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Resident levels of knowledge and support for urban tree protection policies in the Greater Toronto Area

Abstract

Urban trees provide a multitude of ecosystem services and social benefits. Urban trees are also found primarily on private residential property. Municipalities recognize the roles of homeowners in determining urban forest form, and have adopted restrictive methods that limit residents' ability to remove trees on their property, thereby preserving the urban forest that falls on those properties. These measures usually take the form of urban tree protection policies, which require the resident to apply for a permit to remove trees on their property. The objectives of this research project are to (1) Assess resident knowledge and support for municipal urban tree protection policies and (2) examine if levels of knowledge and support differ between socioeconomic groups. These objectives are addressed through a statistical analysis of survey responses for five study neighbourhoods in the Greater Toronto Area (Ontario, Canada). Residents were mostly aware of existing urban tree protection policies. Our results found that awareness for urban tree protection policies was influenced by gender, home ownership, and house type. There was a lack of trends for resident support for the different requirements of urban tree protection policies and socioeconomic variables. As well, this study examined residents future plans to plant, remove and prune trees on their property and if these plans had changed as a result of an extreme ice storm in December 2013. Results show that residents were unlikely to plant and remove trees, and these plans remained largely unchanged. As well, results suggest that tree activities on private property appeared to be related to gender, house type, and house ownership. Further research is required to assess knowledge of urban tree protection policies of residents that come from a range of socioeconomic contexts.

Introduction

Urban trees provide a number of environmental benefits. They can help improve air quality, moderate summer heat island effects in urban areas through evapotranspiration or interception of solar radiation, and are effective in managing urban stormwater runoff (Nowak and Dwyer, 2007). As well, urban trees can provide various social benefits, such as reductions in stress levels or improvements in the moods of individuals (Zhou and Rana, 2012). As urban trees provide positive ecosystem services and social outcomes, it is beneficial that urban managers work to develop strategies that maximise the amount of trees in urban spaces.

The distribution of trees within the urban landscape can vary depending on the built form and difference in land use coverage. In a study of urban tree distribution in Sacramento, California, the highest percentage of trees and potential tree planting locations occur on residential properties (MacPherson, 1998). Moreover, detached single family homes often have higher percentages of urban tree cover than those of other housing types (Nowak and Dwyer, 1996). Therefore, owners of private residential property are significant actors in determining the form of the urban forest.

As residential properties tend to contain a majority of trees in urban settings, municipalities often implement a combination of encouragement and legal restrictions as a means to build-up and preserve the urban forest (Conway and Bang, 2014). Typically, these urban tree protection programs regulate the removal of trees by requiring the property owner apply for a permit before the tree can be removed (Coughlin et al, 1998). A study of urban forest management strategies in Mississauga, Ontario, revealed that these restrictive measures have generally remained the same, and that municipalities continue to limit homeowners' ability to remove trees, often by means of urban tree protection by-laws and policies (Conway and Bang, 2014). Research studies have shown these programs to be effective. In a study conducted in a two Texas neighbourhoods, it was found that mean canopy height and percentages of canopy cover were greater in the neighbourhood that had urban tree protection policies in place, compared to a neighbourhood that lacked such a policy (Sung, 2011). Additionally, another study of those neighbourhoods found that surface heat temperatures caused by the urban heat island effect were lower in areas that had an urban tree protection policy (Sung, 2013).

In their study of resident attitudes surrounding urban tree protection policies in Mississauga, Ontario, Conway and Bang (2014) found that about half of respondents in their study were in agreement with common policies, suggesting that there is a willingness to support urban tree protection programs. However, there was lower support from older residents in older neighbourhoods, likely due to the inability of older residents to maintain trees on their property.

While urban tree protection policies exist, many municipalities are not active in enforcing the penalties that they carry, and violators of these policies often go unpunished (Conway and Urbani, 2007). Additionally, residents may be unaware of the protective measures in place, or the specific criteria outlined in the various regulations for tree removal on private property. There has been a very limited research that examines levels of awareness surrounding urban tree protection by-laws and residential support for various aspects of these policies. This research study has three objectives related to residents' policy awareness and tree management: 1) residential property owners' levels of awareness and support for urban tree protection policies with in five neighbourhoods in the Greater Toronto Area (Toronto, Ontario, Canada); 2: examine residents' recent activity regarding the planting, removal, and maintenance of trees and 3) explore if and how household demographics influence support and management.

Literature Review

Benefits

Urban forests provide a number of biophysical and social benefits for the environments in which they are located. The following are some of the various benefits according to Nowak and Dwyer (2007). Urban trees can act to improve air quality by the removal of airborne pollutants, and they can also help moderate summer heat islands by reducing the amount of incoming solar radiation, as well as through cooling via evapotranspiration. Urban trees can also play a role in urban stormwater management by retaining large volumes of water in the soils that they occupy. In a case study of Dayton, Ohio, a 7% increase in canopy cover corresponds to a 12% reduction in the volume of stormwater runoff during large storm events (Nowak and Dwyer 2007). Narrow belts of trees can reduce noise in urban areas by 3 -5 decibels. Finally, urban trees and other green spaces also improve urban ecosystem function by providing potential habitat for animal species.

