverick, McMullen, Webb, and Zapata; and
- Neuces-Rio Grande River Basin: Brooks, Cameron, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kleberg, Starr, Webb, and Willacy.

[6] The Texas Surface Water Quality Standards are codified in Title 30, Chapter 307 of the Texas Administrative Code

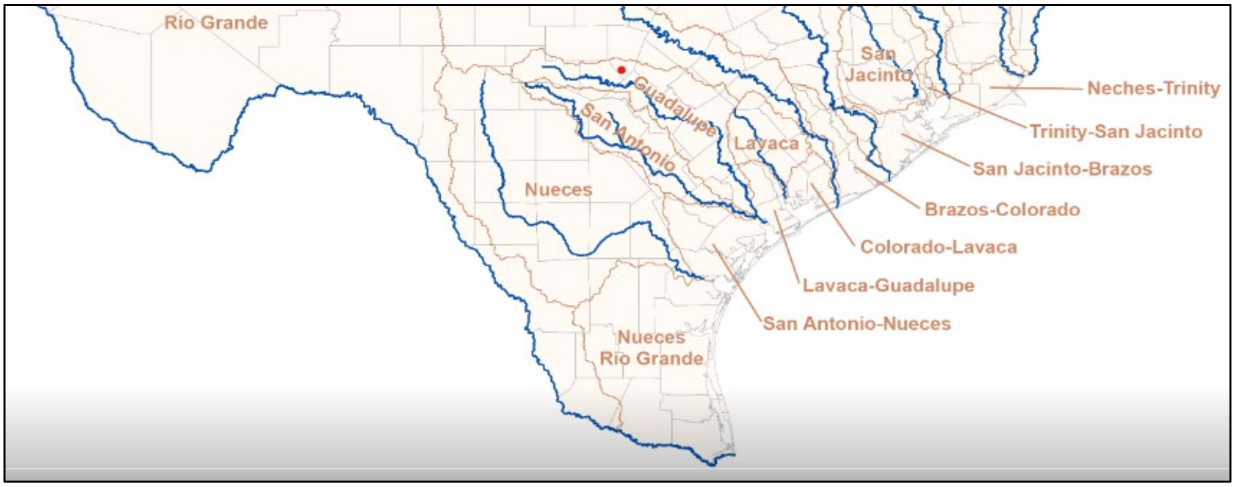

Figure 9. Southern Texas river basins.

Source: (TWDB, 2024a)

The major rivers located within the proposed action area include portions of the Rio Grande and Nueces. With about 1,901 miles in length, the Rio Grande is fifth longest river in the United States. The Rio Grande begins in Colorado, passing through New Mexico, forming part of the Texas and the U.S.-Mexican border, and eventually flowing into the Gulf of Mexico. The Pecos and Devils Rivers flow into the Rio Grande at the Amistad Dam and Reservoir in Val Verde County (TWDB, nd).

The Nueces River flows to Nueces Bay at Corpus Christi, draining into the Gulf of Mexico. The Frio and the Atascosa are the main tributaries of the Nueces River joining it in Live Oak County. Under the Texas Water Code (§ 16.051[f]), segments of the Nueces and Frio River have been designated by the Texas Legislature as unique river segments of unique ecological value such that state agencies or political subdivisions of the state may not construct reservoirs at these locations (TWDB, 2021).

The main lakes and reservoirs located in the proposed program area are shown in Table 4. The two major reservoirs are the Amistad Reservoir in Val Verde County and Falcon Lake in Zapata County. Water use from these reservoirs is prioritized by the purpose of the use, with municipal and industrial rights having priority over irrigation during droughts. This differs from most of Texas, where the water appropriation system gives superior rights to those who first used the water (TWDB, 2021). The sites in the proposed action area that are designated as unique value for constructing reservoirs and subject to the Texas Water Code § 16.051(g-1) are the Nueces Off-Channel Reservoir and the Brownsville Weir and Reservoir in Cameron County (TWDB, 2021).

Table 4. Main lakes and reservoirs in the proposed action area.

Waterbody name	Basin	Texas counties	Capacity	Uses	Additional information
Anzalduas Channel Dam	Rio Grande River	Hidalgo	16,400	flood control; diverts U.S. water share to other areas	On Rio Grande River; shared by United States and Mexico
Amistad International Reservoir	Rio Grande River	Val Verde	3,226,704	flood control, water conservation, recreation, electrical power	On Rio Grande River; allocation is 56.2% to the United States and 43.8% to Mexico
Choke Canyon Reservoir	Nueces River	Live Oak, McMullen	662,821	municipal water, recreation	On Frio River, major tributary of the Nueces River
Delta Lake (Reservoir)	Nueces-Rio Grande River	Hidalgo Willacy	14,000	irrigation	Two separate reservoirs jointed by canal; water diverted by canal system from Rio Grande in Cameron County.
Falcon International Reservoir	Rio Grande River	Zapata	2,666,203	flood control, water conservation, hydroelectric energy, recreation	On the Rio Grande River; Texas has 58.6% of storage capacity.
Lake Casa Blanca	Rio Grande River	Webb	20,000	recreation	On Chacon Creek, a tributary of Rio Grande
Lake Corpus Christi	Nueces River	San Patricio, Jim Wells, Live Oak	254,732	municipal water, recreation	Dam and lake on Nueces River. Owned and operated by city of Corpus Christi
Loma Alta Lake	Nueces-Rio Grande River	Cameron		municipal water, industrial water, recreation	

Waterbody name	Basin	Texas counties	Capacity	Uses	Additional information
Upper Nueces Lake (Reservoir)	Nueces River	Zavala	5,200	municipal, irrigation, recreation	Operated by the Zavala and Dimmit Counties Water Improvement District No. 1

Source: (TWDB, 2024b).

Minor water bodies include streams and arroyos. Secondary streams in the counties of interest (TSHA, 2021) include:

- Howard Draw – Val Verde,
- Johnson Draw – Val Verde,
- Los Olmos Creek – Duval, Kenedy, Kleberg,
- Palo Blanco Creek – Jim Hogg, Duval, Brooks, Kenedy, and
- Turkey Creek – Kinney, Dimmit.

In compliance with Section 305(b) and 303(d) of the Clean Water Act (CWA), TCEQ uses data collected during a specific time to assess water bodies in the state, identifying those that do not meet the uses and criteria defined in the Texas Surface Water Quality Standards. Water quality impairments include high levels of total dissolved solids, bacteria, algal growth, copper, sulfate, or chloride; depressed dissolved oxygen; mercury, dioxin, or polychlorinated biphenyls in tissue. Each water quality parameter is assigned one of five categories reflecting the status of the water quality. Waters falling into Category 5 are added to the 303(d) List of Impaired Waters for which total maximum daily loads or other management strategies may be needed. Results are submitted to EPA biennially (TCEQ, 2022a). The 2022 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d) indicates that surface waters within the 19 counties in the proposed action area contain waterways that are classified as impaired (TCEQ, 2022b).

Federal activities must seek to avoid or mitigate actions that would adversely affect wild and scenic rivers or areas immediately adjacent to the designated rivers (National Wild and Scenic Rivers Act of 1968, as amended (16 U.S.C. §§ 1271-1287)). There are 196 miles of the Rio Grande extending from Mariscal Canyon to the Terrell/Val Verde County line designated as a wild and scenic river. The National Park Service administers 191.2 miles of the Rio Grande River in Texas as part of the National Wild and Scenic Rivers System (NWSRS, n.d.). Riverine habitat may surround or be adjacent to tick-infested premises. Portions of the scenic Devils River and Pecos River flow through Val Verde County and into the Amistad Reservoir on the Rio Grande (TSHA, 2021).

There are four major and three minor aquifers in the South Texas region (George et al., 2011). The following major aquifers are located in all or parts of counties that are part of the area where the CFTEP action is being proposed:

- Carrizo-Wilcox Aquifer – Dimmit, La Salle, Live Oak, Maverick, McMullen, and Webb;
- Edwards Aquifer (Balcones Fault Zone) – Kinney;
- Edwards-Trinity (Plateau) Aquifer – Kinney and Val Verde.
- Gulf Coast Aquifer – Brooks, Camerron, Duval, Hidalgo, Jim Hogg, Jim Wells, Kleberg, Kenedy, Live Oak, McMullen, Starr, Webb, Willacy, and Zapata;

The Yegua-Jackson Aquifer is a minor aquifer reported within the proposed action area with outcrops[7] in La Salle, McMullen, Starr, Webb, and Zapata Counties, with small spots in Duval and Jim Hogg (Davidson & Mace, 2006; George et al., 2011). Subcrop areas of the Sparta and Queen City Aquifers are also found in La Salle and McMullen Counties (TCEQ, 2022c).

3.4 Air Resources

The Clean Air Act (CAA) is the comprehensive federal law that regulates air emissions from stationary and mobile sources (42 U.S.C. §7401 et seq. (1970). It protects the nation's air quality for the purposes of public health and welfare. Among other things, this law authorizes the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants. EPA has established NAAQS for six pollutants, known as criteria pollutants, including ozone, particulate matter less than or equal to 10 micrometers in diameter (PM_{10}), particulate matter less than or equal to 2.5 micrometers in diameter ($PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead. The status of air pollution in any area is based on whether that area is in attainment (compliance) or nonattainment (noncompliance) with the NAAQS.

To enforce requirements under the CAA, the EPA delegated responsibility for ensuring compliance of the NAAQS to local authorities. In Texas, the TCEQ monitors and regulates air quality. Counties in the proposed action area are in the following TCEQ Air Quality Control Area Regions (TCEQ, 2018):

Region 14: Jim Wells, Kleberg, and Live Oak,
Region 15: Brooks, Cameron, Hidalgo, Jim Hogg, Kenedy, Starr, and Willacy, and
Region 16: Dimmit, Duval, Kinney, La Salle, Maverick, McMullen, Val Verde, Webb, and Zapata.

[7] Outcrop areas are the part of an aquifer lying at the land surface.

Cameron, Hidalgo, Kleberg, Maverick, and Webb Counties were the only counties within the proposed action areas that reported Air Quality Index (AQI) values based on monitoring of NAAQS pollutants CO, SO_2, NO_2, ground-level O_3, $PM_{2.5}$, and PM_{10} in 2023 (see Table 5). These five counties reported AQI values of “Good” or “Moderate” (0 to 100) more than 98 percent of the time. Cameron County had six days with AQI values considered “unhealthy for sensitive groups” (101 to 150), while Maverick County had one day, and Webb County had five days. There were no days when the AQI values exceeded 151 with “Very Unhealthy” or “Hazardous” levels of concern (USEPA, 2023). $PM_{2.5}$, PM_{10}, and ozone were the only pollutants detected in these counties; however, none of the counties in the proposed program area are currently listed as nonattainment or maintenance areas for any NAAQS (USEPA, 2024a).

Table 5. AQI monitoring data for Cameron, Hidalgo, Kleber, Maverick, and Webb Counties in 2023.

County	**Days with AQI**	**AQI Good Days**	**AQI Moderate Days**	**AQI Unhealthy for Sensitive Groups Days**	**Days Ozone**	**Days $PM_{2.5}$ / PM_{10}**
Cameron	365	161	198	6	103	262 / 0
Hidalgo	357	206	151	0	19	338 / 0
Kleberg	329	190	139	0	0	329 / 0
Maverick	330	239	90	1	0	330 / 0
Webb	365	227	133	5	161	199 / 5

Source: U.S. EPA AQI reporting by County, 2023 (USEPA, 2023).

3.5 Human Health

Ticks are vectors of a wide number of human pathogens. However, CFTs do not pose a direct risk to human health in the program area as the protozoan parasites *B. bovis* and *B. bigemina* that transmit bovine babesiosis do not seem to be human pathogens (USDA APHIS, 2024a). Humans are not hosts of CFTs, although reportedly both *R. annulatus* and *R. microplus* can feed on human blood (Spickler, 2022a, 2022b). *R. microplus* is a vector for the severe fever with thrombocytopenia syndrome virus, which affects humans in Asia.

There are other ticks that may be found within the program area that bite and transmit bacteria, viruses, and parasites that cause diseases in humans. From 2019-2022, the following tickborne diseases have been reported within the proposed program area (CDC, 2024):

- Anaplasmosis,
- *Ehrlichia chaffeensis* (ehrlichiosis),
- Lyme disease, and

- Spotted fever rickettsiosis.

The American dog tick (*Dermacentor variabilis*), blacklegged tick (*Ixodes scapularis*), the brown dog tick (*Rhipicephalus sanguineus*), the Gulf Coast tick (*Amblyomma maculatum*), and the lone star tick (*Amblyomma americanum*) all have ranges that include southern Texas (CDC, 2025). Deer, cattle, and horses are hosts to two of these ticks: the blacklegged tick and the lone star tick.

The blacklegged tick is known to transmit the following pathogens that cause human diseases (in parentheses):

- *Anaplasma phagocytophilum* (anaplasmosis),
- *Babesia microti* (babesiosis),
- *Borrelia burgdorferi* and *B. mayonii* (Lyme disease),
- *B. miyamotoi* (hard tick relapsing fever),
- *Ehrlichia muris eauclairensis* (ehrlichiosis), and
- Powassan virus (Powassan virus disease).

Large mammals, including deer, cattle, horses, feral swine, and humans, can serve as hosts for adult blacklegged ticks (TickApp, n.d.-a).

Also found within the program area, the lone star tick (*Amblyomma americanum*) is known to transmit the following human diseases and may trigger alpha-gal syndrome (CDC, 2025):

- Bourbon virus,
- *Ehrlichia chaffeensis* and *Ehrlichia ewingii* (ehrlichiosis),
- Heartland virus, and
- *Francisella tularensis* (tularemia).

Larvae and nymphs of the lone star tick feed on small mammals and ground-frequenting birds, in addition to white-tailed deer and cattle. Adult ticks infest deer, cattle, horses, feral swine, sheep, dogs, and humans (TickApp, n.d.-c). White-tailed deer are a primary host and appear to serve as a natural reservoir for *E. chaffeensis* (TickApp, n.d.-c).

Human populations participating in outdoor activities in the counties included in the proposed action that could be exposed to ticks include adult and child residents, hunters, ranch workers, and CFTEP and TAHC employees. In general, tick exposure is not likely to occur on uninfested land. Ranchers and those working with livestock are at increased risk of tick exposure when they travel across tick-infested areas or encounter infested stray livestock or wildlife. Compared to other areas of the country (e.g., Northeast, Midwest), reported cases of tickborne disease in the program area are very low (CDC, 2024). Climate, weather, and land use are factors that may affect the density and range of ticks, so the presence of ticks and the infectious diseases they carry could change in the future.

If tick populations establish in their pastures, people working with livestock in those areas are likely to be exposed to CFTs and other ticks found on livestock. CFTEP and TAHC employees could be exposed to these ticks while performing their work duties. Extra precautions can be taken to prevent tick bites, including:

- Wearing long light-colored pants and tucking the pants into socks or boots.
- Applying tick repellant to exposed skin or permethrin to clothes and gear;
- Immediately showering after exposure to tick habitats and washing and/or drying clothing at high temperatures; and
- Performing a careful body check for ticks (OSHA, 2022).

3.6 Agriculture and Livestock

Except for Cameron, Dimmit, Maverick, and Zapata Counties, all counties in the proposed action area have 50 percent or more of their total land acreage used for farmland which may include cropland, pastureland, or other farming uses. Land acreage in farms, cropland, and pastureland for each of the 19 counties of interest is shown in Table 6 (USDA NASS, 2022). For most counties within the proposed project area (except for Cameron, Hidalgo, and Willacy), the use of farmland for pastureland outweighs that for cropland (see Table 6). Brook, Duval, Jim Hogg, Kinney, Kleberg, McMullen, Val Verde, and Webb Counties use 50 percent or more of their land for pastures, with Duval, Jim Hogg, Kleberg, and Webb County using 75 percent or more (USDA NASS, 2022). Acreage in crops in Cameron, Hidalgo, and Willacy Counties ranges from 30 to 45 percent of the total land in those counties (USDA NASS, 2022). All the 19 counties produce forage as hay/haylage, and most produce grain crops, including corn, sorghum, wheat, oats, and rye. Assorted vegetables and cotton also are grown in many of these counties (USDA NASS, 2022). The top crops for each county, according to the USDA 2022 Census of Agriculture, are provided in Table 6.

A wide range of commercial livestock production in the counties of interest includes various poultry, cattle and calves, goats, hogs and pigs, horses and ponies, sheep and lambs. Livestock inventories for each county per the USDA 2022 Census of Agriculture are provided in Table 6 (USDA NASS, 2022). Of the 19 Texas counties included in this EA, Starr County has the highest number of cattle, ranking 71 out of 254 Texas counties that raise cattle. Webb and Kenedy Counties are also within the top 100 cattle producing counties within Texas (TexasCounties.net, 2022).

Table 6. County agricultural and livestock information in the proposed action area.

County	Land in farms (total) / cropland / pastureland (acres)	Top crops	Livestock inventory	Number of cattle, including calves (rank TX counties, of 254 total)
Brooks	372,375 / 11,328 / 333,912	Forage (hay/haylage); cotton; vegetables; watermelons; proso millet	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; sheep and lambs; turkeys	19,494 (#161)
Cameron	208,701 / 168,839 / 32,815	Sorghum for grain; cotton; corn for grain; sugarcane; forage (hay/haylage)	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	9,645 (#211)
Dimmit	344,379 / 41,629 / 285,275	Forage (hay/haylage); vegetables; cantaloupes and muskmelons; floriculture/bedding crops; bedding/annuals/ perennials	Cattle and calves; goats; horses and ponies; layers; sheep and lambs	9,447 (#213)
Duval	1,115,787 / 42,027 / 974,218	Forage (hay/haylage); sorghum for grain; cotton; cultivated Christmas trees; pecans	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	33,716 (#121)
Hidalgo	535,588 / 310,143 / 180,493	Corn for grain; cotton; vegetables; sorghum for grain; sugarcane for sugar or seed	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	33,018 (#123)
Jim Hogg	587,474 / 16,041 / 564,012	Forage (hay/haylage); sorghum for grain; oats for grain; corn for grain	Cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	20,377 (#157)

County	Land in farms (total) / cropland / pastureland (acres)	Top crops	Livestock inventory	Number of cattle, including calves (rank TX counties, of 254 total)
Jim Wells	398,796 / 116,011 / 219,873	Sorghum for grain; corn for grain; cotton; forage (hay/haylage); dry southern peas (cowpeas)	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets	28,174 (#133)
Kenedy	1,000,174 / (D) / (D)	Forage (hay/haylage); pecans	Cattles and calves; horses and ponies; layers	39,360 (#100)
Kinney	615,924 / 9,525 / 510,297	Forage (hay/haylage); grapes	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	7,753 (#223)
Kleberg	470,997 / 58,989 / 406,290	Sorghum for grain; cotton; forage (hay/haylage); corn for grain; sunflower seed	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	25,092 (#143)
La Salle	552,478 / 11,484 / 424,507	Forage (hay/haylage); olives; corn for grain; wheat for grain; nursery stock crops	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	11,909 (#201)
Live Oak	414,029 / 43,806 / 255,289	Forage (hay/haylage); corn for grain; cotton; sesame; sorghum for grain	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	28,697 (#131)
Maverick	329,643 / 13,233 / 258,975	Forage (hay/haylage); corn for silage/greenchop; pecans; cotton; rye for grain	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs	18,555 (#167)

County	Land in farms (total) / cropland / pastureland (acres)	Top crops	Livestock inventory	Number of cattle, including calves (rank TX counties, of 254 total)
McMullen	580,772 / 8,243 / 475,897	Forage (hay/haylage); corn for grain; sesame	Cattle and calves; goats; hogs and pigs; horses and ponies; layers; sheep and lambs;	13,132 (#189)
Starr	468,257 / 85,536 / 311,240	Sorghum for grain; forage (hay/haylage); corn for grain; sunflower seed; cotton	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	50,623 (#71)
Val Verde	1,417,386 / 4,197 / 1,404,446	Forage (hay/haylage); grapes; pecans; vegetables harvested; tomatoes in the open	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	11,537 (#204)
Webb	2,128,507 / 53,047 / 1,963,620	Forage (hay/haylage); wheat for grain; corn for grain; cotton; oats for grain	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs; turkeys	45,607 (#79)
Willacy	293,861 / 170,402 / 118,996	Sorghum for grain; cotton; corn for grain; forage (hay/haylage); sesame	Broilers and other meat-type chickens; cattle and calves; goats; hogs and pigs; horses and ponies; layers; pullets; sheep and lambs	13,909 (#183)
Zapata	287,324 / 5,980 / 264,004	Forage (hay/haylage); sugarcane for sugar or seed	Cattle and calves; goats; hogs and pigs; horses and ponies; layers; sheep and lambs	12,345 (#197)

Notes:
Total land area for each county is shown in Table 3.
(D) – Information withheld by Census of Agriculture to avoid disclosing data for individual operations.

Sources: Acreage, top crops, and livestock inventory from USDA Census of Agriculture, 2022 State and County Profiles – Texas (USDA NASS, 2022); number of cattle from Texas Counties and ranking from Map of Texas Counties by Cattle Population in 2022 (TexasCounties.net, 2022).

In addition to eliminating and repelling CFTs, AFTS is effective against other ticks, horn flies, house flies, stable flies, mosquitoes, and other insects. These pests can affect livestock health by making painful bites, producing wounds, transmitting diseases, affecting weight, and even causing mortality.

Heavy infestation of ticks on cattle results in a loss of condition (i.e., amount of subcutaneous body fat or energy reserve), failure to put on weight, and severe anemia (Johnson, n.d.). Tick bites are painful and irritating and can cause the infested animal to rub and scratch, resulting in a scabs, wounds, and, sometimes, secondary infections (Johnson, n.d.). Heavily livestock infestations may cause economic losses that can be significant. In addition to CFTs, other ticks that can affect the health of livestock in Texas include:

- Lone Star tick (*Amblyomma americanum*),
- Gulf Coast tick (*Amblyomma maculatum)*,
- Black-legged tick (*Ixodes scapularis*),
- Winter tick (*Dermacentor albipictus*), and
- Spinose ear tick (*Ixodes scapularis*).

White-tailed deer are the primary host of the adult Lone Star ticks, but they also infest cattle, horses, feral swine, sheep, dogs, and humans (TickApp, n.d.-c). The larvae and nymphs feed on small mammals and ground-frequenting birds, as well as white-tailed deer and cattle (TickApp, n.d.-c). The bite of the Lone Star tick can cause deep, irritating wounds (Johnson, n.d.). Heavy infestations can result in pain, discomfort, and severe suffering from the bites and animals may develop an anemic condition from loss of blood (Johnson, n.d.). These ticks can also kill white-tailed deer and transmit several diseases to humans (see Section 3.5, Human Health),

Gulf Coast tick nymphs may attach to large animals, including cattle; while adult ticks attach and feed on cattle, horses, deer, sheep, feral swine, coyotes, dogs, cats, and other carnivores (TickApp, n.d.-b). Adult ticks bite cattle mainly around the ears, eyes, and poll. Heavy infestations can injure the skin and may make the hides unusable (Swiger, 2012). In experiments, the tick has transmitted *Ehrlichia ruminatium*, which causes heartwater, a disease fatal to >80% of wild and domestic ruminants (TickApp, n.d.-b).

Black-legged tick larvae and nymphs mainly feed on small mammals, especially rodents, birds, and lizards (TickApp, n.d.-a). Also known as deer ticks, adult black-legged ticks will feed on large mammals, including deer, cattle, horses, feral swine, and humans. The ticks can transmit *Anaplasma marginale* (bovine anaplasmosis) to cattle and *Anaplasma phagocytophilum* to horses.

The winter tick is a one-host tick that attacks during the winter and late fall. Heavy infestations of this tick cause blood loss that can lead to anemia or even death.
Spinose ear ticks (*Octobius megnini*) often infest livestock, especially cattle and horses, and domestic and wild ruminants (Swiger, 2012). The larvae and nymphs attach in the inner folds of the outer ear where they suck blood. These ticks attach deep within the ears and cause intense irritation, wax accumulation, and excretions that can lead to ear infections (Swiger, 2012). The wounds may become infected with pus-forming organisms resulting in a condition known as canker ear. In an attempt to relieve the irritation, infested animals shake their heads and rub their ears. Animals become dull, fail to grow and develop normally, and lose weight because of the constant irritation. Spinose ear ticks do not transmit disease (Johnson, n.d.).

