City of London
City-Wide White-tailed Deer Management Strategy

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London, ON N6B 1Z2

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NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

City of London
Deer Management Strategy

Project Team:

David Stephenson
Kevin Dance
Phil Anderson
Tara Brenton
Stephen Murphy
Doug Smith
Robin Boles

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225 Labrador Drive, Waterloo, Ontario, N2K 4M8 **Tel:** (519) 725-2227 **Web:** www.nrsi.on.ca **Email:** info@nrsi.on.ca

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1.0 Introduction

1.1 Background

The City of London, like much of southern Ontario, has experienced considerable land use change over the past century with an acceleration of these changes over the past few decades. Despite urbanization changing the landscape around cities from rural agricultural lands, white-tailed deer (*Odocoileus virginianus*) have been able to adapt and thrive in urban natural areas. A number of factors have contributed to the continued presence of deer within urban areas, including retention of remnant natural areas in the urban land use matrix, high reproductive rates of the deer, and lack of natural population controls.

The City of London has experienced this trend. In the past decade concerns have been growing regarding the deer population in portions of the City, especially the Sifton Bog, which has been the catalyst behind the development of this City-Wide Deer Management Strategy. These concerns include the potential impact of deer on the significant natural areas within the City of London. In the case of Sifton Bog, concerns include the fear of irreparable harm to the bog habitat as well as concerns for human safety as a result of deer-vehicle collisions.

The issues of negative deer-human interactions within the City of London came to the forefront in 2000 when the Upper Thames River Conservation Authority (UTRCA) began receiving more calls regarding deer on private property. This resulted in the formation of a community steering committee to study the issue of white-tailed deer. As noted above, the deer population in the Sifton Bog was the major catalyst behind these concerns, but there was also recognition that deer may be issue in other natural areas within the City. The details of the history, ecology and management options for the deer within the Sifton Bog are included in a separate report entitled: "Sifton Bog White-tailed Deer Management Study". The reader is referred to that document for further site-specific information.

Since 2000, numerous strategies have been undertaken by the City of London, including landowner education and a detailed review of various non-lethal management strategies. Other actions, including vegetation monitoring plots and deer population counts in Sifton Bog, and an evaluation of the use of deer exclosures have been undertaken by the City of London, UTRCA, and local academics. These actions have provided considerable information feeding into the City-wide deer management.

To avoid creating future situations in the City similar to that of Sifton Bog, it is important that an over-arching city-wide deer management strategy be prepared which will guide the development of future management strategies for areas with existing or future deer issues. A city-wide deer management strategy will become increasingly important as the City continues to expand outwards into surrounding rural deer habitat.

The City-Wide Deer Management Strategy contained within this document provides guidance on how to approach determining whether and where management for deer may be required. It is possible that site-specific management plans for deer in other natural areas within the City may be required in the future. The key components that should be part of deer management plans for specific areas are identified. The City-Wide Deer Management Strategy can be used to consider the implications of proposed future developments on deer-human interaction and to be proactive by implementing actions which will avoid possible negative deer-human interactions (i.e. deer-vehicle collisions). This City-Wide Deer Management Strategy therefore provides management considerations in a broader landscape context rather than dealing with individual areas on an ad hoc, case by case basis. Understanding the context into which a particular area with deer issues is nested is an important part of a holistic approach to managing deer within the City.

1.2 Organization of this Document

The following is an overview of the contents of the sections within this report.

Section 2 includes a general description of the City of London. The ecology of white-tailed deer is discussed in Section 3, while Section 4 discusses deer issues in the City of London. Sections 5 and 6 provide overviews of deer in select natural areas within the City, as well as natural areas elsewhere for comparison. Section 7 includes a review of

options available for urban white-tailed deer population management.

Recommendations of management in the City of London are included in Section 8.

2.0 City of London Study Area

The City of London is located in southern Ontario with a population of approximately 350,000 as of the 2006 census (City of London 2010). Like many communities throughout southern Ontario, the City of London was first and foremost positioned along the Thames River waterway, which provided advantages for transportation and suitable locations for water-powered lumber and flour mills to the city's founders. Growth and development continued in the form of forestry and agriculture which the surrounding landscape and rich soils provided. The rich habitats provided by dynamic river processes along with expansion and development of the City of London within the Thames Valley Watershed, has led to a mosaic of urban areas interspersed along and around non-developable floodplain and upland habitat of the Thames River Valley Corridor and its tributaries. The modern transportation routes, speed of traffic, and recent expansion of residential areas into former agricultural lands and scenic non-agricultural areas has caused competition between humans and wildlife for environmental space.

The Thames River flows east to west, branching near the middle of the City at The Forks. This major river and various tributaries that flow into the Thames River act as nodes of natural habitat extending out from the river. The largest contiguous natural areas left within the city are located within floodplains, valleylands and adjacent upland forests along the Thames River and its tributaries. The Thames River Corridor, which historically was a positive draw for the settlers of the area, now functions as a wildlife movement corridor. Currently, deer are able to follow the river corridor into the city where they may then follow the finger-like corridors of tributaries or remnant natural areas which extend from the river into residential and commercial areas across the city. Deer are highly adaptable, and will readily make use of any remnant natural areas within the urban landscape. Residential and commercial properties in close proximity to these remnant natural areas also provide habitat for urban deer populations. When the deer get into these areas they may become disoriented and unsure of how to escape from the human disturbances that they may encounter (e.g. people walking dogs etc.). This may make them panic and enter roadways, causing collisions.

In order to provide a starting point for the City of London to understand the deer population within the city overall, five areas within the City (including the Sifton Bog) were examined. Due to the area's known history of high deer population, Sifton Bog was examined in detail during the winter of 2009/10. The Sifton Bog White-Tailed Deer Management Study (NRSI 2011) was prepared concurrently with the City-Wide Deer Management Strategy in order to address the already known deer impacts to this area. The four other areas of interest are The Coves, Warbler Woods, Windemere & Western Road, and Meadowlily Woods, some of which are isolated within the urban areas of the city, and others located on the outskirts. All of these areas are exposed to strong influences from minor and major traffic arteries.

3.0 Understanding White-tailed Deer Ecology

3.1 Deer as "Keystone" Species in Urban Natural Areas

Deer are often 'keystone' species in temperate habitats, in that they have a disproportionate effect on the natural environment relative to their number, especially in the absence of most predators. However, accidents with human vehicles and some increases in coyotes, may be affecting deer populations in some areas. Nonetheless, deer often have many urban-to-exurban habitats available without much competition from other (often extirpated) ungulates and/or predators.

The characteristics of areas that have experienced an over-population of deer include impacts to forest regeneration, damage to nearby crops and landscape plants, as well as elimination of preferred deer foods. Deer impacts on their habitats are both immediate and cumulative. One of the major impacts is foraging of understorey herbs (especially *Trillium* and *Panax* species) without assisting dispersal via scat. The damage is often so extensive that the plants do not survive. The browse on trees can be quite damaging due to removal of lower branches, and bark, as well as impacts to roots that allows disease or girdling to occur. If densities of deer are high, then they may start damaging saplings and seedlings of trees and shrubs and as a result hinder the development of the understory, and the forest declines.

Over-browsing and intensive foraging on preferred plants can compromise the long-term efforts of ecosystem preservation and restoration efforts in remnant natural areas by altering the composition and structure of flora (Witham and Jones 1992). High deer densities in remnant natural areas have been shown to virtually extirpate rare or endangered plants (Miller et al. 1992), reduce the abundance, cover, density, vigor and diversity of native plant species (Strole and Anderson 1992, Witham and Jones 1992, Tilghman 1989), and potentially provide a competitive edge to exotic plant species.

Deer also trample, dig, and erode soils which can cause nutrient loss, and more importantly, allow for invasive plant or invertebrate species to colonize and set in motion a cycle of ever-increasing invasive species populations and decreases in native species. This is especially true if the habitat edge has been made abrupt as a result of urban or

road development adjacent to remnant natural areas. In such cases, the edge to interior ratio of a habitat often increases, making it vulnerable to windthrow, increased light penetration, increased temperatures and reduced humidity (especially in forests, marshes, fens, and bogs).

Once invasive species establish, deer often avoid them and do not destroy them (e.g. garlic mustard (*Alliaria petiolata*)). In many cases deer may browse and disperse the seeds from these invasive plant species while not dispersing the seeds of native species (e.g. invasive buckthorns (*Rhamnus* species) are often dispersed by deer) (Waller et al. 2009). Avoidance of unpalatable species and differential impacts of grazing have been found to shift groundcover vegetation composition in some areas, for example increasing the abundance of grasses, sedges and some ferns (Rooney 2003).

These shifts in vegetation composition create a further series of cascading and indirect effects as the habitat changes so much that other mammals, birds, invertebrates (spiders, springtails, ground beetles), lichens, fungi (especially mycorrhizae), and even bacteria can be harmed, and invasive or less conservative native species replace them. The cumulative impact is that deer can foster an alternate stable state of an ecosystem, where the state is a new and relatively degraded habitat that has diminished nutrient and water-cycling, as well as low biodiversity. The problem is severe because the alternate stable state means that extreme measures of restoration and deer management may be needed if there is to be any hope of restoring the degraded state to some form of more complex and sustainable 'original' state.

White-tailed deer have also been found to impact other wildlife species either directly or indirectly. For example, heavy browse in a park area in Ohio was found to influence recovery of vegetation being established to support a re-introduction program of Karner blue butterflies (*Lycaeides melissa samuelis*) (Kuntz 2009). An overabundant island population of deer was found to reduce the abundance and diversity of intermediate canopy-nesting songbirds due to vegetation changes as well as actual consumption of ground-nesting eggs and young (Raposa and Greene 2009). In a Pennsylvania study, DeCalesta (1994) also found that changes in vegetation via deer browsing impacted intermediate canopy-nesting songbirds and reduced bird species richness and abundance.

Humans also have one further reason to avoid habitats where deer are overabundant as they can carry ticks (*Ixodes*) that vector Lyme disease. Lyme disease is not the direct 'fault' of deer – the disease does best where humans have created fragmented habitats with lush edges of invasive species where ticks can gestate and deer will be attracted. Within the City of London and surrounding region, to date there have been no reported instances of the deer tick or Lyme disease.

3.2 Ecological and Social Carrying Capacity

Ecological carrying capacity (generally denoted 'K') is the maximum number of individuals that a habitat can sustain (McCullough 1984). From the perspective of population dynamics, the ecological carrying capacity is the point at which annual recruitment to the population creates a residual population that does not change over time (McCullough 1984). Hayne (1984) stated that although the actual population level at K is often of interest, knowing the rate of population growth and the population level relative to K is generally of more importance from a management perspective. That is, how close is the population to K and what is the rate of population change (McCullough 1984). It is common for populations to overshoot the ecological carrying capacity both as a result of growth rates as well as the fact that as the population approaches the ecological carrying capacity, the impact of the population (e.g. on the browse availability) can depress the carrying capacity. McCullough (1984) stressed that when a deer population is at the ecological carrying capacity there will be considerable vegetation impact; the maximum level of vegetation impact that is sustainable.

In cases where the deer population exceeds the ecological carrying capacity, the herd often includes smaller numbers of fawns, higher mortality rates (especially of fawns and older deer), lower average weight in age classes, smaller antlers, and increased prevalence of parasites and disease (Brinkman et al. 2005).

Social (or cultural) carrying capacity may be equally relevant in urban areas. Social carrying capacity is the level at which the deer population can coexist with the human population without negative impacts (D'Angelo 2009). It is possible that social carrying capacity can be greater than ecological carrying capacity. This was the case presented

in the 2003 Sifton Bog Deer Management Plan prepared by the Community Steering Committee. However, an important distinction must be made here. Although the social carrying capacity may be greater than the ecological carrying capacity, i.e. the population level at which there is a deer-human conflict is greater than the habitat can sustain, it does not imply that the social carrying capacity should be a management target. If the goal is to have a deer population above that which the habitat could support, it would certainly result in negative impacts to the habitat. Substantial habitat destruction and either the collapse of the population or the need for considerable intervention (e.g. supplemental feeding) would result. In cases where social carrying capacity is greater than the ecological carrying capacity, this level should be regarded as an upper population threshold above which management measures (or perhaps more aggressive measures) may be triggered.

Management of a population at a social carrying capacity that is lower than the ecological carrying capacity would avoid impacts to the habitat, but would require human intervention since the population would continually increase towards K. If the social carrying capacity is close to the maximum number, the growth rate of the population would then be at its maximum. This would require considerable intervention, such as either actively depressing the population levels by removal of deer or actively reducing habitat quality/quantity (thereby reducing the ecological carrying capacity to the desired social carrying capacity).