Trees also provide a number of various social benefits (Zhou and Rana, 2012). These benefits can include the provision of recreational and communal space, aesthetic enjoyment, reduction of stress levels, improvement of mood, and the fostering of social ties with others. Urban trees and green space can also be utilised as an educational tool for the importance of trees in ecological function of the city. Given that urban trees provide many ecosystem services and positive social outcomes, it is to the benefit of the city to generate strategies to retain trees within urban spaces.

Distribution of Trees in Urban Land Use Areas

However, the mixed land use coverage in urban areas means that the distribution of trees within the city can vary depending on urban form and the presence of different land use types. In fact, Shakeel and Conway (2014) state that vegetation in urban settings is often associated with built structures; with detached, on-the-ground homes generally have higher percentage of tree cover. A study conducted by Bourne and Conway (2014) examined tree species diversity among different land use types in the Region of Peel (a regional municipality situated within the Greater Toronto Area), Ontario. Within the study plots examined, approximately one third of the trees identified (via stem counts) of the total trees counted were located on residential land use types. In a study of urban tree distribution in Sacramento, California, McPherson (1988) found that residential land use comprised 42% of overall land use coverage in the city and 50% of land use cover in the suburbs. Correspondingly, 13% of urban trees in the city were located on private residential property in the city and 15% in suburban periphery regions. The findings that have been presented in these articles suggest that because a significant percentage of land use in urban areas is residential and many trees are located there, homeowners act as major drivers of urban forest conditions. Therefore, tree management policies that target trees on private property are be useful in the protection of urban forests.

Management

Since residents and private homeowners can have a considerable impact on the urban forest, municipalities have developed strategies to protect trees that fall on private residential properties. A synthesis report of the tree protection programs in the US written by Coughlin et al (1998) describes the types of strategies that might be utilised to protect the urban forest on

private property. At the time, urban tree management on private properties was relatively new; only in 1981 did the federal government require the adoption of local tree protection policies in the USA. By the mid-1990s tree protection policies were most commonly implemented in Florida and California, where rapid urbanisation and large scale development was occurring (Coughlin at al, 1998), highlighting once again the role that homeowners would come to play in managing the urban forest. Typically, these programs regulate the removal of trees by requiring the homeowner to apply for a permit before certain trees can be cut. These programs usually focus on trees that have a diameter of approximately four inches at breast height. Other tree protection programs in the US impose more specific restrictions on the trees that can be removed due to a special reason, such as size, historic significance, or ecological importance.

Another method that is used to protect and enhance urban vegetation on privately owned land is through encouragement of greening actions, as well as education for greening efforts. A more recent study of urban management strategies in Mississauga, Ontario by Conway and Bang (2014) states encouragement programs include providing tree planting information and providing low cost trees to residents. Efforts to increase the extent of the urban forest through "one million trees" planting programs are currently underway in Mississauga, London, New York, and Los Angeles, among other places.

However, Coughlin et al (1998) concluded that generally, urban tree protection policies cannot protect all trees in the area within a municipality, since some of the programs fall short due to limited coverage, such as the exemption of small and medium sized trees. These programs are also difficult to enforce and lack the comprehensive measures to do so (Conway and Urbani 2007). As a result, almost one half of violations, such as cutting down a tree without applying for the necessary permit, go unnoticed, and if they are, penalties usually involve reprimanding the owner rather than replacing the tree (Coughlin et al 1998). To improve the effectiveness of these programs, the protection of existing trees, as well as the planting of new ones should be included. They suggest that penalties for violators should be in the form of replacement vegetation rather than a fine.

A recent overview of urban forest management plans in Canada (Ordóñez and Duinker 2013) found that much of these management plans have an emphasis on creating by-laws and

policies that concern the protection of trees on private property. However, there are only a few plans that apply penalties for removing trees on private property. Instead these plans tend to heavily prioritize urban tree planting and maintenance over other management aspects (Ordóñez and Duinker 2013). This is an interesting contrast to the results found by Conway and Urbani (2007). The literature seems to suggest that urban forest management strategies have, and still do, place an emphasis on vegetation planting over other various actions. These articles shed light on the areas of municipal urban forest management plans that still require some work if they are to become more effective.

Conway and Urbani (2007) examined the various municipal urban forestry policies that exist in the Greater Toronto Area. They found that there was a significant lack of regulations in regard to tree management on private property apart from the development process. This is important as it highlights the requirement for effective management for land uses where urban tree cover has the potential to enhance the urban forest in Toronto. In their concluding remarks, they suggest that active effort should be made to address the lack of policies in municipalities that have few currently in place, such that they can help residents on private property maintain and grow the urban forest. This is likely due to the inclusion of municipalities without Urban Forest Management Plans, and possibly the recent increase in adoption of such policies, Again, this highlights the need for a comprehensive tree management strategy for municipalities.