Flies can bite and feed on cattle and, just like ticks, cause discomfort and health issues. Stable flies can inflict painful bites to livestock, feeding on blood once a day. Their irritating bites can affect healthy weight gain and milk production in cattle (Swiger, 2012). Horn flies will bite cattle, feed on their blood, and tend to stay on their host animal, feeding 30 to 40 times per day. The bites can lead to cattle weight loss and wounds that blemish their hides (Swiger, 2012). While house flies do not bite, they can infest open wounds and spread pathogens, such as *E. coli*, to livestock (Swiger, 2012). New World screwworm (NWS) (*Cochliomyia hominivorax*) larvae burrow into the tissue of living animals causing extensive damage or feed on fresh carcasses. Female flies lay eggs in on open wounds or other parts of the body in live, warm-blooded animals, primarily livestock, but also birds and humans. Although the NWS has been eradicated in the United States, it is endemic in Cuba, Haiti, the Dominican Republic, and countries in South America and could be reintroduced into the United States.

3.7 Wildlife

The 19 counties in the program occur within the South Texas Plains, Gulf Coast, and Big Bend County Regions (TPWD, n.d-f)). Table 7 details the species that occur within these natural regions. In addition to these wildlife species, exotic species such as the blackbuck and nilgai antelope; axis, fallow, and sika deer; aoudad and mouflon sheep; feral swine (Sheffield, 2013), and red deer or wapiti (Pound et al., 2010) occur within these natural regions. Exotic species and wildlife serving as tick hosts present a threat to the CFTEP by compromising the success of ongoing eradication efforts. Reducing population levels of potential hosts limits the likelihood that CFT host populations will move northward and spread CFTs into new regions.

Table 7. Common regional wildlife in the proposed action area.

Region	Mammals	Reptiles and Amphibians	Birds	Fish and Aquatic Species	Invertebrates, Insects, and Arachnids
Big Bend Country	• Pronghorn antelope • Squirrel • Hooded skunk • Coyote • Javelina • Desert bighorn sheep • Mule deer • Mountain lion • Cactus mouse • Townsend's big eared bat • Jackrabbits • Black bear • Greater long-nosed bat	• Mexican Burrowing toad	• Cactus wren • Roadrunner/ Painted redstart • Pyrrhuloxia • Great horned owl • Vermilion flycatcher • Bullock's oriole • Peregrine flacon • Montezuma quail • Mexican spotted owl	• Rio Grande tetra • Catfish • Green sunfish • Comanche Springs pupfish • Leon Springs pupfish • Pecos Gambusia • Big Bend Gambusia	• Tarantula
South Texas Plains	• Jaguarundi • Ocelot • White-nosed coati	• Texas tortoise • Leopard frog • Indigo snake • Texas longnose snake	• Chachalaca • Caracara • Road runner • Ferruginous pygmy-owl • Green jay • Elf owl • Grooved-billed Anis • Redwing blackbird	• Catfish • Sunfish	• Swallowtail butterfly
Gulf Coast	• Muskrat • Coyote • Marsh rice rat • Mink • River otter • Bottlenose dolphin	• Alligator • Diamond back terrapin • Bull frog	• Roseate spoonbill • Black skimmer • Gulls • Terns • Pelicans • Prairie chicken • Easter brown pelican • Eskimo curlew • Piping plover • Whooping crane	• Spotted sea trout • Red drum • Southern flounder • Striped mullet • Sheepshead • Shrimp • Blue crab • Snappers • Spadefish • Groupers	None listed

Source: Common wildlife Big Bend Country (TPWD, n.d-a)); South Texas Plains (TPWD, n.d-e)); and Gulf Coast (TPWD, n.d-c)).

The Wildlife Division of Texas Parks & Wildlife Department (TPWD) manages 50 Wildlife Management Areas (WMA) encompassing approximately 748,768 acres of land. The WMAs serve as representative locations of the habitats and wildlife found in each ecological region of Texas. WMAs provide sites to "perform research on wildlife populations and habitat, conduct education and demonstrations of sound resource management techniques, and to provide public hunting, hiking, camping, bird watching and a host of other outdoor recreational opportunities (TPWD, n.d-g)."

Portions of Cameron, Hidalgo, Starr, and Willacy Counties are part of the Las Palomas WMA, Lower Rio Grande Valley Units managed by TPWD. The 3,311 acres of land in the Las Palomas WMA preserves native brush nesting habitat, some farmland, and wetlands for white-winged doves. There are 18 units in the WMA with tracts ranging from two to 604 acres in size. Las Palomas WMA features hiking, hunting, and wildlife viewing (TPWD, n.d-h).

TPWD manages WMAs in portions of La Salle and Dimmit Counties as part of the Chaparral WMA. The Chapparal WMA encompasses 15,200 acres of South Texas brush country in La Salle and Dimmit Counties approximately 100 miles southwest of San Antonio. Chaparral WMA serves as a research and demonstration area for the Rio Grande Plains ecological area (TPWD, n.d-b).

TPWD manages the James E. Daughtrey WMA located in portions of Live Oak and McMullen Counties. The WMA is a 34,000-acre multiple-use recreational area located midway between San Antonio and Corpus Christi. The Choke Canyon Reservoir is part of the WMA covering 25,733 acres, The James E. Daughtrey WMA is representative of South Texas habitats and is a component of the South Texas Ecosystem Project. The Reservoir serves as a habitat for migrating species, including various species of waterfowl. The WMA surrounding Choke Canyon Reservoir, excluding the state park units and area associated with dam operations (TPWD, n.d-d)

There are no WMAs in Jim Wells, Kinney, Maverick, Val Verde, Webb, and Zapata Counties (TPWD, n.d-h).

4 Potential Environmental Consequences

This chapter focuses on the potential environmental consequences associated with the use of AFTS on CFT-infested wildlife (i.e., white-tailed deer and nilgai), cattle and horses, and livestock areas (e.g., barns, pens, corrals). The potential effects may be direct or indirect, adverse or beneficial, and of short or long duration. Potential effects are evaluated for the proposed program area in South Texas: Brooks, Cameron, Dimmit, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kinney, Kleberg, La Salle, Live Oak, Maverick, McMullen, Starr, Val Verde, Webb, Willacy, and Zapata Counties. Previous EAs have evaluated the effects of the CFTEP ongoing CFT control methods, while this EA analyzes the potential effects on the human environment associated with adding this additional treatment method.

If white-tailed deer and nilgai could be repeatedly treated with AFTS, the compound could substantially reduce the tick burden on these important alternative hosts of CFTs. Currently, the only treatment methods available are population control for nilgai and ivermectin, permethrin, and population control for white-tailed deer. AFTS would provide an alternative to the synthetic insecticides currently used on wildlife and livestock, helping decrease the risk of ticks developing resistance to these insecticides. Without the CFTEP's efforts to add additional effective CFT controls, CFT infestations are likely to continue to rise and may extend out past the currently impacted Texas counties.

Descriptions and uses of AFTS and its individual active and inert ingredients, their physical and chemical properties, and environmental fate properties are provided in Appendix B. The data on AFTS and the ingredients found in the AFTS formulation are used to develop a human and ecological health risk assessment providing a qualitative evaluation of the potential risks and hazards to human health and non-target organisms based on the proposed uses on CFTs. Where applicable, the properties of AFTS and its components and the results of the human and ecological health risk assessment are cited throughout Section 4, while the details are presented in Appendix B.

4.1 Physical Environment

Potential effects from the use of AFTS on the physical environment are not anticipated based on CFTEP's proposed use patterns and the ingredients that compose AFTS. The product active ingredients, geraniol, castor oil, clove oil, and peppermint oil (see Table 2), are naturally occurring plant-derived oils diluted with water to low concentrations and applied at low volumes. EPA considers these substances to be active ingredients permitted in exempted minimum risk pesticides (40 CFR 152.25), posing little or no risk to humans and the environment. These substances are also exempt from the requirement of a tolerance and can be applied to food crops (40 CFR 180), further indicating their safety. Additionally, EPA has waived many of the biochemical pesticide nontarget organism and environmental fate data requirements for vegetable and flower oils, including castor oil, geraniol, and clove oil as a result of their low risk (USEPA, 2011c).

Mineral oil and potassium cocoate are listed as inert ingredients in AFTS. Mineral oil is a byproduct of the petroleum distillation process; it is considered an inert ingredient by EPA and exempt from the requirement of a tolerance when used on crops pre- and post-harvest (40 CFR 180.910). Potassium cocoate is listed on EPA's Safer Chemical Ingredient List [8](USEPA, 2024b) and has been verified to be of low concern based on experimental and modeled data. Potassium cocoate residues, as either an inert or an active ingredient, in a pesticide formulation are exempt from the requirement of tolerance under Federal Food, Drug, and Cosmetic Act (FFDCA) section 408 (40 CFR 180.950e) (USEPA, 2024).

4.1.1 Soil

Under both alternatives, minor soil disturbances would occur from vehicles driven by CFTEP and TAHC personnel to treatment locations and walking to conduct tick control activities. CFTEP and TAHC employees would primarily use existing vehicle access roads or paths while being careful to avoid soil or vegetation disturbance to the degree possible. If CFTs outbreaks increase, current CFTEP inspection and treatment activities would increase, and these associated minor soil disturbances would also increase. It is expected that the overall soil disturbances or compaction would continue to remain inconsequential.

Under the proposed alternative, CFTEP and TAHC employees would need to disturb surface soil to install the remotely activated sprayers. The automated gate cattle sprayer would not disturb soil as no tubing would need to be laid in the soil. Additional activities that may cause minor soil disturbances or compaction would include refilling or replacing the tanks of automated sprayers, performing maintenance on the automated sprayers, and applying AFTS to livestock and areas where ticks may be found. These activities are likely to occur on previously disturbed ground, including at automated corn feeder locations, fence crossings, barns, and cattle and horse pens/corrals, so little to no additional soil disturbance or compaction is expected.

Under the proposed alternative, due to the low concentrations of the active ingredients and small volume of the mixture used, the AFTS solution is expected to have negligible effects on soil quality. As noted in section 4.1, the active ingredients in AFTS are derived from natural sources and are recognized as being safe to use in the environment. Castor oil, clove oil, and geraniol are not persistent in soil. Peppermint oil is persistent with a half-life in soil of 180 days (Baker et al., 2018b) but is readily biodegradable (Sigma-Aldrich Corporation, 2024a)and would be present at a very low concentration in diluted AFTS solutions.

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[8] EPA's Safer Chemical Ingredient List is located at: https://www.epa.gov/saferchoice/safer-ingredients

The inert ingredients in AFTS, mineral oil and potassium cocoate, are natural substances and also safe to use in the environment; they are not expected to persist in soil. The low solubility and volatility of mineral oil make it more likely to be found in the soil or other terrestrial environments, where it is slowly broken down through metabolic processes (USDA NOP, 2021; USEPA, 2007). Potassium salts of fatty acids are not persistent in the environment with a soil half-life of less than one day, due to being rapidly degraded in the soil by microbial organisms (NPIC, 2001). As with the active ingredients in AFTS, the inert ingredients are expected to have negligible effects on soil quality.

Given the proposed use patterns, dilution of AFTS concentrate in water, and generally low environmental persistence of the AFTS ingredients, the CFTEP anticipates minimal potential impacts to soil from applications of AFTS.

4.1.2 Vegetation

Under both alternatives, short-term disturbances of vegetation in areas where wildlife, livestock, and CFTs can be found may occur by CFTEP and TAHC personnel at treatment locations and walking to conduct tick control activities. CFTEP and TAHC employees would primarily use existing vehicle access roads or paths while being careful to avoid soil or vegetation disturbance to the degree possible. If CFTs outbreaks increase, current inspection and treatment activities would increase, and any associated minor disturbances of vegetation would also increase. Overall, these potential impacts are expected to be minor.

Some fence crossings and areas where wildlife may congregate have adjacent stands of vegetation (see Figure 8). Under the proposed alternative, CFTEP and TAHC employees may cause some minimal disturbances to vegetation when installing the automated sprayers in these locations, refilling or replacing the tanks of the sprayers, and performing maintenance on the sprayers. Potential use locations at automated corn feeders, barns, cattle and horse pens/corrals, and manure piles are already well-used, cleared areas, so no disturbance of vegetation is expected.

When testing the automated sprayers, it was noted that mist from the sprayers set to treat wildlife as they passed through established fence crossings also wet the surrounding foliage and soil. Water droplets on the foliage and soil can last for several hours in the warm, humid coastal environment in such as Cameron County (Goolsby & Shapiro Ilan, 2020), so any AFTS solution landing on nearby plants would be expected to also slowly evaporate. Based on the volume that will be used and concentrations of the active ingredients in AFTS, damage to surrounding plants is not expected. All the active and inert ingredients that make up AFTS are natural substances of minimal risk to the environment and can be safely used on food crops (see Appendix B). While concentrated or undiluted forms of peppermint and clove oil may have adverse effects on plants, the low, diluted amount of the oils in the AFTS mixture applied is not expected to cause damage to plants.

Given the proposed use patterns, dilution of AFTS concentrate in water, and generally low toxicity profile of the AFTS ingredients, the CFTEP anticipates minimal damage to plants where AFTS will be applied.

4.1.3 Water Resources

Under both alternatives, no impacts to water resources are expected as a result of CFTEP and TAHC personnel conducting CFT control activities. Threats to ground and surface water from pesticides used by the CFTEP are not anticipated because of the methods of application, adherence to label instructions, and program controls. For example, feeding stations with ivermectin-treated corn are placed at a minimum of 50 feet from any aquatic areas.

AFTS does not contain any substances regulated as pollutants pursuant to the Clean Water Act (Arkion, 2022). The active ingredients are not soluble in water and degrade in the environment (see Appendix B). In general, plant-derived oils are considered toxic to slightly toxic to fish (USDA APHIS WS, 2024; USEPA, 2011c). However, EPA indicated that they believe that label restrictions will prevent the application of products with these oils to aquatic sites, resulting in low exposure and low risk for aquatic organisms.

Under the proposed alternative, additional CFTEP activities would include installing and performing maintenance on the automated sprayers, refilling with AFTS, and applying AFTS to wildlife via automated sprayers and directly to livestock and livestock areas (e.g., corrals, barns). With the small volume, targeted applications, and affinity of the active ingredients to adhere to soil, the AFTS solution is unlikely to move from use locations into surface waters or leach into groundwater sources at levels that could impact human or aquatic health under the program’s conditions for use. In addition to following label restrictions that are protective of water sources and aquatic areas which include not applying the product directly to water, the CFTEP will use a minimum of 50-ft buffers from aquatic areas. As a result of these factors, no effects on water resources from the use of AFTS are expected.

4.1.4 Air Resources

Under both alternatives, the most common impacts on air quality would be from vehicles driven by CFTEP and TAHC personnel to locations to conduct tick control activities. Driving on unpaved or gravel roads can stir up dust, which has the potential to negatively impact air quality until the dust settles. Air pollution from this fugitive dust associated with vehicular traffic would occur in localized and specific areas, be intermittent, and short-term in duration (minutes). These effects would be negligible to minor and would not impact air quality or non-attainment areas in the program area. If CFTs outbreaks increase, current CFTEP inspection and treatment activities also would increase. A potential increase in associated air emissions from additional CFTEP activities requiring vehicle travel would be expected although these still would be minor.

Under the Proposed Alternative, additional activities that would increase vehicular traffic would include installing and performing maintenance on the automated sprayers, including refilling and replacing tanks. A small area of soil may be disturbed when installing the automated sprayer or replacing components of the sprayer, but this is not expected to result in any dust emissions.

The potential impacts from the applications of AFTS to air quality are not anticipated based on the proposed use patterns of AFTS and the environmental fate characteristics of its ingredients (see Appendix B). With the automated motion-activated sprayers, a limited volume of AFTS is released and aimed directly at the animal triggering the device. The spray nozzles emit a fine mist of solution for 15 seconds covering an area of approximately 9 m^2 (97 ft^2) (Goolsby et al., 2019; Goolsby & Shapiro Ilan, 2020). Similarly, when livestock is treated directly by automated sprayers or

As a result of the targeted applications, small volumes, and short durations of AFTS emitted, use of AFTS is not expected to result in drift. The spraying or application of AFTS does not result in the release of any air pollutants.

The active ingredients in AFTS are not volatile (except geraniol) or persistent in the atmosphere. Geraniol oxidizes upon exposure to air, forming contact (i.e., dermal) allergens that may cause skin sensitization in some individuals. The AFTS label notes that fumes, mist, vapors or spray should not be inhaled (Arkion, nd). Since AFTS is diluted in water and will be mixed and used following the label instructions where there is adequate ventilation, it is not expected to present any air quality impacts that would affect the environment or human health (see Section 4.2, Human Health and Safety, for discussion of inhalation risks).

4.2 Human Health and Safety

Under both alternatives, CFTs do not present a human health risk because humans do not serve as hosts of CFTs nor are they affected by *B. bovis* and *B. bigemina*. However, as discussed in Section 3.5, Human Health, wildlife, such as white-tailed deer, can be hosts to other ticks that can transmit human diseases - most notably the transmission of Lyme disease (caused by the bacteria *Borrelia burgdorferi*) which is vectored by deer ticks (*Ixodes scapularis*). Tick control measures used on wildlife and livestock to control CFTs also indiscriminately work on other ticks that may be present, thereby resulting in an added benefit to human health.

Under both alternatives, current CFT control methods would continue. Exposure to formulated acaricides and chemical residues from Federal actions is highly unlikely for residents, hunters, and ranchers because the use of these chemicals is only during pesticide treatment, access to treatment areas is restricted to authorized personnel, and residues are not readily released from animal hides. The CFTEP discontinues feeding deer ivermectin-treated corn 60 days prior to the start of the deer hunting season, limiting the treatment period from February through July. The withdrawal time of 60 days allows ivermectin residues in tissues to decrease to below the tolerance level set for white-tailed deer by hunting season.

For CFTEP treatment activities using pesticides, occupational exposures may potentially occur through incidental ingestion, inhalation, and dermal contact during mixing, loading, and application. Regardless of the type of acaricide that is used, personnel handling these chemicals must use all appropriate personal protective equipment and follow all required hygiene practices and precautionary measures. Program personnel that are applying, mixing, or loading pesticides are required to wear proper protective clothing and gear to preclude exposure.

The potential human health risks associated with the use of AFTS by the CFTEP are determined based on the toxicity of the product and the potential for exposure. The potential for exposure depends on APHIS' proposed application method and the environmental fate profile for AFTS. AFTS is an EPA exempted minimum risk pesticide, indicating that it poses little or no risk to humans and the environment. Reflecting its safety, the product is available for purchase and use by the general public. The physical and chemical properties, environmental fate, and toxicity of AFTS and the individual active and inert ingredients that compose AFTS are examined in Appendix B and used to evaluate the potential human health risk associated with use of the product. As discussed Appendix B and in the previous sections of this EA, APHIS does not anticipate impacts to soil, water, and air quality ultimately affecting human health associated with the proposed program use of AFTS.

For the general public, potential direct and indirect exposure to AFTS is unlikely due to the application methods and restricted access to locations where the product would be used. AFTS would be used on private properties, refuges, and other controlled public sites and not in areas that are easily accessed by the general public. The remotely activated sprayers would not be set up in areas commonly accessed by the general public. Sprayers targeting wildlife would be strategically placed on properties that have a restricted access point. Comparable security will be provided at refuges and other public sites. A sign in both English and Spanish will be posted if sprayers are placed on public lands. There is potential for a person to ignore the signage, however, with the minimum risk posed by AFTS and the small volume emitted by the automated sprayers when triggered, the risk is considered low. Livestock and livestock areas would be treated with AFTS on private properties where members of the general public would not be present. In general, the risk to the general public from direct contact exposure to AFTS is expected to be negligible.

There are no anticipated threats to ground and surface water that may be used as drinking water because of the physical, chemical, and environmental fate properties of AFTS and the proposed treatment methods (see Appendix B for exposure assessment and risk evaluation). Minor amounts AFTS residues may deposit on the soil; however, the levels in soil would be extremely small due to the low concentrations and dilution of the active ingredients. Automated sprayers or treatments areas would be located a minimum of 50 feet from any aquatic areas. It is unlikely that any AFTS residues would be transported this distance to any surface water used as a source for drinking water during a rain event. In addition, AFTS is unlikely to leach into groundwater or dissolve into surface water because, having low solubility, the active ingredients bind to soil and degrade in place by normal biological, physical, and/or chemical processes.

Dietary exposure through food and water intake is not anticipated (see Appendix B). Although most of the active ingredients in AFTS are classified as Generally Recognized as Safe (GRAS) and AFTS is exempt from residue tolerance limits, AFTS is not labeled for use on food crops and cannot be applied to water. Acute oral toxicity studies show that AFTS is not expected to present acute hazard through the oral route. Furthermore, consumption of animals treated with AFTS would also not result in human dietary exposure as the formulation is topically applied to their hides/coats and not ingested by the animals. There are no requirements for a withdrawal time prior to consumption of meat from wildlife or cattle treated with AFTS. Exposure to AFTS through contact with treated livestock or wildlife is not expected to be harmful to people. AFTS and the individual ingredients in the formulation have low or negligible dermal toxicity.

Under the Proposed Alternative, CFTEP and TAHC employees may potentially be exposed to AFTS when handling and mixing AFTS concentrate, filling tanks and hand-held sprayers with the AFTS mixture, installing and performing maintenance on automated sprayers, and applying the diluted AFTS to livestock, wildlife, or in livestock areas or structures. The potential occupational exposures and associated risk from AFTS are evaluated in detail in Appendix B.

The AFTS label includes the following precautionary statements:

> "Causes skin irritation and serious eye damage. May cause an allergic skin reaction. Suspected of causing genetic defects. Causes organ damage through prolonged or repeated exposure. If swallowed and enters airways, may be fatal. Wear protective clothing/gloves and eye/face protection when handling, mixing and applying this product. Do not breathe fumes, mist, vapors or spray. Thoroughly wash face, hands and any exposed skin after handling. Do not eat, drink or smoke when using this product. Take off contaminated clothing and wash clothing before reuse (Arkion, nd)."

Any exposure is expected to be mitigated through proper worker hygiene, use of PPE per the AFTS label, which includes protective gloves, protective clothing, eye and face protection, and use in well-ventilated areas. APHIS CFTEP and TAHC employees working with AFTS are licensed pesticide applicators who understand the risks associated with pesticide use and disposal.

Due to the toxicity profiles for ingredients in the AFTS formulation, their environmental fate properties, and the program's proposed use patterns, the CFTEP use of AFTS to control CFTs is expected to pose negligible risks to public and occupational human health under the Proposed Alternative (see Appendix B for details). The use of AFTS could potentially provide beneficial effects for human health through the control of other ticks and insects found on wildlife, on livestock, and in treatment areas that transmit human diseases (see Section 3.5, Human Health).

EO 13045 – Protection of Children from Environmental Health Risks and Safety Risks: Children may suffer disproportionately from environmental health and safety risks due to their developmental stage, higher metabolic rates, and behavior patterns, as compared to adults. In 2023, the U.S. population of persons under the age of 18 numbered 72.7 million—or 21.7% of the total population (USCB, 2023). USDA APHIS activities will comply with EO 13045 by identifying, assessing, and addressing the potential environmental health and safety risks that may disproportionately affect children. AFTS is an EPA exempted minimum risk pesticide, indicating that it poses little or no risk to humans and the environment. Potential direct and indirect exposure to AFTS by children is unlikely due to the application methods and restricted access to locations where the product would be used. Adverse direct or indirect effects on children are not expected to occur from the CFTEP proposed uses of AFTS.

4.3 Socioeconomics

Impacts on socioeconomic resources include how the proposed action could potentially affect elements of the human environment such as population, employment, income, property values, housing, and public services. This section discusses the potential effects of the proposed action on the various social and economic characteristics throughout the 19-county area. Economic impacts include impacts that individuals, groups, properties, and businesses would experience from a change in business and economic activity as a result of the proposed action. General information describing the population and economic environment in the 19 counties within the proposed treatment area are provided in Appendix A.

The largest counties in the proposed action area are Webb and Val Verde Counties at 3,375.59 and 3,232.67 square miles, respectively. The smallest county is Willacy County at 784.77 square miles. The average population of these counties is 101,004 people, with the most populated being Hidalgo County (898,471) and least populated being Kenedy County (343) (TAC, 2025). Duval, Jim Hogg, Kenedy, Kinney, La Salle, Live Oak, McMullen Counties are 100 percent rural. Hidalgo County at 8.91 percent rural is the most developed county of the proposed action area. See Appendix A for each county's land area, population, percentage rural area, and largest communities.

Data from the U.S. Census Bureau shows that residents in almost half the counties within the proposed program area have a lower per capita income compared to the that for Texas ($39,446) and the United States ($43,289). Starr County has the lowest per capita income of $32,785 compared to $117,599 for McMullen County. For the 19 counties, the average per capita income is $48,265.40, while the average median income is $48,251.20 (average household incomes are shown in Appendix A). Unemployment ranges from 1.8 percent in McMullen County to 11 percent in Starr County, averaging 5.5 for the proposed action area. The poverty rates in these counties range from 12.4 percent for McMullen County to 30.40 percent for Zapata County, with the average, 23.65, higher compared to that for Texas (13.7 percent) and the United States (11.1 percent) (see Appendix A for details).

