HOUSTON TOAD
HABITAT MANAGEMENT GUIDELINES

U.S. Fish and Wildlife Services
Austin Ecological Services Field Office

10711 Burnet Road, Suite 200
Austin, Texas 78758

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TABLE OF CONTENTS

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This plan was prepared by Paige Najvar in the U.S. Fish and Wildlife Service's Austin Ecological Services Field Office.

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1.0 INTRODUCTION

The U.S. Fish and Wildlife Service (Service) developed this document for the purposes of (1) providing guidance to land managers on management practices that can be used to manage and restore habitat for the Houston toad (*Anaxyrus* [formerly *Bufo*] *houstonensis*) and (2) providing recommendations to avoid or minimize impacts to the Houston toad while conducting these activities. Specific application procedures and treatment parameters will need to be decided by land managers on a case-by-case basis depending on habitat conditions and other factors. **Caveat: Some of these practices may require an endangered species permit**. See "Permit Requirements" section below.

Although the following areas may contain Houston toads, they are generally not considered favorable habitat for this species: (1) open pastures absent of canopy cover (Forstner 2002a, pp. 18-19; Forstner 2003, p. 12); (2) pastures of coastal Bermuda grass (*Cynodon dactylon*) or other heavy, rhizomatous mat-forming grasses (Yantis 1989, p. 6); or (3) forested areas with a dense, woody understory and low light availability (such as yaupon [*Ilex vomitoria*] thickets), as suggested by Yantis (1989, p. 6).

The Service and the U.S. Department of the Interior (DOI) recommend an adaptive management approach be taken with habitat management guidelines for Houston toad conservation. We consider adaptive management to be an adaptive approach that involves the following: (1) exploring alternative ways to meet management objectives, (2) predicting the outcomes of alternatives based on the current state of knowledge, (3) implementing one or more of these alternatives, (4) monitoring to learn about the impacts of management actions, and then (5) using the results to update knowledge and adjust management actions (DOI 2009, p.1).

This document may be updated as new scientific information on management techniques becomes available. We welcome new information that would improve these management recommendations, particularly results of research quantitatively assessing the results of management practices and additional research on the habitat needs for the Houston toad and its prey base (including, but not limited to canopy cover, stem density of canopy and shrub cover, and ground cover density). New information can be provided to the Service's Austin Ecological Services Field Office (attention: Recovery Branch). We hope that you find this document useful, and we appreciate your efforts to conserve the Houston toad.

1.1 Permitting Requirements

While the overall intent of the management practices presented in this document is to provide recommendations aimed at creating, enhancing, restoring, or protecting habitat for the Houston toad, some impacts to this endangered species are likely to occur as a result of their implementation. We encourage landowners and land managers to seek coverage for "incidental take"[1] under the Endangered Species Act of 1973, as amended (ESA) for any activities that may

[1] According to the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Incidental take" is take that results from activities that are otherwise lawful. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns such as breeding, feeding, or sheltering

affect Houston toads. Incidental take is prohibited by the ESA unless you have a permit. Several permitting processes are available for landowners planning to undertake these management activities. See our website for more information on endangered species permits: http://www.fws.gov/endangered/permits/index.html

1.2 Management Goal

The goal of Houston toad management is to ensure that Houston toad habitat or potential habitat is managed in a way that will enhance the survival and recovery of the species.

1.3 Management Objectives

The following objectives will help ensure that the above goal is achieved:

Objective 1 – Restore, enhance, or preserve optimal forest canopy cover by planting native trees or selectively thinning to facilitate Houston toad sheltering, movement, and foraging. Currently, the best available information suggests that 80 percent forest canopy cover is optimal (Brown et al. 2013, p. 146).

Objective 2 – Establish, maintain, or protect a diverse assemblage of native herbaceous ground cover species to provide optimal Houston toad habitat for foraging and movement.

Objective 3 – Maintain or enhance pine and mixed hardwood-pine/woodland/forest conditions by controlling woody, understory species to facilitate Houston toad sheltering, movement, and foraging. Tree species found under optimal habitat conditions may vary, but typically include loblolly pine (*Pinus taeda*), post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*), and/or sandjack oak (*Q. incana*) (Forstner 2003, p. 4).

Objective 4 – Protect or enhance habitat within and/or immediately adjacent to potential breeding ponds to facilitate successful Houston toad reproduction, emergence, and juvenile survival.