The implementation of urban tree protection policies can lead to the significant improvement of the urban forest in areas where they are applied. A study conducted by Sung (2011) in a Texas neighborhood compared mean canopy height of trees, and percentages of canopy cover in areas that had urban tree protection policies to those that did not. Sung (2011) found that the mean canopy heights of trees on private property in areas where there was an active tree protection policy were, on average, 0.58m higher than trees in areas where the policy was not present. As there were few variables that could have caused height difference of trees in this area, Sung (2011) concludes that the height difference can be attributed to the adoption of tree removal permits in that neighborhood. In a study of another Texas neighborhood, Sung (2013) found that tree cover percentages in four neighbourhoods with a tree protection policy were higher in the four control study areas used in the project. The use of urban tree protection policies not only protects trees on private grounds, but also can help to protect the ecosystem

services that they provide. In the same study, Sung (2013) examined whether the effects of the urban heat island, a common microclimate phenomena in urban areas, are less pronounced in areas that had a tree protection policy in place. The study showed that on average, land surface temperatures were 1.5- 3.9˚C lower in areas with a tree protection ordinance in comparison to areas that did not (Sung 2013). These studies briefly illustrate the direct and added benefits to urban ecosystems as an outcome of implementing urban tree protection strategies.

The potential efficacy of urban tree protection programs has been shown in previous studies, the attitudes toward municipal forestry policies can differ among individuals for a number of reasons. Zhang et al (2007), in a study of Alabama, found that in general, a majority of survey respondents stated that urban trees and related programs were "very important" to them, suggesting that there was a sense of support for tree protection policies. Only 43% of respondents stated that they would likely donate money to finance urban tree activities, but when asked if funding for urban tree activities such as planting and maintenance should come from government sources, a majority of the survey respondents said that it is "very important" to them. The authors also mentioned that an awareness of municipal tree programs is related to a positive relationship with the support for urban forestry initiatives in general. These studies indicate that residents are generally in favour of various municipal plans to manage the urban forest, but support for tree protection policies is lower. Conway and Bang (2014) conducted a study in Mississauga, Ontario regarding resident attitudes to the use of urban tree protection policies in four Mississauga neighbourhoods that had a majority of residences as on the ground home. In regards to the tree removal by-law, they found that 43% of survey respondents were in agreement with the policy, but 29% of the survey respondents indicate that they were in disagreement with the policy.

Zhang et al (2007) more broadly explored trends in socioeconomic variables in relation to forest management strategies that support the work of the studies previously mentioned. They found that there was also an increased willingness to donate time and money to urban forestry programs from individuals that knew about the program, were younger than 56 years of age, and had an average annual household income that was equal or greater than $75000 USD. Similarly, Lorenzo et al (2000) found a similar positive relation between income and willingness to pay for urban forestry programs. Positive attitudes regarding urban tree protection programs for

individuals who are educated and have a good annual household income are a recurring pattern that is found throughout the literature regarding urban tree management.

Conway and Bang (2014) also found that in their Mississauga study areas there was a decreased level of support for restrictive tree protection policies from individuals in older neighbourhoods within the city. These individuals' lower support tended to be a result of an inability to take proper care of trees on their property, or from those who do not want to deal with the risks of large trees in their neighbourhood. Individuals that reside in relatively new neighbourhoods tended to have more support for tree protection policies. This could be due to the higher average level of education (attended or received a university degree), which has been associated with higher levels of support for tree protection initiative. In relation to education level, Lorenzo et al's (2000) found that in their study of a New Orleans neighbourhood found a significant percentage of individuals who had attended or completed college were willing to pay six to twelve extra dollars per year to fund urban forest programs.

Landry and Chakraborty (2009) found a parallel pattern with regards to areas with lower median household incomes having reduced access to urban trees and therefore might be less willing to support urban tree protection activities. However, they found that there was a decreased tree cover in areas with a greater proportion of African American individuals and renters in their Tampa, Florida study area. Zhang et al (2007) state that race and residence type has little influence on support for tree protection programs, but the patterns highlighted by Landry and Chakraborty (2009) are not a result of different levels of support.

There is a growing amount of literature on urban forestry that examines urban forest management plans used by municipalities to preserve trees on private residential properties. Management strategies themselves tend to take two approaches: encouragement of greening activities, and the use of restrictive policies to retain urban trees on private property. Many of the articles that were examined here focused on the presence of urban tree protection policies and factors that influence the attitudes of individuals toward these policies, such as age of neighbourhoods, income and education levels, and the age of the individual. However, there are few studies that focus specifically on homeowners' levels of awareness about urban tree protection regulations and how this awareness might influence individuals' attitudes and support

for the use of urban tree protection programs. This is a gap in the literature that this study can start to fill. Gaining a better understanding of levels of knowledge for urban tree protection policies among homeowners can help managers develop new strategies to appeal and educate homeowners so that municipal governments can better manage urban trees on residential property.

Methods

Study Areas

The study area is five neighbourhoods in the Greater Toronto Area (Figure 1). Specifically, one neighbourhood located in the City of Mississauga, the City of Brampton, central Toronto (North York), East Toronto (Scarborough), and in West Toronto (Etobicoke). Each neighbourhood chosen is equivalent to one census tract.