CFT eradication and containment measures have been essential for food security, marketability, and sustainability of the U.S. cattle industry. State and federal government programs led to the eradication of CFTs in the 20th century. It was estimated that, before eradication, CFT infestation alone could reduce the weight of a 1,000-pound steer by 200 pounds in a year and reduce milk production of dairy cattle by 25% (USDA ARS, 1968). This previous eradication is estimated to continuously provide $3 billion per year in savings from direct and indirect economic losses due to ticks and disease (TAMU, n.d.). Approximately 70 to 90 percent of infected cattle that have not previously been exposed to the disease die (Swiger, 2017). Consequently, the disease's reemergence has the potential to cause significant socioeconomic impacts, with an estimated impact to U.S. cattle production that could be as high as $1 billion (Swiger, 2017).

As CFTs advance into Texas, the socioeconomic impacts posed by CFTs fall most heavily on those communities that depend on ranching for their livelihood. Texas ranks first in the nation in beef production with 14.62 percent of the U.S. total or 27,863,500 beef cattle. Starr and Webb Counties have the highest total cattle production of the 19 counties making up the proposed action area, ranking 71st and 79th in cattle populations out of 254 Texas counties, respectively (TexasCounties.net, 2022).

Under the No Action Alternative, APHIS would not use AFTS as part of the CFTEP for tick control on wildlife (white-tailed deer and nilgai), cattle, horses, or livestock areas. APHIS would continue to carry out current CFTEP activities that help prevent the spread of CFTs and potential exposure of livestock to babesiosis. An increase in the number of CFT infestations could result in a rise in adverse economic impacts on affected producers and consumers, including the loss of jobs, loss of market share, loss of property, and higher consumer prices. The spread of CFT may affect the overall unemployment rates within these 19 counties where unemployment ranges from 1.8 to 11 percent and averages 5.5 percent (TAC, 2025).

Adoption of the Proposed Alternative would help limit the spread of CFTs across the region, improve cattle health, and provide socioeconomic benefits to ranchers residing within the 19 counties where the CFTEP would use AFTS. The benefits would extend to ranchers and the general public in the surrounding counties by preventing the spread of CFTs into other counties in Texas and through the stabilization of state economy.

Maestas and Goolsby (Maestas & Goolsby, 2024) noted that the use of motion activated livestock sprayers could decrease the need for traditional tick treatment methods, such as dipping vats, spray boxes, or high-volume sprayers, reducing the need to round up and move animals, thereby reducing personnel costs and stress to livestock. Applying AFTS on wildlife using automated sprayers presents a new treatment option that may stop the spread of CFTs and present cost savings to ranchers by reducing the need to treat livestock and preventing production losses and the death of livestock.

Overall, under the Proposed Alternative, the use of AFTS would provide an environmentally friendly and safe control of CFTs, supporting the economy and employment within the proposed action area. The product has the added benefit of controlling other types of ticks and insects that can carry diseases that impact the health of both humans and animals.

4.4 Wildlife and Livestock

Under both alternatives, wildlife may experience short-term disturbances by CFTEP and TAHC personnel traveling to treatment locations and conducting tick control activities. If CFT outbreaks increase, current inspection and treatment activities would increase, and any associated minor disturbances of wildlife would also increase.

AFTS is an EPA exempted minimum risk pesticide, indicating that it poses little or no risk to humans and the environment, including animals. The physical and chemical properties, environmental fate, and toxicity of AFTS and the individual active and inert ingredients that compose AFTS are examined in detail in Appendix B. The information is used to evaluate the potential risk to wildlife and livestock associated with proposed uses of AFTS. AFTS has low or no toxicity to mammals, birds, reptiles, and plants; as a result, impacts to wildlife and livestock are not expected from exposure to AFTS. As discussed in Appendix B and in the previous sections of this EA, APHIS does not anticipate that wildlife and livestock would be affected by AFTS, either indirectly through impacts on vegetation, soil, water, and air quality or by direct contact with the product.

Under the Proposed Alternative, with applications of AFTS, CFTs are less likely to become established in the wildlife population in Texas and subsequently disseminated throughout South Texas and to livestock. Treating white-tailed deer using ivermectin medicated corn at feeders is only permitted from February to August, so the ability to use AFTS during the hunting season when use of medicated corn is not allowed should increase the overall mortality of the tick populations and help decrease infestations in livestock. Currently there are no tick control treatments available for use on nilgai, so treatment with AFTS should be beneficial.

Some minor temporary adverse effects on various wildlife species are possible due to disturbances of areas to install and maintain the automated sprayers, vehicle traffic, and the presence of humans. As much as possible, remotely activated sprayers will be placed in areas dominated by bare ground, buffelgrass, or other non-native vegetation. Placement of automated sprayers will not remove brush or native vegetation that migratory birds would use as nesting substrate. AFTS will not be used within a minimum of 50 feet from aquatic areas which should avoid disturbing shorebirds. Treatment locations such as corn feeders, barns, livestock pens/corrals, and other ranch areas, such as manure piles, are already well-used, cleared areas, and frequented by humans, so no new disturbances of soil, vegetation or wildlife are expected at these sites.

If birds enter the area where AFTS sprayers are placed, direct risk to them is expected to be low because the method of application would not expose these birds or their prey to AFTS. In addition, the ingredients in the AFTS formulation are practically non-toxic to birds (see Appendix B). Coating bird eggs with oil reduces hatching success (e.g., (Shonk et al., 2004)); oils clog the pores of birds' eggs, which prevents oxygen from entering the egg and asphyxiates the developing embryo. EPA uses birds as surrogate species for reptiles. It can be assumed that eggs of other terrestrial species laid within the spray zone of remote spray devices may not hatch if sufficiently covered with AFTS spray. However, the CFTEP does not anticipate its use of AFTS will expose bird or terrestrial species eggs. Birds or other species are not likely to establish nesting sites near the spray devices due to human disturbance during set-up and servicing, disturbance when the spray devices are triggered, and the frequent presence of wildlife at the locations where the sprayers will be installed.

The AFTS label indicates: "Harmful to aquatic life with long-lasting effects. Do not contaminate water with concentrate, spray mixture or rinsate. Do not spray directly on ponds of all kinds, lakes, rivers or other bodies of water. Avoid unnecessary release into the environment" (Arkion, nd). AFTS's mode of action is suffocation. APHIS does not anticipate potential impacts to aquatic species from its use of AFTS because of the proposed use pattern, including the use of 50-ft buffers from water resources, label requirements which include not applying the product directly to water, and the environmental and toxicological properties of the ingredients in the AFTS formulation.

In addition to eliminating and repelling CFTs, AFTS is effective against other ticks, horn flies, house flies, stable flies, mosquitoes, and other insects. Insects susceptible to AFTS that may be on or around wildlife when treated with AFTS or in the spray zone are likely to be exterminated. The potential impacts would be very localized and limited to insects present when the sprayers are activated by wildlife. Birds that eat these insects have a broader foraging range than the proposed treatment locations, so would not lose a food source. AFTS is practically non-toxic to birds and ingestion of inadvertently treated prey is not expected to impact birds. As discussed in Section 4.5.1, Endangered Species, and shown in Table 9, no federally listed insect species or species proposed for listing or their proposed or designated critical habitat are found in the proposed program area. CFTEP use of AFTS would provide a benefit by helping control or eradicating CFTs and other insects that may carry diseases that affect wildlife.

The AFTS formulation and the individual ingredients that comprise the product are practically non-toxic to mammals, birds, and reptiles. Based on the toxicity of the individual ingredients in the AFTS formulation, AFTS' low acute oral and dermal toxicity (Kabaru, 2023), and environmental fate properties, the ecological risk from its proposed use are found to be negligible (see Appendix B). The CFTEP does not anticipate adverse effects to terrestrial or aquatic species through potential exposure to AFTS.

Under the Proposed Alternative, APHIS would use AFTS on cattle as another CFT control method. The low-volume, repeated application of AFTS would decrease the need for traditional CFT control methods, such as dipping vats, spray boxes, or high-volume sprayers. Additionally, using an automated sprayer on livestock may reduce the need to round up the animals, thereby reducing stress to the animals that may be associated with frequent gatherings and transport (Maestas & Goolsby, 2024). Use of AFTS poses a negligible risk to livestock due to the low concentration of active ingredients, low use volume, and rapid degradation of AFTS ingredients in the environment by normal biological, physical, and/or chemical processes.

The toxicity profile for AFTS and the individual active and inert ingredients in the AFTS formulation, their environmental fate properties, and the program's proposed use patterns indicate low potential exposure and risk to target wildlife, cattle, horses, and nontarget terrestrial and aquatic species. In addition to eliminating and repelling CFTs, AFTS is effective against other ticks, horn flies, house flies, stable flies, mosquitoes, and other insects. The use of AFTS could potentially provide an added benefit to wildlife and livestock through the control of other insects that affect animal health and transmit diseases.

4.5 Wildlife Protections

4.5.1 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) and its implementing regulations require Federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of critical habitat. There are 45 federally listed species and species proposed for listing in the program area (Brooks, Cameron, Dimmit, Duval, Hidalgo, Jim Hogg, Jim Wells, Kenedy, Kinney, Kleberg, La Salle, Live Oak, Maverick, McMullen, Starr, Val Verde, Webb, Willacy, and Zapata Counties) (Table 8).

Table 8. Federally listed species in the program area in Texas.

Taxon	Common name	Scientific name	Listing status*	Critical habitat in program area (yes or no)
Mammals	Gulf Coast jaguarundi	*Puma yagouaroundi cacomitli*	E	No
Mammals	Ocelot	*Leopardus pardalis*	E	No
Mammals	Tricolored bat	*Perimyotis subflavus*	PE	No
Mammals	West Indian manatee	*Trichechus manatus*	T	No
Birds	Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	T	Yes
Birds	Eastern black rail	*Laterallus jamaicensis ssp. jamaicensis*	T	No
Birds	Golden-cheeked warbler	*Setophaga chrysoparia*	E	No
Birds	Mexican spotted owl	*Strix occidentalis lucida*	T	Yes
Birds	Northern aplomado falcon	*Falco femoralis septentrionalis*	E	No
Birds	Piping plover (Atlantic Coast and Northern Great Plains populations)	*Charadrius melodus*	T	Yes
Birds	Rufa red knot	*Calidris canutus rufa*	T	Proposed
Birds	Southwestern willow flycatcher	*Empidonax traillii extimus*	E	No
Birds	Whooping crane	*Grus americana*	E	No
Reptiles	Green sea turtle (North Atlantic DPS)	*Chelonia mydas*	T	No
Reptiles	Hawksbill sea turtle	*Eretmochelys imbricata*	E	No
Reptiles	Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	No
Reptiles	Leatherback sea turtle	*Dermochelys coriacea*	E	No
Reptiles	Loggerhead sea turtle (Northwest Atlantic Ocean DPS)	*Caretta caretta*	T	No
Amphibians	San Marcos salamander	*Eurycea nana*	T	No
Amphibians	Texas blind salamander	*Eurycea rathbuni*	E	No
Fishes	Devil's River minnow	*Dionda diaboli*	T	Yes
Fishes	Fountain darter	*Etheostoma fonticola*	E	No
Fishes	Mexican blindcat	*Prietella phreatophila*	E	No
Fishes	Rio Grande silvery minnow	*Hybognathus amarus*	EXPN	No
Mussels	Mexican fawnsfoot	*Truncilla cognata*	PE	Proposed
Mussels	Salina mucket	*Potamilus metnecktayi*	PE	Proposed

Taxon	Common name	Scientific name	Listing status*	Critical habitat in program area (yes or no)
Mussels	Texas hornshell	*Popenaias popeii*	E	Proposed
Insects	Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	No
Insects	Comal Springs riffle beetle	*Heterelmis comalensis*	E	No
Insects	Monarch butterfly	*Danaus plexxipus*	PT	No
Crustaceans	Peck's Cave amphipod	*Stygobromus pecki*	E	No
Plants	Ashy dogweed	*Thymophylla tephroleuca*	E	No
Plants	Black lace cactus	*Echinocereus reichenbachii* var. *albertii*	E	No
Plants	Bracted twistflower	*Streptanthus bracteatus*	T	No
Plants	Bushy whitlow-wort	*Paronychia congesta*	PE	Proposed
Plants	Prostrate milkweed	*Asclepias prostrata*	E	Yes
Plants	Slender rush-pea	*Hoffmannseggia tenella*	E	No
Plants	South Texas ambrosia	*Ambrosia cheiranthifolia*	E	No
Plants	Star cactus	*Astrophytum asterias*	E	No
Plants	Texas ayenia	*Ayenia limitaris*	E	No
Plants	Texas snowbells	*Styrax platanifolius* ssp. *texanus*	E	No
Plants	Texas wild-rice	*Zizania texana*	E	No
Plants	Tobusch fishhook cactus	*Sclerocactus brevihamatus* ssp. *tobuschii*	T	No
Plants	Walker's manioc	*Manihot walkerae*	E	No
Plants	Zapata bladderpod	*Physaria thamnophila*	E	Yes

*E=endangered, T=threatened, P=proposed, EXPN=non-essential experimental population
Source: (USFWS, 2024).

APHIS has determined that the uses of AFTS as part of the CFTEP will have no effect on federally listed species or species proposed for listing or their proposed or designated critical habitat for the following reasons:

1. The program will use a 50-foot buffer from aquatic areas to prevent runoff or drift of AFTS into waterbodies to protect fish, shellfish, amphibians, and aquatic plants.
2. AFTS has low or no toxicity to mammals, birds, reptiles, and plants.
3. The targeted application of AFTS would not expose monarch butterflies to treatments. In addition, the program will avoid placing sprayers near milkweed plants to prevent exposure of monarch larvae to AFTS spray. Therefore, program use of AFTS will not jeopardize the continued existence of the monarch.

4. The CFTEP use of AFTS will not affect pollinators of listed plants or plants proposed for listing. The targeted application of AFTS directly to wildlife and livestock would not expose pollinators of those plants to AFTS.
5. Treatments would not be made or sprayers placed within designated or proposed critical habitat of listed species in the proposed program area.

Appendix B presents details on the AFTS active and inert ingredients, including toxicity and an exposure assessment.

4.5.2 Migratory Bird Treaty Act

Federal law prohibits an individual to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird or any part, nest, or egg of any such bird (16 U.S.C. §§ 703-712; 50 CFR § 21).

Texas occurs within the Central Flyway, a bird migration route that is composed of the States of Montana, Wyoming, Colorado, New Mexico, Texas, Oklahoma, Kansas, Nebraska, South Dakota, and North Dakota, and the Canadian provinces of Alberta, Saskatchewan, and the Northwest Territories. Many of the migratory bird species of the Central Flyway winter in Central and South America. Some migrate across the Western Hemisphere to the Arctic Circle, and others migrate to South America (NAS, 2025). Birds in this flyway include the American oystercatcher (*Haematopus palliatus*), black skimmer (*Rynchops niger*), brown pelican (*Pelecanus occidentalis*), greater sage-grouse (*Centrocercus urophasianus*), least tern, lesser prairie chicken (*Tympanuchus pallidicinctus*), piping plover, reddish egret (*Egretta rufescens*), redhead (*Aythya americana*), red knot, ruddy turnstone (*Arenaria interpres*), sanderling (*Calidris alba*), sandhill crane (*Grus canadensis*), whooping crane, and Wilson's plover (*Charadrius wilsonia*) (NAS, 2025). Birds that migrate along this route depend on stopover habitat, such as native prairie and wetland areas.

Disturbance of nesting migratory birds is not expected because APHIS will not remove brush or native vegetation that migratory birds would use as nesting substrate; as much as possible, remotely activated sprayers will be placed in areas dominated by bare ground, buffelgrass, or other non-native vegetation. APHIS will place sprayers a minimum of 50 feet from aquatic areas which will avoid disturbance of nesting shorebirds from placement and servicing of feeders.

Coating bird eggs with oil reduces hatching success (e.g., (Shonk et al., 2004)). Oils clog the pores of birds' eggs, which prevents oxygen from entering the egg and asphyxiates the developing embryo. However, the CFTEP does not anticipate its use of AFTS will expose migratory bird eggs. The Program does not anticipate that migratory birds will establish nesting sites near the sprayers due to ongoing human disturbance from servicing the equipment and reloading the concentrate mixture, wildlife traffic along paths and fence crossings where sprayers would be located, and disturbances when the automated spray devices are triggered.

Aquatic species that serve as food prey for birds are unlikely to be exposed to AFTS. APHIS will place remote sprayers a minimum of 50 feet from aquatic areas to prevent any environmental transport of AFTS that could affect fish and invertebrate prey. Terrestrial insects that serve as prey for birds could potentially be affected by AFTS spray (Appendix B); however, the impact would be very localized and limited to insects present when the sprayers are active by wildlife. Also, birds have a broader foraging range than the proposed treatment locations. AFTS is practically non-toxic to birds and ingestion of inadvertently treated prey is not expected to impact birds.

4.5.3 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles (*Haliaeetus leucocephalus*), including their parts, nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

Golden eagles (*Aquila chrysaetos*) are rare to locally uncommon in the Panhandle and western Trans-Pecos area, and very rare to casual throughout the remainder of Texas (Lockwood and Freeman, 2004). For bald eagles, breeding populations occur mainly in the eastern half of the state and along coastal counties from Rockport to Houston (TPWD, undated). Nonbreeding populations of bald eagles are found mainly in the Panhandle, Central, and East Texas, and in other suitable habitat throughout Texas (TPWD, undated).

Bald eagles in Texas commonly eat coots, catfish, rough fish, and soft-shell turtles (TPWD, undated). Carrion is also common in the diet of bald eagles, especially in younger birds (TPWD, undated). Golden eagles eat a variety of foods, mainly mammals ranging in size from ground squirrels up to prairie-dogs, marmots, and jackrabbits (NAS, 2016b). They may also prey on smaller rodents, birds, snakes, lizards, large insects, and carrion (NAS, 2016b).

Should bald or golden eagles occur in an area where AFTS sprayers are placed, direct risk to them is expected to be low because the method of application would not expose these birds or their prey to AFTS. In addition, the ingredients in the AFTS formulation are practically non-toxic to birds (see Appendix B).

4.6 Tribal and Historic Properties

4.6.1 Tribal Consultation and Coordination

USDA is committed to protecting tribal lands, archaeological resources, and Indian sacred sites. Adhering to Executive Orders 13175 ("Consultation and Coordination with Indian Tribal Governments") and 13007 ("Indian Sacred Sites"), along with the Archaeological Resources Protection Act, the agency engages with tribal officials throughout project lifecycles to identify and address potential impacts. By utilizing historical records, mapping tools, and collaborating with local authorities, USDA ensures that its actions respect cultural and religious resources. Because AFTS is an exempt minimum risk pesticide product, it is not regulated by the EPA and may be purchased and used by members of the general public. It poses minimal risk to the environment and human health and is non-toxic. As a result, APHIS does not believe that it is currently necessary to consult with tribal officials.

However, USDA will work with tribes if they express interest in participating in the CFTEP program or if they believe that the program may have negative impacts on their lands, resources, or sacred sites. This is in accordance with USDA's commitment to protecting tribal lands, archaeological resources, and Indian sacred sites. If the program's expansion onto Tribal lands becomes necessary to address tick-infested animals, USDA officials will promptly consult with the governing Tribal authorities and local Tribal Historic Preservation Officers.

4.6.2 Historic, Cultural, and Visual Resources

CFTEP activities, including inspection, treatment, and certification activities, are unlikely to impact soil, water, vegetation, or air resources because there are no long-term disturbances to the ground, waterways, plant materials, or air quality. Short-term disturbances could include effects of pesticide use and disposal, and maintenance/installation that may disturb soil and vegetation. These activities have not adversely affected soil or water resources.

The visual resources for the counties in the proposed action area are the rangeland and pastures serving as habitat for animals and recreational or scenic areas directly along the Rio Grande River, other rivers, and reservoirs. There are some areas where hunting occurs. The visual resources also include any buildings, street patterns and road characteristics, view corridors, and vistas. The proposed action would not result in alterations of land. Landowners would not be obligated to make long-term changes to their land under either alternative so they would not incur irretrievable commitments of resources.

The National Historic Preservation Act of 1966, as amended (16 U.S.C. § 470 et seq.), requires Federal agencies to consider the impact on properties included in, or eligible for inclusion in, the National Register of Historic Places (36 CFR §§ 63 and 800). Listed historic places present in each county can be found in the Texas Atlas of Historic Places, https://atlas.thc.state.tx.us/.

APHIS' program activities will not alter, change (restore or rehabilitate), modify, relocate, abandon, or destroy any historic buildings, edifices, or nearby infrastructure. Therefore, APHIS program activities will not directly or indirectly alter characteristics of a historic property that qualifies it for inclusion in the National Register of Historic Properties. The listed historic cemeteries may provide habitat corridors for deer and ticks, nevertheless, treatments with AFTS will not be placed onsite at any listed historic property. The proposed action will not disturb the ground for construction. This proposed action does not include mowing, herbicidal treatments, or removal of plant material from any site. The proposed activities will not use heavy equipment that creates noise levels requiring auditory protection. Any potential visual, atmospheric, or auditory effects during installation, upkeep, and application of AFTS will be limited in duration, intensity, and area.

5 Other Reasonably Foreseeable Effects

The potential effects to human health and the environment from the proposed use of AFTS are not anticipated because of the proposed use pattern, environmental fate properties, and negligible toxicity of the active ingredients in AFTS. While the proposed use of AFTS is to control and eradicate CFTs, AFTS has the added benefit of controlling other types of ticks and insects that can carry diseases that impact both human and animal health. In addition to using AFTS as part of the CFTEP, APHIS could potentially use AFTS to prevent and control NWS flies.

NWS are larvae or maggots of the NWS fly that burrow into the flesh of warm-blooded animals, causing infection and serious, often deadly damage to the animal. NWS flies lay eggs in open wounds or orifices of live tissue. These eggs hatch into dangerous parasitic larvae, and the maggots burrow or screw into flesh with sharp mouth hooks. The wound can become larger, and an infestation can often cause serious, deadly damage. NWS primarily infest livestock, but can also affect mammals, including humans, and birds.

The parasite was last eradicated from the United States in 1966. Eradication efforts are ongoing in Central America where NWS have been found; the pest is considered endemic in Cuba, Haiti, the Dominican Republic, and South America, presenting a tremendous threat to animal health and potential economic impacts. If NWS infestations were to occur in along the border, in Texas, or elsewhere in the United States (TAHC, 2025), APHIS would potentially use insecticides to prevent its spread and eradicate the pest. The program has identified AFTS as one of the pesticides to potentially use against NWS (the list is found online at: https://www.aphis.usda.gov/sites/default/files/pesticides-for-nws.pdf). The treatments would be applied in a timely manner to ensure that there is no survival of adult screwworm flies and no movement of flies outside the treatment area.

AFTS and other pesticides applications to control NWS flies may occur at the same locations where the product would be used for CFT control. Although, it may not be necessary to make additional treatments at a location to target NWS files, as AFTS works on NWS files at the same time it works on CFTs. Even if additional locations need to be treated to help control NWS flies, when AFTS is properly used according to label directions and precautionary measures are followed, applications are expected to pose minimal risks to human health under the preferred alternative.

Pesticide use in the proposed program area by other APHIS programs is reasonably foreseeable. There are active Federal quarantines in Texas that include the proposed program area for the following plant pests:

- Citrus greening and Asian citrus psyllid,
- Imported fire ants, and
- Mexican fruit fly.

Additionally, ongoing APHIS programs in South Texas using pesticides include the Boll Weevil Cooperative Eradication Program. These programs do not treat livestock. Chemical treatments are applied only to specific locations or to quarantined products bound for non-quarantine areas. For example, citrus nursery stock is treated for Asian citrus psyllid with an APHIS-approved soil drench or in-ground granular application no more than 90 days and no fewer than 30 days before shipment, followed by an APHIS-approved foliar spray no more than 10 days before shipment (7 CFR 301.76-6). Such treatments are both targeted and infrequent, and they use EPA-registered products labeled for use on the specified pest. The potential for effects related to exposure to these pesticides by workers will be reduced by the use of PPE. Risk to the general public from exposure to these chemicals is also not anticipated because of the method of application, program controls, and restriction of public access to treatment areas.

In summary, the potential effects associated with the preferred alternative when assessed in relation to the current baseline and past, present, and future activities constitute a small, insignificant incremental change to the human environment. Some of these changes may be positive such as the reduction in CFTs, other ticks, and insects that can adversely affect human and animal health and the associated economic benefits. To preserve environmental quality for the human population and ecological resources, the CFTEP would minimize potentially negative impacts by following label directions and best management practices.