Ecological carrying capacity is often presented in the literature as a density (all citations converted from original to number of deer per hectare in following discussion). A wide range of densities are presented in the literature, but these reflect local habitat conditions and may have limited value in determining ecological carrying capacity for a local population. In fact, Halls (1984) claimed that there is no standard methodology for determining carrying capacity. As such, estimates are generally subjective and include wide margins of error. Generally researchers cite densities at which visible negative impacts, especially to vegetation, occur. However, Halls (1984) noted that by the time damage to vegetation is evident to the manager, the impacts to the vegetation are generally great and the population may be on a trajectory to far overshoot carrying capacity. The only exceptions are where specific actions like harvesting are taken, in which case more accurate values (for ungulates) are possible because of more precise

population counts related to each harvested deer being measured and geo-referenced (Nielsen et al 1997, Keyser et al 2006, Majudano 2007). However, this would not apply to urban deer populations since direct harvesting is generally not permitted or publically accepted in urban areas.

Brinkman et al. (2005) reported carrying capacities in agriculturally-dominated upland landscapes at 0.01 deer/ha, and in lowlands at 0.2 to 0.31 deer/ha. Masters et al. (no date) provided a similar average for agricultural lands: 0.07 deer/ha (ranging from 0.02 deer/ha on low productivity sites to 0.17 deer/ha on high productivity sites). DeNicola et al. (2008) studied suburban deer populations and found that deer became problematic when the density exceeded 0.2 deer/ha, but found it was common to find suburban deer densities greater than twice that. Raposa and Greene (2009) cited a number of deer densities that caused vegetation impacts ranging from 0.02 deer/ha to 0.17 deer/ha. Recommendations were cited to avoid human-deer conflicts in suburban areas of 0.04 deer/ha, and 0.02 deer/ha to avoid impact to plant diversity in forested areas.

There are very few examples of ecological carrying capacity calculated for urban deer populations. Some of this relates to the difficulty in calculations wrought by an instability in reproductive rates as populations approach carrying capacity (i.e. fawn survivorship may plunge as the ecosystem degrades rapidly and the carrying capacity is not reached – although the ecosystem may be shattered) (Peterson et al. 2004). In other cases, variation in dispersal can make calculations difficult (Porter et al. 2004), although suburban habitats can, ironically, make this easier if they are ecological traps for deer with effectively one way in/out.

Much of the issue with calculating carrying capacity relates to the challenge of determining the size of the habitat being used by urban deer. When there is a natural habitat embedded in an urban matrix, the determination of the spatial scale of the population is difficult to assess as it includes both natural habitats as well as portions of the urban matrix. So, for example detecting a number of deer in a remnant habitat patch in an urban area in which the home ranges of deer extend into the urban matrix, the density would be in error if based solely on the area of remnant natural habitat. Some component from the urban matrix must be included in the determination of carrying capacity in such situations.

3.3 Home Range

No discussion of carrying capacity can be complete without a clear understanding of the scale of the assessment. Many researchers emphasize the need to assess deer populations at a landscape level (e.g. Webb et al 2009, Brinkman 2003) and caution that focusing on a relatively small specific habitat can lead to erroneous conclusions. These researchers also emphasize the dangers of extrapolating from population studies in rural and forested habitats to urban and suburban areas. An important consideration is whether a habitat area, such as the Sifton Bog, provides sufficient habitat area to sustain a deer, or whether the home range of the animal exceeds the habitat patch.

Brinkman et al (2005) listed a number of sources citing white-tailed deer home ranges in a number of habitat types from 50 to 4800ha. They recognized that home range size varies through the year with winter ranges in agriculturally-dominated landscapes (averaging 5200ha) being greater than summer ranges (averaging 2300ha). Several researchers have found that home range sizes in suburban and urban areas are less than in rural areas. For example, Gaughan and Destefano (2005) found that home ranges of suburban deer populations were one tenth those of rural deer. Similarly D'Angelo (2009) found that deer home ranges in suburban habitats ranged from 20 to 800ha with most averaging 260ha. Suburban and urban deer also tended to have more elongated home ranges (Piccolo et al. 2000). Home range size is also known to change (increase) as deer density decreases.

3.4 Annual Cycle/Movement of White-tailed Deer

In regions with heavy snow, deer will congregate to traditional "deer yards" for the winter months, often forming groups of up to 50 individuals or more. These yards will usually occur in low-lying areas with dense cover, where an abundance of food and shelter will help to sustain the deer for a long period of time. Yards also help to keep trails open for easy movement through the snow as well as to provide protection from predators (National Audobon Society 1996). In most portions of southern Ontario, winter conditions, especially snow depth, are not sufficiently severe to force deer into yards. As such, true yarding may be very rare in many areas including the City of London, but deer may still preferentially use areas providing cover for thermoregulation, energy conservation, etc.

During the winter months, the deer will drastically reduce activity levels thereby limiting energy expenditure. Its diet during this time of year primarily consists of twigs and buds of maple, dogwood, aspen, willow and sumac, as well as evergreens and cedar in the more northerly part of their range (Kurta 2005). Grasses, herbs and leaves are browsed during the summer months, along with acorns, mushrooms, apples, corn and celery, when available. White-tailed deer may travel many kilometers between their summer and winter habitats. Although they may occupy the same home range throughout the years, they are not territorial animals.

Antler growth on the males will begin in the early spring. Growth will cease in late summer, and by fall the velvet will begin peeling off to reveal the hard boney tissue beneath. Most antlers will drop by January, although it is possible to see them on some individuals until early spring of the following year, just before growth begins again.

Rutting, or the breeding season, occurs in autumn for this species, peaking in November and lasting for approximately 2 months. Males that are still running in bachelor groups will begin sparring amongst themselves to establish strength and dominance. Buck groups will diminish and individuals will travel great distances in search of multiple mates, often challenging any male encountered during this time. If a doe is not successfully fertilized, she will come into heat again 28 days after the first attempt (Kurta 2005).

Fawns, usually twins, are born in late spring (late May-June). The doe will hide her young in tall grasses as she browses during the day, and will return periodically to nurse. A few weeks later, the fawns will begin feeding on grasses, however will not be completely weaned until they are approximately 4 months in age. Although some deer will become sexually mature during their first winter, it is highly unlikely males will have the opportunity to mate until they are older and stronger. Six or seven month old females may mate, and if successful, they will usually birth one fawn instead of two (Hinterland Who's Who 2010).

During the spring and summer months, male white-tailed deer will sometimes form small bachelor groups, and will spend the majority of their time feeding while slowly walking.

Although similar movements and feeding patterns are observed amongst females, the does will live the majority of the year in a family group, with her newest fawns of the year, as well as the yearlings from the season prior (Kurta 2005).

White tail deer can live for up to 15 years in the wild, however, few individuals survive for more than 3 to 6 years (Swihart et al. 1995). The age structure of white-tailed deer in urban areas in the northeastern United States has been found to be skewed towards older age classes (Cornicelli 1992, Witham and Jones 1992). Studies by Witham and Jones (1992) and Cornicelli (1992) indicated 50-70% of urban deer to be >2.5 years of age. According to Swihart et al. (1995) the age structure of white-tailed deer in urban areas is similar to that of rural unhunted deer populations.

3.5 Urban Deer Behavioral Considerations

In the urban context, natural areas which offer cover habitat for deer are typically isolated or there are weak corridors of habitat leading to more rural woodlots. The location of roadways can influence the type and extents of habitats used by deer and have a direct impact on deer populations. The extent of impact is greater on major than minor traffic arteries. Three key behavioural considerations of rural versus urban white-tailed deer are discussed below. These factors can help provide some insight into the causes of negative deer-human interaction in urban areas.

1. Movement and Daily Routes.

   There are four daily movement occurrences of the white-tailed deer under rural conditions. Major feeding and travel opportunities for white-tailed deer are usually at dusk and dawn and last from one to three hours. Minor feeding and travel opportunities occur at noon and midnight and last one-half to two hours. Because travel and feeding in urban areas are influenced by human activity, the major and minor feeding occurrences in the urban setting are compressed into almost exclusively nocturnal movements. During the nocturnal movements of deer in the urban environment, deer will forage on residential lawns and landscaping and therefore regularly cross main roads and residential streets. The nocturnal movements of deer in the urban environment increases the risk of deer-vehicle collisions as it is a time when drivers have reduced visibility and deer activity is high.

2. Security Zones

   All white-tail deer have security zones which are used repetitively for bedding. Locations of these zones can vary both seasonally and year to year, based on factors such as human activities and environmental conditions (e.g., water levels and time of leaf-drop in fall). In rural areas, most white-tailed deer have numerous security bedding areas that cover a relatively large area to escape detection. Escape cover is also more readily available in a variety of directions should predators or an alarm response be triggered. The London urban white-tailed deer have smaller areas for the locations of safe bedding areas, and few options for a safe escape, should they be disturbed in a security area that is positioned poorly within an urban setting.

3. Deer Physiology

   Deer are prey animals that respond to threats by what is termed “the flight response”. Urban white-tailed deer are ill equipped to run over smooth surfaces like pavement, or cement, which dominate a large part of the urban landscape. Their aversion to movement, traffic, humans, and lights exacerbates the deer’s panic response. Full flight response through residential areas can result in deer leaping fences and becoming trapped, or they run across roads resulting in collisions, or in some cases, death.

3.6 Overview of Data Requirements

White-tailed deer researchers agree that setting goals is a basic first step in determining appropriate management activities. This is often overlooked and may have a number of ecological, social, political, and financial aspects. There is also a need to understand the population dynamics of the herd in order to predict effects of management. Generally the key information needs relate to population growth and habitat sustainability and include mortality, growth rate, immigration and emigration. In many white-tailed deer management programs immigration and emigration are assumed to balance and are often ignored. In those cases it is assumed that the numbers of deer leaving and entering the population are roughly equal. However, in some instances a habitat may act as a ‘source’, i.e. providing more individuals to the overall population and thereby having a net larger emigration. In other cases the habitat may act as a ‘sink’ in which

the population experiences a net greater immigration, perhaps due to mortality. In either case it is important to know whether the population being managed has known spatial bounds and whether the population is 'closed' (i.e. contained within the specific area) or subject to exchange of individuals with neighbouring habitats (i.e. 'open').

Based on our experience with white-tailed deer management, a list of information needs for managing an urban deer population was assembled as follows:

- Immigration and emigration
- Availability of browse (quality and quantity)
- Impact of browsing on regeneration in the habitat, influences on invasive species and change in the vegetation community
- Size of the home range of deer
- Seasonal and annual movement patterns
- Sources and amount of mortality (road kills, other)
- Role/influences of predators
- Critical habitats for the deer (e.g. security zones, winter yards)
- Population growth rate, including seasonal/annual variations
- Age structure of the deer population
- Sex structure of the deer population
- Current health of the herd

A fundamental goal of most studies is to understand the carrying capacity of the habitat. This concept is discussed in more detail below. Although white-tailed deer studies vary, most researchers emphasize the need to manage on a landscape level, not focus on a specific habitat patch or sensitive habitat component. The management of white-tailed deer at a landscape level is necessary in order to understand the broader population of deer within the management area. Managing deer at a broad landscape scale enables an understanding by managers of things such as where deer are emigrating from and where movement corridors exist. In some examples of urban wildlife studies, it is assumed that the remnant natural habitats are the extent of the area that needs to be assessed to understand the species. However, in the case of deer, the neighbouring urban land uses (including lawns and parks) can form an integral part of this mobile

species' habitat. The contribution of these urban land uses and movements between the remnant natural habitats and the urban matrix must also be considered.

This approach needs to be taken by the City of London as the City continues to grow through the development of rural areas around the City edges. The adoption of a landscape level approach can provide the insight needed to direct future development of remaining rural lands in the city limits based on the decided management goals of the City. Deer management at this level can therefore allow for corridors of deer movement into the city to be maintained or to remove movement corridors to reduce the immigration of deer into significant natural areas or habitats in order minimize deer caused impacts to the remaining natural areas within the City. Taking a landscape level approach to deer management also allows for smaller isolated areas to be identified and managed more appropriately as immigration and emigration are better understood as a result of this management approach.

4.0 London Deer Population Issues and Challenges

4.1 Deer-Vehicle Interactions

Deer-vehicle collisions are a threat to human safety and are one of the predominant causes of deer mortality within suburban environments where lack of natural predators or hunting bans exist. Collisions with deer can result in serious vehicle damage, personal injury and human mortality.

Data collected from wildlife-vehicle collisions does not always identify the species of animal, but the frequency of wild animal – vehicle collisions is very high (OMNR 2006). In past studies in North America the number of deer-vehicle collisions has been correlated to both traffic volume (Bryant 1992), and greater deer abundance (Blouch 1984). Most deer collisions occur during October through to December and to a lesser extent May to June. These periods coincide with heightened deer activity during the autumn breeding season and the spring yearling deer dispersal from their birth ranges (Allen and McCullough 1976 (Michigan data), Decker et al. 1990 (New York data), Puglisi et al. 1974 (Pennsylvania data)).