Objective 5 – Control red-imported fire ants (*Solenopsis invicta*) to reduce direct mortality of Houston toads and native invertebrate species that comprise the Houston toad's food source.

(64 FR 60727). Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR§17.3).

2.0 HOUSTON TOAD HABITAT MANAGEMENT

2.1 Forest Management

2.1.1 Purpose of Forest Management

The Houston toad depends on native forest ecosystems for feeding, breeding (see section 2.2 *Breeding and Nursery Habitat Management* below), and sheltering. The target forest ecosystem conditions for Houston toads include the following: (1) a mixed plant species composition, (2) canopy cover (ideally 80 percent), (3) an open understory with a diverse herbaceous component, and (4) breeding pools with shaded edges (McHenry and Forstner 2009, p. 83; Forstner and Dixon 2011, pp. 38-42).

2.1.2 Forest Management Practices

Forest Enhancement/Restoration – Management Objectives 1 and 2

Background

Overstory tree canopy cover appears to be a necessary component of Houston toad habitat. Forest enhancement and restoration activities, such as tree planting, can help create cover that is believed to be favorable for the Houston toad.

Recommendations

Tree Planting

- Native pine and oak species should be planted in open areas to establish a forest canopy among the native herbaceous plant community.

- Trees should be planted within relatively open areas. This is expected to provide habitat for the Houston toad within 10 to 20 years of initial planting by creating shade and microclimates that will not only support a diverse assemblage of native grasses and forbs, but also provide a more favorable temperature regime for the Houston toad. These conditions are expected to facilitate and enhance Houston toad movement and foraging and provide shade for emerging juveniles.

- In areas where trees are planted (such as wildfire recovery areas in Bastrop County), care should be taken to ensure understory encroachment does not shade out or overtake newly planted trees by implementing brush control methods (see "Brush Management" section below).

Herbaceous Ground Cover

- Landowners should strive to maintain and improve range conditions to prevent livestock overuse and restore plant communities on which Houston toads depend. This can be

achieved by implementing light to moderate stocking rates, grazing regimes, and prescribed burning (see the *Prescribed Burning* section below) that maximize the overall heterogeneity of the native herbaceous community.

- If necessary, native grasses and forbs also can be planted to enhance Houston toad habitat for foraging and movement.

- Landowners should also consider converting or managing some or all of their non-native and sod-forming grass grasses (coastal Bermuda grass) to native grasses. If improved forage production and reduced maintenance costs (such as fertilizer, herbicides, and irrigation costs) are landowner objectives, then landowners should plant high-quality native grasses that are adapted to local conditions, such as Indiangrass (*Sorastrum nutans*), little bluestem (*Schizachyrium scoparium*), and sideoats grama (*Bouteloua curtipendula*), which are ideal for grazing and require less maintenance.

Tree Thinning

- Selective thinning of trees should aim to reduce stem density in the understory and sub-canopy while preserving canopy cover.

Avoidance and Minimization Measures

- Tree species to be planted should be native to the area and non-invasive. We recommend speaking with local Texas Parks and Wildlife Department (TPWD) or Service biologists to help select which tree species to plant in specific areas.

- Details on site preparation, density and locations of plantings, and site follow-up management will be specific to each property. We suggest landowners contact the Texas A&M Forest Service, TPWD, or Service biologists for site specific information and recommendations.

- Machine planting of trees **should not** occur within a 50-meter (164-foot) radius of any water feature that lies within or adjacent to forest areas (within 305 meters [1,000 feet]) with canopy cover greater than 40 percent at any time of the year to avoid crushing Houston toads that are burrowed in the soil.

- Machine planting of vegetation (for example, using a seed drill) is only recommended in large, open areas, such as pastures that are 5 acres (2 hectares) or greater in size. Machine planting in these large pasture areas may occur at any time of the year.

- Hand planting of seedlings and hand thinning of undesirable trees may be conducted at any time of the year in areas outside of a 50-meter (164-foot) radius from the edges (high water mark) of each water feature within or adjacent to forest areas (within 305 meters [1,000 feet]) or evolving forest areas (about 40 percent or greater canopy cover). Hand planting of seedlings and hand thinning within these areas should occur only from July 1

through December 31 (outside of the Houston toad breeding season and emergence period).

- All imported soil and nursery products should be inspected thoroughly for red-imported fire ants prior to use and, if fire ants are present, the products should be treated before locating in Houston toad habitat.