6 Agencies Contacted

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Environmental and Risk Analysis Services
Policy and Program Development
5601 Sunnyside Ave.
Beltsville, MD 20705

U.S. Department of Agriculture
Animal and Plant Health Inspection Service
Cattle Fever Tick Eradication Program
Surveillance, Preparedness, and Response Services
Veterinary Services
2150 Centre Avenue
Fort Collins, CO 80526

Texas Animal Health Commission
2105 Kramer Lane
Austin, TX 78758

7 Agency Certifying Statement

Agency Certifying Statement for EA Page Limit and Deadline

The APHIS Responsible Official certifies that this EA:

- Demonstrates the agency has thoroughly considered the factors mandated by the National Environmental Policy Act (NEPA);
- Represents the agency's good-faith effort to prioritize documentation of the substantive issues and most important considerations required by NEPA within the congressionally mandated page limits;
- Reflects the agency's expert judgment;
- Addressed briefly, or left unaddressed, any issues or considerations that were, in the agency's judgment, comparatively not of a substantive nature;
- Represents the agency's good-faith effort to fulfill NEPA's requirements within the Congressional timeline (or within the minimally extended timeline) and this effort is substantially complete; and
- Contains analysis that is adequate to inform and reasonably explain the responsible official's final decision regarding the proposed action or selected alternative.

8 References

Anderson, D. P., Hagerman, A. D., Teel, P. D., Wagner, G. G., Outlaw, J. L., & Herbst, B. K. (2010). *Economic impact of expanded fever tick range, APFC Research Report 10-2*. https://afpc.tamu.edu/research/publications/548/Tick-Study-RR-10-02.pdf

Arkion. (2022). *Arkion Fly and Tick Spray Safety Data Sheet*. Arkion Life Sciences.

Arkion. (2024). *Arkion Fly & Tick Spray Website*. Arkion Life Sciences, Retrieved from https://flyandtick.com/

Arkion. (nd). *Arkion Fly and Tick Spray Label*. Arkion Life Sciences, LLC;

Baker, B. P., & Grant, J. A. (2018a). *Castor Oil Profile, Active Ingredient Eligible for Minimum Risk Pesticide Use*. Cornell Cooperative Extension and New York State Integrated Pest Management Program; Retrieved from https://ecommons.cornell.edu/server/api/core/bitstreams/1f5acd8c-bb49-4570-b0ec-6a1d6575fb18/content

Baker, B. P., & Grant, J. A. (2018b). *Geraniol Profile, Active Ingredient Eligible for Minimum Risk Pesticide Use*. Cornell Cooperative Extension and New York State Integrated Pest Management Program; Retrieved from https://ecommons.cornell.edu/server/api/core/bitstreams/e8082a42-96b2-4484-a73e-06aa9591ec53/content

Baker, B. P., Grant, J. A., & Malakar-Kuenen, R. (2018a). *Cloves & Clove Oil Profile Active Ingredient Eligible for Minimum Risk Pesticide Use*. Cornell Cooperative Extension and New York State Integrated Pest Management Program; Retrieved from https://ecommons.cornell.edu/server/api/core/bitstreams/afcd64d1-654a-4bf4-a62f-094234dbf29b/content

Baker, B. P., Grant, J. A., & Malakar-Kuenen, R. (2018b). *Peppermint and Peppermint Oil Profile: Active Ingredient Eligible for Minimum Risk Pesticide Use*. https://ecommons.cornell.edu/server/api/core/bitstreams/0a67cf6f-2c09-442f-adf1-2c60002e75f2/content

Bampidis, V., Azimonti, G., Bastos, M. d. L., Christensen, H., Durjava, M., Kouba, M., López-Alonso, M., López Puente, S., Marcon, F., Mayo, B., Pechová, A., Petkova, M., Ramos, F., Sanz, Y., Villa, R. E., Woutersen, R., Brantom, P., Chesson, A., Schlatter, J., . . . Dusemund, B. (2023). *Safety and efficacy of feed additives consisting of essential oils derived from the flower buds or the leaves of Syzygium aromaticum (L.) Merr. & L.M. Perry (clove bud oil and clove leaf oils) for all animal species (FEFANA asbl)*. (1831-4732). EFSA Panel on Additives Products or Substances used in Animal Feed; Retrieved from https://efsa.onlinelibrary.wiley.com/doi/abs/10.2903/j.efsa.2023.8183

Bayer. (2009). *Co-Ral Flowable Insecticide (EPA Registration 11556-98)*. Bayer HealthCare LLC, Animal Health Division; Retrieved from https://www3.epa.gov/pesticides/chem_search/ppls/011556-00098-20090918.pdf

BPDB. (2024). *Castor oil*. Bio-Pesticides Database, University of Hertfordshire; Retrieved from http://sitem.herts.ac.uk/aeru/bpdb/Reports/3019.htm

Burnett, C. L., Bergfeld, W. F., Belsito, D. V., Klaassen, C. D., Marks Jr, J. G., Shank, R. C., Slaga, T. J., Snyder, P. W., & Andersen, F. A. (2011). Final Report on the Safety Assessment of *Cocos nucifera* (Coconut) Oil and Related Ingredients. *International Journal of Toxicology*, *30*, 5S-16S. https://cir-reports.cir-safety.org/view-attachment/?id=79ee6359-8e74-ec11-8943-0022482f06a6

Castoroil.in. (2006). Castor Oil Chemicals & Derivatives. In *Comprehensive Castor Oil Report* (pp. 21). Castoroil.in. http://www.castoroil.in/downloads/Comprehensive_Castor_Oil_Report_chapter3.pdf

CDC. (2024). *Geographic Distribution of Tickborne Disease Cases*. U.S. Centers for Disease Control and Prevention; Retrieved from https://www.cdc.gov/ticks/data-research/facts-stats/geographic-distribution-of-tickborne-disease-cases.html

CDC. (2025). *Where Ticks Live*. U.S. Center for Disease Control and Prevention; Retrieved from https://www.cdc.gov/ticks/about/where-ticks-live.html?CDC_AAref_Val=https://www.cdc.gov/ticks/geographic_distribution.html

ChemSupply Australia. (2024). *Safety Data Sheet Clove Oil*. Retrieved from https://shop.chemsupply.com.au/documents/JSJT4BFF.pdf

CIR. (2008). *Final Report of the Cosmetic Ingredient Review Expert Panel. Amended Safety Assessment of Cocos Nucifera (Coconut) Oil, Coconut Acid, Hydrogenated Coconut Acid, Hydrogenated Coconut Oil, Ammonium Cocomonoglyceride Sulfate, Butylene Glycol Cocoate, Caprylic/Capric/Coco Glycerides, Cocoglycerides, Coconut alcohol, Coconut Oil Decyl Esters, Decyl Cocoate, Ethylhexyl Cocoate, Hydrogenated Coco-Glycerides, Isodecyl Cocoate, Lauryl Cocoate, Magnesium Cocoate, Methyl Cocoate, Octyldodecyl Cocoate, Pentaerythrityl Cocoate, Potassium Cocoate, Potassium Hydrogenated Cocoate, Sodium Cocoate, Sodium cocomonoglyceride Sulfate, Sodium Hydrogenated Cocoate, and Tridecyl Cocoate* Cosmetic Ingredient Review; Retrieved from https://www.cir-safety.org/ingredient/potassium-cocoate

Cohen, M. S., Eisenbrand, G., Fukushima, S., Gooderham, N. J., Guengerich, F. P., Heckt, S. S., Rietjens, I. M. C. M., Bastaki, M., Davidsen, J. M., Harman, C. L., McGowen, M. M., & Taylor, S. V. (2020). FEMA GRAS assessment of natural flavor complexes: Mint, buchu, dill and caraway derived flavoring ingredients. *Food and Chemical Toxicology*, *135*. https://www.sciencedirect.com/science/article/pii/S027869151930660X?via%3Dihub

Davidson, S. C., & Mace, R. E. (2006). *Numbered Report 365, Chapter 1 Aquifers of the Gulf Coast of Texas: An Overview*. https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R365/ch01_intro

.pdf#:~:text=Aquifers%20of%20the%20Gulf%20Coast%20of%20Texas:%20An%20Overview%20Sarah

Doleželová, P., Mácová, S., Plhalová, L., Pištěková, V., & Svobodová, Z. (2011). The acute toxicity of clove oil to fish *Danio rerio* and *Poecilia reticulata*. *Acta Veterinaria Brno*, *80*(3), 305-308. https://doi.org/10.2754/avb201180030305

Ebert, T. A., Kevan, P. G., Bishop, B. L., Devan, S. D., & Downer, R. A. (2007). Oral toxicity of essential oils and organic acids fed to honey bees (Apis mellifera). *Journal of Apicultural Research and Bee World*, *46*(4), 220-224. https://atrium.lib.uoguelph.ca/server/api/core/bitstreams/ee98cc94-8421-4bb5-bbac-2c1f0bdd81fe/content

ECHA. (2023). *Peppermint, ext.* European Chemicals Agency; Retrieved from https://echa.europa.eu/registration-dossier/-/registered-dossier/14548/5/5/2

Ellis, M. D., & Baxendale, F. P. (1997). Toxicity of Seven Monoterpenoids to Tracheal Mites (Acari: Tarsonemidae) and Their Honey Bee (Hymenoptera: Apidae) Hosts When Applied as Fumigants. *Journal of Economic Entomology*, *90*(5), 1087-1091. https://academic.oup.com/jee/article/90/5/1087/2216706

Gahukar, R. T. (2017). A review of castor-derived products used in crop and seed protection. *Phytoparasitica*, *45*(5), 655-666. https://doi.org/10.1007/s12600-017-0625-7

Genovese, A. G., McLean, M. K., & Khan, S. A. (2012). Adverse reactions from essential oil-containing natural flea products exempted from Environmental Protection Agency regulations in dogs and cats. *Journal of Veterinary Emergency and Critical Care*, *22*(4), 470-475. https://doi.org/10.1111/j.1476-4431.2012.00780.x

George, J. E. (1990). Wildlife as a constraint to the eradication of *Boophilus* spp. (Acari: Ixodidae) (abstract only). *Journal of Agricultural Entomology*, *7*(2), 119-125.

George, J. E., Pound, J. M., & Davey, R. B. (2004). Chemical control of ticks on cattle and the resistance of these parasites to acaricides. *Parasitology*, *129 Suppl:*, S353-366. doi: 10.1017/s0031182003004682

George, P. G., Mace, R. E., & Petrossian, R. (2011). *Aquifers of Texas*. Texas Water Development Board; Retrieved from https://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R380_AquifersofTexas.pdf#page=76

Goolsby, J., Cantu, D., Racelis, A., Vasquez, A., Hoffmann, W. C., Shapiro Ilan, D. I., Hinojosa, J., Bonilla, D., Ellis, D., & Perez De Leon, A. A. (2019). Development of a remotely activated field sprayer and evaluation of temperature and aeration on the longevity of *Steinernema riobrave* entomopathogenic nematodes for treatment of cattle fever tick infested nilgai. *Subtropical Agriculture and Environments*, *70*, 1-5. https://www.subplantsci.org/wp-content/uploads/2019/07/SAES-Goolsby-et-al.-2019.pdf

Goolsby, J. A., Maestas, L., Saelao, P., & Lohmeyer, K. H. (2022). Evaluation of Repellency of Stop the Bites® Botanical Pesticide to White-Tailed Deer at Corn Feeders. *Southwestern Entomologist*, *47*(2), 277-284. https://bioone.org/journals/southwestern-entomologist/volume-47/issue-2/059.047.0202/Evaluation-of-Repellency-of-Stop-the-Bites-Botanical-Pesticide-to/10.3958/059.047.0202.full

Goolsby, J. A., Maestas, L. P., Garcia, R., May, M., Lohmeyer, K. H., Picanso, J., Anderson, D., Coy, J., & Bonilla, D. (2023). Preventative Methods to Reduce the Spread of Cattle Fever Ticks on Wildlife and Protect Local Endangered Species in South Texas. *Southwestern Entomologist*, *48*(2), 289-302. https://bioone.org/journals/southwestern-entomologist/volume-48/issue-2/059.048.0201/Preventative-Methods-to-Reduce-the-Spread-of-Cattle-Fever-Ticks/10.3958/059.048.0201.full

Goolsby, J. A., & Shapiro Ilan, D. I. (2020). Passive transfer of Steinernema riobrave entomopathogenic nematodes with potential implications for treatment of cattle fever tick-infested nilgai. *Biocontrol Science and Technology*, *20*(12), 1330-1339. https://www.tandfonline.com/doi/full/10.1080/09583157.2020.1817332

Graham, O., Gladney, W., & Trevino, J. (1972). Some non-bovine host relationships of *Boophilus annulatus* (abstract only). *Folia Entomologica Mexicana*, *22-23*, 89-90.

Haro-González, J. N., Castillo-Herrera, G. A., Martínez-Velázquez, M., & Espinosa-Andrews, H. (2021). Clove Essential Oil (Syzygium aromaticum L. Myrtaceae): Extraction, Chemical Composition, Food Applications, and Essential Bioactivity for Human Health. *Molecules*, *26*(21). https://doi.org/10.3390/molecules26216387

IARC. (2023). *IARC Monographs on the identification of carcinogenic hazards to humans*. Retrieved 06/13/2023 from https://monographs.iarc.who.int/agents-classified-by-the-iarc/

Irwin, R. (1992). *Toxicity studies of castor oil in F344/N rats and B6C3F1 mice, dosed feed studies*. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Toxicology Program; Retrieved from https://ntp.niehs.nih.gov/sites/default/files/ntp/htdocs/st_rpts/tox012.pdf

Johnson, D. L., G; Studebaker, G; Hopkins, JD. (n.d.). Ticks on Beef Cattle. *Livestock Insect Series*. https://www.uaex.uada.edu/publications/pdf/FSA-7027.pdf

Johnson, W. (2007). Final Report on the Safety Assessment of *Ricinus Communis* (Castor) Seed Oil, Hydrogenated Castor Oil, Glyceryl Ricinoleate, Glyceryl Ricinoleate SE, Ricinoleic Acid, Potassium Ricinoleate, Sodium Ricinoleate, Zinc Ricinoleate, Cetyl Ricinoleate, Ethyl Ricinoleate, Glycol Ricinoleate, Isopropyl Ricinoleate, Methyl Ricinoleate, and Octyldodecyl Ricinoleate. *International Journal of Toxicology*, *26 (Supplement 3)*, 31-77. https://journals.sagepub.com/doi/epdf/10.1080/10915810701663150

Kabaru, J. M. (2023). *Reports of acute toxicological studies on Arkion Fly and Tick Spray*. Unpublished report prepared for Arkion Life Sciences, LLC.

Kaura, T., Pervaiz, N., & Mewara, A. (2021). Chapter 32 - Larvicides: Plant oils and Zika control. In C. R. Martin, C. J. Hollins Martin, V. R. Preedy, & R. Rajendram (Eds.), *Zika Virus Impact, Diagnosis, Control, and Models* (pp. 337-348). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-820267-8.00032-7

Kimbaris, A. C., Papachristos, D. P., Michaelakis, A., Martinou, A. F., & Polissiou, M. G. (2010). Toxicity of plant essential oil vapours to aphid pests and their coccinellid predators. *Biocontrol Science and Technology*, *20*(4), 412-422. https://www.tandfonline.com/doi/pdf/10.1080/09583150903569407

Lewis, K. A., Tzilivakis, J., Warner, D., & Green, A. (2016). *An international database for pesticide risk assessments and management.* https://doi.org/10.1080/10807039.2015.1133242

Lindberg, C. M., Melathopoulos, A. P., & Winston, M. L. (2000). Laboratory evaluation of miticides to control *Varroa jacobsoni* (Acari: Varroidae), a Honey Bee (hymenoptera: Apidae) Parasite. *Apiculture and Social Insects*, *93*(2), 189-198. https://academic.oup.com/jee/article/93/2/189/767996

MacLeman, E. (2022). Geraniol. *The Derm Review*. Retrieved April 1, 2025, from https://thedermreview.com/geraniol/

Maestas, L. P., & Goolsby, J. A. (2024). Effectiveness of Two Botanical Pesticides for Treatment of Cattle to Control Cattle Fever Ticks in a Pen Trial, Using a Motion Activated 3-D Quik Hand™ Sprayer. *Southwestern Entomologist*, *49*(4), 1344-1357, 1314. https://doi.org/10.3958/059.049.0427

Mahdavikia, F., & Saharkhiz, J. (2015). Phytotoxic activity of essential oil and water extract of peppermint (*Mentha* × *piperita* L. CV. Mitcham). *Journal of Applied Research on Medicinal and Aromatic Plants*, *2*, 146-153. https://www.sciencedirect.com/science/article/abs/pii/S2214786115300164

Maypole, J., & Woolf, A. (2007). Essential Oils. In M. B. Shannon, SW; Burns, MJ (Ed.), *Haddad and Winchester's Clinical Management of Poisoning and Drug Overdose* (Fourth ed.). https://www.sciencedirect.com/science/article/pii/B9780721606934501067?via%3Dihub

McNab, W. H., & Avers, P. E. (1994). Chapter 37: Southwest Plateau and Plains Dry Steppe and Shrub. In *Ecological Subregions of the United States*. https://www.fs.usda.gov/land/pubs/ecoregions/ch37.html

Mehri, M., Sabaghi, V., & Bagherzadeh-Kasmani, F. (2015). *Mentha piperita* (peppermint) in growing Japanese quails diet: Performance, carcass attributes, morphology and microbial populations of intestine. *Animal Feed Science and Technology*, *207*, 104-111. https://www.sciencedirect.com/science/article/pii/S0377840115001820?via%3Dihub

Merck. (2023). *The Merck Index Online.* Cambridge, UK: Royal Society of Chemistry. https://www.rsc.org/merck-index

MMW. (2010). Chapter 6 - Clove Oil (Eugenol). In *Marin Municipal Water District Vegetation Management Plan: Herbicide Risk Assessment* (Draft ed., pp. 47). Marin Municipal Water District https://s3-us-west-2.amazonaws.com/drugbank/cite_this/attachments/files/000/000/108/original/Eugenol.pdf?1527189892

Mohammadi Nejad, S., Özgüneş, H., & Başaran, N. (2017). Pharmacological and Toxicological Properties of Eugenol. *Turk J Pharm Sci*, *14*(2), 201-206. https://doi.org/10.4274/tjps.62207

NAS. (2025). *Central Flyway*. National Audubon Society; Retrieved from https://www.audubon.org/climate/survivalbydegrees/flyway/central

NIH. (1999). *Toxicological Profile for Total Petroleum Hydrocarbons (TPH). Appendix E, Identify, Components, and Chemical/Physical Properties of Selected Petroleum Products*. National Institutes of Health, Agency for Toxic Substances and Disease Registry (ATSDR); Retrieved from https://www.ncbi.nlm.nih.gov/books/NBK595976/

NIH. (2024a). *Castor Oil. PubChem*. National Institutes of Health, National Library of Medicine, National Center for Biotechnology Information; Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/Castor%20Oil

NIH. (2024b). *Geraniol, PubChem CID 637566*. National Institutes of Health, National Library of Medicine, National Center for Biotechnology Information; Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/637566

NIH. (2024c). *Peppermint Oil, PubChem*. National Instututes of Health, National Library of Medicine, National Center for Biotechnology Information; Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/Peppermint-Oil

NPIC. (2001). *Potassium Salts of Fatty Acids (Technical Fact Sheet)*. National Pesticide Information Center; Retrieved from https://npic.orst.edu/factsheets/archive/psfatech.pdf

NWSRS. (n.d.). *National Wild and Scenic Rivers System, Rio Grande Texas*. National Wild and Scenic Rivers System; Retrieved from https://www.rivers.gov/river/rio-grande-texas

OECD. (2003). *OECD/SIDS Report on Menthols*. Organization for Economic Cooperation and Development, Geneva; Retrieved from https://hpvchemicals.oecd.org/UI/handler.axd?id=ccf70d5b-5c14-44a2-a54d-956661decf2d

Opdyke, D. L. J. (1975a). Clove Bud Oil. *Food and Cosmetics Toxicology*, *13*, 761-763.

Opdyke, D. L. J. (1975b). Clove Stem Oil. *Food and Cosmetics Toxicology*, *13*, 765-767.

Opdyke, D. L. J. (1978). Clove Leaf Oil Madagascar. *Food and Cosmetics Toxicology*, *16*, 695.

OSHA. (2022). *OSHA FactSheet: Reducing the Risk of Worker Exposure to Diseasee-Carrying Ticks*. (DTSEM FS-4190 09/2022). Occupational Safety and Health Administration; Retrieved from https://www.osha.gov/sites/default/files/publications/OSHA_FS-4190.pdf

Pérez de León, A., Mahan, S., Messenger, M., Ellis, D., Varner, K., Schwartz, A., Baca, D., Andreotti, R., Rodriguez Valle, M., Rosario Cruz, R., Domingues Garcia, D. I., Pagan, M., Canabal, C. O., Urdaz, J., Mattei, F., Soltero, F., Guerrero, F., & Miller, R. J. (2018). 10. Public-private partnership enabled use of anti-tick vaccine for integrated cattle fever tick eradication in the USA. *Ecology and Control of Vector-Borne Diseases*. https://doi.org/10.3920/978-90-8686-863-6_10

Pound, J. M., George, J. E., Kammlah, D. M., Lohmeyer, K. H., & Davey, R. B. (2010). Evidence for role of white-tailed deer (Artiodactyla: Cervidae) in epizootiology of cattle ticks and southern cattle ticks (Acari: Ixodidae) in reinfestations along the Texas/Mexico border in South Texas: A review and update. *Journal of Economic Entomology*, *103*, 211–218. https://academic.oup.com/jee/article/103/2/211/2199389?login=true

Prashar, A., Locke, I. C., & Evans, C. S. (2006). Cytotoxicity of clove (Syzygium aromaticum) oil and its major components to human skin cells. *Cell Prolif*, *39*(4), 241-248. https://doi.org/10.1111/j.1365-2184.2006.00384.x

Shalaby, S. E. M., El-Din, M. M., Abo-Donia, S. A., Mettwally, M., & Attia, Z. A. (2011). Toxicological affects of essential oils from eucalyptus *Eucalyptus globules* and clove *Eugenia caryophyllus* on albino rats. *Polish Journal of Environmental Studies*, *20*(2), 429-434. https://www.researchgate.net/publication/286110625_Toxicological_Affects_of_Essential_Oils_from_Eucalyptus_Eucalyptus_globules_and_Clove_Eugenia_caryophyllus_on_Albino_Rats

Sheffield, W. J. (2013). Exotics. In *Handbook of Texas Online*. https://www.tshaonline.org/handbook/entries/exotics

Shonk, K. A., Kevan, S. D., & Weseloh, D. V. (2004). The effect of oil spraying on eggs of double-crested cormorants. *The Environmentalist*, *24*, 119-124. https://www.researchgate.net/publication/226107897_The_Effect_of_Oil_Spraying_on_Eggs_of_Double-Crested_Cormorants

Sigma-Aldrich Corporation. (2023). *Clove Oil Safety Data Sheet C8392*. Sigma-Aldrich Inc. St. Louis, Missouri, USA; Retrieved from https://www.sigmaaldrich.com/US/en/product/sigma/c8392

Sigma-Aldrich Corporation. (2024a). *Peppermint Oil Safety Data Sheet*. Sigma-Aldrich Inc. St. Louis, Missouri, USA; Retrieved from https://www.sigmaaldrich.com/US/en/sds/aldrich/77411?sdslanguage=en&msockid=2d39bd7627136dbc17ebab70269c6c09

Sigma-Aldrich Corporation. (2024b). *Sigma-Aldrich Safety Data Sheet for Mineral Oil* (Version 6.9, Revision Date 09/07/2024). Sigma-Aldrich Inc. St. Louis, Missouri, USA; Retrieved from https://www.sigmaaldrich.com/US/en/sds/sial/18512?srsltid=AfmBOoq_bFvhQG1Nb4-iCIJ8IrHq62PKR_27GNSFqj3A3l6swYnat0By

Sigma-Aldrich Corporation. (2025). *Geraniol Safety Data Sheet, Version 6.6, Revision Date 07/21/2025*. Sigma-Aldrich Inc. St. Louis, Missouri, USA; Retrieved from https://www.sigmaaldrich.com/US/en/sds/aldrich/163333?userType=anonymous&msockid=2d39bd7627136dbc17ebab70269c6c09

Spickler, A. R. (2022a). *Rhipicephalus (Boophilis) annulatus*. The Center for Food Security & Public Health, Iowa State University; Retrieved from https://www.cfsph.iastate.edu/Factsheets/pdfs/boophilus_annulatus.pdf

Spickler, A. R. (2022b). *Rhipicephalus (Boophilus) microplus and R. australis*. The Center for Food Security & Public Health, Iowa State University; Retrieved from https://www.cfsph.iastate.edu/Factsheets/pdfs/boophilus_microplus.pdf