Information collected on deer-vehicle interactions throughout the City of London was reviewed to identify the extent of occurrences (”occurrences” do not necessarily refer to mortality). Deer-vehicle occurrence (DVO) records from 2004 to 2008 were provided by the UTRCA and are based on London Police Department records. A map showing DVO locations throughout the city is provided in Appendix I. Note that the DVO locations are shown based on recorded nearest intersection or street address, and are approximate.

In addition to the DVO data, deer mortality data was obtained from the City of London between 2006 and 2009. In order to observe seasonal variation, Figure 1 presents the mortality data on a monthly basis.

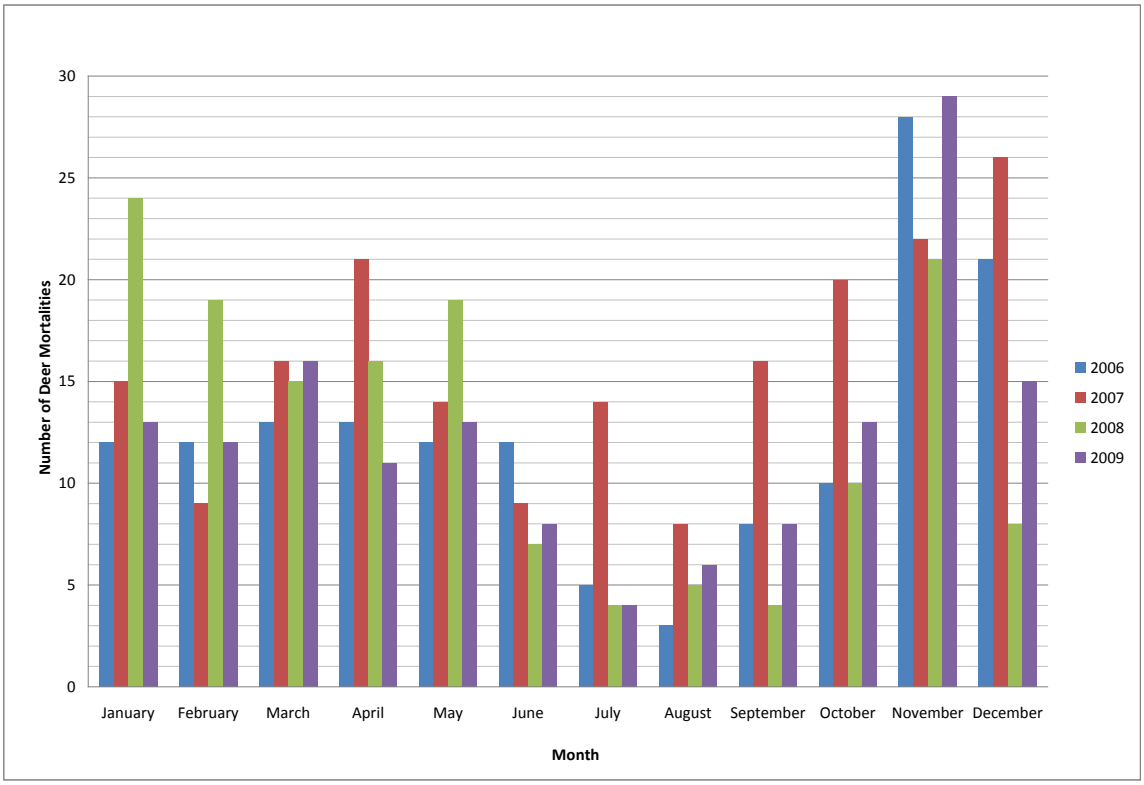

Figure 1. Deer Mortalities within the City of London, 2006-2009

Peaks in deer mortalities due to interactions with vehicles occur in the spring (April & May), and in the fall (especially November). This data correspond to the peaks discussed above from other jurisdictions and similarly correspond to when the greatest deer movement occurs.

The number of total annual DVO and mortalities within the City of London are summarized in Table 1.

Table 1. Deer-Vehicle Occurrences and Mortalities, 2004 - 2009

Year	Deer-Vehicle Occurrences (UTRCA)	Deer Mortalities (City of London)
2004	210	Unknown
2005	200	Unknown
2006	172	149
2007	224	190
2008	243	152
2009	Unknown	148

The following are general trends identified by the DVO records within the City of London:

- The majority of DVO records are located adjacent to or near to woodlands, with larger concentrations of DVO records being located near larger woodlands or multiple woodland patches located close to each other,
- Some areas within the city have only scattered and minimal DVO records, e.g. east of Western Road, north of the south Thames River Tributary and south of the northern Thames River Tributary (from Fanshawe Lake), and west of Clarke Road,
- The majority of DVO records are from locations near the urban rural interface, and
- Concentrations of DVO records appear to be associated with areas with numerous aquatic features (creeks, streams, river) and numerous wooded habitats (either contiguous or multiple separate woodlands).

Specific locations:

- The majority of DVO records are from west of Western Road and are especially associated with the Thames River and tributaries which flow into the Thames River,
- Numerous DVO records are from the Kilally Woods area where tributaries to the Thames flow through a steep wooded river valley and riparian areas. The tributary that flows through Kilally Woods begins north of the City and provides a potential corridor for rural deer to follow into the city, and
- Another area of concentration of DVO records is located south of the southern Thames River Tributary around Meadowlily woods and to the east around Airport Road. This area is located at the urban edge of the city and therefore represents an area at the urban rural interface.Other areas of concentration located at the urban rural edge include:
    - The area directly south of Fanshawe Lake, to the area around Highbury Ave north where there are numerous woodland patches and wooded corridors along the north tributary of the Thames River.
    - The area of Sifton Bog is an area of particularly high numbers of DVO records, with records extending north around Hyde Park Road as far as Sunningdale Road West.
    - Numerous DVO records are also located on the south side the Thames River west of Wonderland Road to Woodhull Road. Most records in this area are

closely associated with the Thames River, especially in the area of Warbler Woods. In addition to the area of Warbler Woods, there are numerous DVO records associated with Dingman Creek in the area of Elvage Drive and Westdel Bourne, as well as near Southdale Road west.

4.2 Disease

There is concern that deer populations within residential or suburban areas may pose a threat to human health by increasing the exposure to disease such as Lyme disease, encephalitis and parasites. There are also concerns that a large deer population would pose a threat to the herd health by increasing the potential spread of disease or parasites within the herd (such as Chronic Wasting disease (CWD)). These health and disease issues are discussed below; however, they are not a concern or threat in the City of London at this time.

Lyme Disease

Lyme disease is an infection caused by the spirochete bacteria *Borreliea burgdorferi* that is transmitted by the bite of a tick called *Ixodes scapularis*, also known as the Black-legged or Deer Tick. The spread of Lyme disease requires the presence of the bacteria, the deer tick and a mammal host (most often deer and rodents). Studies have shown that an infected tick normally cannot begin transmitting the bacteria until it has been attached to its host about 36-48 hours. If infection occurs, 80% of people will have a red, slowly expanding “bull’s-eye” rash appear around or near the site of the bite 3 to 31 days after the bite. If left untreated, complications involving joints, heart and nervous system can develop.

Ticks carrying Lyme disease are rare in Ontario except in Long Point, Point Pelee and Rondeau Parks. There have been only 12 people with Lyme Disease reported in the Middlesex-London area since 1988 and all but one were demonstrated to have been infected outside of this area. In Middlesex-London, Lyme disease is not currently a concern.

Additional information is available on the American Lyme Disease Foundation website (http://www.aldf.com/), which includes a number of links to other websites providing credible information about Lyme disease.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a contagious neurological disease affecting deer, elk and moose. It causes a characteristic spongy degeneration of the brains of infected animals resulting in emaciation, abnormal behavior, loss of bodily functions and death.

CWD belongs to a group of diseases known as transmissible spongiform encephalopathies (TSEs). Within this family of diseases, there are several other variants that affect domestic animals: scrapie, which has been identified in domestic sheep and goats for more than 200 years, bovine spongiform encephalopathy (BSE) in cattle (also known as "mad cow disease"), and transmissible mink encephalopathy in farmed mink.

Although many observers try to compare CWD with "mad cow disease", the diseases are distinctly different. Currently, there is no evidence that CWD poses a risk for humans. However, public health officials recommend that human exposure to the CWD infectious agent be avoided as they continue to evaluate any potential health risk. The World Health Organization has reviewed available scientific information and concluded that currently there is no evidence that CWD can be transmitted to humans.

It is not known exactly how CWD is transmitted. The infectious agent may be passed in feces, urine or saliva. Transmission is thought to be lateral (from animal to animal). Although maternal transmission (from mother to fetus) may occur, it appears to be relatively unimportant in maintaining epidemics.

Because CWD infectious agents are extremely resistant in the environment, transmission may be both direct and indirect. Concentrating deer and elk in captivity or by artificial feeding probably increases the likelihood of both direct and indirect transmission between individuals.

While CWD has been found in the United States and Canada, the OMNR (2010) reports that no deer, elk, moose or woodland caribou in Ontario are infected with CWD. The transmission of CWD between ungulates remains a general concern, but is not an immediate issue in the City of London or southern Ontario.

Additional information is available on the Chronic Wasting Disease Alliance website (http://www.cwd-info.org/), which includes a number of links to other websites providing credible information about CWD.

4.3 Property Damage and Personal Injuries

As discussed in section 4.1 substantial property damage and occasional injuries to humans result every year from motor vehicle accidents involving deer. When local populations of deer grow, so do the reports of damage to orchards, nurseries, landscape materials, and agricultural and garden crops. Within suburban areas a common complaint received from residents is damage to gardens and ornamental plants by browsing deer.

Although damage to gardens and ornamental plants may seem to appear suddenly, the problem does not develop overnight. When deer populations are low, suburban residents typically enjoy seeing and having deer around, so the deer populations often grow unhindered. However, as the deer population grows so does the browsing pressure on garden and ornamental plants, because deer generally prefer landscape plantings and agricultural crops to other wild foods in their range. Severe damage is usually the result of highly preferred plantings located in an area with a high deer population. Even in areas of moderate deer density, landscape plantings and specialty crops are sometimes prone to severe damage. It is at this point, when deer start to encroach on private property and cause noticeable damage, they are suddenly considered a nuisance and threat. Increased damage to property may result from deer responding to recent land development or insufficient reduction of the local deer population through hunting or natural causes. The simplest way to avoid this human-deer conflict is for suburban residents that have properties that back onto woodlots where deer are known to be, to select plantings for their yards that are not preferred by deer as browse. Fencing also provides another option for residents who do not want to limit what ornamental plants they use in their gardens. Open fencing (wood or wire), however would have to be at least 8 ft tall and must be in accordance with applicable city by-laws (OMAFRA 1999). Deer will not jump over obstacles if they cannot see where they will be landing. Therefore if a solid fencing material or obstructions in the deer

landing zone is used fences can be lower. One option is to supplement fencing with tall shrubs, which the deer cannot see through (especially coniferous shrubs or trees as they remain a solid barrier all year roundEliminating supplemental food sources is an important contribution of local residents' to deer management.

4.4 Supplemental Feeding

The diet of white-tailed deer often depend on the agricultural activities and land use practices of humans (Anthony et al. 2000). Suburban areas provide high quality foods in the form of gardens, ornamental plantings, and fertilized lawns (Swihart et al. 1995), while nearby woodlands offer daytime refuge. Furthermore, suburban residents often provide supplemental food to attract deer for viewing or with the intention of assisting their survival. Deer can be opportunistic and take advantage of residents unknowingly providing supplemental food by improperly disposing of food waste.

These practices often affect an animal's normal movement patterns, concentrate deer in locations they would normally not inhabit, can contribute to localized traffic hazards, damage crops and ornamental plants, and add an increased potential for disease transmission (OMNR 2006). Supplemental feeding can enhance deer reproductive rates, encourage deer to congregate in sensitive areas (Doenier et al. 1997), make deer more tolerant of people, and reduce the rate of normal winter mortality, thus contributing to an artificially high deer population. Aggression between deer can become apparent when supplemental feeding takes place, wasting vital energy reserves, leading to injury or death while subordinate deer are kept away from the feeding stations. Overbrowsing by larger deer removes food available to fawns.

Throughout past years some residents of the City of London living in close proximity to natural areas have been providing supplemental food for the deer. Recently the UTRCA has enforced a ban on feeding all wildlife within London's natural areas. Signage and educational information about the detrimental effects of feeding wildlife have been utilized in an attempt to educate residents and alter human behavior. In addition, the City of London is currently exploring the possibility of creating a bylaw to control supplemental feeding.