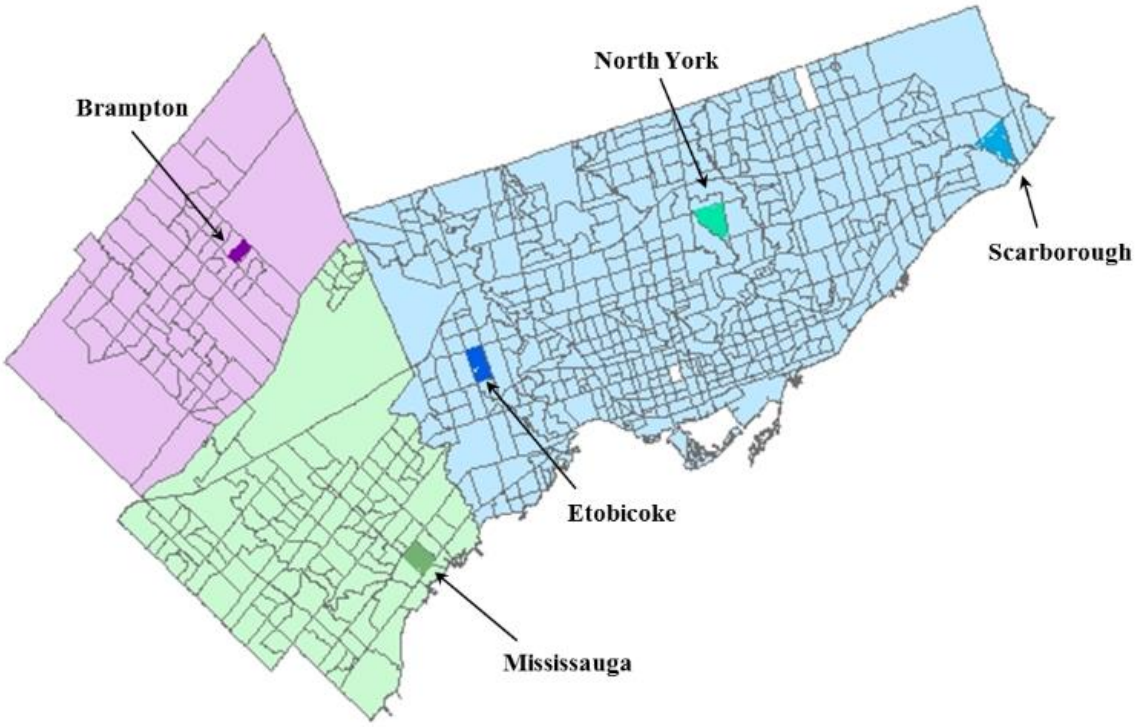

Figure 1: Map of Study Neighbourhoods within the Greater Toronto Area

Potential neighbourhoods were identified as those that had greater than 80% of homes in the form of on-the-ground houses (i.e detached, semi-detached, and townhouses), since these

housing options are the most likely to have yards where trees can be located. Also, potential neighbourhoods had a canopy cover that was equal or greater to the municipality's top quartile of canopy cover. The specific canopy cut-offs were above 15%, 24%, and above 38% for Brampton, Mississauga, and Toronto respectively. Thus, areas where residents have the greatest opportunity to remove trees were the focus. Once potential census tracts were identified, the five study neighbourhoods were chosen based on the census tract that had a minimal proportion of public land use (Parks, etc.) and that had the most even distribution of tree canopy cover. Basic characteristics of the five neighbourhoods in this study are provided in Table 1.Due to the canopy cover and housing criteria, the study neighbourhoods are relatively high income and are not representative of the municipalities as a whole, but are reflective of canopy areas that receive the most urban forest benefits and bear the most costs & risks.

Neighbourhood	Average % Canopy Cover	Population	Population Density (km^2)	Average Household Income ($CAD)
Brampton	17 %	4004	4.00	82,308
Mississauga	44%	3580	1.74	91,262
Toronto Central (North York)	50%	6641	2.49	125,227
Toronto East (Scarborough)	49%	5571	1.96	106,472
Toronto West (Etobicoke)	44%	3979	1.95	155,370

Table 1: Neighbourhood characteristics for the five study areas used in the research project

Survey for Homeowners

The primary data for this study was collected from a mail-out survey sent to 400 randomly selected residents in each neighbourhood that lived in on-the-ground residences (for a total of two thousand total surveys), conducted in the summer of 2014. Each survey was given a numerical identifier to keep a track of the responses and help organise them into a database. Residents that were selected for this study also had the option to complete the survey online, if they wished.

The survey had several sections, as it was part of a larger study that examined resident experiences with trees following an extreme ice storm event that affected Southern Ontario in December of 2013. The survey contained five sections in total: a section regarding residents' perceived benefits and risks associated with trees on their property; urban tree activities (planting, removal, and pruning) on homeowners' properties; resident experiences with trees and future plans following a severe ice storm in December 2013; levels of awareness and support for various aspects of urban tree protection by-laws in each municipality; and a final section with questions regarding household demographic information. For this study, the sections regarding maintenance of trees on resident property following the ice storm, by-law knowledge and support, and household demographic were used.