Spindler, P., & Madsen, C. (1992). Subchronic toxicity study of peppermint oil in rats. *Toxicology Letters*, *62*, 215-220. https://www.sciencedirect.com/science/article/pii/037842749290024E

Swiger, S. L. (2012). *Managing External Parasites of Texas Cattle*. AgriLife Extension, Texas A&M System; Retrieved from https://extensionentomology.tamu.edu/wp-content/uploads/2021/09/E-570-Cattle.pdf

Swiger, S. L. (2017). *Cattle Fever Ticks*. Texas A&M AgriLife Extension; Retrieved from https://livestockvetento.tamu.edu/files/2018/11/ENTO-065-Cattle-Fever-Ticks.pdf

TAC. (2025). *Texas County Profiles*. Texas Assocation of Counties; Retrieved from https://imis.county.org/iMIS/CountyInformationProgram/CIPCountySearch.aspx

TAHC. (2024a). *Cattle fever ticks, fact sheet*. Texas Animal Health Commission; Retrieved from https://www.tahc.texas.gov/news/brochures/TAHCFactsheet_FeverTick.pdf

TAHC. (2024b). *Monthly Fever Tick Situation Report, December 31, 2024*. Texas Animal Health Commission; Retrieved from https://www.tahc.texas.gov/animal_health/feverticks-pests/FeverTickSituationReport.pdf

TAHC. (2025). *Fever Ticks & Pests*. Texas Animal Health Commission; Retrieved from https://www.tahc.texas.gov/animal_health/feverticks-pests/#longhornedticks

TAHC, & USDA. (2016). *Fever Tick Vaccine Fact Sheet*. Texas Animal Health Commission and the U.S. Department of Agriculture; Retrieved from https://www.tahc.texas.gov/news/brochures/TAHCBrochure_FeverTickVaccineFactSheet.pdf

TAMU. (2024). *Dominant Soil Orders of Texas*. Texas A&M University (TAMU) Soil Characterization Laboratory; Retrieved from https://soildata.tamu.edu/about/resources/

TAMU. (n.d.). *Eradicating Cattle Fever Ticks: New Threats, New Challenges*. Texas A&M AgriLife Research; Retrieved from https://web.tahc.texas.gov/animal_health/feverticks-pests/CattleFeverTicks_AgriLife.pdf

Tarbin Jannuzzi, A. (2022). Eugenol aggravates UVA-induced cytotoxic and genotoxic response in HaCaT human keratinocytes. *Journal of Research in Pharmacy*. https://dergipark.org.tr/en/pub/jrespharm/issue/91489/1686818

TCEQ. (2018). *Yearly Summary Report By Site*. Texas Commission on Environmental Quality; Retrieved from https://www.tceq.texas.gov/cgi-bin/compliance/monops/select_year.pl

TCEQ. (2022a). *2022 Texas Integrated Report - Texas 303(d) List (Category 5)*. Texas Commission on Environmental Quality; Retrieved from https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2022/2022-303d.pdf

TCEQ. (2022b). *2022 Water Body Assessment by Basin*. Texas Commission on Environmental Quality; Retrieved from https://www.tceq.texas.gov/waterquality/assessment/22twqi/22basinlist

TCEQ. (2022c). *Groundwater Assessment for the 2022 State of Texas Water Quality Inventory*. Texas Commission on Environmental Quality; Retrieved from https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2022/2022-groundwater-as-465-22.pdf

TCEQ. (nd). *An Introduction to the Texas Surface Water Quality Standards*. Texas Commission on Environmental Quality; Retrieved from https://www.tceq.texas.gov/waterquality/standards/WQ_standards_intro.html

Texas Almanac. (nd). *Physical regions of Texas*. Texas Almanac; Retrieved from https://www.texasalmanac.com/drupal-backup/images/maps/PhysicalReg.pdf

TexasCounties.net. (2022). *Texas Counties: Cattle Population in 2022*. TexasCounties.net; Retrieved from https://www.texascounties.net/statistics/cattle2022.htm

Thomas, D. B., & Duhaime, R. (2022). Medicated corn feeders to disinfest cattle fever ticks, *Boophilus* (*Boophilus*) *microplus* (Acari: Ixodidae), from a suburban population of white-tailed deer, *Odocoileus virginianus* (Cervidae). *Experimental and Applied Acarology*, *86*, 431–441. https://link.springer.com/content/pdf/10.1007/s10493-022-00699-7.pdf

Thorup, I., Würtzen, G., Carstensen, J., & Olsen, P. (1983). Short term toxicity study in rats dosed with peppermint oil. *Toxicology Letters*, *19*, 211-215.

TickApp. (n.d.-a). *Black-legged tick*. Texas A&M AgriLife Research and Texas A&M AgriLife Extension Service. Retrieved June 4 from https://tickapp.tamu.edu/home/tick-identification/black-legged-tick/

TickApp. (n.d.-b). *Gulf Coast tick*. Texas A&M AgriLife Research and Texas A&M AgriLife Extension Service. Retrieved July 21 from https://tickapp.tamu.edu/home/tick-identification/gulf-coast-tick/

TickApp. (n.d.-c). *Lone star tick*. Texas A&M AgriLife Research and Texas A&M AgriLife Extension Service. Retrieved June 4 from https://tickapp.tamu.edu/home/tick-identification/lone-star-tick/

TPWD. (n.d-a). *Big Bend Country*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions/big-bend

TPWD. (n.d-b). *Chaparral WMA*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/huntwild/hunt/wma/find_a_wma/list/?id=45

TPWD. (n.d-c). *Gulf Coast*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions/gulf-coast

TPWD. (n.d-d). *James E. Daughtrey WMA*. Texas Wildlife and Parks Department; Retrieved from https://tpwd.texas.gov/huntwild/hunt/wma/find_a_wma/list/?id=46

TPWD. (n.d-e). *South Texas Plains*. Texas Parks and Wildlife Department; Retrieved from https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions/south-texas-plains

TPWD. (n.d-f). *Texas Natural Regions*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/education/resources/texas-junior-naturalists/regions

TPWD. (n.d-g). *Wildlife Management Areas of Texas*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/huntwild/hunt/wma/

TPWD. (n.d-h). *Wildlife Management Areas: Find a WMA*. Texas Parks & Wildlife Department; Retrieved from https://tpwd.texas.gov/huntwild/hunt/wma/find_a_wma/

TSHA. (2015). *The Handbook of Texas, "Cameron County", "Hidalgo County", "Jim Wells County", "Kinney County", "Val Verde County", and "Willacy County"*. Texas State Historical Association; Retrieved from https://www.tshaonline.org/handbook

TSHA. (2021). *Texas Almanac, Secondary Streams of Texas*. Texas State Historical Association; Retrieved from https://www.texasalmanac.com/articles/secondary-streams-of-texas

TWDB. (2021). *2022 State Water Plan, Water for Texas*. Texas Water Development Board; Retrieved from https://www.twdb.texas.gov/waterplanning/swp/2022/index.asp

TWDB. (2024a). *River basins*. Texas Water Development Board; Retrieved from https://www.twdb.texas.gov/surfacewater/rivers/river_basins/index.asp

TWDB. (2024b). *Texas Lakes and Rivers, History of Reservoir Construction in Texas*. Texas Water Development Board; Retrieved from https://www.twdb.texas.gov/surfacewater/rivers/reservoirs/index.asp

TWDB. (nd). *International Amistad Dam and Reservoir map*. Texas Water Development Board; Retrieved from https://www.twdb.texas.gov/surfacewater/rivers/reservoirs/plates/rio_grande/existing/amistad.pdf

Tworkoski, T. (2002). Herbicide effects of essential oils. *Weed Science*, *50*(4), 425-431. https://www.cambridge.org/core/journals/weed-science/article/herbicide-effects-of-essential-oils/12E79407D8741A7819A22C5F10CAECE0

USCB. (2023). *Table S0201 Selected Population Profile in the United States*. U.S. Census Bureau; Retrieved from https://data.census.gov/table/ACSSPP1Y2023.S0201?q=total+population

USCB. (2025). *QuickFacts*. U.S. Census Bureau; Retrieved from https://www.census.gov/quickfacts/

USDA APHIS. (2014). *Treatment of Animals for Ticks with Coumaphos (Co-Ral®). VS Guidance 7003.1*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service; Retrieved from https://www.aphis.usda.gov/sites/default/files/vsg-7003.1.pdf

USDA APHIS. (2017). *Cattle Fever Tick Eradication Program Use of Ivermectin Corn, Final Environmental Assessment, January 2017*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service; Retrieved from https://www.aphis.usda.gov/sites/default/files/ivermectin-corn.pdf

USDA APHIS. (2023). *Protecting U.S Cattle from Fever Ticks: Cattle Fever Tick Eradication Program and Treatment Options*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service; Retrieved from https://www.aphis.usda.gov/sites/default/files/bro-cft-treatment-options.pdf

USDA APHIS. (2024a). *Bovine Babesiosis Information Sheet*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service; Retrieved from https://www.aphis.usda.gov/sites/default/files/bovine-babesiosis-infosheet.pdf

USDA APHIS. (2024b). *Cattle Fever Tick Research Milestones*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service; Retrieved from https://www.aphis.usda.gov/sites/default/files/cattle-fever-tick-research-milestones-508.pdf

USDA APHIS WS. (2023). *Wildlife Services Tech Note: Snake Repellents*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services. Retrieved May 28 from https://www.aphis.usda.gov/sites/default/files/tn_snakerepellents.pdf

USDA APHIS WS. (2024). *Use of Minimum Risk Pesticides in Wildlife Damage Management*. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services; Retrieved from https://www.aphis.usda.gov/sites/default/files/29-minimum-risk-pesticides.pdf

USDA ARS. (1968). *The Fight Against Cattle Fever Ticks*. (PA-475). U.S. Department of Agriculture, Agricultural Research Service; Retrieved from https://archive.org/details/CAT10246321/page/8/mode/2up

USDA NASS. (2022). *2022 State and County Profiles - Texas*. USDA Census of Agriculture, U.S. Department of Agriculture, National Agricultural Statistical Service; Retrieved from https://www.nass.usda.gov/Publications/AgCensus/2022/Online_Resources/County_Profiles/Texas/index.php

USDA NOP. (2021). *Technical Evaluation Report: Mineral Oil, Livestock*. U.S. Department of Agriculture, National Organic Program; Retrieved from https://www.ams.usda.gov/sites/default/files/media/MineralOilTR2021.pdf

USEPA. (1993). *Reregistration Eligibiity Decision (RED) Flower and Vegetable Oils*. (EPA 738-R-93-031). U.S. Environmental Protection Agency; Retrieved from https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_G-114_01-Dec-93.pdf

USEPA. (2001). *Plant Oils Fact Sheet.* U.S. Environmental Protection Agency; Retrieved from https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/fs_G-114_01-Jul-01.pdf

USEPA. (2004a). *Geraniol; Exemption from the Requirement of a Tolerance; Final Rule*. (OPP-2004-0068; FRL-7351-1). U.S. Environmental Protection Agency; Retrieved from https://www.federalregister.gov/documents/2004/04/28/04-9577/geraniol-exemption-from-the-requirement-of-a-tolerance

USEPA. (2004b). *List of Inert Pesticide Ingredients. List 4B - Other ingredients for which EPA has sufficient information to reasonably conclude that the current use pattern in pesticide products will not adversely affect public health or the environment.- By CAS Number*. U.S. Environmental Protection Agency, Office of Pestide Programs; Retrieved from https://www.epa.gov/sites/default/files/2015-10/documents/inerts_list4bcas_0.pdf

USEPA. (2004c). *Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision (TRED) for Menthol*. U.S. Environmental Protection Agency, Prevention, Pesticides and Toxic Substances; Retrieved from https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/tred_PC-051601_28-Sep-04.pdf

USEPA. (2007). *Revised Reregistration Eligibility Decision for Aliphatic Solvents, November 29, 2007*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances; Retrieved from https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-063503_29-Nov-07.pdf

USEPA. (2010). *Vegetable and Flower Oils Summary Document, Registration Review: Initial Docket, March 2010. Case 8201*. U.S. Environmental Protection Agency, Biopesticides and Pollution Prevention Division; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2009-0904-0005

USEPA. (2011a). *Flower Oils Interim Registration Review Decision Case Number 8202*. (EPA-HQ-OPP-2011-0628-0013). U.S. Environmental Protection Agency; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2011-0628-0013

USEPA. (2011b). *Flower Oils Summary Document Registration Review: Initial Docket Case 8202*. United Staes Environmental Protection Agency; Retrieved from https://www.bing.com/ck/a?!&&p=3dec6306635e5034679df53506e32bbeef6873a7a6ff0b54e0a7e10e06e6f481JmltdHM9MTczNDQ4MDAwMA&ptn=3&ver=2&hsh=4&fclid=1f132552-3af3-6d0d-3aa0-319e3be16c11&psq=EPA-HQ-OPP-2011-0628-0005_content.pdf&u=a1aHR0cHM6Ly9kb3dubG9hZHMucmVndWxhdGlvbnMuZ292L0VQQS1IUS1PUFAtMjAxMS0wNjI4LTAwMDUvY29udGVudC5wZGY&ntb=1

USEPA. (2011c). *Non-target Organism Studies, Hazard Assessment, and Endangered Species Assessment for Vegetable and Flower Oils in Support of Registration Review*. U.S. Environmental Protection Agency, Office of Chemical Safety, Pesticides, and Pollution Prevention; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2011-0628-0002

USEPA. (2012). *Flower Oils Final Work Plan, Registration Review Case Number: 8202*. U.S. Environmental Protection Agency, Biopesticides and Pollution Prevention Division; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2011-0628-0006

USEPA. (2016a). *BEAD Chemical Profile (BCP) for Registration Review: Aliphatic Solvents (Case No. 3004)*. U.S. Environmental Protection Agency, Office of Chemical Safety and Pollution Prevention; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2016-0039-0005

USEPA. (2016b). *Registration Review: A Joint Problem Formulation and Draft Risk Assessment of the Environmental Fate and Ecological Risk of Aliphatic Solvents*. U.S. Environmental Protection Agency, Environmental Fate and Effects Division; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2016-0039-0007

USEPA. (2018). *Memorandum: Aliphatic Solvents. Draft Human Health Risk Assessment in support of Registration Review*. U.S. Environmental Protection Agency, Health Effects Division, Pesticide Re-Evaluation Division; Retrieved from https://www.regulations.gov/document/EPA-HQ-OPP-2016-0039-0014

USEPA. (2020). *Registration Review Assessment for Vegetable Oils (Case No. 8201): Canola Oil, Castor Oil, Soybean Oil and Jojoba Oil; and Flower Oils (Case No. 8202): Oil of Mustard, Oil of Citronella, Indole, Lavandin Oil, Oil of Lemongrass, Oil of Eucalyptus,* *Oil of Orange, Eugenol, Bergamot Oil, Alpha-Ionone, Balsam Fir Oil, and Geraniol*. U.S. Environmental Protection Agency; Retrieved from https://www.bing.com/search?q=Registration+Review+Assessment+for+Vegetable+Oils+%28Case+No.+8201%29%3A+Canola+Oil%2C+Castor+Oil%2C+Soybean+Oil+and+Jojoba+Oil%3B+and+Flower+Oils+%28Case+No.+8202%29%3A+Oil+of+Mustard%2C+Oil+of+Citronella%2C+Indole%2C+Lavandin+Oil%2C+Oil+of+Lemongrass%2C+Oil+of+Eucalyptus%2C+Oil&form=ANNH02&refig=68926091ce504efe8ec4fcc4f3421a06&pc=U531

USEPA. (2023). *Air Quality Index Annual Summary Data, 2023 by County*. U.S. Environmental Protection Agency; Retrieved from https://aqs.epa.gov/aqsweb/airdata/download_files.html#Annual

USEPA. (2024a). *Nonattainment Areas for Criteria Pollutants (Green Book)*. U.S. Environmental Protection Agency; Retrieved from https://www.epa.gov/green-book

USEPA. (2024b). *Safer Chemical Ingredients List*. U.S. Environmental Protection Agency; Retrieved from https://www.epa.gov/saferchoice/safer-ingredients

USFWS. (2024). *Official Species List Texas Coastal & Central Plains*. U.S. Fish and Wildlife Service, Information for Planning and Consultation; Retrieved from https://ipac.ecosphere.fws.gov/

Velisek, J., Svobodova, Z., & Piackova, V. (2005). Effects of clove oil anaesthesia on rainbow trout (Oncorhynchus mykiss). *Acta Veterinaria Brno*, *74*, 139-146. https://actavet.vfu.cz/media/pdf/avb_2005074010139.pdf

Velisek, J., Svobodova, Z., Piackova, V., Groch, L., & Nepejchalova, L. (2005). Effects of clove oil anaesthesia on common carp (Cyprinus carpio L.). *Veterinary Medicine - Czech*, *50*(6), 269-275. https://vetmed.agriculturejournals.cz/artkey/vet-200506-0004_effects-of-clove-oil-anaesthesia-on-common-carp-cyprinus-carpio-l.php

Venarsky, M. P., & Wilhelm, F. M. (2006). Use of clove oil to anaesthetize freshwater amphipods. *Hydrobiologia*, *568*(1), 425-432. https://doi.org/10.1007/s10750-006-0225-x

WHO. (2009). *IARC Monographs on the Identification of Carcinogenic Hazards to Humans: Queried Mineral Oil*. ;World Health Organization, International Agency for Research on Cancer; Retrieved from https://monographs.iarc.who.int/list-of-classifications

Appendix A Socioeconomic Data

Table A-1a. Population statistics - Brooks, Cameron, Dimmit, and Duval Counties, Texas.

Description	Brooks County	Cameron County	Dimmit County	Duval County
Total county area (mi^2)	943.64	1,276.43	1,334.51	1,795.59
Total population	7,076	421,017	8,615	9,831
Percent rural	36.45	17.58	34.82	100
Largest communities, population	Falfurrias: 4,609	Brownsville: 186,738 Harlingen: 71,892 San Benito: 24,861	Carrizo Springs: 4,892 Asherton: 722 Big Wells: 483	San Diego: 3,748 Freer: 2,461 Benavides: 1,183
Median household income	$36,695	$51,716	$27,374	$40,415
Unemployment rate (%)	6.0	5.7	3.8	4.5
Poverty rate (%)	29.70	23.50	27.30	29.10

Source: Texas Association of Counties (TAC, 2025) and U.S. Census Bureau (USCB, 2025).

Table A-1b. Population statistics - Hidalgo, Jim Hogg, Jim Wells, and Kenedy Counties, Texas.

Description	Hidalgo County	Jim Hogg County	Jim Wells County	Kenedy County
Total county area (mi^2)	1,582.83	1,136.21	868.54	1,945.80
Total population (2020 Census)	870,781	4,838	38,891	350
Percent rural (2020 Census)	8.91	100	50.08	100
Largest communities, population (2020 Census)	McAllen: 142,210 Edinburg: 100,243	Hebbronville: 4,101	Alice: 17,891 Orange Grove: 1,165	Sarita: 205
Median household income	$53,160	$44,736	$50,814	$43,037
Unemployment rate (%)	6.5	5.4	5.7	6.1
Poverty rate (%)	26.90	24.60	21.20	14.90

Source: Texas Association of Counties (TAC, 2025) and U.S. Census Bureau (USCB, 2025).

Table A-1c. Population statistics - Kinney, Kleberg, La Salle, and Live Oak Counties, Texas.

Description	Kinney County	Kleberg County	La Salle County	Live Oak County
Total county area (mi^2)	1,365.12	1,090.20	1,494.23	1,078.88
Total population	3,129	31,040	6,664	11,335
Percent rural	100	19.64	100	100
Largest communities, population	Brackettville: 1,341 Spofford: 41	Kingsville: 25,402	Cotulla: 3,718 Encinal: 541	George West: 2,171 Three Rivers: 1,474
Median household income	\$53,572	\$52,903	\$48,675	\$59,202
Unemployment rate (%)	4.7	4.8	2.8	4.2
Poverty rate (%)	21.0	22.10	27.10	17.0

Source: Texas Association of Counties (TAC, 2025) and U.S. Census Bureau (USCB, 2025).

Table A-1d. Population statistics - Maverick, McMullen, Starr, and Val Verde Counties, Texas.

Description	Maverick County	McMullen County	Starr County	Val Verde County
Total county area (mi^2)	1,291.78	1,156.78	1,229.10	3,232.67
Total population	57,887	600	65,920	47,586
Percent rural	6.57	100	28.60	10.31
Largest communities, population	Eagle Pass: 28,130	Tilden: 190	Rio Grande City: 15,317 Roma: 11,561	Del Rio: 34,673
Median household income	\$46,052	\$71,112	\$38,824	\$56,619
Unemployment rate (%)	7.9	1.8	11.0	4.5
Poverty rate (%)	22.80	12.40	28.80	20.20

Source: Texas Association of Counties (TAC, 2025) and U.S. Census Bureau (USCB, 2025).

Table A-1e. Population statistics - Webb, Willacy, and Zapata Counties, Texas.

Description	**Webb County**	**Willacy County**	**Zapata County**
Total county area (mi^2)	3,375.59	784.77	1,058.02
Total population	267.114	20,164	13,889
Percent rural	5.86	35.60	21.22
Largest communities, population	Laredo: 255,205 Rio Bravo: 4,450	Raymondville: 10,236 Lyford: 2,249	Zapata: 5,383
Median household income	$57,899	$42,279	$41,688
Unemployment rate (%)	4.1	8.2	6.9
Poverty rate (%)	22.50	27.80	30.40

Source: The County Information Program, Texas Association of Counties (TAC, 2025).

Table A-2. Agricultural production in counties in the proposed action area.

County	Agricultural products value			
	Crops[1] ($1,000)	Livestock, poultry, and animal products[1] ($1,000)	Cattle population (in-state rank)[2]	Total Agriculture[1] ($1,000)
Brooks	3,485	20,721	19,494 (161 of 254)	24,206
Cameron	125,443	3,347	9,645 (211 of 254)	128,790
Dimmit	6,920	3,693	9,447 (213 of 254)	10,612
Duval	1,947	13,073	33,716 (121 of 254))	15.019
Hidalgo	362,855	23,187	33,018 (123 of 254)	386,043
Jim Hogg	174	8,399	20,377 (157 of 254)	8,573
Jim Wells	39,927	32,690	28,174 (133 of 254)	72,616
Kenedy	N/A	N/A	39,360 (100 of 254)	18,849
Kinney	38	3,749	7,753 (223 of 254)	3,788
Kleberg	16,377	35,428	25,092 (143 of 254)	51,805
La Salle	1,122	6,544	11,909 (201 of 254)	7,667
Live Oak	1,553	13,412	28,697 (131 of 254)	14,965
Maverick	2,939	41,358	18,555 (167 of 254)	
McMullen	868	8,598	13,132 (189 of 254)	9,466
Starr	4,091	3,182	50,623 (71 of 254)	7,272
Val Verde	289	15,192	11,537 (204 of 254)	15,482
Webb	477	31,041	45,607 (79 of 254)	31,518
Willacy	90,337	5,054	13,909 (183 of 254)	95,391
Zapata	253	4,941	12,345	5,194

County	Agricultural products value			
	Crops[1] ($1,000)	Livestock, poultry, and animal products[1] ($1,000)	Cattle population (in-state rank)[2]	Total Agriculture[1] ($1,000)
			(197 of 254)	

Sources: 1 – 2022 Census of Agriculture, County Profile (USDA NASS, 2022);
2 – Texas Counties: Cattle Population in 2022 (TexasCounties.net, 2022).
N/A – Not applicable.

Table A-3. Summary of listed historic sites present for the counties within the proposed action area.

County	National Historic Register Listings	Texas Historic Landmark	Cemeteries (Historic Cemeteries)	Museums
Brooks	1	1	19 (2)	1
Cameron	34	81	106 (18)	12
Dimmit	3	5	7 (1)	2
Duval	0	2	70 (4)	1
Hidalgo	22	36	90 (14)	9
Jim Hogg	0	4	13 (4)	1
Jim Wells	0	1	31 (6)	0
Kenedy	1	1	4 (1)	1
Kinney	2	22	15 (1)	0
Kleberg	6	5	8 (2)	4
LaSalle	4	1	11 (2)	1
Live Oak	1	8	18 (5)	1
Maverick	2	7	8 (1)	1
McMullen	0	2	6 (1)	0
Starr	9	17	103 (2)	1
Val Verde	3	7	18 (4)	4
Webb	9	13	31 (4)	4
Willacy	2	1	24 (2)	0
Zapata	4	1	27 (2)	2

Source: County data from Texas Historical Commission database: Search - Atlas: Texas Historical Commission

Appendix B Human and Ecological Health Evaluation for AFTS

B.1 Introduction

This appendix provides a human and ecological health risk assessment providing a qualitative evaluation of the potential risks and hazards to human health and non-target organisms based on the active and inert ingredients found in the Arkion Fly and Tick Spray (AFTS) formulation (Table B-1) proposed for use on cattle fever ticks (CFTs).