5.0 Case Histories of London's Natural Areas

To assist with the preparation of this report, a series of natural areas within the City of London were reviewed. Based on the review of the deer-vehicle occurrence data for the entire City of London as well as input from City staff, the UTRCA, the Environmental and Ecological Planning Advisory Committee (EEPAC), and the Animal Welfare Advisory Committee (AWAC), 5 case history areas were identified as possible locations where deer management may be required. These locations are near existing natural areas and are known as The Coves, Warbler Woods, Kilally Woods, Meadowlily Woods, and Sifton Bog. The locations of these areas are shown in Appendix I. These five areas are not intended to represent all areas with deer within the City, but do include areas known for relatively high deer populations, higher areas of deer-vehicle occurrences, and represent a range of natural habitat sizes and types, as well as a range of existing urbanization.

Investigation into the five areas included fall ground surveys as well as a winter aerial survey. The aerial flyover of the City of London, with particular focus on these five case history areas, was conducted on March 8, 2010. The aerial survey was conducted from a Cessna-172. The altitude of the flyover ranged from approximately 180m to 900m. The flight altitude and flight path were influenced in some areas by factors such as cell phone towers (Warbler Woods) or proximity to the air space of London Airport (Meadowlily Woods).

Both video and still photos were taken of the areas examined during the aerial survey and locations of any deer observations, numbers of deer, locations of prime wintering habitat and locations of deer trails were recorded. Table 2, below, presents a summary of the natural areas of interest within the City of London.

As discussed, the Sifton Bog was the catalyst for the City of London's white-tailed deer management planning. A separate report, The Sifton Bog White-Tailed Deer Management Study (NRSI 2011), has been prepared that characterizes the Sifton Bog and its deer issues in greater detail.

Table 2. Summary of Natural Area Case Histories

Area of Interest	Deer Habitat	Surrounding Land Uses and Habitat Connectivity	Comments on Nearby Deer-Vehicle Occurrences (DVO)
The Coves	Sparse, open cover, with vegetation concentrated along narrow, steep westerly facing banks. Insufficient winter cover for deer.	Poor connectivity, largely surrounded by development. Weak connection to the Thames River.	· Relatively few DVOs, mainly east along Wharncliffe Rd. S. · No strong relationship between DVOs and the river.
Warbler Woods	Non-riparian area with deciduous dominated woodlands and a narrow rectangular strip of planted white pine. Adjacent to agricultural lands providing food for sustainable deer herd. Insufficient winter cover for deer.	Strong connection to Thames River through valley towards Oxford Street West. Secondary wooded corridor blocked by sound barrier wall along Oxford Street West. Area becoming isolated with future development, and some crescent roads encroaching. Oxbow on Thames River to the east provides ideal habitat for white-tail deer.	· Most DVOs located north, towards the river. · Some DVOs to the west, at the outskirts of the city. Some DVOs in nearby residential streets.
Kilally Woods	Rich riparian woodland with steep riverbanks and wide floodplain. Variety of topography, large range, numerous security and feeding areas. Insufficient winter cover for deer.	Strong connection to Thames River. Western Road impedes any travel upriver.	· Clusters of DVOs are located north of Windermere Rd. and south of Sunningdale Rd W between Adelaide Street North and Wonderland Rd North. · No strong relationship between DVOs and the river. Some DVOs in nearby residential streets.
Meadowlily Woods	Riparian area dominated by deciduous trees. Probably the largest intact natural area with a variety of species and terrain. Insufficient winter cover for deer.	Strong east/west riparian connection to river. Upriver there continues to be ideal habitat on the other side of Hamilton Road. Future development pressure.	· DVOs seem to be radiating outwards to the west, south and east, along major roads.

Area of Interest	Deer Habitat	Surrounding Land Uses and Habitat Connectivity	Comments on Nearby Deer-Vehicle Occurrences (DVO)
Sifton Bog	Non-riparian open peat bog surrounded by swamps, marshes, upland forests and shrub thickets. Minimal winter cover available for deer.	Poor connectivity, surrounded by development. Minimal connection southwest to Thames River through residential developments.	· High volume of nearby DVOs radiating in all directions from the bog, including nearby residential streets.

6.0 Case Histories of Areas with Deer-Human Conflicts

The white-tailed deer situation faced by the City of London is not unique. A number of municipalities in southern Ontario and elsewhere are experiencing the impacts of over-abundant deer populations. In many of these municipalities, remnant natural areas are associated with undevelopable riparian zones and are thus connected to a network of potential habitats (especially considering that white-tailed deer are fairly mobile, and will travel through many habitat types). In these cases there is a clear exchange of deer throughout the landscape. Site-specific problem areas, such as parks, golf courses, or cemeteries are generally a local expression of landscape-level phenomena. As such, in most areas deer control or management has not been regarded as a priority.

There are three main categories from which deer-human conflicts arise:

- Social – Public safety due to vehicle collisions, health concerns associated with deer diseases, damage to landscaping vegetation in urban areas,
- Ecological – Impacts of intensive foraging on vegetation and wildlife species, encroachment into traditional habitats due to human land development, and
- Economic – Expenses related to crop or property damage, vehicle collisions, abatement and mitigation (Ontario Ministry of Natural Resources 2006).

Several case study examples representing natural environment areas facing similar situations (i.e. conflicts between humans and white-tailed deer populations) are discussed in the following sections.

6.1 RIM Park, City of Waterloo, Ontario

RIM Park is located in the northeast corner of the City of Waterloo and is bordered by development to the west, agricultural and wooded areas to the north and the Grand River to the east and south. Much of the land surrounding RIM Park is actively tilled, and the golf course provides other habitats that are readily used by deer. The deer habitats within the park are connected via riparian areas to adjacent attractive deer habitats.

This municipal park was built between 2000 and 2002, and contains active use areas including baseball diamonds, soccer fields, golf course and the Walter Bean walking trail. A range of habitats are found within the park including forests, meadows, marshes and riparian woods. This park contains the Rural East Woodland Wetland, the largest remnant woodland found within the City of Waterloo. The area has historically supported a white-tailed deer population that used the woodlands for winter habitat and also moved to neighbouring township lands via wooded corridors and by crossing shallow fords across the Grand River.

Deer monitoring began in 1999, prior to construction of the park, and continued during construction (2000 & 2001) and after construction (2002 - 2004) (NRSI 2004). In 2003/2004, monitoring included use of four infra-red monitors which recorded date, time and direction of deer movement. The deer movement patterns for white-tailed deer in RIM Park during 2003/2004 are shown in Figure 2. Other surveys conducted to assess the deer population in RIM Park included pellet group surveys and winter track and deer bed surveys.

As part of the RIM Park monitoring, there was considerable concern over the potential impacts of development on the deer. The purpose of the deer monitoring was to identify changes in movement patterns, use of habitat within the park, and whether and how known deer yards on site were impacted by park construction. Another issue studied was whether nearby trails would impact the yard area as well as the deer's typical movement patterns.

The monitoring at RIM Park identified that deer avoided areas of active construction. However, the deer were found to quickly return to such areas after construction ended. The main deer yard within the park was found to be used throughout the period of construction at RIM Park. Through the use of the infra-red monitors and other detailed surveys, started in 2002/2003, two smaller deer yards were discovered in addition to the large deer yard identified in 1999 (NRSI 2004). The deer monitoring program at RIM Park also identified a relationship between deer activity and the harvesting of agricultural lands at this time as well as during the rut (typically peaking in November and depending on seasonal temperature and weather may extend into early December) (NRSI 2004).

Post-construction monitoring in 2002/2003 and 2003/2004 focused on whether operation of the park influenced deer numbers, movement patterns or habitat use. Although monitoring ceased in 2004, anecdotal information from local hunters in the township reported an overall decline in the deer population numbers. One of the key concerns was the proximity of trails and golf course maintenance and operation to the sensitive deer yard habitats. There were proposals for cross country ski trails in proximity to the deer yards that were not approved due to anticipated impacts on the deer.

RIM Park in the City of Waterloo provides and example with similar natural features that are providing deer habitat in the City of London. At RIM Park the Grand River and remaining riparian woodlands in the floodplain provide both year round habitat for deer and winter deer yarding areas. Similarly the Thames River and associated riparian areas in the floodplain provide much of the remaining habitat available for deer in the City of London. RIM Park provides and example of a reverse situation to that of the City of London, where management actions were conducted to maintain the deer population in the park, and ensure the influx of people and activities would not cause deer to leave the area. Therefore, activities etc. that were avoided at RIM park could provide management options for the City of London to deter deer from certain areas. Important insights from RIM Park include:

- Construction activities can deter deer from the area but results may be temporary, and deer will return when construction ends,
- Avoidance of any developments on highly used deer trails throughout the site, resulted in continued use of traditional trails,

- Avoidance of any development in winter deer yarding areas resulted in continued use of yarding areas, by white-tailed deer, and
- Proposed ski trails that would have intruded into wintering deer yarding areas were not approved, as it was considered that they would disturb wintering deer.

Figure 2. Deer Movement and Habitat Use Patterns within RIM Park (NRSI 2004)

RIM Park habitats are similar to those found in most municipalities in southern Ontario, (i.e. they are associated with riparian systems and have been left undeveloped, primarily due to the slopes and hazards associated with the watercourses). This tends to create a very connected and 'open' deer population that can readily move through a range of habitats without conflicts with humans, except in cases where deer enter rear yards of neighboring residences.

RIM Park has yet to experience full development of the agricultural lands surrounding much of the woodland in the park. It is possible that the future loss of these agricultural fields may negatively affect the deer. Also, increased residential development in the area may result in increased human use of the natural areas and disruption of the sensitive deer habitats.

6.2 Preservation Park, City of Guelph, Ontario

Preservation Park is located in the south end of the City of Guelph, east of the Hanlon Expressway and between Stone Road West and Laird Road. Discussions with City of Guelph staff (Young pers. comm. 2009) revealed that high white-tailed deer populations and nearby residential development were resulting in a number of conflicts.

Preservation Park is mainly comprised of woodland but also contains sections of open scrubland and old field. The location of Preservation Park is shown in Figure 3.

Discussions with Art Timmerman from the Guelph District MNR office identified that there are many deer within Preservation Park, and that complaints have been made regarding deer damaging nearby homeowners' landscape plants (Timmerman pers. comm. Jan 7, 2010).

No formal studies have been conducted on the deer population within Preservation Park. Currently, the City of Guelph is addressing the deer issue in Preservation Park by focusing on trying to reduce the impacts faced by residents, rather than addressing the deer themselves. The City of Guelph is doing so through public education in the form of providing information to landowners (Timmerman pers. comm. Jan 7, 2010).

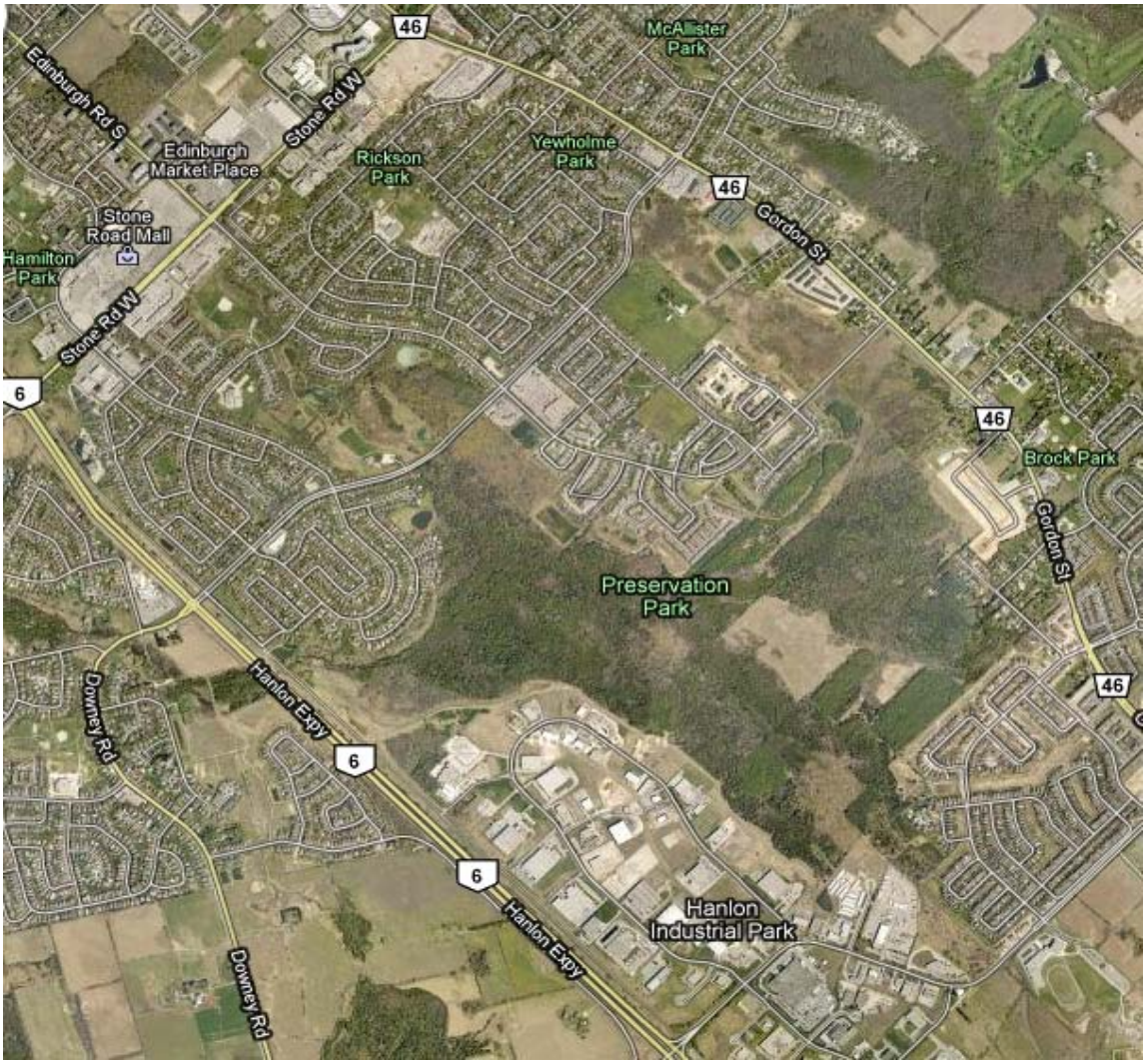

Figure 3. Location of Preservation Park, City of Guelph

The City has provided residents near Preservation Park with information pertaining to the importance of not feeding the deer (which is sometimes done for viewing opportunities). The information provided by the City also lists which plants white-tailed deer do not like to eat. Providing landowners with lists of plants which are not palatable to deer is an attempt to reduce the food available to the deer as well as to reduce the loss of landscape plants to deer browse and therefore reduce landowner complaints. The City of Guelph is also providing packages to new landowners, which includes the information discussed above.