Brush Management – Objectives 1, 2, 3, and 4

Background

Without active management, native grasses and other herbaceous vegetation are often replaced with dense stands of invasive, woody brush species, such as yaupon (Mitchell et al. 2005, p. 17). In addition, suppression of wildfires leads to a dramatic increase in the density of understory brush in forested habitat within the range of the Houston toad (Lost Pines Recovery Team 2011, p. 203; Brown et al. 2012, p. 143). Brush management can help create understory conditions favorable to the Houston toad and facilitate restoration of native ground cover.

Recommendations – Mechanical Brush Treatment

- Preferred methods for mechanical brush control include hand thinning with loppers or chainsaws/brushcutters/clearing saws, shredding with a rotary mower, masticating with a hammer-flail or forestry mulcher, or cutting with hydraulic shears attached to a skid-steer loader.

- When shredding brush with a hammer-flail, relatively small diameter shrubs and trees (those less than about 2 inches DBH) will be shredded once they are contacted by the flail attachment.

- Once cut, relatively larger shrubs and trees should not be shredded, but left on the ground, since they may serve as microhabitats for burrowing Houston toads.

- Loblolly pines of 2 meters (6.5 feet) in height or greater should not be cut or shredded, as they have the potential to become desired canopy trees.

Avoidance and Minimization Measures – Mechanical Brush Treatment

- Hand thinning of undesirable trees may be conducted in areas within a 50-meter (164-foot) radius from the edges (high water mark) of each water feature within or adjacent to forest areas (within 305 meters [1,000 feet]) or evolving forest areas (about 40 percent or greater canopy cover) (to avoid crushing Houston toads burrowed in the soil).

- Hand thinning within a 50-meter radius of water features should only occur from July 1 through December 31 (outside of the Houston toad breeding season and emergence period when adults and juveniles are most active and moving across the land surface).

- Hand cutting and manually stacking slash and brush within a 50-meter radius of water features should only be conducted from July 1 through December 31.

- Brush shredding or shearing should only be conducted from July 1 through December 31.

- Efforts should be made to minimize soil disturbance by using soft-tracked vehicles whenever possible. Metal-tracked vehicles that tend to create significant soil disturbance (for example, bulldozers) should not be used to reduce understory density within forested areas.

- Heavy mechanical equipment (for example, tractors, large trucks, bulldozers) should not be used within a 50-meter radius of water features that may be occupied by Houston toads at any time of the year to avoid direct mortality by running over and crushing individual toads.

- Mechanical equipment should not be refueled within a 50-meter radius of water features at any time of the year to minimize potential impacts to water quality should a fuel spill occur.

- Any soil areas that are disturbed from the use of heavy mechanical equipment should be restored using native vegetation.

Recommendations – Chemical Brush Treatment

Chemical brush management (herbicide use) is often used as a follow-up treatment to mechanical brush management to reduce re-sprouting of mechanically treated brush (Cathey et al. 2006, pp 25-26). Subsequent use of prescribed fire may also further enhance and maintain desired understory conditions (see *Prescribed Burning* below). For example, since a yaupon sprouts from its base, it typically re-sprouts after cutting or burning (Mitchell et al. 2005, p. 17; Cathey et al. 2007, p. 24). The use of herbicides can extend the period between mechanical brush management activities within Houston toad habitat.

We recommend an integrative pest management approach to ensure the least amount of chemical product is used to achieve the desired outcome. This minimizes the potential for impacts to non-target species and lowers operation costs. More information on this approach is available on the following website: http://www.epa.gov/opp00001/factsheets/ipm.htm

- Individual plant treatment (IPT) using the chemical triclopyr butoxyethyl ester (10-25 percent in basal oil diluent applied to stems is recommended).

- Some aggressive plant species may need to be treated within water/drainage areas to control overgrowth using the IPT method. We recommend following Agrilife Extension's "cut stump spray" methods for treating aggressive plants. This is available online at: http://texnat.tamu.edu/about/brush-busters/cut-stumps.

Avoidance and Minimization Measures – Chemical Brush Treatment

- Herbicides should be used in accordance with the product label requirements for dilution, application, clean-up and disposal.

- Herbicide applications should be limited to individual plant treatment or ground application to maintain better control over areas that are treated (the use of boom sprayers mounted to tractors or all-terrain vehicles are not recommended).