Table B-9. Ingredients in Arkion Fly and Tick Spray.

Chemical Name	CAS Number	Weight %
Active ingredients		**30**
Castor oil	8001-79-4	12
Geraniol	106-24-1	8
Oil, peppermint	8006-90-4	5
Oil, clove	8000-34-8	5
Inert ingredients		**70**
Oils, mineral	8012-95-1	Trade secret
Potassium cocoate (soap base)	61789-30-8	Trade secret

Source: (Arkion, nd).

Data includes information cited in United States Environmental Protection Agency (EPA), information from online databases, peer reviewed studies, and other publicly available literature.

A problem formulation, dose-response assessment, exposure assessment, and risk characterization are provided below for each active and inert ingredient found in AFTS. The problem formulation section covers each ingredient's chemical description, product use, physical and chemical properties, environmental fate, and hazard identification. Environmental fate describes how chemicals move and degrade in the environment. The environmental fate processes include 1) persistence, degradation, and mobility in soil; 2) movement to air; 3) migration potential to groundwater and surface water; 4) degradation in water; and 5) plant uptake.

The dose-response assessment section discusses the dose levels (toxicity criteria) for potential human health effects, including acute and chronic toxicity. It also discusses available ecological effects data for terrestrial and aquatic species. Available acute and chronic toxicity data are summarized for all major taxa. This data will be integrated with the exposure analysis section to characterize the risk of chemical repellents to nontarget species. This section gathered information from online databases and searches for relevant peer-reviewed and other published literature. Unless otherwise specified, the toxicity of the technical active ingredient for nontarget mammals and birds was assumed to be similar to the toxicity of the end-use formulations, which is a conservative approach. The toxicity of degradants and metabolites of the chemical repellents to nontarget species are unknown but are assumed to be similar to the parent chemicals for this risk assessment

The exposure assessment section evaluates the potential for exposure of humans to AFTS. The exposure assessment considers the CFTEP proposed use patterns for AFTS. An exposure pathway for AFTS includes (1) a release of AFTS into the environment, (2) an exposure point where contact can occur with AFTS, and (3) an exposure route such as ingestion, inhalation, or dermal contact by which contact can occur. Exposures for the identified human populations are evaluated qualitatively for each identified exposure pathway. Risks associated with adverse human health are characterized qualitatively in this section. The ecological exposure potential and risk characterization for AFTS are also discussed. In cases where data is lacking, EPA assumes that avian toxicity data is representative of reptiles and terrestrial-phase amphibians, and fish toxicity data is representative of aquatic-phase amphibians.

B.2 AFTS

B.2.1 Problem Formulation

Description and Uses

AFTS is an all-natural soap-based insecticide labeled for use on horses, dairy and beef cattle, and areas where livestock are kept. It eliminates and repels most flying and crawling insects, including flies, ticks, horn flies, house flies, stable flies, mosquitos, and other insects.
AFTS consists of the active ingredients castor oil, geraniol, clove oil, and peppermint oil.

Per the criteria set by the EPA, AFTS qualifies as an exempt minimum risk pesticide product under section 25(b) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and, as such, is exempt from regulation under FIFRA (Arkion, nd). Pesticides exempt under FIFRA section 25(b) are also exempt from pesticide registration in Texas. This product is available for purchase and use by the general public.

Physical and Chemical Properties

The product is composed of natural plant oils (Tables 1 and B-1). The product concentrate is a pale white liquid emulsion with a mint-like smell. AFTS is miscible in water and has a relative density of 1 gram per milliliter (g/mL). No other physical or chemical properties are available.

Environmental Fate

The environmental fate describes the processes by which AFTS and its ingredients move and are transformed in the environment. The environmental fate processes include: 1) mobility and migration potential in the environment, 2) persistence and degradation, and 3) plant uptake.

No environmental fate data is available for AFTS.

Hazard Identification

The AFTS label and the Safety Data Sheet (SDS) state that the product causes skin irritation and serious eye damage. It also may cause an allergic skin reaction and damage to organs through prolonged or repeated exposure. AFTS is suspected of causing genetic defects. According to the label, it may be fatal if swallowed and enters airways (Arkion, 2022, nd).

AFTS works by stripping the exoskeleton of insects leading to immediate respiratory distress and soon eventually death (Arkion, 2024). The AFTS label states that the product is harmful to aquatic life with long-lasting effects (Arkion, nd).

B.2.2 Dose-Response Assessment

Human Health Dose-Response

Acute Toxicity

Based on the results of an acute oral toxicity study for AFTS, the acute oral LD_{50} in rats was estimated at >2000 mg/kg (Kabaru, 2023). AFTS is not expected to present acute hazard through the oral route.

An acute dermal LD_{50} of >2,000 mg/kg in rats was estimated from an acute dermal toxicity test, indicating the material is unlikely to present acute hazard via the dermal route (Kabaru, 2023). In an acute dermal irritation study, rabbits received a single 4-hour topical exposure to 0.5 g of the test substance and were observed for 14 days. AFTS did not cause irritation, indicating AFTS is a non-irritant to skin (Kabaru, 2023).

AFTS was non-irritating to rabbits in an acute eye irritation test where rabbits were exposed to a single 24-hour topical exposure (Kabaru, 2023).

An acute eye irritation test was conducted with a rabbit where it was exposed to a single 100 mg/eye topical application of AFTS for 24 hours. The test substance did not cause eye irritation over a 14-day observation period, and, as a result, is considered non-irritating to rabbit eyes (Kabaru, 2023).

In an unpublished study on AFTS, a single 4-hour acute inhalation exposure for rats resulted in an LC_{50} > 5 mg/L of air, indicating low inhalation toxicity (Kabaru, 2023).

A skin sensitization test on male guinea pigs over a period of 30 days was conducted to determine the potential for AFTS to cause skin sensitization. No skin sensitization was observed in the treated animals. Under the conditions of this study, AFTS is considered to not be a skin sensitizer (Kabaru, 2023).

Subchronic and Chronic Toxicity

No subchronic or chronic toxicity test data for AFTS is available.

Ecological Dose-Response

No ecological toxicity test data for AFTS is available.

B.3 Castor Oil

B.3.1 Problem Formulation

Description and Uses

Castor oil (Chemical Abstract Service (CAS) Number 8001-79-4) is a vegetable oil derived from the castor plant (*Ricinus communis*). Castor oil is widely used in food products, cosmetics, and pharmaceutical products (NIH, 2024a). Castor oil is an active ingredient in several products as a mold inhibitor and as a repellent to control moles, voles, and gophers from lawns, ornamentals, golf courses and athletic fields. Its mode of action is non-toxic. Castor oil was first registered as a biochemical pesticide by EPA in 1994 (USEPA, 2010).

Castor oil is an active ingredient in AFTS concentrate comprising 12% of the formulation.

EPA considers castor oil exempt from the requirements of FIFRA, including studies for non-target organisms (USEPA, 2011c).

Physical and Chemical Properties

Castor oil is a colorless to very pale-yellow liquid with a mild or no taste or scent (NIH, 2024a). It has low solubility in water with a solubility less than 1 milligrams per milliliter (mg/mL) at 68 degrees Fahrenheit (°F) (NIH, 2024a). Its density, 0.95 grams per cubic centimeter (g/cm^3) at 25 degrees Celsius (°C), is less than water, indicating it will float (NIH, 2024a). It has a boiling point of 313 C° (595 °F) (Castoroil.in, 2006) Its octanol/water partition coefficient (K_{ow})[9] (calculated) is 6.19 (Baker & Grant, 2018a) indicating it is not very soluble in water.

[9] K_{ow} is the ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase octanol/water system. This parameter refers to the distribution of an organic compound between octanol and water phases, quantifying the substances's lipophilic and hydrophilic properties. Chemicals with low Kow

Environmental Fate
EPA has waived many of the environmental fate data requirements for castor oil due to low concentrations in end use products, low use volume, and the rapid biological, physical, and chemical degradation in the environment by normal biological, physical, and/or chemical processes that can be reasonable expected to exist where the pesticides are applied (USEPA, 2011c). Like other vegetable oils, castor oil is expected to be broken down by a range of microorganisms in the environment, indicating it is not expected to bioaccumulate or persist in the environment. A log K_{ow} of 0.79 indicates that castor oil does not tend to bioaccumulate. In its evaluation of vegetable oils, including castor oil, EPA indicated that no risks to the environment are expected from use of these oils in pesticide products (USEPA, 2001).

Hazard Identification
Castor oil is not considered to be a hazardous substance or mixture, although it may cause dermal irritation.

EPA considers castor oil to be a minimal risk active and inert ingredient applied to food crops (40 Code of Federal Regulations (CFR) 180.950) that are exempt from the requirement of a tolerance (the legal limit for a pesticide chemical residue in or on a food) under section 408 of the Federal Food, Drug, and Cosmetic Act (FFDCA). Additionally, the United States Food and Drug Administration (FDA) has approved the use of castor oil as a natural flavoring substance and natural adjuvant permitted for direct addition to food for human consumption (21 CFR 172.510).

B.3.2 Dose-Response Assessment

Human Health Dose-Response
In their evaluation of plant oils, including castor oil, EPA indicated that no adverse effects to humans are expected from the use of these substances in repellents and insecticides (USEPA, 2001). Most of these oils are found in common foods, and many are approved as food flavorings by FDA. Per 40 CFR 180.950(e), residues resulting from the use of castor oil as either an inert or an active ingredient in a pesticide chemical formulation are exempted from the requirement of a tolerance under FFDCA section 408, if such use is in accordance with good agricultural or manufacturing practices[10]. EPA establishes exemptions from the requirement of a tolerance

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values (e.g., less than 10) may be considered relatively hydrophilic; they tend to have high water solubilities, small soil/sediment adsorption coefficients, and small bioconcentration factors for aquatic life. Conversely, chemicals with high Kow values (e.g., greater than 10^4) are very hydrophobic.

[10] Section 408(b)(2)(A)(i) of FFDCA allows EPA to establish an exemption from the requirement for a tolerance only if EPA determines that the tolerance is "safe." Section 408(b)(2)(A)(ii) of FFDCA defines "safe" to mean that "there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue,

where it can be shown that the risks from aggregate exposure to pesticide chemical residues under reasonably foreseeable circumstances will pose no appreciable risks to human health. EPA considers the toxicity of the inert in conjunction with possible exposure to residues of the chemical ingredient through food, drinking water, and through other exposures that occur as a result of pesticide use in residential settings.

Acute Toxicity

Castor oil is practically nontoxic with an acute oral LD_{50}[11] >10 grams per kilogram (g/kg) in rats and mice (Baker & Grant, 2018a; Irwin, 1992).

In acute dermal irritation studies, undiluted castor oil caused severe to slight irritation to rabbit skin, mild irritation to guinea pig and rat skin, and no irritation to miniature swine skin (Johnson, 2007). In general, in human clinical tests, castor oil is not a significant skin irritant, sensitizer or photosensitizer (Johnson, 2007).

In an acute eye irritation study, castor oil did not cause irritation in rabbits (Johnson, 2007 as cited in (Baker & Grant, 2018a)).

Subchronic and Chronic Toxicity

In subchronic 90-day oral toxicity studies, male and female F344/N rats were fed diets ranging from 0.62% to 10% castor oil for 13 weeks. No effect on survival or changes in food consumption were noted and there were no significant differences in mean body weights (Irwin, 1992).

Inhalation toxicity data is unavailable.

Castor oil is not mutagenic or clastogenic, based on *in vitro* genetic toxicity assays (Irwin, 1992). Reproductive toxicity was not observed in mice fed up to 10% castor oil for 13 weeks (Johnson, 2007).

Castor oil is not a known carcinogen (Baker & Grant, 2018a).

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including all anticipated dietary exposures and all other exposures for which there is reliable information." This includes exposure through drinking water and in residential settings but does not include occupational exposure. Section 408(b)(2)(C) of FFDCA requires EPA to give special consideration to exposure of infants and children to the pesticide chemical residue in establishing a tolerance and to "ensure that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide chemical residue. . . ."

[11] LD_{50} (median lethal dose) is defined as a statistically derived estimate of the single oral or dermal dose or concentration of a substance that would cause 50 percent mortality to the test population under specified conditions.

Ecological Dose-Response

EPA considers castor oil to be exempt from the requirements of FIFRA, including the data requirements for non-target organisms (USEPA, 2011c).

Aquatic Toxicity

In general, vegetable and flower oils, including castor oil, are considered toxic to fish given their mode of action as suffocating agents (USEPA, 2011c). However, EPA indicated that they believe that label restrictions will prevent the application of these products to aquatic sites, resulting in low exposure and low risk for aquatic organisms.

Terrestrial Toxicity

Acute and chronic toxicity data in non-target species is limited. For mammals, castor oil has an acute oral and dermal LD_{50} of > 5,000 milligrams per kilogram (mg/kg) in the rat (BPDB, 2024), indicating a relatively low acute toxicity.

Generally, phytotoxicity[12] has not been observed for castor oil used on agricultural crops (Gahukar, 2017).

B.4 Geraniol

B.4.1 Problem Formulation

Description and Uses

Geraniol (CAS 106-24-1) is a naturally occurring terpenoid found in plants, including plants for human consumption (Baker & Grant, 2018b). Significant quantities of geraniol are found in rose oil, palmarosa oil, and citronella oil, with smaller amounts in geranium, lemon, and many other essential oils (MacLeman, 2022).

Geraniol is used as a repellent for mosquitos and ticks, and as a pesticide against arthropods, nematodes, and arachnids, as well as against bacteria and fungi (Baker & Grant, 2018b). It is used extensively in cosmetics, household products, and pharmaceuticals, because of its low toxicity and environmentally-friendly profile. The substance is also used on food crops, including grapes, strawberries, nuts, hops, cucurbits, stone fruit, and pome fruit. Geraniol is used in small quantities to add a citrus flavoring. It is used in alcoholic and nonalcoholic beverages, baked goods, chewing gum, frozen dairy, gelatin (pudding), gravies, hard candy, meat products, and soft candy (NIH, 2024b).

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[12] Signs of phytotoxicity include leaf burning, scorching, yellowing or reddening of leaf tips, vein clearing or necrosis.

Geraniol is an active ingredient permitted for use in minimum risk pesticides (40 CFR 152.25(f)) that are exempted from regulation by the EPA under FIFRA Section 25(b), indicating it poses little or no risk to humans and the environment. Additionally, geraniol is classified by FDA as Generally Recognized as Safe (GRAS) as a food additive used as a synthetic flavoring agent and adjuvant (21 CFR 182.60).

Geraniol is an active ingredient in AFTS concentrate comprising 8% of the formulation.

Physical and Chemical Properties

Geraniol is a colorless to pale yellow oily liquid with a sweet rose or geranium-like odor (NIH, 2024b; Sigma-Aldrich Corporation, 2025).

This substance has a boiling point of 229 to 230 °C. Geraniol is practically insoluble in water with a water solubility of 100 mg/L at 25 °C (77 °F) (Sigma-Aldrich Corporation, 2025). It has an estimated soil adsorption coefficient (Koc) of 90 (NIH, 2024b). The estimated Henry's Law Constant[13] is 1.15×10^{-5} atm-m^3/mol (NIH, 2024b). Geraniol has a vapor pressure of approximately 0.03 millimeters of mercury (mmHg) (temperature not provided) (NIH, 2024b). It has a n-octanol/water partition coefficient (K_{ow}) of 2,060 (log K_{ow} = 2.5) at 25 °C (77 °F) (Baker & Grant, 2018b; Sigma-Aldrich Corporation, 2025) indicating its low affinity for water.

Environmental Fate

Geraniol is not expected to persist in the environment based on its chemical and physical properties (Baker & Grant, 2018b). Geraniol is extremely volatile and biodegrades readily in air, soil and water, as well as through microbial activity. In air and soil, it has a half-life of 0.261 hours and 720 hours (30 days), respectively (Baker & Grant, 2018b). Geraniol's estimated half-life in water is a 3 days (model river) and 34 days (model lake), respectively (Baker & Grant, 2018b; NIH, 2024b). Its air photodegradation half-life is 0.71 hrs.

Based on its estimated K_{oc}, geraniol is expected to have high mobility in soil and is not expected to adsorb to suspended solids and sediment in water (NIH, 2024b). Additionally, based on its estimated Henry's Law Constant, geraniol is expected to volatize from moist soil surfaces and water surfaces (NIH, 2024b). However, based on its estimated vapor pressure, geraniol is not expected to volatilize from dry soil surfaces.

The estimated bioconcentration factor (BCF) of 100 indicates moderate potential for bioconcentration in aquatic organisms (NIH, 2024b).

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[13] Henry's Law Constant (HLC) is the ratio of a chemical concentration in the gas phase to that in the aqueous phase at equilibrium. HLC is expressed as atm-m3 /mole or Pa-m3 /mole. HLC provides an indication of a chemical's volatility from water indicating potential environmental partitioning, potential removal in sewage treatment plant, and possible routes of environmental exposure (EPA 2015 EPI).

EPA has waived much of the fate data for vegetable and flower oils, including geraniol, due to low concentrations in end use products, low use volume, and rapid degradation in the environment by normal biological, physical, and/or chemical processes that can be reasonably expected to exist where the pesticides are applied (USEPA, 2011c).

Hazard Identification

Geraniol is included on the EPA list of minimum risk active ingredients (40 CFR 152.25(f)(1)). EPA waived most data and registration requirements for geraniol and other flower-derived essential oils because of their natural occurrence, safe use as fragrances and flavoring agents, and low exposure (USEPA, 1993). Geraniol is classified by FDA as Generally Recognized as Safe (GRAS) as a food additive used as a synthetic flavoring agent and adjuvant (21 CFR 182.60). EPA has exempt geraniol from the requirement of a tolerance for residues in or on all food or feed commodities (40 CFR 180.1251) (USEPA, 2011b).

Geraniol can potentially autoxidize upon air exposure. As a result, when geraniol-containing products are applied to the skin, the oxidized unstable geraniol molecule may cause skin irritation (MacLeman, 2022).

EPA conducted a literature search, finding no reports of adverse effects from exposure to geraniol in humans (USEPA, 2020). Baker and Grant (Baker & Grant, 2018b) summarized incidents reported by the National Pesticide Information Center (NPIC) between April 1, 1996, and March 30, 2016. Most of the 23 incidents involved dermal or respiratory effects, such as irritation and skin discoloration.

B.4.2 Dose-Response Assessment

Human Health Dose Response

Flower oils, including geraniol, are naturally-occurring substances, have non-toxic modes of action, and have a significant safe history of exposure to humans and the environment. Along with other flower oils, the EPA waived all the toxicity tests required for the pesticide registration for geraniol based on low toxicity and lack of exposure (USEPA, 2011a).

Acute Toxicity

Geraniol has an acute oral LD_{50} of 3,600 mg/kg in rats and is considered practically nontoxic (Toxicity Category III) (NIH, 2024b; Sigma-Aldrich Corporation, 2025).

In an acute dermal irritation corrosion test in rabbits, geraniol has a dermal LD_{50} of > 5,000 mg/kg (Toxicity Category III) and described as not irritating (NIH, 2024b; Sigma-Aldrich Corporation, 2025).

For an acute inhalation study in mice, the median effective dose (ED_{25}) was 570 µg/L (FFHPVC 2004 as cited in (Baker & Grant, 2018b)).

An acute eye irritation test in rabbits found that geraniol can cause serious damage to the eyes at 100% dosage (Sigma-Aldrich Corporation, 2025) but was cleared from the eyes naturally at lower concentrations of 5 and 12.5 percent (Baker & Grant, 2018b).

Geraniol was found to not be a skin sensitizer in the guinea pig (NIH, 2024b).

Subchronic and Chronic Toxicity

In 90-day oral toxicity studies in rats, no adverse effects were observed at the highest dose of 10,000 parts per million (ppm) (FFHPVC 2004 as cited in (Baker & Grant, 2018b)).

A 90-day inhalation toxicity study found a NOAEL of 60 mg/kg in maternal rats (FFHPVC 2000 as cited in (Baker & Grant, 2018b)).

In geraniol mutagenicity/genotoxicity testing (negative in the Ames assay in *Salmonella typhimurium* strains tested at 100 µg), the substance was not mutagenic (EPA 2007 as cited in (Baker & Grant, 2018b)).

Geraniol is not a known human carcinogen (Baker & Grant, 2018b; Sigma-Aldrich Corporation, 2025).

Ecological Dose-Response

EPA has waived all nontarget toxicity data requirements for flower oils, including geraniol, "due to the low concentration of the active ingredient in end-use-products, low use-volume, and rapid degradation in the environment by normal biological, physical, and/or chemical processes that can be reasonable expected to exist where pesticides are applied" (USEPA, 2012).

Aquatic Effects Analysis

Geraniol is moderately to slightly toxic to freshwater fish and freshwater invertebrates (Table B-2).

Table B-2. Acute and chronic toxicity to aquatic vertebrates and invertebrates for geraniol.

Taxonomic group	Test species	Test result	Reference
Freshwater Fish	Rainbow trout (*Oncorhynchus mykiss*)	96-hr LC_{50} 3700 µg/L (3.7 mg/L)	(NIH, 2024b)
Freshwater Fish	Zebrafish (*Danio rerio*)	96-hr LC_{50} 14.0 mg/L	(NIH, 2024b)

Taxonomic group	Test species	Test result	Reference
Freshwater Invertebrate	Water flea (*Daphnia magna*)	24-hr LC_{50} 35.0 mg/L 48-hr LC_{50} 8.98 mg/L	(NIH, 2024b)
Algae (aquatic plants)	Green algae (*Desmodesmus subspicatus*)	72-hr EC_{50} 13.1 mg/L	(Sigma-Aldrich Corporation, 2025)

Definitions:
LC_{50} (lethal concentration 50) = the concentration that kills 50% of the test animals during the observation period.
EC_{50} (median effective concentration) = the concentration of test substance which results in a 50 percent reduction in either algae growth or algae growth rate or *Daphina* immobilization.

Terrestrial Effects Analysis

According to EPA, geraniol poses a moderate to low risk to non-target species. EPA (USEPA, 2010) reported geraniol as practically nontoxic to nontarget mammals, birds, and plants. The acute oral toxicity in northern bobwhite quail is > 10,000 milligrams per kilograms body weight per day (mg/kg bw/day) (Gwynn 2014 as cited in (Baker & Grant, 2018b)).

Acute and chronic toxicity studies on honey bees (*Apis mellifera*) are unavailable; however, studies on the use of geraniol to treat parasites and pathogens in bees report low or no toxicity to bees (Baker & Grant, 2018b).

B.5 Peppermint Oil

B.5.1 Problem Formulation

Description and Uses

Peppermint oil (CAS No. 8006-90-4) is a volatile oil derived from the culinary and medicinal herb plant *Mentha piperita*. Peppermint oil has more than 30 known components, but the primary one is menthol. Peppermint oil is used as flavoring agents in foods, in certain medicinal products, and in personal care products. Peppermint oil is also used in a range of pesticidal products including insect repellents, insecticides, acaricides, vertebrate animal repellents, antimicrobial disinfectants, bactericides, fungicides and herbicides (Baker et al., 2018b).

EPA classifies peppermint oil as a plant-derived essential oil. Peppermint oil is an active and inert ingredient permitted for use in minimum risk pesticides (40 CFR 152.25(f)) that are exempted from regulation by the EPA under FIFRA Section 25(b), indicating it poses little or no risk to humans and the environment. Peppermint and peppermint oil are exempt from the requirement of a tolerance and can be applied to food crops (40 CFR 180). Under 21 CFR 182.20, FDA considers peppermint oil as GRAS for its intended use in food, within the meaning of section 409 of the FFDCA. USDA National Organic Program (NOP) considers peppermint oil to be a nonsynthetic plant oil and allows its use in organic production (7 CFR 205).

Peppermint oil is an active ingredient in AFTS comprising 5% of the formulation.

Physical and Chemical Properties

Peppermint oil is a colorless to pale yellow liquid (NIH, 2024c). It has a strong minty odor (NIH, 2024c). It is very slightly soluble to insoluble in water (NIH, 2024c). It has a boiling point of 212 °C and a calculated vapor pressure of 0.3 mmHg at 25 °C and calculated K_{ow} (octanol/water partition coefficient) of 19.94 (Baker et al., 2018b). The estimated soil adsorption coefficient (K_{oc}) is 2,413 at 20 C° (ECHA, 2023).

Environmental Fate

Peppermint oil's estimated half-life in soil and water is 180 days and 360 days (Baker et al., 2018b). The substance is considered persistent in soil (Lewis et al., 2016), but is also considered to be readily biodegradable (ECHA, 2023; Lewis et al., 2016). Peppermint oil is volatile with a short estimated half-life in air of under an hour (Baker et al., 2018b).