White-tailed deer movements between Preservation Park and natural areas to the east across Gordon Street have been identified in a series of background documents (Totten

Sims Hubicki 1998, 2002). Deer-vehicle collisions in this area have resulted in some deer mortalities (5 mortalities in 2009). Recently the City has prepared a draft Natural Heritage System that addresses this movement by requiring developments along Gordon Street to include a 20 to 50m wide habitat linkage.

The situation at Preservation Park is similar to what is occuring in the City of London, with natural areas that contain many deer being surrounded by urban development. Some natural corridors, however, are present around Preservation Park which allow for deer movement in and out of the park. Maintenance of this connectivity has been a key goal of land use planning around Preservation Park. The connectivity of the park to other natural areas allows for immigration and emigration which has both positive and negative aspects. While the connectivity allows deer to leave the area if food sources become limited, this connectivity also allows for deer to continually enter both the city and the park, thus creating deer-human conflict.

The City of Guelph has not focused its management approach on understanding the ecological impacts that the deer may be causing. Therefore no monitoring has been conducted to assess the ecological impact of the deer populations in Guelph on vegetation and ecological communities. The management approach taken by the City of Guelph is to let the deer stay and provide for their movement, and try to get landowners to adapt to them and learn how to deal with them through education (provided by the city). The danger with this approach is that the extent of deer browse impacts on specific plant species and vegetation communities that are particularly susceptible to deer browsing is not known. This approach also assumes that public education is enough to reduce deer caused impacts. But, with no assessments being done on the impacts of deer on plants, vegetation communities and damage to residential landscaping, there is no way to evaluate whether the public education approach is working and reducing possible deer impacts to the natural environment.

6.3 Dundas Valley, City of Dundas, Ontario

There have been long-term issues with white-tailed deer in the Dundas Valley (Timmerman pers. comm. Jan 7, 2010). Hamilton Conservation Authority (HCA) has acquired large tracts of land in the Dundas Valley that are managed under the Conservation Authority's management regulations, which include no hunting. The

Dundas Valley is a large wooded corridor with a range of habitats including areas of thick pine forest, Carolinian forest, waterfalls, creeks, and marsh. The terrain of the Dundas Valley limits human development or use for agriculture, due to the steeply sloped valleys and shallow soils of the Niagara Escarpment, and has contributed to this area being retained. The lands in the Dundas Valley are a mixture of privately and publicly owned (Hamilton Conservation Authority) lands.

A variety of white-tailed deer issues in the Dundas Valley were brought to the attention of HCA in recent years. Complaints to the Conservation Authority were made by residents adjacent to woodlands of the Dundas Valley, regarding white-tailed deer damaging their property, such as eating or trampling trees, shrubs, and herbaceous plants. Through discussions with Art Timmerman (pers. comm. Jan 7, 2010) and Shari Faulkenham (pers. comm. Jan 8, 2010) some of the residents from the residential developments that surround the Dundas Valley were found to be feeding the deer. One individual resident was found feeding 50lb bags of grain to deer in their backyard, with as many as 20 to 30 deer being present at a time. The high concentration of deer resulting from feeding also contributed to deer becoming habituated and deer going out on roads, with some being hit by vehicles. HCA staff also became concerned and aware of the high white-tailed deer population in the Dundas Valley when staff observed deer with stunted growth, including some 10 and 12 point bucks under 200lb (Faulkenham pers. comm. Jan 8, 2010).

Ministry of Natural Resources and HCA staff have worked together to conduct helicopter surveys of the Dundas Valley in order to determine deer densities within the valley (Yagi and Timmerman 2009). Based on these surveys, Dundas Valley has a high deer density value of 0.35 deer/ha. Deer densities are discussed in greater detail above (see Section 3.2).

The OMNR/HCA report provides recommendations for the management of the deer population within the Dundas Valley. These include the creation of a Stakeholder Group which will report to City Council, a controlled hunt (possibly by Six Nations), maintenance or improvement of movement corridors, landowner education and revision of the municipal animal control by-law to prevent the feeding of deer (and other species as well, including coyotes).

The creation of a stakeholders group made up of individuals with various interests and backgrounds (e.g., local residents, Conservation Authority staff) is anticipated to review the issues with the deer population and relate issues, concerns and recommendations to City Council (Faulkenham pers. comm. Jan 8, 2010).

Individuals of Six Nations have been found to be bow hunting for white-tailed deer on Conservation Authority lands (Timmerman pers. comm. Jan 7, 2010). Consequently, HCA is currently in discussions with Six Nations regarding their use of Conservation Authority lands for hunting and the possibility of their inclusion in conducting controlled hunts in the Dundas Valley to manage the deer population. Staff stressed the importance of involving Six Nations in the process early on in order to build positive relationships with them. If a controlled hunt is to take place MNR recommends that in addition to the number of deer determined to be removed based on the population level, an additional number of individuals be taken. The additional number of deer to be removed is intended to address compensatory rebound (where does will produce twins or triplets because conditions allow so, due to the increased food availability resulting from a smaller deer population).

One of the areas involved in the helicopter surveys was Iroquois Heights where 65 ha were flown over to estimate the deer population. During the survey, as many as 102 deer were observed (1.57 deer/ha) (Faulkenham pers. comm. Jan 8, 2010).

Vegetation impacts due to the high deer population in the Dundas Valley have been seen especially in tree saplings. In recent years deer within the Dundas Valley have been found during the winter to be browsing on non-preferred tree and shrub species. Faulkenham noted that within the last two years almost all of the staghorn sumac (*Rhus hirta*) in the Dundas Valley had their bark stripped off by deer. In the Carolinian forest habitats, maples and various shrubs such as witch hazel (*Hamamelis virginiana*) have been found to be browsed. However, ironwood saplings (*Ostrya virginiana*) have largely been found to be left alone by the deer. The unpublished results of the exclosure studies conducted in the Dundas Valley by Dawn Bazely (York University) appear to suggest that in exclosures, more shade tolerant trees saplings quickly re-vegetate and the ironwood sapling numbers decrease compared to outside of the exclosures.

Surveys in the Dundas Valley have indicated that in areas with high deer densities trilliums are no longer present or are in poor condition due to browsing. In these areas garlic mustard has been found to be invading the forests. In contrast, in areas with low/lower deer densities trilliums are more prevalent and less garlic mustard is present (Faulkenham pers. comm. Jan 8, 2010).

6.4 Rondeau Provincial Park, Ontario

Rondeau Provincial Park has a long history of managing deer populations within the park (since the early 1900s). Deer management had at that time largely consisted of conducting a regular cull to maintain populations at the desired levels. By 1974, culls in Rondeau Provincial Park were stopped as a result of negative public perceptions of that form of deer management. After the culls were banned at Rondeau, the white-tailed deer population within the park grew to over 600 individuals. Rondeau has experienced deer population densities of 25 to 30 deer/km^2 (OMNR 2006), compared to southern Ontario white-tailed deer population densities in the range of 4 to 10 deer/km^2 (City of London 2009).

As a result of the growing number of deer within the park, it was determined that decisive management of the white-tailed deer was necessary as their destruction of native vegetation throughout the park began to threaten other significant wildlife species protected in the park. Long-term monitoring of breeding bird populations, understory vegetation and exclosures have been conducted (starting around 1978) in order to assess the ecosystem response within the park to the changing deer population within the park (Mclaren and Tom-Dery 2007).

Staff at Rondeau Provincial Park turned to the local First Nations to assist in the management of the white-tailed deer population within the park. Individuals of First Nations participated in a planned cull of deer in the park in 1993 where an aboriginal shooter removed 322 individuals from the park deer population (Mclaren and Tom-Dery 2007). The next cull in the park took place in 1998, with the cull occurring yearly until 2002 (Mclaren and Tom-Dery 2007).

In addition to the meat, First Nations participants were able to keep any other parts of the deer that were of use to them (e.g. for clothing or ceremonies).

6.5 Case Histories in the Northern United States

Montgomery County, Maryland

In August 1995 Montgomery County completed their deer management plan entitled "Comprehensive Management Plan for White-tailed Deer in Montgomery County, Maryland: Goals, Objectives, Implementation" and which was revised in 2007 (Montgomery County Deer Management Work Group 2007).

In 1993, concerns raised by citizens in Montgomery County resulted in the creation of a white-tailed deer task force. The Montgomery County council was given the task of identifying what human-deer conflicts were occurring and provide recommendations on how to address the conflicts they identified. In Montgomery County, the major issues that were identified included deer-vehicle collisions, damage of agricultural crops, damage to residential gardens and ornamental shrubbery, impacts to parks and natural areas, and health concerns over Lyme disease (Montgomery County Deer Management Work Group 2007).

Like many areas throughout North America, Montgomery County has experienced increased urban development and therefore increased encroachment of urban areas into historically agricultural lands. Similar to the situation in Ontario where urban centres expand into once rural areas, city by-laws inhibiting hunting within city limits have resulted in deer populations increasing dramatically within the County (Montgomery County Deer Management Work Group 2007).

Des Plaines and Palo, Illinois

Piccolo et al. (2000) summarized the results of research into deer in urban environments with focus on two urban reserves: Des Plaines, a highly urbanized area and Palo, a more suburban area. In both cases natural habitats were surrounded by urban development. In this study deer were fitted with radio collars to identify their home ranges so that characteristics of their habitats could be assessed to understand what influences their choice of a home range. This study found that the size of natural habitat and the food availability in that habitat were influencing factors in whether deer remained in natural habitats or turned to feeding in urban areas. At Des Plaines deer were found to leave the security of the forest preserve to feed in residential areas, crossing roads

and rivers, thus creating potential for human-deer conflict. Piccolo et al. (2000) therefore suggest that in an urban setting deer will expand their home range into residential areas if the carrying capacity of their natural habitat is exceeded (due to reduced food resources caused by over-browsing).

Summary

There are a fairly large number of case histories in the United States of deer overabundance including some in urban or suburban areas. Like the examples above, in most cases active population control (cull) was ultimately recommended.

DeNicola & Williams (2008) summarized the results of using sharp shooters to control deer in three suburban areas, Iowa City, Iowa, Princeton, New Jersey, and Solon, Ohio.

A major goal of controlling the deer population in these areas was to reduce deer-vehicle collisions. This study found that in Iowa City, Princeton, and Solon deer-vehicle collisions decreased, as a result of the use of a sharpshooting program, by 78%, 75% and 49% respecitively (DeNicola & Williams 2008b). Also worth noting is that the percent decrease in deer-vehicle collisions was nearly proportionate to the percent of population decline that resulted from the sharpshooting programs.

6.6 Summary of Lessons Learned from Other Areas

The white-tailed deer situation in the City of London is not unique. There are a number of municipalities in southern Ontario that are experiencing the impacts of over-abundant deer populations. In many of these municipalities remnant natural areas are often associated with undevelopable riparian zones and are thus connected to a network of potential habitats (especially considering that white-tailed deer are fairly mobile and require little in the way of travel habitat characteristic). In these cases there is clear exchange of deer throughout the system and site-specific problem areas, such as parks or golf courses, are generally a local expression of a landscape-level phenomenon. As such, in most areas deer control or management has not been regarded as a priority.