- Herbicides should only be used July 1 through December 31 (outside of the Houston toad breeding season and emergence period when adults and juveniles are most active and moving across the land surface). However, there may be situations that necessitate the use of herbicides outside of this time frame to more effectively meet management objectives, particularly in areas that are not currently occupied by the Houston toad (and are being restored as Houston toad habitat) and/or when the IPT method is being used.

- Herbicides not labeled for aquatic application should be avoided within a 50-meter (164-foot) radius from the edges (high water mark) of each water feature within or adjacent to forest areas (within 305 meters [1,000 feet]) or evolving forest areas (about 40 percent or greater canopy cover) at any time of the year (with exceptions for treatment of particularly aggressive species, such as Chinese tallow (*Triadica sebifera*) and yaupon, and then only used outside of the Houston toad breeding season (see below)). If depth to groundwater is shallow (near surface) in areas to be treated, care should be taken with certain herbicides to avoid potential for groundwater contamination.

- Herbicide application should occur when ephemeral wetlands are dry (typically late summer). Any remaining water sources should be avoided during the application process.

- A 50-meter buffer zone should be implemented around all potential water features that could potentially support Houston toad breeding and emergence.

- Herbicide applications should be avoided when storms are forecasted to avoid loss of product to stormwater runoff and potential water quality declines within the habitat area.

- Applications should take place when wind speed is 10 miles per hour (mph) or less to avoid drift (movement of spray droplets or pesticide vapors away from its intended target area) and minimize potential impacts to non-target species.

<u>Prescribed Burning</u> – Management Objectives 1, 2, and 3

Background

Periodic wildfires were once common throughout the historic Houston toad range and these fires helped form and maintain healthy forested habitats that the Houston toad and other wildlife species depended on for their survival. Subsequent fire exclusion has resulted in diminished

forest health through the encroachment of woody (fire-sensitive) vegetation and reduced herbaceous biomass and diversity of herbaceous ground cover vegetation. Therefore, prescribed burning is an important tool for wildlife management (Russell et al. 1999, p. 374). It can be used to reduce hazardous fuel loads (Agee and Skinner 2005, pp. 86-87) as well as to enhance the biomass and diversity of herbaceous vegetation by killing or reducing hardwood understory trees (Cain et al. 1998, pp 211-217; Russell et al. 1999, p. 374).

The reduction of hardwood understory vegetation and subsequent facilitation of herbaceous plant growth on the forest floor may indirectly improve habitat conditions for Houston toad foraging by leading to an increase in arthropod abundance over the long term, but studies are needed to confirm this. Although research on the effects of prescribed burning on the Houston toad, its habitat, and its prey base is needed, we believe prescribed fire may also reduce vegetative cover and litter depth to help facilitate juvenile movement and dispersal (Brown et al. 2011, p. 142). We expect restoration of herbaceous understory vegetation to begin within one year of initial brush thinning and prescribed fire implementation.

Recommendations

- In existing forests and woodlands with moderate to heavy woody understory encroachment, we recommend conducting multiple, low to moderate intensity prescription burns following initial mechanical thinning treatments to achieve desirable habitat characteristics.

Avoidance and Minimization Measures

- If possible, firebreaks should not be constructed within a 50-meter (164-foot) radius from the edges (high water mark) of each water feature within or adjacent to forest areas (within 305 meters [1,000 feet]) or evolving forest areas (about 40 percent or greater canopy cover).

- All prescribed burns should be conducted in accordance with an associated prescribed burning plan and all local, State, and Federal regulations.

- Appropriate conditions of weather and fuels for meeting habitat objectives with prescribed fire may exist at any time of the year. Trained fire management professionals should be able to make appropriate decisions as to when prescribed burning should be conducted to meet management goals. It is critically important that such decisions include consideration of potential Houston toad breeding and emergence activities that may be occurring at a property to be burned. If possible, burning a tract with ongoing Houston toad breeding and emergence activities should be avoided (generally between December 31 and July 1).

- Firebreaks and fire lines should be maintained in non-burning years by mowing and hand cutting. This should be conducted only between July 1 through December 31 (outside of the Houston toad breeding season and emergence period when adults and juveniles are most active and moving across the land surface).

- Methods of maintaining fire breaks or fire lines in non-burning years that mechanically disturb the soil, such as plowing or disking should be avoided.