Hazard Identification

Peppermint oil is classified as GRAS by FDA when used in food (21 CFR 182.20) (Cohen et al., 2020). Additionally, peppermint oil is an active and inert ingredient permitted for use in minimum risk pesticides (40 CFR 152.25(f)) that are exempted from regulation by the EPA under FIFRA Section 25(b), indicating it poses little or no risk to humans and the environment.

Allergic reactions to peppermint/peppermint oil have been reported in a small percentage of the population (Baker et al., 2018b). Baker et al. (Baker et al., 2018b) summarized incidents reported in NPIC. From April 1, 1996, to March 30, 2016, there were 14 human health incidents, mostly involving formulated products with multiple active ingredients. One incident was from accidental inhalation, and another was from ingestion by a two-year-old who did not show symptoms. The outcomes of the other incidents were not reported.

B.5.2 Dose-Response Assessment

Human Health and Dose Response

Acute Toxicity

Peppermint oil is practically nontoxic (Toxicity Category IV) for acute oral and dermal exposures. The acute oral LD_{50} in rats was 2.426 mg/kg and in mice 2.490 mg/kg (NIH, 2024c). The acute dermal LD_{50} in rabbits was > 5,000 mg/kg (Hayes et al., 2007 as cited in (Baker et al., 2018b)). In rabbits, menthol, a primary component in peppermint oil, caused severe eye irritation in an acute eye irritation study (USEPA, 2004c). Menthol is a mild dermal irritant but not a skin sensitizer (Hayes et al. 2007 as cited in (Baker et al., 2018b)). No studies were available on acute inhalation toxicity for peppermint oil.

Subchronic and Chronic Toxicity
In 28-day and 90-day subchronic oral toxicity studies in rats, the No Observable Adverse Effect Level (NOAEL) for peppermint oil was 10 mg/kg/day and 40 mg/kg/day, respectively (Spindler & Madsen, 1992; Thorup et al., 1983). In the 28-day study, the peppermint oil had higher levels of pulegone and lower levels of menthol, which may explain the shorter length study having the lower adverse effect level (Baker et al., 2018b).

Peppermint oil was negative in both the Ames Test and in a mouse lymphoma mutagenesis assay (carcinogenicity test) (Baker et al., 2018b).

Peppermint oil is not classified as carcinogenic (Baker et al., 2018b).

Ecological Dose-Response

Aquatic Effects Analysis
In general, vegetable and flower oils are considered toxic to fish given their mode of action as suffocating agents (USEPA, 2011c). Peppermint oil's toxicity data for aquatic species is limited; some data are available for menthol.

In aquatic vertebrate toxicity studies, L-menthol has a 96-hour EC_{50} of 18.4 mg/L in *Pimephales promelas*, 96-hour LC_{50} of 15.6 mg/L in *Danio rerio*, and 48-hour LC_{50} of 26 mg/L in *Oryzias latipes* (OECD, 2003).

In aquatic invertebrates, L-menthol has a 24-hour EC_{50} of 37.7 mg/L and 48-hour EC_{50} of 26.6 mg/L in *Daphnia magna* (OECD, 2003).

Terrestrial Effects Analysis
Peppermint oil is practically nontoxic to mammals (NIH, 2024c). Avian toxicity studies are unavailable. However, in a 5-week feed supplement study, dried peppermint leaves at rates between 10 and 40 g/kg diet/week were added to the diet of Japanese quail (*Cortunix japonica*) with no adverse changes in body weight gain, feed conversion ratio, or feed intake (Mehri et al., 2015).

In an acute toxicity study, honey bees (*Apis mellifera*) were exposed to menthol as a fumigant for 24 hours at 35 °C, resulting in an LC_{50} of 5.3 micrograms per milliliter (µg/mL) (Ellis & Baxendale, 1997). The two-spotted lady bird beetle (*Adalia bipunctata*) and seven-spotted ladybird beetle (*Coccinella septempuntata*), both predatory insects of aphids, had a 24-hour LC_{50}

to peppermint oil vapors at 21°C of 0.62 µL/L and 0.67 µL/L, respectively (Kimbaris et al., 2010).

Peppermint oil can be phytotoxic. In a laboratory experiment, inhibitory effects on germination and growth factors were observed in the tomato (*Lycopersium esculantum*) at 900 µL/L peppermint oil and in the radish (*Raphinus sativus*) at 1800 µl/L peppermint oil (Mahdavikia & Saharkhiz, 2015).

Baker et al (Baker et al., 2018b) summarized animal incidents reported to NPIC from April 1, 1996, to March 30, 2016. Most incidents were nonfatal and involved dogs and cats; however, there was one cat fatality from exposure to a formulation that contained lemon grass oil, cinnamon oil and peppermint oil as active ingredients. Incidents reported to the Animal Poison Control Center between 2006 and 2008 involved exposure of cats and dogs to flea products that contained peppermint oil and other active ingredients (Genovese et al., 2012). Of the 39 incidents, one incident resulted in death and two resulted in the animals being euthanized.

B.6 Clove Oil

B.6.1 Problem Formulation

<u>Description and Uses</u>

Cloves are the aromatic dried flower buds of the evergreen tree *Syzygium aromaticum*, native to Southeast Asia. Clove oil (CAS Number 8000-34-8) is an essential oil that can be produced from the tree's flower buds or other plant parts (e.g., leaves, stems). Eugenol (CAS number 97-53-0) which makes up 85 to 95 percent of clove oil is its main component. Isoeugenol and methyleugenol make up the remaining 5 to 15 percent of the ingredients composing clove oil.

Cloves and clove oil have a sharp phenolic smell and strong acrid taste that work to deter and prevent feeding by some species of mammals (rabbits and deer). Clove oil is recognized for its antibacterial, antifungal, antiviral, antitumor, antioxidant, and insecticidal properties (MMW, 2010). Eugenol, β-caryophyllene, α-humulene, and eugenyl acetate are the main volatile compounds of clove oil with antioxidant, antimicrobial, anti-inflammatory, analgesic, antiviral, and anticancer properties (Haro-González et al., 2021).

Clove oil is used in medicine, flavoring, dentistry, perfumery, confectionery, soaps, laboratory reagent (ChemSupply Australia, 2024), and as fish anesthesia (Baker et al., 2018a). USDA APHIS Wildlife Services uses products containing clove oil in an aerosol spray mixture and a vapor fumigant to repel brown treesnakes in Guam (USDA APHIS WS, 2023). The insecticidal toxicity of clove oil varies due to different insect susceptibilities, variability in the concentration of eugenol and other active substances in the clove oil, and insect feeding behaviors. Arthropods that are susceptible to clove oil include mites, termites and mosquitoes (Baker et al., 2018a).

EPA has determined that clove oil is minimum risk pesticide active ingredient that is exempt from FIFRA under the Minimum Risk Exemption regulations in 40 CFR 152.25(f). Cloves and their derivatives, including clove oil, are approved as GRAS by the FDA and can be added directly to human food (21 CFR 184.1257).

When ready for use with an end-use concentration is not to exceed 100 ppm, clove oil is exempt from the requirement of a tolerance for active and inert ingredients for use in antimicrobial formulations (food-contact surface sanitizing solutions) (40 CFR 180.940). EPA established an exemption from the requirement of a tolerance for residues of eugenol (2-methoxy-4-(-2-propenyl)phenol) in or on all food commodities when used in accordance with good agricultural practices (USEPA, 2004a).

Clove oil is an active ingredient in AFTS concentrate comprising 5% of the formulation.

Physical and Chemical Properties

Clove oil is colorless to pale yellow in color. Clove oil has a sharp odor and is insoluble in water. Clove oil has a boiling point of 251 °C (Sigma-Aldrich Corporation, 2023). It has a vapor pressure of 4.91×10^{-6} mmHg (Baker et al., 2018a). Clove oil has a density of 1.038 to 1.060 g/cm^3 at 25 °C (Merck, 2023). It has an octanol/water coefficient of log K_{ow} of 0.99 (Baker et al., 2018a).

Environmental Fate

Clove oil has a soil half-life of 21.5 hours, a water half-life of 78.4 hours, and an air half-life of 0.01 hours, indicating low to no environmental persistence (Baker et al., 2018a).

Hazard Identification

Cloves and clove oil have minimal to no human health hazards. Cloves and their derivatives, including clove oil, are approved as GRAS by the FDA and can be added directly to human food (21 CFR 184.1257) (Baker et al., 2018a). Cloves and clove oil are exempt from the requirement of a tolerance in or on all food and feed crops when used as a pesticide active ingredient or inert ingredient under 40 CFR 180.1164(d) because it is considered a commonly consumed food commodity (Baker et al., 2018a).

Side effects including oral and skin irritation, allergic reactions, nausea, vomiting, respiratory symptoms, hepatic necrosis, lethargy, ataxia, seizures, headaches, and decreased blood coagulation have been linked to use of clove oil (Kaura et al., 2021; Maypole & Woolf, 2007). A National Pesticide Information Center database review identified 19 reported incidents associated with clove and clove oil use between 1996 and 2016, or about one annually. None of the incidents were serious, and most involved formulated products with multiple ingredients (Baker et al., 2018a).

B.6.2 Dose-Response Assessment

Human Health Dose Response

Acute Toxicity

Clove and clove oil have low to no toxicity to mammals through all routes of exposure (Table B-3). Cloves are a commonly consumed food commodity with a significant history of human exposure, demonstrating minimal toxicity.

Most of the biological effects observed for clove oil result from eugenol. At low doses, eugenol has few side effects other than local irritation, rare allergic reactions, and contact dermatitis. Exposure or ingestion of a large amounts of eugenol can result in tissue injury and a syndrome of acute onset of seizures, coma and damage to the liver and kidneys (Haro-González et al., 2021)

Acute dermal irritation studies on mice and rabbits found clove oil to not be irritating and moderately irritating, respectively. In closed-patch tests on human skin, clove bud oil applied at a rate of 20% weight by weight (w/w) in Vaseline or ointment caused primary irritation or erythema in 2 out of 25 human subjects. However, 2% and 5% clove bud oil did not cause any reactions in human subjects (Opdyke, 1975a, 1975b).

A European Food Safety Authority panel examined the safety and efficacy of clove oils when used as sensory additives in feed and water for drinking for all animal species. The panel noted that these clove oils additives should be considered as irritants to skin and eyes and the respiratory tract and as skin sensitizers to human users. Unprotected users handling the essential oil may be exposed to methyleugenol. In order to reduce this risk, exposure should be minimized.

Table B-3. Acute oral median lethality studies for mammals for cloves and clove oil.

Study	Test Species	Result	EPA Toxicity Category	Reference
Acute Oral Toxicity (LD_{50})	Albino Wistar Rat (male)	Flower oil: 3,598 mg/kg-bw	III	(Shalaby et al., 2011)
Acute Oral Toxicity (LD_{50})	Laboratory Brown Rat	Leaf oil: 1,370 mg/kg-bw	III	(Opdyke, 1978)

Study	Test Species	Result	EPA Toxicity Category	Reference
Acute Oral Toxicity (LD_{50})	Laboratory Brown Rat	Bud oil: 2,650 mg/kg-bw	III	(Opdyke, 1975a)
Acute Oral Toxicity (LD_{50})	Laboratory Brown Rat	Stem oil: 2,020 mg/kg-bw	III	(Opdyke, 1975b)
Acute Dermal Irritation (LD_{50})	Domestic Rabbit	Leaf oil: 1,200 mg/kg-bw	III	(Opdyke, 1978)
Acute Dermal Irritation (LD_{50})	Domestic Rabbit	Bud oil: >5,000 mg/kg-bw	IV	(Opdyke, 1975a)
Acute Dermal Irritation (LD_{50})	Domestic Rabbit	Stem oil: >5,000 mg/kg-bw	IV	(Opdyke, 1975b)
Primary Dermal Irritation	Domestic Rabbit	Moderately irritating	III	(Opdyke, 1975a, 1978)
Primary Dermal Irritation	Laboratory Mouse	Not irritating to severely irritating	II-IV	(Opdyke, 1975a, 1978)

Source: (USDA APHIS WS, 2024).

Definitions: LD_{50} - median lethal dose; mg/kg-bw – milligrams per kilograms body weight.

Subchronic and Chronic Toxicity

Albino male Wistar rats gavaged with clove oil at 10% of the LD_{50} (~360 mg/kg-bw) for one month were found to have liver inflammation and renal corpuscular tubules that were convoluted and hemorrhaging in the interstices of the kidneys (Shalaby et al., 2011).

No chronic toxicity studies for clove oil were found.

Prenatal developmental toxicity studies showed no difference between treated and control groups of rats, mice, hamsters, and rabbits (Baker et al., 2018a). Clove oil is highly cytotoxic[14] to human fibroblasts at concentrations as low as 0.03% w/w. Cytotoxic and genotoxic effects are attributed to eugenol, the main chemical component of clove oil (Prashar et al., 2006), as well as α-humulene, and β-caryophyllene (Haro-González et al., 2021). Although, some studies report no genotoxic concerns with eugenol (Mohammadi Nejad et al., 2017; Prashar et al., 2006; Tarbin Jannuzzi, 2022).

Cloves and clove oil are not classified as carcinogens by the International Agency for Research on Cancer (IARC, 2023).

[14] Cytotoxic substances damage or kill cells.

Ecological Dose-Response

Aquatic Effects Analysis

Clove oil is slightly toxic to freshwater fish and aquatic invertebrates (Table B-4).

Table B-4. Acute and chronic toxicity to aquatic vertebrates and invertebrates for clove oil.

Taxonomic group	Test species	Test result	Reference
Freshwater Fish	Rainbow trout (*Oncorhynchus mykiss*)	10-min LC_{50} 81.1 mg/L	(Velisek, Svobodova, & Piackova, 2005)
Freshwater Fish	Rainbow trout (*Oncorhynchus mykiss*)	30-min LC_{50} 65.0 mg/L	(Velisek, Svobodova, & Piackova, 2005)
Freshwater Fish	Rainbow trout (*Oncorhynchus mykiss*)	24-hr LC_{50} 61.5 mg/L	(Velisek, Svobodova, & Piackova, 2005)
Freshwater Fish	Carp (*Cyprinus carpio*)	96-hr LC_{50} 74.3 mg/L	(Velisek, Svobodova, Piackova, et al., 2005)
Freshwater Fish	Zebrafish (*Danio rerio*)	96-hr LC_{50} 18.2 mg/L	(Doleželová et al., 2011)
Freshwater Fish	Guppy (*Poecilia reticulata*)	96-hr LC_{50} 21.7 mg/L	(Doleželová et al., 2011)
Freshwater Invertebrates	Gammarus (*Gammarus minus*)	EC_{50} >14.7 µL/ml	(Venarsky & Wilhelm, 2006)

Source: (USDA APHIS WS, 2024).

Definitions:
EC_{50} = median effect concentration; hr – hour; LC_{50} = median lethal concentration; mg/L – milligrams per liter; min – minute; µL/ml – micrograms per milliliter.

Terrestrial Effects Analysis

No acute oral median lethality or subacute dietary toxicity studies for mammals or birds were found for clove oil.

Clove oil was not toxic to western honey bees (*Apis mellifera*) at a dose of 1 mg/bee over a 48-hr period (Lindberg et al., 2000). In another study, the 8-day oral LD_{50} for clove oil was estimated to be reached with a 7,800-ppm solution. The 14-day oral LD_{50} was estimated to be reached with a 240 ppm solution for honey bees (Ebert et al., 2007).

The American Society for the Prevention of Cruelty to Animals Animal Poison Control Center reported that between 2006 and 2008, 39 cats and nine dogs were involved in exposure incidents with flea products that contained clove oil and other active ingredients exempt from federal registration (Genovese et al., 2012). Symptoms included skin erythema, vomiting, diarrhea, lethargy, edema, ataxia, seizures, weakness, recumbent tachycardia, agitation, anorexia, hyperactivity, hypersalivation, panting, retching, tremors, vocalization, and renal failure.

Clove oil can be used as an herbicide and is highly phytotoxic.

Studies have shown leaf injury to dandelion (*Taraxacrum officinale*) at a 2% w/w[15] concentration (Tworkoski, 2002) and 8% w/w concentrations of clove oil caused plant injury to common lambsquarters (*Chenopodium album*), common ragweed (*Ambrosia artemesiifolia*), and johnsongrass (*Sorghum halepense*) (Tworkoski, 2002). No studies on the effects on nontarget plants were found.

A European Food Safety Authority panel examined the safety and efficacy of clove oils when used as sensory additives in feed and water for drinking for all animal species (Bampidis et al., 2023). They concluded that "the use of clove oils is very unlikely to induce adverse effects in long-living and reproductive animals and is considered of no concern for target species for fattening at the following concentrations in complete feed: 25–50 mg/kg for clove bud oil, 28–100 mg/kg for clove leaf oil and 20 mg/kg for caryophyllene-rich fraction of clove leaf oil."

B.7 Mineral Oil

B.7.1 Problem Formulation

Description and Uses

Mineral oil (CAS Number 8012-95-1) is a synthetic substance that is manufactured by refining crude oil and is included in a class of petroleum hydrocarbons called aliphatic solvents. Aliphatic solvents were first registered as insecticides in 1990 and are also used as inert ingredients in other pesticide products (USEPA, 2016a). Crude petroleum oil is the predominant source of mineral oils used in organic and conventional agriculture, as well as food for human consumption, cosmetic products and drugs (USDA NOP, 2021).

Mineral oil is applied topically for mite, lice and other parasite control in sheep, goats, cattle, hogs and other livestock, as well as use as a lubricant (USDA NOP, 2021; USEPA, 1993). Mineral oil has also been used in conventional agricultural production as an animal feed additive and as a dust suppressant (USDA NOP, 2021), although under 7 CFR 205.190, it is prohibited for use as a dust suppressant in organic livestock production.

[15] % w/w, mass percentage of a solution component, defined as the ratio of the component's mass to the solution's mass.

The USDA NOP currently permits the use of mineral oil in organic livestock production for direct topical application, external parasiticide or local anesthetic as applicable, and as a lubricant (i.e., treatment of intestinal compaction) under 7 CFR 205.603.

The substance is commonly used to control bloat in conventional cattle production. Conventional livestock producers also use mineral oil as a dust control agent in the formulation of vitamin and mineral premixes for supplementation of livestock feed.

Mineral oils have insecticide, acaricide and fungicide uses as spray oils on conventional crops as well as residential and municipal property. Mineral oil products also have aquatic uses as mosquito larvicides/pupacides (USEPA, 2007). The substance may also be used as mosquito larvicide in select aquatic areas (USEPA, 2016a).

Mineral oils are registered for use on fruits, vegetables, tree nuts, and several row crops (USEPA, 2016a). Aliphatic solvents, such as mineral oil, are most often used in the form of horticultural oil to suffocate insects on plant surfaces rather than direct chemical toxicity (USEPA, 2016a).

Mineral oils are exempt from the requirement of a tolerance when applied to growing crops, in accordance with good agricultural practices (40 CFR 180.905). However, EPA established a tolerance of 200 ppm for residues of mineral oil used as a post-harvest treatment to corn grain and sorghum grain (40 CFR 180.149). Residues of mineral oils are exempt from the requirement of a tolerance when used as an inert ingredient in pesticide formulations applied to growing or harvested crops (40 CFR 180.910) and directly to animals (40 CFR 180.930).

Mineral oil (CAS Number 8012-95-1) is an inert ingredient in AFTS concentrate. Its weight percent in the formulation is a trade secret (Arkion, nd).

Physical and Chemical Properties

In general, mineral oil is a clear liquid and has no odor to an odor like burned lubricating oil (NIH, 1999; USEPA, 2007). Mineral oil is considered insoluble in water (NIH, 1999). It has a vapor pressure of <0.5 mmHg at 20 °C (USEPA, 2007). Based on data for aliphatic solvents, the log K_{ow} is estimated to be from 5 to 20 (USEPA, 2007). EPA estimated the soil adsorption coefficient, K_{oc}, as $\geq$ 4,910,000 g/ml for C_{15}-C_{50} aliphatics solvents, including mineral oil (CAS Number 8012-95-1) (USEPA, 2016b).

Environmental Fate

Mineral oil is relatively immobile with an estimated high K_{oc}, indicating high sorption to organic matter in the soil, as well as foliar surfaces (USEPA, 2016b). The low solubility and volatility of mineral oil also makes it most likely to be found in the soil or other terrestrial environments and unlikely to migrate within the environment (USEPA, 2007, 2016b). Although mineral oil has a longer environmental lifetime in soil, it undergoes slow biodegradation (USEPA, 2007). It has a short 2- to 3-day half-life in aquatic environments (USEPA, 2007).

Aliphatic solvents do not undergo photodegradation (USEPA, 2007).

The mineral oil used for veterinary applications is highly refined (i.e., purified) and non-toxic, as a result, it is unlikely to be the source of environmental contamination (EFSA, 2012, as cited in (USDA NOP, 2021).

<u>Hazard Identification</u>

Mineral oil is not a hazardous substance or mixture (Sigma-Aldrich Corporation, 2024b). The EPA has stated that mineral oil is not hazardous to mammals, birds, honey bees, and aquatic life, with a few exceptions (USEPA, 2007). EPA considers mineral oil as an inert ingredient that is exempt from the requirement of a tolerance when used in pesticide formulations applied to growing crops or to raw agricultural commodities after harvest (40 CFR 180.910).

FDA allows the use of mineral oil (CAS No. 8012-95-1) as a direct addition to food for human consumption for specific uses (21 CFR 172.878) and as a secondary direct food additive permitted in food for human consumption, mostly during the processing of certain commodities (21 CFR Part 173). FDA also lists mineral oil as a permitted indirect food additive when used as a component of adhesives, food coatings, and as a surface lubricant in food processing (21 CFR Part 175). USDA NOP allows the use of mineral oil in organic production on animals and animal feed (USDA NOP, 2021).

B.7.2 Dose-Response Assessment

<u>Human Health and Dose Response</u>

The environmental lifetimes of mineral oil are relatively long, but the substance and its metabolites are biologically inert and generally non-toxic. Mineral oils and aliphatic petroleum hydrocarbons have extraordinarily low absorption by oral and inhalation routes which is consistent with the essentially no adverse toxicity observed in oral and inhalation toxicity studies (USEPA, 2018).

Acute Toxicity

Generally, in mammalian acute toxicity testing, aliphatic solvents showed a very low degree of acute toxicity (USEPA, 2018). Studies show these chemicals to be Toxicity Category IV for oral (>5,000 to 15,000 mg/kg), dermal (>2,000 mg/kg), and dermal irritation studies. Aliphatic solvents were Toxicity Category III for inhalation (>3.5 mg/L) and eye irritation studies. They are not skin sensitizers (USEPA, 2018).

Subchronic and Chronic Toxicity

Based on subchronic and chronic toxicity studies, mineral oils are virtually non-toxic by the oral and dermal route (USEPA, 2007). They have limited inhalation toxicity is due to its physical properties and not to chemical toxicity (i.e., irritating effects related to the body's defense mechanism against the exposure to a foreign material when the aliphatic oils enter the lungs) (USEPA, 2007).

No reproductive or developmental toxicity effects were observed from a range of studies exposing experimental animals to mineral oil, including dermal dosing studies, 4-week inhalation study, one-generation reproductive study, and single daily gavage dose studies (USEPA, 2007).

Laboratory tests examining germ cell mutagenicity (Ames, *In vitro* mammalian cell, and micronucleus tests) were negative (Sigma-Aldrich Corporation, 2024b), In reviewing mutagenicity studies for aliphatic solvents, EPA concluded that these chemicals are not mutagenic (USEPA, 2018).

Mineral oils are considered highly to severely refined oils and are classified as Group 3 for carcinogenicity to humans (USEPA, 2007; WHO, 2009). Both the International Agency on Research on Cancer and the National Toxicology Program do not consider mineral oil at levels greater than or equal to 0.1% to be a probable, possible or confirmed human carcinogen (Sigma-Aldrich Corporation, 2024b).

Ecological Dose-Response

EPA has classified mineral oil as having low acute toxicity to plants and animals within the environment and stated that it is unlikely to migrate from its initial place of application (USEPA, 2007). The Agency has approved mineral oil for direct application to both terrestrial and aquatic systems as a pesticide (EPA, 2007, and EFSA, 2012, as cited in (USDA NOP, 2021)). In their technical evaluation report of mineral oil, USDA NOP noted that "the highly refined mineral oil used in veterinary applications is even less likely to be a source of environmental contamination because in this application, potentially harmful aromatic compounds are completely removed" (EPA, 2007; EPA 2009; and EFSA, 2012, as cited in (USDA NOP, 2021)).

Aquatic Effects Analysis

Mineral oil is non-toxic to fish, shrimp, and other marine invertebrates (USEPA, 2007). EPA assumed that aliphatic solvents toxicity data for fish are protective of aquatic-phase amphibians.