Questions regarding future tree planting plans asked whether homeowners would plant, remove, or prune any trees in the near future (the next three years), and if residents' plans to plant, remove, or prune trees on their property had changed in response to the damage caused by the December 2013 ice storm. Questions regarding residents' knowledge and support for urban tree protection policies focused on awareness of the various polices, and residents opinions on various aspects of the tree protection polices, specifically the specific criteria of trees on a property that require an individual to apply for a permit to remove a tree.

Basic summary statistics were generated for the responses that were received. Summary statistics for household level demographic questions were also calculated. IBM Statistical Package for Social Sciences (SPSS) was used to perform crosstabulation analyses between questions regarding household sociodemographic variables and future tree activities, as well as levels of knowledge and support for tree protection by-laws. Cramer's V was used as the measure of correlation to determine significance for each crosstabulation.

Urban Tree Protection By-laws

Municipalities utilise restrictive measures as a way of preserving trees that are located on privately owned property. These measures typically take the form of a permit that the homeowner must apply for, at a cost, to remove trees on their property (Conway and Bang, 2014). Outlines for the different urban tree protection policies in place in the study neighbourhoods are below.

Brampton's urban tree protection by-law states that a permit is required in order to remove a tree that is greater than 30cm in diameter at breast height (DBH).Brampton's tree protection by-law does not list potentially hazardous trees as having to be removed (no application needed) Replacement trees may be required for every tree that is removed, is the permit is granted. The permit application costs $50.

Mississauga's urban tree protection by-law states that a permit is required if there are more than three trees greater than 15 centimeters in diameter. The permit costs $355 in order to remove the first three trees, and $80 to remove any additional trees. If the permit is granted, one replacement tree is required for each tree under 50cm that is removed, and two replacement trees are required for every tree greater than 50cm that is removed. Replacement trees are not required if the tree that is removed is dead, dying, or poses a physical hazard.

Toronto's urban tree protection by-law requires homeowners to apply for a permit to remove trees that are greater than 30cm in diameter OR are more than 1.4m above the ground. The by-law requires one replacement tree for each tree that is removed. The cost of the permit is $100 per tree, but if the tree removal is part of a construction project, the cost rises to $300 per tree.

Results

Response rates for the five study neighbourhoods are provided below. The response rate was very good, with the lowest percentage of responses being Brampton with 47% and the highest response rate from Scarborough at 61% (Table 2).

Neighbourhoods	Return to Sender	Received	Total Surveys Sent	% of Total Response	% of received surveys
Brampton	19	188	400	47.00%	49.34%
Mississauga	18	208	400	52.00%	54.54%
Etobicoke	16	245	400	49.25%	63.80%
North York	18	197	400	59.25%	51.57%
Scarborough	10	245	400	61.25%	63.08%
TOTAL:	**81**	**1075**	**2000**	**53.75%**	**56.02%**

Table 2: Survey response rates for the five study neighbourhoods.

Summary of household demographic information

All summary tables for household demographic responses can be seen in Appendix A.

A majority of respondents in all of the study neighbourhoods stated that their ethnic backgrounds were either from the British Isles or European, and other ethnicities having smaller percentages. A majority of respondents stated named Canada as their country of birth.

A majority of respondents in all study neighbourhoods stated that they were born in Canada. Mississauga had the highest percentage of respondents that said they were born in Canada (80.95%), and North York had the lowest percentage of respondents that were born in Canada (54.84%).

For all neighbourhoods, a majority of respondents said that they have lived in their current residence for 20 or more years. This was not surprising, as older neighbourhoods were targeted for this study based on their built form and canopy cover criteria.

Almost all respondents in all neighbourhoods owned their current houses. With the exception of Brampton, almost all of the houses in the study areas were detached homes. Brampton had the lowest percentage of detached homes at 58.10%, with one third of respondents living in semi-detached homes.

With the exception of the Brampton study neighbourhood, the most common household income category is over $180,000. Etobicoke had the largest percentage of residents with an average household income over $180,000 (47.59%), while Scarborough has a more even average household income, with similar percentages in the $60,000 – 89,000, $90,000 – 119,000, and $180,000+ ranges.

The general family composition of the households in the study neighbourhoods tended to be older families. There were a low percentage of respondents that had children living with them, and a considerable percentage of respondents had at least two family members aged 45 – 64 in the household.

Tree Management Activities

Neighbourhoods	Do you plan to plant a tree in the next 3 years?			Do you plan to remove a tree in the next 3 years?			Do you plan to prune your trees in the next 3 years?		
	Yes	No	Maybe	Yes	No	Maybe	Yes	No	Maybe
Brampton	18%	57%	25%	12%	66%	21%	68%	22%	9%
Mississauga	27%	39%	33%	26%	47%	27%	78%	8 %	14%
Etobicoke	24%	50%	26%	21%	51%	28%	81%	7%	13%
North York	16%	60%	24%	11%	65%	24%	78%	8%	14%
Scarborough	18%	53%	28%	20%	61%	20%	65%	15%	19%

Table 3: Percentages of respondents future tree maintenance plans (planting, removal, and pruning plans)

Across the study neighbourhoods, a majority of respondents stated that they had not planned to plant or remove trees on their property in the near future. Homeowners in Brampton had the highest percentages of respondents that said they would not plant or remove in the next three years (76% for planting and 85% for removal); whereas Etobicoke had the lowest percentage of respondents saying they would not plant or remove (50% for planting and 51% for

removal). Mississauga had the highest proportion of respondents that stated they would plant (41%). However, the majority of respondents in all neighbourhoods stated that they will prune trees on their property in the near future, with Mississauga having the highest proportion of respondents (81%) that said they will do so. There were also fewer "maybe" responses.