In two of the Ontario case histories described above (RIM Park and Preservation Park), there is existing or impending residential development encircling the remnant natural areas. This creates an ‘island’ or refuge for the deer amongst a larger home range area

that includes residential areas. Human-vehicle interactions and property damage are recorded. In these cases pre-development planning has been used to avoid facilities that would directly or indirectly affect deer (especially wintering habitat in Waterloo) or provide for travel opportunities (such as in Guelph). Education of residents in terms of feeding deer, landscaping, etc. has been implemented and found to be somewhat effective. Control of the deer by a cull is not being considered in these urban Ontario examples.

Control of deer numbers by a cull is still a very prevalent management approach in the United States as well as a number of parks in Ontario. In more urbanized areas, a greater amount of information on the deer population and especially use of urban portions of home ranges as well as deer movements have been identified by a number of researchers even when a cull is being considered. Post-cull population numbers are being monitored in most locations, but the need for continual control has been identified as an issue since the underlying habitat characteristics are generally left unaddressed.

7.0 Deer Management Options

Southern Ontario is not the only location in Canada or North America which is facing the need to develop management strategies to mitigate or eliminate human-wildlife conflicts. Management to control human-ungulate conflicts has been necessary for species including bison (*Bison bison*), sitka black-tailed deer (*Odocoileus hemionus sitkensis*), and mule deer (*Odocoileus hemionus*) and in areas from Ontario to British Columbia to California and Wisconsin (McLaren and Tom-Dery 2007).

Developing management strategies for white-tailed deer in the suburban/urban environment can be much more complicated than dealing with and trying to understand rural deer populations. There are many factors which influence urban deer populations and therefore may complicate the ability to understand populations in the suburban/urban environment. Factors may include the influence of disturbances such as the presence of humans and dogs, roads, the amount of vehicle traffic, habitat quality, proximity to residential developments and agricultural lands, riparian areas, natural corridors etc.

No single white-tailed deer management technique or strategy is universally appropriate to address all situations. Complexities of suburban deer issues and the current limitations of available techniques make 'quick-fix' solutions unlikely. Short term strategies can relieve immediate problems, while long-term approaches will maintain deer populations at target levels (Anthony et al. 2000). Long term strategies are particularly appropriate for managing deer populations because of their reproductive rates (which can cause populations to double within one or two years). Combining two or more methods may therefore improve results and increase the acceptability of the program for a wider range of stakeholders. The objective of most management programs is the reduction of conflicts to an acceptable level, not the complete elimination of either the problems or the deer herd. A successful deer management program will require sustained effort and commitment from both landowners and the community. This will also minimize the need for 'quick-fix' solutions to unforeseen issues that arise.

Prior to any costly management options being implemented, an adaptive resource management approach would be appropriate. Adaptive management is characterized

by establishing clear and measurable goals, implementing management actions, monitoring those management actions, evaluating management actions based on established goals, and adapting policy and management actions as necessary (Pennsylvania Game Commission, 2009).

Two distinct deer management methods exist, population control (which can be employed using lethal or non-lethal forms), and non-population control (Bishop et al. 2007). Population control methods specifically change or alter the dynamics or populations of the deer, in turn affecting the habitat affected by that population. Alternatively, non-population control methods alter the effects of a deer population, or alter human behaviour, without directly acting on the deer themselves. Both management methods have distinct advantages and disadvantages, not the least of which is public perceptions, and the ultimate effectiveness of the management technique.

7.1 Population Control Methods

When population control methods are employed, immediate effects on deer populations are usually obvious, along with an immediate reduction on habitat effects and deer-vehicle interactions. However, unless deer are completely eliminated (on a large scale) all population control methods must be repeated at regular intervals. Consequently, while these methods may appear efficacious and decisive, they often produce only short-term results. As these methods do not address the underlying causes of the deer population issue, “new” deer can relocate into the area. As well, a compensatory rebound effect can be seen, whereby the reproduction rates of the remaining deer increase.

Lethal methods of population control are often perceived by the general public as being less humane than non-lethal controls. Consequently, non-lethal population control options are often more socially acceptable than their lethal counterparts. However, due to several factors, options perceived as non-lethal can often be better described as “delayed” or “unintentionally lethal”. The death of deer due to capture myopathy, caused by the stress of chase and/or capture, is a possibility with many “non-lethal” population control options. Injuries sustained during capture are also possible causes of mortality, along with regulations restricting the release of relocated deer.

The population control management options are described below. A summary of the advantages and disadvantages unique to each of these options is provided in Table 3, below.

Lethal Population Control Methods

- **Controlled Hunt Using Archery -** Deer are baited, with archers waiting on elevated platforms to kill any buck or doe or fawn that comes by to feed. This is a proven effective technique, with a limited cost. It has been shown to increase deer wariness toward humans, possibly alleviating some nuisance problems. There is potential to generate revenue for landowners or communities using this method. A significant disadvantage to this method is that archery hunting is commonly perceived to result in higher wounding losses and increased travel distances before deer succumb to their injury. This could lead to possible conflicts with nearby residents, or an increased risk of deer-vehicle incidents.

- **Controlled Hunt Using Sharpshooters** - Deer are baited, with sharpshooters waiting on elevated platforms to kill any buck or doe or fawn that comes by to feed. An advantage over archery is that sharpshooting generally results in a faster death. The presence of occupied houses nearby renders sharpshooting both disruptive and less safe for the residents. In addition, people and wildlife can be disturbed by the noise of gunshots.

- **Capture and Euthanasia** - Deer are captured (usually with nets) and killed in a humane fashion, generally using a stun gun that shoots a retractable bolt into the deer's forehead. Death from capture myopathy is common, despite perception that this method may be more humane than controlled hunting.

Non-Lethal Population Control Methods

- **Deer Drive** – Dogs are used to chase deer out of a habitat being managed. This is a low-cost option, but liability issues arise over potential property damage or

deer-vehicle incidents during the drive. Capture myopathy is a risk, and the deer can return to the area very quickly.

- **Capture and Relocation** – Deer are captured and relocated away from the natural area. In addition to being relatively expensive, deer mortality can be high when this method is employed. The Ministry of Natural Resources prohibits captured deer from being re-released into the wild. Consequently, they are likely to be released to a farm and eventually slaughtered for meat. Beyond this, capture myopathy and capture-related injuries are possibilities. This technique also has the potential to spread harmful and contagious pathogens from one deer population to another.

- **Sterilization** - Studies in the United States on Gonacon and SpayVac have shown these methods to be successful in preventing reproduction in white-tailed deer. MGA transplants sterilize female deer for up to 5 years. In the U.S., approval of Gonacon is expected in this year, but won't be commercially available for another 12 to 18 months. Approval in Canada has not been granted, and generally requires at least one study in this country. Consequently, it is unknown when this method might be available here.

  While this method is non-lethal and thus acceptable to many urban/suburban residents, the long-term health effects on deer are unknown. Studies are required within the target area to determine that the treated deer populations are isolated, or closed, from adjacent populations. Deer immigration from adjoining properties would negate any fertility control efforts within the treated area, as new immigrants would not have been exposed to the fertility agents. Within a closed population, this technique requires several years before results become apparent, as it only controls future breeding, not existing population numbers. A large proportion of the does (79-90%) must be treated, and all treated deer must be marked.

7.2 Non-Population Control Methods

Non-population control methods affect deer indirectly, either by altering aspects of their habitat, or changing human behaviour. While these methods tend to be more complex and slower-acting than population controls, they often provide long term and ancillary benefits. The non-population control management options are described below. A summary of the advantages and disadvantages unique to each of these options is provided in Table 4, below.

- **Exclusion Methods** – Exclusion methods prevent deer from accessing particular areas with the intention of reducing or eliminating plant damage. Methods include electric and non-electric fencing, and individual plant protection. Fencing should be erected prior to deer damage to prevent deer from establishing feeding patterns. Deer can be very persistent once they've established a feeding pattern, which can make excluding them very difficult. When installed and maintained properly, exclusion is considered to be one of the most effective methods to reduce deer damage and functions well under intense deer pressure. Permanent fences can last for 30 years or longer, while less expensive temporary fencing can be useful in protecting plants for short periods of time.

  Exclusion can be cost-effective over the long term, depending on the size of the area being treated (i.e., it is not practical over large areas) and the value of protected plants. The cost of installation and maintenance of exclusion methods must be considered, and some habitat modifications, like vegetation removal and control, may be required to maintain some of the types of fencing. Unfortunately, the unattractive appearance of some exclusion methods may preclude their use on landscaping plants, and they are difficult to use across water and floodplains. This method could be used to define smaller areas within a habitat that could be planted with native plants, or used to protect existing native species (although complete exclusion requires 10ft high fencing). Exclusion fencing offers the only fool-proof means to protect a site (providing that the deer removed from isolated area prior to erecting it).

- **Feeding Ban** – Enhanced education and enforcement to stop people feeding deer. Public education can be accomplished through signage at designated areas, educational brochures being provided to area residents and schools, and an enforcement blitz with assessed fines. A feeding ban may decrease the deer population, but increase the effect of deer browse, as deer find alternative food sources. An enforcement blitz has associated costs, and may have negative public perceptions due to the associated fines.

- **Feeding Stations** – Supplemental feeding is often proposed as a means to improve the condition of the deer or to take pressure off other food sources. Creating feeding stations provide wildlife viewing opportunities and can encourage the deer to move to a particular area (though causing increased damage nearby). Feeding stations can also cause deer populations to increase due to more births and immigration, and the larger deer concentrations can spread disease. Fed deer become increasingly tame and tolerant of human activity. Thus, creating feeding stations essentially relocates the deer problems rather than reducing them. The higher populations can result in more deer-human, and deer-vehicle interactions.

- **Infrastructure and Planning Tools** – Design bridges to allow or discourage deer passage, thereby managing the routes taken by deer into and out of the city. Implement planning techniques such as ensuring that sufficiently large habitat areas and corridors for wildlife are provided, and including the consideration of deer activities during the design of developments.

- **Landscape Alternatives** – The use of less preferred herbaceous and woody plants and the use of deer repellant can be employed to discourage deer from a particular location. Substantial scientific literature exists on the effectiveness of landscape alternatives on reducing damage, but they are only useful in areas with low to moderate deer feeding pressure and where other forage is available. Costs can be high for larger properties. Deer species preference lists are readily available, and can be employed at the landowner level. Individual plants may be protected through the use of repellants, which can be used prior to or upon observation of damage, but must be reapplied throughout the growing season.

Unfortunately, people and deer often prefer the same plants, and few ornamentals are classified as rarely damaged by deer. Landscape alternatives may displace the problem to neighboring areas.

- **Pedestrian Trail Systems** – The goal of this option is to increase the amount of human disturbance experienced by the deer, in an attempt to discourage the deer. To be effective, the trails must be placed in critical yarding or bedding habitat. Creating trails has the advantage of increasing the recreational potential of an area, but also introduces opportunities for the natural areas to be damaged by human presence, including people leaving the marked trail. Also, natural areas may experience some damage during trail construction.

- **Traffic safety program** - Implement a city-wide program to reduce collisions with deer, which can include public education and wildlife warning systems. Programs such as these have been proven to reduce collisions, but take time to be effective. A program could be based on the successful traffic safety program in Ottawa known as "Speeding Can Cost You ... Deerly". This program has had the ancillary benefit of reducing traffic accidents generally. Public awareness should include information about yearly periods when deer activity is highest (November/December during breeding season). Strieter-Lite Reflectors can be used as a wildlife warning reflector system designed to prevent deer-vehicle collisions. A traffic safety program may result in increased deer population due to the reduced deer-vehicle-related mortality.