2.2 Breeding and Nursery Habitat Management

2.2.1 Purpose of Breeding and Nursery Habitat Management

Houston toads are known to breed and reproduce in small pools of water, ephemeral ponds (ponds that persist temporarily, not year-round) (Kennedy 1962, p. 241; Brown 1971, p. 190; Forstner 2003, p. 10), and permanent water bodies (Forstner 2003, p. 10; Quinn and Ferguson 1983, p. 11). Eggs and tadpoles remain in these aquatic habitats and develop within them until they emerge as metamorphosed juvenile toads (Hillis et al 1984, p. 66; Quinn and Mengden 1984, p. 189; Greuter 2004, pp. 65-66). After they emerge, juveniles stay within 3 to 5 meters (10 to 16 feet) of the pond for about 3 weeks until they begin to disperse (Greuter 2004, p. 69). Juvenile Houston toads have been found to remain within a 50-meter radius of the emergence pond for at least 13 weeks (Greuter 2004, p. 70). Thus, restricting ground disturbing activities within this area, particularly during this time, which is considered the Houston toad's breeding and emergence period (lasting from January 1 through June 30), would protect juveniles within habitat that is vital to their survival (Greuter 2004, pp. 70-71).

2.2.2 Breeding and Nursery Habitat Management Practices

<u>Existing Pond Protection/Enhancement</u> – Management Objective 4

Background

Because of their importance to Houston toad reproduction and juvenile survivorship, the protection or enhancement of ephemeral, wet-weather ponds or other water features within a forested area or evolving forested area may be beneficial. Thus, extensive clearing of native vegetation and alteration of drainage patterns should be avoided in and around potential breeding ponds within forested areas.

"Isolated" ponds located outside of a forested area may support breeding activity, but may not support a successful emergence of juveniles. Such isolated ephemeral ponds may operate as breeding "sinks" and provide no long-term benefit to the Houston toad (Forstner and Dixon 2011, p. 9).

Livestock and feral hog management are also important components of breeding pond protection and enhancement. Livestock wading and feral hog use can prevent vegetation from establishing around the pond's perimeter and result in high levels of nitrates (from nitrogenous wastes, such as urine and manure), increased turbidity, decreased water quality, and an overall adverse environment for amphibian egg and tadpole development (Knutson et al. 2004, p. 677; Schmutzer et al. 2008, p. 8). Elevated ammonia, nitrate, and nitrite levels are known to negatively affect amphibian embryo and larvae survival and larval body size (Jofre and Karasov 1999, pp. 1,808-1,810). Livestock wading into breeding areas leads to habitat alternation in the form of vegetation loss and soil compaction at the pond's edge that deters Houston toad breeding

activity (Forstner 2001, p. 3). It may also result in the destruction of egg clutches and mortality of tadpoles, juveniles, and adults (Bull 2009, p. 243).

Recommendations

- Houston toads have been known to use stock tanks and other water sources as breeding and emergence habitat after livestock use is restricted (Forstner 2001, p. 3). Therefore, landowners can help enhance these habitat areas by restricting livestock and feral hog access to potential breeding sites by fencing these areas, especially during the Houston toad's breeding and emergence season (which lasts from January 1 through June 30 each year). Livestock may be allowed access to a small portion of the pond or excluded entirely.

- Providing alternative watering stations, such as concrete or other forms of structural troughs, is strongly encouraged to divert livestock use to areas away from potential Houston toad breeding sites.

- Where shade is not present at pond edges, it should be created by planting trees following recommendations under *Forest Enhancement/Restoration* above.

- Native vegetation should be restored to pond banks by planting native ground cover, such as native perennial bunch grasses and annual grasses (for example, ryegrass, oats, wheat, or rye) to provide cover for emerging Houston toad juveniles following recommendations under *Forest Enhancement/Restoration* above.

Avoidance and Minimization Measures

- Modification or disturbance of ephemeral, wet-weather ponds or other water features within a forested area or evolving forested area should be avoided.

- A 50-meter protective buffer zone should be implemented around all water features that could potentially support Houston toad breeding and emergence. Activities that could negatively impact juvenile Houston toad should be restricted in these areas (suggestions for restrictions of specific activities are provided throughout this document).

- Consideration should be given to bank stability to ensure that slope, vegetation composition and amount of cover, and slope integrity (degree to which soil has been disturbed as a result of livestock or wildlife usage, vehicle traffic, or other factors) are suitable for Houston toad breeding and emergence. Ponds with a more gradual slope are preferred by Houston toads for breeding (Forstner and Ahlbrandt 2003, p. 320). We define "unsuitable" as having a steep slope (greater than 5:1), no vegetative cover, and highly disturbed soil conditions (approximately 100 percent disturbed). We recommend ponds with shallow slopes (maximum of 5:1), a high percentage (approximately 100 percent) of vegetative cover consisting of native grass and forb species, and undisturbed soil conditions (approximately 0 percent disturbed).