Neighbourhoods	Planting plans changed?		Removal plans changed?		Pruning plans changed?	
	Percent Yes	Percent No	Percent Yes	Percent No	Percent Yes	Percent No
Brampton	13%	87%	13%	86%	23%	77%
Mississauga	7%	93%	9%	91%	22%	78%
Etobicoke	10%	90%	18%	82%	26%	74%
North York	3%	97%	8%	92%	23%	77%
Scarborough	9%	91%	12%	88%	18%	82%

Table 4: Percentage of respondents that have changed their future tree activities as a result of the December 2013 ice storm.

In all five study areas, the ice storm in December 2013 had little effect on the future plans of respondents to plant, remove, or prune trees on their property. In fact, a majority (at least 81%) of respondents in all neighbourhoods stated that their plans to plant and remove trees on their property had remained the same as before the ice storm. North York residents were the least likely to change their plans in response to the storm (97% for unchanged planting plans and 91.89% said removal plans were unchanged). Brampton had the largest percentage of respondents that said they had changed their plans to plant and remove trees (13% for planting and 13% for removal). Respondents were slightly more likely to have altered their plans to prune trees on their property as an outcome of the ice storm, with Etobicoke having the highest percentage of respondents that said they had changed their pruning plans (26% of respondents).

Neighbourhoods	Percent of respondents that knew about the by-law
Brampton	44%
Mississauga	62 %
Etobicoke	71 %
North York	56 %
Scarborough	70 %

Table 5: Percentages of respondent knowledge for urban tree protection by laws

In all study neighbourhoods except for Brampton, the majority of respondents claimed to have previously known about the private tree protection policies that were in place in their municipality. Brampton had a majority (56%) of respondents that were unaware of such a policy. Scarborough had the highest rate of resident knowledge concerning the tree protection by-laws (70%).

Neighbourhoods	1.0: Number and size is defined as appropriate	2.0: By-law should be stricter, size should be lower	3.0: By-law should be relaxed, small number of trees should be exempt	4.0: Tree removal on private property should not be regulated by the city
Brampton	31%	20%	6%	43%
Mississauga	37%	32%	5%	27%
Etobicoke	36%	5%	18%	37%
North York	32%	7%	18%	38%
Scarborough	21%	8%	21%	50%

Table 6: Percentages of respondent opinions regarding the size requirement for a removal permit application.

For all study neighbourhoods, the most common response was either that the current size requirements for tree removal permits were appropriate as defined in their municipality's by-law, or that tree removal on private property should not be regulated by the city. Scarborough had the highest percentage of residents (50% of respondents) that believed that restricting tree removal was not a responsibility of the city and the highest percentage of respondents (20.63%) of all

neighbourhoods that thought the requirements should be relaxed. Mississauga had the highest percentage of respondents that thought the size requirement for removal was appropriate (37.19%) and also the lowest percentage of respondents that thought tree removal should not be regulated (26.63%). Interestingly, Mississauga had a considerable percentage of respondents (31.65%) that felt that the size requirements should be stricter.

Neighbourhoods	1.0: Potential Replacement tree requirement is defined as appropriate if a permit is granted	2.0: By law should be stricter	3.0: By law should be relaxed, no replacement trees required	4.0: Tree removal on private property should not be regulated by the city
Brampton	39%	10%	9%	43%
Mississauga	49%	14%	8%	29%
Etobicoke	48%	5%	12%	32%
North York	40%	4%	14%	38%
Scarborough	38%	5%	14%	43%

Table 7: Percentages of respondent opinions regarding the replacement tree requirement, should a removal permit be granted.

There was again a division of respondents that felt that the replacement tree requirements were defined as appropriate, versus a proportion of respondents felt it should not be regulated by the city. For Mississauga, Etobicoke, and North York, the majority of respondents agreed that the replacement tree requirement was currently defined appropriately (49%, 48% and 40% respectively). Scarborough again had the majority of respondents (42.86%) stating that tree removal should not be regulated by the city, but also had a nearly equal number (37.95%) that thought the requirements were reasonable.

Neighbourhoods	1: Current application fee is defined as appropriate	2.0: By-law should be stricter, with a higher application cost	3.0: By-law should be relaxed, with a lower application cost	4.0: Tree removal on private property should not be regulated by the city
Brampton	28%	11%	17%	44%
Mississauga	34%	19%	20%	27%
Etobicoke	33%	9%	17%	39%
North York	33%	4%	21%	38%
Scarborough	26%	6%	22%	46%

Table 8: Percentages of respondent opinions regarding the cost required to apply for a permit.

When asked about the cost of the permit application, the most common response in all study areas (except for Mississauga) felt that tree maintenance activities on private property should not be regulated by municipal authorities. Mississauga had a majority of respondents that felt the permit cost application was appropriate. Once again the fewest responses were given for altering permit costs.