Table 3. Summary of Advantages and Disadvantages of Population Control Management Options

Management Options	Advantages	Disadvantages
Population Control	**Immediate effect on deer population**	**Must be repeated regularly**
Lethal		**Negative public perception**
Controlled Hunt Using Archery	Can increase wariness towards humans Potential to generate revenue for landowners or communities	Archery results in high wounding and increase in travel distance before deer succumb to their injury, leading to possible conflicts with nearby residents and deer-vehicle incidents
Controlled Hunt Using Sharpshooters		Unsafe to shoot guns near occupied houses Disturbance from noise of gunshots
Capture and Euthanasia		Death from capture myopathy is common
Non-Lethal	**More socially acceptable than lethal methods**	**Some delayed or unintentional deer mortality**
Deer Drive	Low cost	Deer can return very quickly to original area
Capture and Relocate		Expensive High mortality rate during capture Released to farms (often for meat) Risk of spreading disease
Sterilize	Positive public perception	Approval takes time Effects on population slow Long-term health effects unknown Population must be “closed” Large proportion of females must be treated

Table 4. Summary of Advantages and Disadvantages of Non-Population Control Management Options

Management Options	Advantages	Disadvantages
Non-Population Control	**Produce long-term and ancillary benefits**	**Rarely have an immediate effect on deer populations**
Exclusion Methods	Reliable and performs well under intense deer pressure Produces immediate effects Flexible - permanent or temporary fencing can be used	High cost excludes use of fencing large areas Deer must be removed from area being fenced Maintenance is an ongoing cost Habitat modification sometimes needed Possible perception of detracting from aesthetics of an area, as 10' fences are required Difficult to use across water or floodplains
Feeding Ban	Raises awareness of human effects on wildlife and engages public	Changing human behaviour is challenging Requires enforcement
Feeding Stations	Provides wildlife interaction opportunities for residents Can be used to draw deer to a desired location	Deer become increasingly tame and tolerant of human activity May lead to population increases Increased damage to natural areas occurs near feeding stations Disease transmission risk increased
Infrastructure and Planning Tools		Very long-term
Landscape Alternatives	Can be practiced at the landowner level Individual plants may be protected Deer species preference lists are readily available Substantial scientific literature on effectiveness	Limited ornamental plant options May displace the problem to neighboring areas Only useful in areas with low to moderate deer feeding pressure, in areas where other forage is available Potential high application cost for larger properties or gardens Repellants must be reapplied frequently Does not eliminate damage

Management Options	Advantages	Disadvantages
Pedestrian Trail System	Encourages human recreation and enjoyment of the natural area	Deer may habituate to human activities May lead to degradation of habitat during construction and during trail use, when people leave the trail
Traffic Safety Program	Proven to reduce collisions Widespread effects on traffic safety	Does not address non-traffic deer issues May increase deer populations

8.0 London Deer Management Recommendations

Management techniques that directly affect deer (i.e. those that involve "touching" individual animals) require permits to be obtained, have a negative public perception, are not likely to be accepted by the stakeholders involved in developing the City of London's City-Wide Deer Management Strategy, and are not suited to urban environments. Many examples of municipalities that have used culling or removal of deer from urban areas can be found in the literature. In most cases the control measure was implemented once deer populations reached a 'crisis' level. In the absence of monitoring and intervention, these munciplaities were faced with few options.

Implementing non-population control methods is recommended within the City of London. It is important that non-population control methods are understood and considered when conducting future studies to determine the need for and type of deer management best suited for an area of concern. These surveys should provide the information needed to assess the effectiveness and suitability of the different types of non-population control methods. Background review is always an important part of such studies so that new and innovative non-population control methods, which have been found to be successful and are not outlined in this document, can be considered as management options. Based on the discussion above, and considering our current understanding of the white-tailed deer in the City of London, the following non-population control management options are recommended.

8.1 Provide Landowner Education

A number of information packages have been prepared and used at the Sifton Bog, and can be developed and applied throughout the City of London. Examples of these are included in Appendix II.

Educational workshops and brochures on urban deer management will help to mitigate the social, environmental and economic impact of deer. These workshops and brochures should include valuable information on what individual property owners can do such as selecting ornamental plant species less attractive to deer or the use of

repellent and scare techniques to protect individual plants or areas such as yards and gardens.

It may also be possible to get information across to the public by working with local television or radio stations. On television an interview (or possibly a few short segments over a couple of nights focusing on a couple of key points) highlighting the key things landowners should know and can do if they have deer problems could increase awareness across the city. Similarly talking about the deer issues on the radio could help reach more individuals and a radio interview could possibly allow for a question and answer period.

8.2 Enforce Feeding Ban

Residents feeding deer encourages deer population growth, contributes to deer becoming acclimatized to human presence, and concentrates deer in a location, resulting in damage to the area and possibly disease transmission. Enforcing the ban on feeding deer (and other wildlife) can improve these aspects, and consequently reduce incidents of nuisance deer. This may prove challenging, as enforcement requires continuous monitoring and public pressure in the face of the resulting fines is likely to be negative. However, reducing or eliminating nuisance feeding of deer is an essential component of improving the human-deer relationship.

8.3 Provide Traffic Safety Education

There should also be a city-wide traffic safety program implemented such as the "Speeding Can Cost You Deerly" utilized in Ottawa for reducing deer vehicle collision incidents. This may also include a partnership between the City of London, Upper Thames River Conservation Authority, Local Police Department and local media to address seasonal issues with heightened deer movement (November/December breeding season).

Strieter-Lite Reflectors if properly installed and maintained, may significantly reduce the number of accidents involving motor vehicles and deer, by 78 – 90% (Grenier 2002). Strieter-Lite reflectors create a reflective light that appears to be moving. The intent is to keep deer and other wild animals from crossing the road until the vehicle has passed.

To the driver the reflection is hardly noticeable because the light is reflected across the road and not back to the driver. As the vehicle approaches the reflectors from dusk to dawn its headlights shine on 70 small curved mirrors. The curved surfaces of the small mirrors reflect flashes of dim light at 54 angles horizontally and vertically. Each curved mirror beams light across the roadway, and each reflection moves across the road as the angle of the light from the vehicle changes. Spacing of the reflectors along each roadside is equal to the distance between the reflector lines resulting in complete coverage. The light grows more intense as the vehicle nears the reflector. The result is a strobe-like effect that indicates movement to animals.

If deer collisions become a major issue within the City of London the use of intelligent warning systems could be considered, but they are rather expensive systems to put in place. Intelligent warning systems are a relatively new technology and have been developed to either warn off wildlife or to warn drivers that there may be wildlife crossing or at the edge of the road ahead. Wildlife warning systems use technology which can detect deer and other wildlife about to cross a roadway and acts to frighten them away through he use of sound and/or lights. Wildlife protection systems on the other hand work by the use of signs with flashing lights which warns drivers to anticipate wildlife on the road ahead and therefore slow down their driving speed. The wildlife protection systems are a portable system which could be moved from location to location as needed.

8.4 Install Fencing

The use of exclusion fencing may be a valuable initial step to managing an area to reduce the impacts that deer may be causing to a natural area and its vegetation communities. The use of fencing for exclusion purposes can be particularly suitable to protect regionally and provincially significant herbaceous species, shrubs or trees. Exclusion fencing can act as a temporary protection measure for such species until such a time that the form of deer management for the area of concern is decided upon. Consideration of where to place fencing is also important as it can include fencing off areas within a woodlot (e.g. a particular at risk vegetation community), or could also be concrete sound barrier style walled fencing.

Concrete sound barriers can fulfill multiple purposes including sound reduction of noisy roads and blocking deer from entering or leaving certain areas. For example concrete sound barriers were found along Commissioners Road west near its intersection of Oxford Street where a small creek flows north under Commissioners Road a short distance to the Thames River. A wooded corridor follows the creek channel, the concrete noise barrier was not continuous across this area and multiple deer tracks indicated deer were moving from the river to south of Commissioners Road. A continuous wall in this location would act to hinder deer movement from the Thames River into the subdivisions to the south of Commissioner's road. Fencing may also be erected to act as one way gates which can either keep deer from leaving an area of little concern or entering into an undesired location.

8.5 Consider Infrastructure Design Options

Considerations can be made for both modifications of existing bridges which are still structurally sound as well as for building new bridges within the City of London. The modification of existing bridges can be in the form of making temporary or permanent fencing to keep deer from entering the city under bridges along the Thames River, or channeling deer out of the city with one-way gates. Developing some form of permanent Texas gate which could be put under bridges and would not get silted-over during flood events could be another option to keep deer out of the city. Texas gates hinder the movement of hoofed animals as they typically do not like walking on the surface that they create. An example of a Texas gate is shown in Figure 4.

Figure 4. Photographs of Texas Gates

The City of London could also make sure to consider the movement of deer in and out of the city when new bridges are needed, as bridge designs could be made to reflect the desire to have deer pass under the bridge rather than over roads to reduce collisions. On the other hand bridge designs could also reflect the desire to hinder the movement of deer into the city under bridges in the east and west ends of the City.

Other possible infrastructural design considerations include incorporating underpasses at appropriate culvert locations (i.e. where deer are known to cross roads). The suitability of putting in such underpasses should be considered in the future when new culverts need to be put in under roads.

8.6 Use Existing Planning Tools

It would be valuable for the City to request, when appropriate, that Environmental Impact Studies (EIS) for proposed developments consider potential impacts on deer. This can be applied on the outskirts of the city relating to deer use in woodlands and nearby agricultural fields, and within the city itself relating to deer movement patterns. This sort of thinking for the future is necessary to avoid creating situations where natural areas become surrounded by development and deer-vehicle collisions become more likely to occur.

8.7 Collect Detailed Deer-Vehicle Collision Information

Currently, a wildlife contractor for the city receives calls from Animal Control and the London Police concerning the pick-up and disposal of deer. Realizing that not all calls involve contact with the individuals involved in incident, deer vehicle occurrence that do allow contact with the driver should include additional information such as deer sex, age class, condition, and direction the deer was traveling if possible. This information can be utilized for the analysis of possible trends such as deer population, deer movement between natural areas, seasonal migration patterns within the city of London and high incident areas to assist with further monitoring and management activities.

8.8 Implement Additional Deer Monitoring

Effective management of the deer in and around the City of London depends on detailed and accurate data. Several pieces of information are needed to continue to monitor and adapt the management plan including:

- Determining the location and extent of the winter yarding or concentration area(s) of the urban deer population,
- Collecting more detailed deer-vehicle occurrence information (as described above), especially the ratio of does to fawns, and
- Creating a centralized repository for information relating to anecdotal deer encounters/information throughout the city, with special focus on the five natural areas of interest.

The assembly of current information on deer population trends, locations of damage, high deer-vehicle occurrence locations will alter the City to potential future deer issues. Having this 'early warning' system will allow management options to be considered and implemented and avoid the possibility of culling or other population control measures.

8.9 Develop Site Specific Management Plans

A white-tailed deer management plan has been developed for Sifton Bog (NRSI 2011). As monitoring throughout the city continues, it may become evident that site-specific management plans for the four other natural areas of interest are necessary. This may be triggered by increased localized road mortality or resident complaint.

8.10 Thresholds for Implementing Population Control

Implementing a combination of City-wide and site-specific white-tailed deer management plans is intended, amongst other things, to avoid the need for population control measures. As noted above there are many examples where municipalities felt that no options other than animal removal were available to address the immediacy of their concerns.

Typically population control measures have been implemented where wildly fluctuating deer populations are encountered. This type of fluctuation was seen in the Sifton Bog area when the local habitats were under transformation from partially agricultural to fully urban. To date in the City of London, the impacts of white-tailed deer on sensitive ecosystems like the Sifton Bog, has not been found. Populations in that area appear to have stabilized at a level around the predicted ecological carrying capacity.

Deer herds have the ability to increase quickly as a result of available resources, but without predators or human removal, do not have a population mechanism to quickly reduce population numbers that does not have the associated public concerns over deer-vehicle collisions, damage to landscaping and the public relations issues associated with seeing animals in poor condition.

Are there thresholds in the white-tailed deer population in the City of London that would trigger the use of population control measures? This is as much or more a social question as opposed to an ecological one, as much management of residents as it is deer. Populations of deer will stabilize as the lands around habitat refugia become built out (as seen in the Sifton Bog). It can be expected that some residents would never support deer removal, while others may accept it especially if human safety was in the forefront. In the end, education of residents in terms of expected deer population fluctuations, implications of artificial feeding, landscaping choices, etc are the best tools for the City to use for managing the white-tailed deer issue.