- If not excluded entirely, livestock should be allowed access to only a small portion of a water feature. This could be achieved by fencing existing ponds, but providing a single lane to water for livestock. As an enhancement practice for ponds that provide water for livestock, part of the edge of a pond could be fenced to protect Houston toad habitat at the pond's edge, while a smaller portion (such as 30 percent or less of the pond's edge) could allow livestock access.

2.3 **Red-imported Fire Ant Control** – Objective 5

Background

Red-imported fire ants (fire ants) are known to prey on newly metamorphosed juveniles (Freed and Neitman 1988, pp. 455-456) and on the invertebrate community, which is believed to be an important part of the food base for the Houston toad (Bragg 1960, p. 106). Controlling heavy fire ant infestations in Houston toad habitat may help minimize their impact on these species. Fire ant control is expected to reduce mortality of Houston toad adults and juveniles within the first year of implementation.

General Recommendations

Landowners can help to control fire ant infestations by limiting soil disturbance, avoiding the excessive removal of overstory trees (as fire ants are more prevalent in disturbed areas (Tschinkel 1988, p. 80)), properly disposing of trash, and inspecting imported soil and nursery products thoroughly for fire ants prior to use. We recommend landowners contact their local Agricultural Extension office for information on how to inspect these products for fire ants and steps to take if they are present.

Generally, we recommend spot-treatment of pesticides rather than broadcast applications to focus treatments directly on or around the mounds and to avoid treatment of areas that are not infested. This minimizes potential effects to non-target species, such as other insect species that are important dietary components of the Houston toad. However, spot-treatments may not always be the most effective approach, particularly in large areas that are heavily infested with fire ants.

Adult Houston toads will be less vulnerable to potential impacts from pesticides than juveniles; therefore, we recommend applications occur within the timeframe from July 1 through December 31 (outside of the Houston toad breeding season and emergence period). However, there may be situations that necessitate the use of pesticides outside of this time frame to meet management objectives more effectively, particularly in areas the Houston toad does not currently occupy (and are being restored as Houston toad habitat).

Recommendations – Spot-treatment

- We recommend treating fire ants mounds individually with non-chemical means if possible (for example, boiling water, diatomaceous earth) or with a commercial fire ant bait. Note that boiling water will kill vegetation in the immediate area.

- When use of commercial fire ant bait is necessary, we recommend bait containing the active ingredients hydramethylnon or fenoxycarb, such as Amdro, Award, or Logic for areas other than pastures or cropland. Additional information on these commercial fire ant baits is available on the following website: http://fireant.tamu.edu/controlmethods/products/

Avoidance and Minimization Measures – Spot-treatment

- Baits should be used in accordance with the product label and must only be placed near fire ants mounds and not near the mounds of native ant species.

- To avoid adverse effects on non-target species, bait should only be applied when fire ants are actively foraging to prevent accumulations of excess bait.

- Pesticide applications should be avoided when storms are forecasted.

- If applications will involve aerosolized liquids, applications should occur when wind speed is 10 miles per hour (mph) or less to avoid drift (movement of bait away from its intended target) and effects to non-target species.

- Pesticides should never be applied directly to water.

Recommendations – Broadcast Treatment

- We recommend the use of broadcast fire ant baits in late summer or fall (late August through early October) to treat large areas with heavy fire ant infestation while Houston toads are usually dormant.

- We recommend methoprene-based (for example, Extinquish Plus®) and organic derived products (for example, spinosad) to lessen potential impacts on non-target species. Additional information is available on the following website: http://fireant.tamu.edu/controlmethods/products/extinguish_plus/

Avoidance and Minimization Measures – Broadcast Treatment

- Pesticide application should occur when ephemeral wetlands are dry (typically late summer). Any remaining water sources should be avoided during the application process.

- A 50-meter buffer zone where not fire ant bait is applied should be implemented around all water features that could potentially support Houston toad breeding and emergence.

- Pesticide applications should be avoided when storms are forecasted to avoid loss of product to stormwater runoff and potential water quality declines within the habitat area.

- Pesticides should be used in accordance with the product label requirements for dilution, application (including amount of product), and disposal.

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