Neighbourhoods	Public Consultation	Meeting	Contacted a Councillor	No Action	Other
Brampton	8%	0.00%	6%	94%	4%
Mississauga	12%	11%	10%	74%	3%

Table 9: Percentages of various resident actions following the December 2013 ice storm. Only Brampton and Mississauga have been included in this table as these municipalities have recently adopted protection plans. Mississauga's urban tree protection plan was adopted in March 2013 and Brampton's in February 2006 .As Toronto adopted them in 2004, this might have been too long ago for respondents to remember.

Statistical Analysis of survey questions and household demographic variables

	Brampton					
Demographic	**P-Values**					
	Future Tree Planting	Have Planting Plans changed?	Future Tree removal	Have Removal plans changed?	Future Tree Pruning	Have Pruning Plans changed?
Gender	0.006	0.0011	0.0011	0.043	0.0011	0.014
Caribbean	0.0011	0.0011	0.0011	0.0011	0.01	0.0011
Canadian	0.0011	0.003	0.0011	0.0011	0.0011	0.0011
Other	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Born In Canada	0.001	0.0011	0.027	0.005	0.0011	0.001
Ownership	0.0011	0.006	0.003	0.003	0.0011	0.003
House Type	0.0011	0.026	0.0011	0.049	0.0011	0.041
Income	0.015	0.0011	0.0011	0.0011	0.0011	0.0011
Number of Family Under 18	0.01	0.0011	0.0011	0.0011	0.0011	0.0011
Mississauga						
Demographic	**P-Values**					
	Future Tree Planting	Have Planting Plans changed?	Future Tree removal	Have Removal plans changed?	Future Tree Pruning	Have Pruning Plans changed?
Education	0.0011	0.0011	0.0011	0.0011	0.0011	0.004
East and Southeast Asian	0.0011	0.0011	0.0011	0.0011	0.027	0.0011
Caribbean	0.0011	0.0011	0.0011	0.002	0.0011	0.0011
Ownership	0.0011	0.003	0.0011	0.0011	0.0011	0.0011
Income	0.0011	0.027	0.0011	0.0011	0.007	0.035

Etobicoke						
Demographic	**P-Values**					
	Future Tree Planting	Have Planting Plans changed?	Future Tree removal	Have Removal plans changed?	Future Tree Pruning	Have Pruning Plans changed?
Gender	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Education	0.0011	0.0011	0.0011	0.0011	0.0011	0.04
European	0.01	0.0011	0.0011	0.0011	0.0011	0.0011
Born In Canada	0.0011	0.001	0.005	0.0011	0.0011	0.0011
Ownership	0.0011	0.0011	0.042	0.0011	0.0011	0.0011
House Type	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Income	0.0011	0.0011	0.0011	0.0011	0.014	0.0011
Number of Family 65+	0.026	0.0011	0.0011	0.0011	0.019	0.009
Number of Family 45 - 64	0.03	0.0011	0.0011	0.0011	0.0011	0.0011
Number of Family 18 - 44	0.03	0.0011	0.0011	0.0011	0.0011	0.0011
Number of Family Under 18	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
North York						
Demographic	**P-Values**					
	Future Tree Planting	Have Planting Plans changed?	Future Tree removal	Have Removal plans changed?	Future Tree Pruning	Have Pruning Plans changed?
Gender	0.0011	0.038	0.001	0.0011	0.0011	0.0011
Education	0.0011	0.0011	0.0011	0.0011	0.01	0.037
European	0.0011	0.0011	0.0011	0.026	0.0011	0.0011
Born In Canada	0.011	0.013	0.01	0.0011	0.0011	0.0011

Residence Time	0.023	0.0011	0.0011	0.048	0.0011	0.0011
Ownership	0.0011	0.0011	0.002	0.0011	0.0011	0.0011
House Type	0.007	0.027	0.0011	0.017	0.0011	0.0011
Number of Family 45 - 64	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Number of Family 18 - 44	0.02	0.0011	0.0011	0.0011	0.0011	0.0011
Number of Family Under 18	0.03	0.0011	0.0011	0.0011	0.0011	0.0011
Scarborough						
Demographic	**P-Values**					
	Future Tree Planting	Have Planting Plans changed?	Future Tree removal	Have Removal plans changed?	Future Tree Pruning	Have Pruning Plans changed?
Gender	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Education	0.027	0.0011	0.0011	0.0011	0.0011	0.0011
East and Southeast Asian	0.0011	0.021	0.0011	0.0011	0.015	0.0011
Other	0.0011	0.0011	0.0011	0.0011	0.006	0.0011
Born In Canada	0.0011	0.0011	0.0011	0.0011	0.0011	0.0011
Ownership	0.0011	0.0011	0.0011	0.0011	0.0011	0.033
House Type	0.0011	0.001	0.0011	0.011	0.0011	0.0011
Number of Family 65+	0.0011	0.027	0.0011	0.026	0.0011	0.027
Number of Family Under 18	0.02	0.0011	0.0011	0.0011	0.02	0.0011

Table 9: Crosstabulation results of future tree planting, removal, and maintenance plans for all study areas with household demographics (only significant values, i.e: $p<0.05$ have been included in the results).