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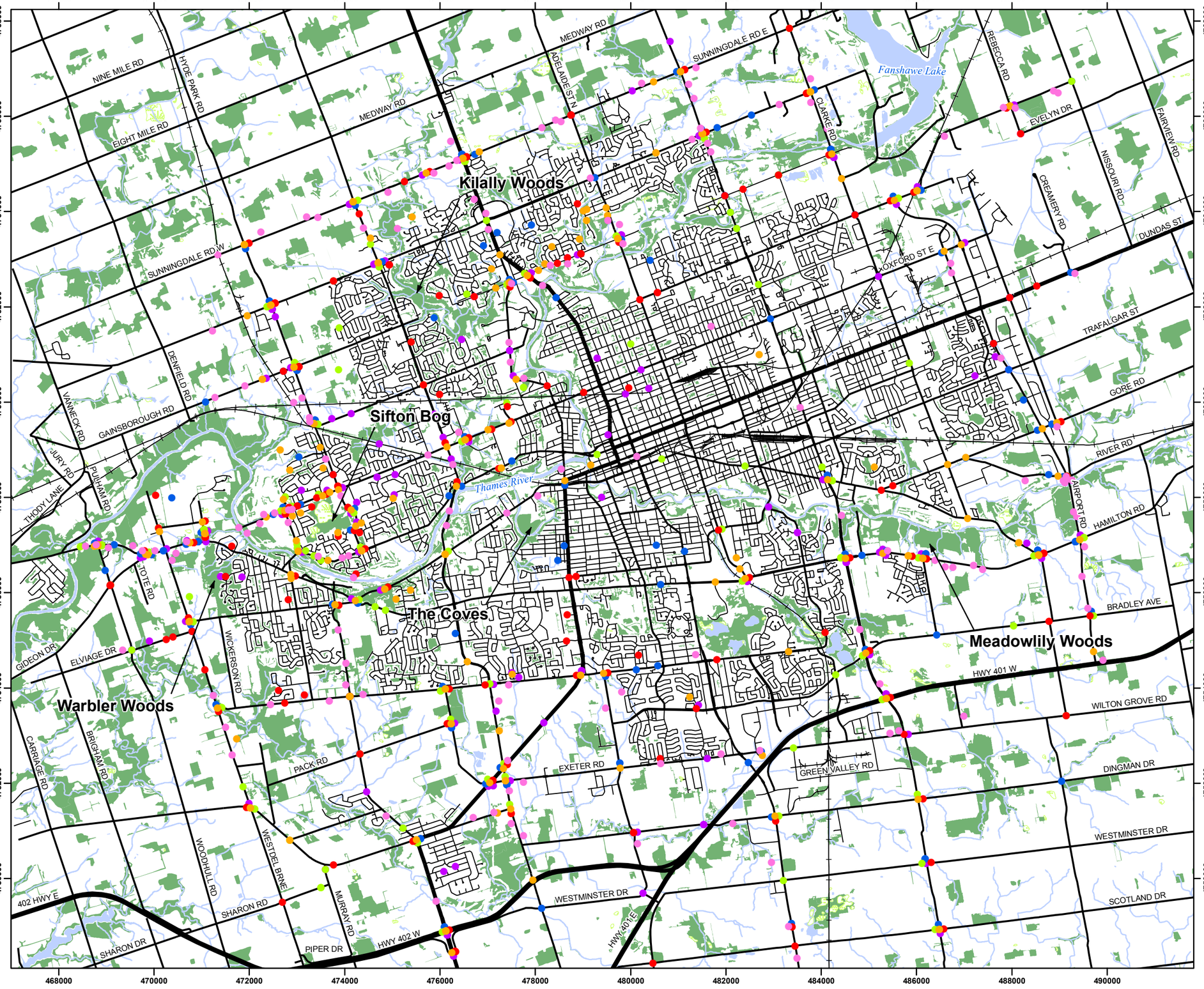
Appendix I

Map of Deer-Vehicle Occurrence Locations within the City of London, 2004-2008

Appendix I

City of London City-Wide Deer Management Strategy

Deer-Vehicle Occurence (DVO) Locations, 2004-2009



Legend

- DVO 2009
- DVO 2008
- DVO 2007
- DVO 2006
- DVO 2005
- DVO 2004
- Highway
- Primary Road
- Secondary Road
- Railway
- Watercourse
- Wooded Area
- Waterbody
- Wetland Area

N

0 1 2 3 4 Kms

NAD83 - UTM Zone 17N Scale: 1:80,000 (11 x 17")	Project: 0991 Date: June 3, 2010

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

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Appendix II

Sample Landowner Education Materials Used for Sifton Bog

October 9, 2008

Dear Resident,

The City of London and the Upper Thames River Conservation Authority (UTRCA) are in the process of completing a Conservation Master Plan for the Sifton Bog Environmentally Significant Area (ESA). This Master Plan will help guide future management initiatives inside and surrounding this ESA over the next 10 years. This report has been through an extensive community consultation process and is expected to be completed in December, 2008.

One of the pressing management issues that we as land managers face, and you as landowners and stewards of this unique natural area deal with on a daily basis, is the increasing population of urban wildlife, particularly White-tailed Deer. This issue has been one of many discussed during the preparation of the Sifton Bog Master Plan. One recommendation that will be coming out of this Master Planning process is that any feeding of wildlife, specifically White-tailed Deer, by the general public be stopped.

Annual deer counts completed by the UTRCA over the past five years indicate that there are approximately 55 deer within Sifton Bog and surrounding upland habitats. The Ministry of Natural Resources (MNR) suggests that this area's natural carrying capacity is three deer. Supplementary feeding of White-tailed Deer by the general public is one of the many factors that contribute to this unusually high concentration. While we all enjoy seeing wildlife, research has demonstrated that deer actually get little to no benefit from being fed (please refer to the attached fact sheet for more information).

The Sifton Bog ESA is monitored and managed by the Upper Thames River Conservation Authority ESA Management Team, under contract with the City of London. This ESA Management Team will continue to educate the public in an effort to stop illegal feeding of wildlife. If these proactive measures do not prove effective, the UTRCA's Provincial Offences Officers will have the option to issue a ticket to anyone caught feeding deer.

We ask that you respect this request out of concern for the health of the deer, the integrity of the sensitive bog ecosystem, and for the benefit of all residents. For more information, please contact Dan Jones, Environmentally Significant Areas Operations Supervisor, at 519-451-2800 ext. 281.

Sincerely,
UPPER THAMES RIVER CONSERVATION AUTHORITY

Alex Shivas
Coordinator, Lands and Facilities

London
CANADA

Deer Deterrent information, who to call, etc.

The City of London and the Upper Thames Conservation Authority have been working to find feasible solutions to address the concerns of overabundant deer within the City. For many of us, seeing deer crossing the road ahead or wandering about in backyards and parks is a common occurrence. The current deer issue initially arose around the Sifton Bog and has been gaining public attention over the past few years.

While there is no socially and politically acceptable method of deer management to all, we hope that by helping to reduce the impacts that deer are having on our neighbourhoods and significant natural areas, we can move closer to a natural balance between humans and wildlife.

For those of us who have enjoyed the pleasure of walking down the sturdy boardwalk towards the picturesque and provincially rare Sifton Bog, you may have noticed the lack of ground cover in the swamp thicket as you enter, the freshly clipped twigs or the multitude of deer runs that penetrate the bog-mat vegetation. It is evident that there are deer within the Sifton Bog and many professionals and provincial documents have referenced our Sifton Bog as having one of the most dense urban deer populations in Ontario. The Sifton Bog is not the only place where the impacts of deer are being seen, but it does deserve special attention and protection because it is a unique ecosystem trapped in the middle of our city. Following are some strategies that are currently underway and will be monitored over the next few years to evaluate their effectiveness.

What Can I Do?

The progression of urbanization and the loss of wildlife habitat are two of the major factors contributing to the overpopulation of deer within our urban centres. As a result, public encounters with deer occur quite frequently, so if we can become educated on what to do and what not do to in certain situations, we can help to ensure the health and safety of the public as well as the deer.

When Driving:

- Drive with your headlights on before dusk and after dawn because the light can reflect off a deer's eyes, helping you see it standing on the side of the road.
- Always take deer crossing signs seriously -- these areas have been identified due to past accidents or current deer populations. Reduce your speed and be on the lookout.
- Deer travel around at all times of the day, so be especially cautious at dawn and dusk.
- Deer travel in groups, so if you see one deer there are probably more.
- Never swerve to try and avoid a deer. That's how the most serious accidents often occur. If a deer is on the road in front of you hold the wheel, brake firmly and safely and stay in your lane so the deer can decide where it's going to run.
- If you do hit a deer, don't try and move the deer yourself. Report the incident to the police and your insurance company.

DO NOT Feed the Deer:*

- When unnatural feeding opportunities are available, deer congregate in that area, causing stress and other ecological impacts on the immediate environment. Usually these areas are located near roadways or other property owners, and create a nuisance or increase the chances of deer/vehicle collisions.
- During favourable environmental conditions, does give birth to twins or triplets. Supplemental feeding may enable the deer to have multiple births, which increases the population at an unsustainable rate.

If a Deer is in my Backyard:

- Leave the animal alone and try not to spook it. Deer become stressed easily when pursued by humans. They panic when startled which could result in damage to your property, injury to you, and injury or even death to the deer. Call animal control.

How Can I Deter the Deer:

- The truth is that when deer are hungry enough they will brave your backyard and munch down on anything they find. There are however, several plant species that deer would rather not eat, which when planted around the periphery of your property may work to keep the deer out.
- Deer don't like ornamental grasses or herbs and plants that have a strong fragrance such as Sage, Lemon Balm, Monarda and Russian Sage. They also don't like plants with thorns and thistles such as cleome, barberry and purple coneflower (but they do like roses).
- Below are links to some of the most recent and effective deer repellent methods that are currently being used. There are countless websites that identify other techniques and ideas to use.

Gardening:

Look on the 'Plant Guides' page at www.northerngardening.com for a wide selection of unpalatable perennials, biennials, annuals, shrubs and trees that deer would rather not eat. The website also lists many homemade and store bought repellents, as well as landscaping tips that will help keep the deer out of your yard.

'Garden Web' is an excellent forum where people relate their personal experiences with deer repellents and deer resistant plantings. http://forums.gardenweb.com/forums/load/difficult/msg1119510325699.html

Repellents:

The products listed below were all developed in the US but do currently ship to Canadian locations. Most of the repellents can be found at your local Home Hardware or Canadian Tire store.

- Wireless Deer Fencing - www.wirelessdeerfence.com/wdf/index.html
- Liquid Fence - www.liquidfence.com
- Wildlife Management - www.lake-aeration.com/animal_control.asp

Who To Call

Sick and Injured deer <u>ONLY</u>, on public and private property:

- Animal Control (London Animal Care Centre) at **519-685-1330**. Hours: Monday to Friday, 8 am to 8 pm (9 pm from May 1 to October 31), Saturday/Sunday 8 am to 4 pm. For emergencies outside of those hours call **519-685-1640**.

Deceased deer on <u>PUBLIC & PRIVATE</u> property:

- Environmental Services Dispatch – City of London at **519-661-4965**, 24 hours a day, year round. If the carcass is deemed to be on private property, the City will forward you on to their wildlife contractor and the property owner will be responsible removal of the deer at their expense.

Deceased deer on <u>PRIVATE</u> property:

- Property Owners are responsible for removal of the carcass at their own expense. You are encouraged to call the Environmental Services Dispatch for the City of London at **519-661-4965** and you will be referred on to the City's wildlife contractor.

Sick, injured or deceased deer <u>OUTSIDE</u> of the city:

- Regional Ontario Provincial Police (OPP) at **1-888-310-1122** or ***OPP** from a cell phone.

*Do Not Feed Wildlife **(from UTRCA fact sheet/ website)**

The UTRCA and the City of London, like many other provincial and federal agencies, do not encourage the feeding of wildlife.

Feeding wildlife almost always has negative consequences for the wildlife involved, including:

- Increased disease transmission
- The loss of natural foraging skills
- Eating foods that are nutritionally incompatible
- Altered reproduction rates caused by artificial food sources. Feeding wildlife may sustain higher than natural population levels.
- Affecting migration patterns
- Altering the ecological balance. Feeding one wildlife species and not another puts some at an unfair advantage and alters the ecological balance.
- Increasing human/ wildlife interaction. Wildlife may lose their natural fear of people, which could result in dangerous encounters with people and collisions with vehicles.

People who feed wildlife do so with the best of intentions and feel they are looking after the welfare of these wild animals; however, they should be aware that wildlife needs to remain wild. Wild animals should derive their food and shelter from natural habitats and under natural conditions. This will help maintain natural adaptations that ensure the long-term survival of the individual animals and of the species. For these reasons, it is illegal in many municipalities (including London, Ontario) to feed wildlife. The general rule is: Do not feed wildlife.

Feeding Deer

People are often tempted to feed White-tailed Deer during the winter in order to "save" them from winter conditions. This practice causes a particular set of problems. Research has shown that deer actually get little or no benefit from being fed during the winter. In fact, there are a number of negative consequences.

- Deer visiting feeding areas lose their natural wildness and aversion to people.
- Feeding manufactured food products removes the deer's natural adaptations to cope with severe winters in their natural habitat.
- Natural migration patterns to wintering areas may be disrupted if the animals are enticed to remain at a feeding area.
- Deer become concentrated around feeding areas, resulting in the destruction of natural habitat.
- Concentrations of deer at feeding stations increase the risk of disease transmission among the animals.
- The digestive system of deer adapts to their typical natural food (woody browse) that is available during winter. Improper feeding of other food types can cause digestive problems that may result in death.
- Deer that become accustomed to feeders and are then not fed proper quantities or quality of food may die.
- Most of the food at a feeding area is typically eaten by a few dominant deer.
- Many deer feeding areas are near populated areas and homes, increasing the risk of dogs chasing and killing deer.
- Feeding deer near populated areas or highways greatly increases the risk of deer / vehicle collisions.
- Deer concentrated at feeding areas near homes inevitably cause a nuisance problem for neighbours, as deer eat and damage nearby shrubs and gardens.
- Winter mortality is a major driving force in keeping populations at long-term sustainable levels.

Special thanks to the New Brunswick Department of Natural Resources for providing much of the information for this factsheet.