One study reported that fish can survive a 50/50 mixture of mineral oil and water. However, mineral oil may be hazardous to oysters, as it may disrupt their ability to metabolize nutrients.

Mineral oil may also be hazardous to water fleas (*Daphina magna*), which may be suffocated when coated in mineral oil; coating is the mode of action of pesticides and parasiticides against mites and mosquitos (EPA 2007 and EFSA 2012, as cited in (USDA NOP, 2021)).

In *Daphnia magna* (aquatic invertebrate), aliphatic solvents have an EC_{50} of ≤ 0.9 mg/L based on floating and immobilized daphnia (USEPA, 2007, 2016b). In mysid shrimp (estuarine/marine invertebrate), the LC_{50} was 1.15 mg/L, indicating aliphatic solvents are moderately toxic to estuarine/marine invertebrates (USEPA, 2016b). EPA (USEPA, 2016b) found deficiencies in the 96-hour acute toxicity studies in various fish species; however, the data from those studies suggest aliphatic solvents are not expected to cause mortality in freshwater or estuarine/marine fish (USEPA, 2007).

In EPA's ecological risk evaluation, acute risk levels of concern are exceeded for freshwater invertebrates in waterbodies adjacent to treated fields exposed to aliphatic solvents from spray drift alone, runoff alone, or direct application to waterbodies (USEPA, 2016b). EPA determined that a buffer size of 460 feet from the edge of the site reduces the acute risk to freshwater invertebrates from spray drift alone. Estuarine/marine invertebrates also are at acute risk from direct application to water only.

No toxicity data is available for aquatic plants. A potential risk is presumed based on the phytotoxicity warning found on labels and plant damage incidents. However, aliphatic solvents are used safely in waterbodies and on crops (USEPA, 2016b).

Terrestrial Effects Analysis
Mineral oil is generally non-toxic to both plants and animals and is unlikely to have effects on crops (USEPA, 2007). EPA assumes that estimates of risks to avian species are protective of reptilian and terrestrial-phase amphibians (USEPA, 2016b). In mammals and birds, no effects were observed in acute toxicity studies at the maximum concentrations tested for aliphatic solvents (USEPA, 2016b). In rats, the maximum dose was > 28 g/kg-bw (as cited in (USEPA, 2007)). In birds, the maximum dose was 2250 mg/kg-bw (USEPA, 2007). Mineral oil is toxic where it is applied directly to eggs (USEPA, 2007). In these cases, mineral oil may have a hazardous effect to terrestrial vertebrates that lay eggs on or adjacent to treated fields by preventing airflow through the eggshell causing suffocation of the developing bird or mammal (USEPA, 2016b).

In adult honey bees, no effects were observed in oral and contact toxicity studies with aliphatic solvents (USEPA, 2016b). EPA concluded that acute risks to terrestrial vertebrates and adult honey bees are not expected. At the time of their evaluation, EPA noted that required studies for aliphatic solvents with honey bees are necessary to conduct a complete risk assessment on pollinators.

In their review of information for the registration review of aliphatic solvents, EPA did not find any toxicity studies for terrestrial plants. However, EPA noted that "Risk to terrestrial and aquatic plants is possible per phytotoxicity warnings on product labels and incident reports of plant damage" (USEPA, 2016b). Although EPA also noted that high amounts of aliphatic solvents end-use products are safely used on many crops. In an EPA evaluation of mineral oil for pesticide use, the agency stated that it "does not have concerns for phytotoxicity" (USEPA, 2016b).

B.8 Potassium Cocoate (Soap Base)

B.8.1 Problem Formulation

Description and Uses

Potassium cocoate (CAS No. 61789-30-8, synonyms: cocoa fatty acids, potassium salts; fatty acids, coco, potassium salts; coconut fatty acids potassium salt; coconut oil potassium salt; potassium coco soap; and potassium coconut oil soap) is derived from coconut oil and used as a soap base. It is part of the coconut oil and related fatty alcohols, fatty acid esters, and salts group (Burnett et al., 2011). Potassium cocoate is produced by combining the fatty acids of coconut oil with potassium hydroxide (Burnett et al., 2011). Potassium cocoate is used in cosmetics and personal care products (Burnett et al., 2011). Potassium cocoate is used as a surfactant in a wide range of products including body washes, shampoos, conditioners, and soaps. It functions as a surfactant-cleansing agent and surfactant-emulsifying agent (CIR, 2008).

EPA (USEPA, 2004b) lists potassium cocoate as an inert pesticide ingredient that will not adversely affect public health or the environment. Potassium cocoate residues are exempt from the requirement of a tolerance under FFDCA section 408 (40 CFR 180.950(e)).

Potassium cocoate is an inert ingredient in the AFTS concentrate formulation. The percentage weight is a trade secret and is not provided.

Physical and Chemical Properties

Potassium cocoate is a white to yellow liquid with a faint odor (Burnett et al., 2011).

Environmental Fate

Potassium salts of fatty acids, such as potassium cocoate, are naturally occurring and are not persistent in the environment. The estimated soil half-life is less than one day, being rapidly degraded in the soil by microbial organisms (NPIC, 2001).

Hazard Identification

Potassium cocoate is listed on EPA's Safer Chemical Ingredient List[16], and has been verified to be of low concern based on experimental and modeled data. Potassium cocoate residues used as either an inert or an active ingredient in a pesticide formulation are exempt from the requirement of a tolerance under FFDCA section 408 (40 CFR 180.950(e)).

B.8.2 Dose-Response Assessment

Human Health and Dose Response

Published toxicity studies for potassium cocoate are limited. The Cosmetic Ingredient Review Expert Panel determined the toxicity data on coconut acid, coconut oil, hydrogenated coconut acid, and hydrogenated coconut oil can be extrapolated to potassium cocoate: "The salts and esters of the expanded group of coconut ingredients [includes potassium cocoate] are expected to have similar toxicological profiles as the regular and hydrogenated forms of the oil and the acid" (CIR, 2008).

Acute Toxicity

In acute oral toxicity studies, coconut oil and hydrogenated coconut oil were nontoxic (CIR, 2008). In an acute dermal toxicity study, hydrogenated coconut oil was nontoxic (CIR, 2008).

In a short-term dietary toxicity study in rats, no mortality or morbidity were observed for the coconut fat groups for diets formulated to contain between 10 and 75% calories from coconut fat (CIR, 2008).

No pathological changes were observed in subchronic studies exposing Wistar rats to diets containing 25% coconut oil (CIR, 2008).

In eye irritation studies, rabbits administered coconut oil and hydrogenated coconut oil experienced minimal eye irritation (CIR, 2008).

In a skin irritation study, skin of 40 healthy volunteers and 480 volunteers with active skin diseases were patch tested with 15 µL of 5% aqueous potassium cocoate (Burnett et al., 2011). Five participants (0.9%), all with active skin diseases, reported positive responses (Burnett et al., 2011).

Ecological Dose-Response

Aquatic Effects Analysis

[16] EPA Safer Chemical Ingredient List: https://www.epa.gov/saferchoice/safer-ingredients.

Published information is lacking on the toxicity of potassium cocoate to aquatic species.

Terrestrial Effects Analysis

Fatty acids and their potassium salts, including potassium cocoate, have been found to be very low in toxicity to animals via the oral route (NPIC, 2001). EPA lists potassium cocoate as an inert pesticide ingredient that will not adversely affect public health or the environment (USEPA, 2004b).

B.9 Exposure Assessment and Risk Characterization for AFTS

AFTS is a soap-based insecticide for stable, barn and outdoor use on beef cattle, dairy cattle and horses. As described in Section 2.2, the CFTEP is proposing to utilize AFTS to control CFTs directly on wildlife, cattle, and horses and in areas around livestock where the ticks may emerge and cause infestation. The product has the added benefit of controlling other types of ticks and flies that can pose health concerns for both humans and animals. AFTS qualifies for exemption from registration with the EPA under FIFRA Section 25(b) as a minimal risk pesticide. The product is available for use by the general public. The treatment scenarios proposed by the CFTEP were detailed in Section 2.2 and are also described below.

AFTS would be used directly onto white-tailed deer through the use of remotely activated sprayers at corn feeders. The sprayers would be the same as those described in Goolsby et al. (Goolsby et al., 2019) but without the need for aerators (see Figure 5). The AFTS mix would be contained in 57-liter (15.1-gal) spray tanks for direct application at the label rate of 10 to 12 fluid (fl) ounces (oz) concentrate per gallon of water (Table 2) (Arkion, nd). Sprayers are triggered by ultra-sonic sensors when deer approach the feed tubes, applying AFTS from the rear of the animal to avoid eye contact. The pump emits 180 ml (6.1 fl oz or 0.05 gallons) of AFTS solution through 8 m (26.2 ft) of tubing on the ground to 3 spray nozzles. Treatments with AFTS could be conducted year-round, although currently ivermectin-treated corn is provided to deer only between the months of February through July.

The CFTEP is also proposing to make AFTS solution treatments directly onto wildlife, including nilgai and white-tailed deer, for control of CFTs by remotely activated sprayers located at fence crossings or other areas that wildlife congregate (Goolsby et al., 2019). Wildlife could also be passively treated as they contact wet foliage and soil from the sprayers around the crossing. The battery powered sprayer is activated by sonic sensors that detect movement of wildlife through fence crossings (Goolsby et al., 2019). These sprayers would be the same as those described above, for use on white-tailed deer at corn feeders. The same concentration and volume of AFTS solution would be used as on white-tailed deer at corn feeders (Table 2) (Arkion, nd). Treatments could be conducted year-round.

AFTS treatments would be made directly on cattle and horses by CFTEP and TAHC employees using pressure sprayers, sponges (horses), or tank dipping (cattle). A solution of 10 to 12 fl oz AFTS per gallon of water would be applied to thoroughly wet the coat of cattle (Table 2). For treating horses, per the label, 6 fl oz AFTS per gallon of water would be applied, particularly to the topline, underline, flanks, withers and other infested areas while avoiding the face or genitalia. Treatments could be repeated at intervals of 5 to 12 days or as reinfestation warrants. Per the product label, feed, food, or water sources would not be sprayed.

Per the AFTS label, the product can be used on structures and areas where livestock are kept, such as stalls, barns and other structural areas, dairy areas, areas around cattle, as well as manure piles and other places where flies and ticks may congregate or emerge. Under the preferred alternative, CFTEP and TAHC employees would use a backpack or mechanical sprayer to apply AFTS solution mixed at the label-specified rates (Table 2), 3-4 fl oz AFTS per quart (covering 375 sq ft per quart) or 10-12 fl oz AFTS per gallon (covering 1,500 sq ft per gallon), on these locations. Following the label instructions, feed, food or water sources would not be sprayed directly. Treatments would be repeated as necessary.

B.9.1 Human Health Exposure and Risk Characterization

Human health risks associated with the use of AFTS are determined based on the toxicity of AFTS and the potential for exposure. The potential for exposure depends on APHIS' proposed application method and the environmental fate profile for AFTS. The toxicity profile for the active and inert ingredients in the AFTS concentrate formulation, their environmental fate properties, and the CFTEP's proposed use patterns are expected to result in low exposure and risk to humans.

All the active (castor oil, geraniol, peppermint oil, and clove oil) and inert ingredients (mineral oil and potassium cocoate) found in AFTS are listed by EPA as ingredients eligible for the minimum risk exemption. Thus, AFTS is considered an exempted minimal risk pesticides by the EPA (40 CFR 152.25), posing little or no risk to humans and the environment.[17]

There are limited human health toxicity data on AFTS, but acute oral, dermal, and inhalation studies indicate the product does not present a human health risk from short-term exposures to the product (see section B.2.2, Human Health Dose Response) (Kabaru, 2023). These results are consistent with other studies on the ingredients found in AFTS. Individually, the ingredients comprising AFTS have low toxicity or other human health hazards and are commonly found in consumer products and food.

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[17] EPA minimum risk pesticides website: https://www.epa.gov/minimum-risk-pesticides.

Toxicity data related to acute human exposure pathways for the active ingredients found in AFTS are summarized as follows:

- Castor oil, geraniol, peppermint oil and clove oil have low oral toxicity (Baker & Grant, 2018a, 2018b; Baker et al., 2018a, 2018b).
- Castor oil, geraniol, peppermint oil and clove oil have low dermal toxicity (Baker & Grant, 2018a, 2018b; Baker et al., 2018a, 2018b).
- Geraniol is not a dermal irritant (Baker & Grant, 2018b), while peppermint oil and clove oil have been reported to be non-irritant or mild dermal irritants (Baker et al., 2018a, 2018b). Undiluted castor oil has been reported to be a dermal irritant in one study but reported to be mildly irritating and non-irritating in other studies (Baker & Grant, 2018a).
- Castor oil, geraniol, peppermint oil and clove oil are not skin sensitizers (Baker & Grant, 2018a, 2018b; Baker et al., 2018a, 2018b).
- There are no reports of castor oil, peppermint oil and clove oil being toxic through the inhalation route (Baker & Grant, 2018a; Baker et al., 2018a, 2018b). However, geraniol has been reported to have an inhalation LC_{50} of 0.57 mg/L (Baker & Grant, 2018b).
- Castor oil and clove oil are not eye irritants (Baker & Grant, 2018a; Baker et al., 2018a), while geraniol has been reported to cause reversible eye irritation (Baker & Grant, 2018b). Peppermint oil has been reported to cause severe eye irritation (Baker et al., 2018b)or moderate irritation (USEPA, 2004c).

The AFTS label (Arkion, nd) has the following hazard statements:

> "Causes skin irritation and serious eye damage. May cause an allergic skin reaction. Suspected of causing genetic defects. Causes organ damage through prolonged or repeated exposure. If swallowed and enters airways, may be fatal."

Acute toxicity studies on AFTS did not find it to be a skin irritant (Kabaru, 2023), although in some studies castor oil, peppermint oil, and clove oil individually have been found to be mildly irritating. Peppermint oil was observed to cause severe to moderate eye irritation, but AFTS did not. There are no subchronic or chronic toxicity studies available for AFTS.

In a subchronic oral toxicity study, clove oil was found to result in liver inflammation and kidney damage (Haro-González et al., 2021). Clove oil components, eugenol, α-humulene, and β-caryophyllene, have been shown to be highly cytotoxic with antitumor activity(Haro-González et al., 2021). Some studies have shown that eugenol is genotoxic, while others report no genotoxic concerns (Mohammadi Nejad et al., 2017; Prashar et al., 2006; Tarbin Jannuzzi, 2022). None of the ingredients in AFTS are known carcinogens.

These active ingredients only make up 30 percent of the AFTS formulation and are further diluted with water for application. Furthermore, the concentrations of these ingredients in the AFTS formulation are low compared to the test concentrations of each of the individual ingredients in these studies, so the human health effects from exposure to the AFTS formulation should be less. In addition to the low toxicity of AFTS to humans or mammals, low volumes of AFTS would be used by the CFTEP. For these reasons, AFTS is not expected to adversely affect human health or the environment.

Potential oral, dermal, and inhalation exposure to the general public is not expected based on the proposed use locations. The remotely activated sprayers would be set up in areas that are not easily accessible by the public. Remote sprayers set up at corn feeding stations and wildlife crossings and areas where wildlife may congregate would be strategically placed at locations such as private properties, at refuges, and other public sites with restricted access. The corn feeders are placed on properties that will have a point of access that will be locked, so access to the sprayers at these locations would also be restricted. Comparable security measures are used at refuges and other public sites. A sign in both English and Spanish is posted if feeders are placed on public lands (USDA APHIS, 2017) and any sprayers would have similar signage when installed on public lands. As noted in the 2017 Ivermectin Corn EA (USDA APHIS, 2017), there is potential for a person to ignore the signage and breach the exclusion fencing to access treated corn due to the fence's height of 34 inches. Similarly, a person could ignore signs posted at remotely activated sprayers and enter the treatment area. The sprayers and tanks holding AFTS mixture would be visible, but if activated by a person, the volume dispensed is low and, based on toxicity data, there is a negligible risk to humans as a result of direct contact with the product.

Dietary exposure through food intake is not expected as AFTS is not labeled for use on food crops. Consumption of animals treated with AFTS would also not result in dietary exposure. AFTS is topically applied to animals at low volumes and residues would be expected to be negligible. Most of the active ingredients in AFTS are common ingredients in food and consumer products and are classified as GRAS; also, AFTS is exempt from residue tolerance limits, reflecting its safety. Maestas et al. noted that the low-volume, repeated application of a botanical pesticide, such as AFTS, on meat animals, such as cattle, does not require a withdrawal time (Kahn and Line 2010 as cited in (Maestas & Goolsby, 2024)). AFTS is not expected to present health effects to humans via ingestion route.

Exposure to AFTS through contact with treated livestock or wildlife is not expected to be harmful to people. Under the proposed alternative, only CFTEP and TAHC employees would be using AFTS. The active ingredients in AFTS have low or negligible dermal toxicity and AFTS is available to the general public for treatment of cattle, horses, and areas where flies and ticks may be found. However, for sensitive individuals, dermal irritation may potentially occur through contact with AFTS or treated hide when wet. Per the product label and SDS, if skin contact with

AFTS occurs, the affected area should be washed off immediately with soap and plenty of water for at least 15 minutes (Arkion, 2022, nd). Medical help should be sought if the skin reaction persists.

There are no anticipated threats to ground and surface water that may be used as drinking water because of the proposed treatment methods and environmental fate of AFTS. Locations where animals and areas to be treated with AFTS would be located a minimum of 50 feet from any aquatic areas and, with the low volumes that are to be used, it is unlikely that any AFTS mixture would be transported by surface runoff to any surface water source used for drinking water.

The potential for exposure to people is greatest for CFTEP and TAHC employees mixing, loading, and applying AFTS. Occupational exposure to AFTS may potentially occur through oral, inhalation and dermal routes of exposure. Any exposure is expected to be mitigated through proper worker hygiene, use of PPE per the AFTS label, which includes protective gloves, protective clothing, eye and face protection, and use in well-ventilated areas. The AFTS safety data sheet provides the following precautionary advice for safe handling of the product:

> Handle in accordance with good industrial hygiene and safety practices. Avoid contact with skin, eyes or clothing. Do not eat, drink or smoke when using this product. Ensure adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment. Take off contaminated clothing and wash before reuse. Remove contaminated clothing and shoes.

When AFTS is properly used according to label directions and precautionary measures are followed, the proposed applications are expected to pose minimal risks to human health under the preferred alternative.

Ranchers and other workers not involved in administering AFTS treatments may be present when cattle, horses, and structures and areas where the animals are kept are being treated. The CFTEP and TAHC will follow all label precautionary measures and not make AFTS applications when bystanders could be exposed to the product. Livestock and property owners will be informed about the potential hazards identified on the product label.

Overall, AFTS is a minimum risk pesticide that is available for purchase and use by the general public. Due to the low toxicity of AFTS to humans or mammals, the CFTEP's proposed use patterns, the low volume that would be used, and the training of CFTEP and TAHC applicators, low exposure and risk to humans from the proposed uses of AFTS are expected. The CFTEP believes it is unlikely that, when used in accordance with the label, the risks to the public or CFTEP and TAHC employees from the use of AFTS are expected to be negligible.

B.9.2 Ecological Exposure and Risk Characterization

The ecological exposure potential and risk characterization for AFTS is discussed in this section.

Acute oral, dermal, and inhalation studies on AFTS indicate the product does not present a risk to mammals from short-term exposures to the product (see summary in section B.9.1, Human Health Exposure and Risk Characterization) (Kabaru, 2023). These results are consistent with studies on the individual ingredients found in AFTS. Based on toxicity studies (summarized in the previous sections of Appendix B), the active ingredients in the AFTS formulation are considered practically non-toxic to mammals, birds, and plants.

The two main ingredients in AFTS responsible for fly and tick mortality and repellence are castor oil, which reduces the production of eggs and leads to the mortality of flies and ticks (Arnosti et al. 2011, Ghosh et al. 2013 as cited in (Maestas & Goolsby, 2024)); and geraniol, which in various forms is a repellant and significantly reduces the tick burden on cattle (Khallaayoune et al. 2009, Singh et al. 2018, Ibrahium et al. 2022 as cited in (Maestas & Goolsby, 2024)).

Generally, EPA considers castor oil to be exempt from the requirements of FIFRA, including the data requirements for non-target organisms (USEPA, 2011c). Vegetable and flower oils, including castor oil, are considered toxic to fish given their mode of action as suffocating agents (USEPA, 2011c). However, EPA indicated that they believe that label restrictions will prevent the application of products with products including castor oil to aquatic sites, resulting in low exposure and low risk for aquatic organisms.

According to EPA, geraniol poses a moderate to low risk to non-target species. EPA (USEPA, 2010) reported geraniol as practically nontoxic to nontarget mammals, birds, and plants. Geraniol is moderately to slightly toxic to freshwater fish and freshwater invertebrates (Table B-2), but, as with castor oil, label restrictions are expected to be protective of aquatic organisms.

As noted in section B.9.1, the active ingredients only make up 30 percent of the AFTS formulation and are then diluted with water for application. Furthermore, the concentrations of these ingredients in the AFTS formulation are low compared to the test concentrations of each of the individual ingredients in toxicity studies, so the ecological effects from exposure to the AFTS formulation are expected to be even less.

Applications of AFTS to livestock (i.e., dairy and beef cattle and horses) would be made on ranches or private properties where non-target ecological receptors would not be exposed. Locations such as stalls, manure piles, barns and other structural areas where flies and ticks appear or congregate where CFTEP would directly apply AFTS are all places where non-target species and their habitats would not likely be exposed.

Terrestrial plants and soil-dwelling species within the 9-m^2 area surrounding the remote sprayers targeting wildlife (e.g., nilgai, white-tailed deer) would be exposed to the sprayed AFTS. Damage to plants is not expected because of the low toxicity profiles for the ingredients in the AFTS formulation, the dilution of the AFTS with water, and the small volume of the solution that would contact the vegetation. For these same reasons, terrestrial species that may forage on plants with residue from the sprayers and soil-dwelling species within the spray zone are not expected to be affected by AFTS. Corn feeders are placed in clearings, so remote sprayers targeting white-tailed deer coming to the feeders are expected to be in open areas away from plants.

AFTS's mode of action is suffocation. Oils clog the pores of birds' eggs, which prevent oxygen from entering the egg and asphyxiate the developing embryo. As a result, coating bird eggs with oil reduces hatching success (e.g., (Shonk et al., 2004)). Reptilian eggs are impacted by oils in the same manner as bird eggs. However, the CFTEP does not anticipate its use of AFTS will expose bird eggs or those of other terrestrial species. Birds or other species are not likely to establish nesting sites near the sprayers as these are to be placed at fence openings where there is wildlife traffic or other areas that wildlife congregate. Additionally, due to human disturbance during set-up and maintenance and the commotion when the spray devices are triggered, birds and other species are likely to stay away from these locations.

The AFTS label (Arkion, nd) states:

> "Harmful to aquatic life with long-lasting effects. Do not contaminate water with concentrate, spray mixture or rinsate. Do not spray directly on ponds of all kinds, lakes, rivers or other bodies of water. Avoid unnecessary release into the environment."

The CFTEP does not anticipate exposure of aquatic resources from its use of AFTS due to the proposed use patterns, including the use of 50-ft buffers from aquatic resources, the label requirements (mentioned above), and the environmental fate properties (e.g., low volatility, limited mobility in soil) of the ingredients in the AFTS formulation. Terrestrial wildlife species sprayed with AFTS may enter water bodies where residues may wash off; however, the CFTEP does not expect this to result in significant exposure to aquatic species because of the very low volume that would potentially be transferred to water and the diluted AFTS mixture used.

Although not specified on the label, in addition to ticks and flies, AFTS is effective on mosquitoes and other insects (Arkion, 2024). So, non-target insects could potentially be affected by AFTS spray; however, any impacts would be limited to the small areas where AFTS is applied. AFTS is practically non-toxic to birds and ingestion of treated prey is not expected to impact birds. Also, birds or other species that may eat these insects would have a broader foraging range than the treatment areas, so they will have other food sources.

Based on the toxicity of the composition of the AFTS formulation, as well as the non-toxic mode of action and environmental fate properties, and the low volumes used, the potential ecological exposure and risk from its proposed use patterns are expected to be negligible. The CFTEP does not anticipate adverse effects to the environment or nontarget terrestrial and aquatic species.

B.10 Summary

AFTS poses little to no risk to the environment. CFTEP and TAHC applicators will adhere to label requirements, which include wearing the appropriate PPE and not applying the product directly to water, and they will not apply the product within 50 ft of any aquatic resources. Based on the proposed uses, the small quantities of the active ingredients in the formulated product, anticipated low volume used, the lack of toxicity, and the environmental fate properties, the CFTEP proposed uses of AFTS are not expected to harm the humans and nontarget terrestrial and aquatic species.