There are several household level demographics that may influence future planting, removal, and pruning activities. Gender is a variable that is common for all study neighbourhoods (except Mississauga), and it appeared to have an influence on future planting, removal and pruning plans on residents' property. Education was a common variable in all study areas except for Brampton, and seemed to influence whether residents' pruning plans had changed as a result of the December 2013 ice storm in Mississauga, Etobicoke, and North York. Income was a common demographic variable for Brampton, Mississauga, and Etobicoke neighbourhoods, and may have an effect on residents' future pruning plans in Mississauga and Etobicoke. There also appears to be a relationship between family composition and the various urban tree activities. In all neighbourhoods but Mississauga, the number of children in a household has a potential influence on respondents' decisions to plant a tree in the next three years.

Knowledge	Neighbourhoods				
Demographic	Brampton	Mississauga	Etobicoke	North York	Scarborough
Gender	0.0011		0.0011	0.0011	0.0011
British Isles	0.006	0.01			0.001
Caribbean		0.026			
Other Ethnicity	0.037				
Born In Canada	0.0011		0.0011	0.0011	0.0011
Ownership	0.0011		0.0011	0.0011	0.0011
House Type	0.0011		0.0011	0.0011	0.0011
Number of Family Members under 18 years old			0.0011		

Table 10: Crosstabulation results of levels of respondents' knowledge regarding municipal urban tree protection policies with household level demographics (only significant values, i.e: $p<0.05$ have been included in the results).

Except for Mississauga, gender, whether respondents were born in Canada, house ownership, and house type seem to have a bearing on resident knowledge of urban tree protection policies.

Tree size requirement	**Neighbourhoods**				
Demographic	Brampton	Mississauga	Etobicoke	North York	Scarborough
South Asian		0.039			
East and Southeast Asian				0.026	
Residence Time	0.006				0.016
Income				0.019	
Number of Family Members aged 45 - 64					0.01

Table 11: Crosstabulation results of respondents' opinions regarding tree size requirements outlined in the by-laws, with household level demographics (only significant values, i.e: $p<0.05$ have been included in the results).

There were few significant relationships between respondent opinions about the size requirement in urban tree protection policies with household level variables. Length of residence at the respondents' current home was a common demographic variable for Brampton and Scarborough study neighbourhoods, but there were no other shared variables among study areas. Etobicoke had no significant relationships between size requirement opinions and household demographics.

Tree replacement requirement	**Neighbourhoods**				
Demographic	Brampton	Mississauga	Etobicoke	North York	Scarborough
Gender		0.021			
Education	0.041				
British Isles	0.024				
Caribbean			0.024		
Number of Family Members aged 18 and under					0.0011

Table 12: Crosstabulation results of respondent' opinions regarding the tree replacement requirement outlined in the by-laws, with household level demographics (only significant values, i.e: $p<0.05$ have been included in the results).

Again, there were few relationships between respondent opinions about the tree replacement requirements as outlined in the tree protection policies with household level variables. There were no common variables between study areas.

Application cost	**Neighbourhoods**				
Demographic	Brampton	Mississauga	Etobicoke	North York	Scarborough
South Asian					0.013
Canadian Ethnicity				0.029	
Born In Canada				0.001	
Income					0.049
Number of Family Members age 18 – 44		0.04	0.02		
Number of Family Members age 18 and under		0.04			0.03

Table 13: Crosstabulation results of respondent opinions regarding the permit application cost with household level demographics (only significant values, i.e: $p<0.05$ have been included in the results).

In the Mississauga and Scarborough study areas, there appears to be relationships between the number of children in a household and resident opinions regarding the permit application cost defined in the tree protection policies. Similarly, in the Mississauga and Etobicoke study areas, the number of family members ages 18 – 44 seemed to have a bearing on the opinions concerning the application cost. In these study areas, family composition may have an effect on the opinions regarding the permit cost. However, aside from these common variables, there are not very much other variables shared between study neighbourhoods.

Discussion

In terms of knowledge and support for various aspects of urban tree protection by-laws, our results do not necessarily support the trends that have been presented in the literature, but present different trends between other household level demographics. Trends in the literature suggest that awareness for municipal urban forestry efforts and urban forest protection programs is often related to an individuals' average income (Zhang et al 2007) and level of education

(Lorenzo et al 2000, Jones et al 2012). In our research study, there were no significant relationships between income and education with support for municipal tree protection policies. This is notable especially for the Toronto study neighbourhoods as the median household incomes were all greater than $100,000 annually. Also, a majority of respondents in all study areas were educated and owned a university degree. These trends are interesting as a majority of respondents in all neighbourhoods (except Brampton) also stated that they knew about the tree protection by-laws (Table 5). However there were consistent trends (except in Mississauga) between levels of by-law knowledge with gender, ownership, house type, and if the respondents were born in Canada (Table 10). This is an interesting contrast with the results presented by Zhang et al. (2007), who found that gender and residence type were not statistically significant when it came to levels of support for urban forestry efforts.

A possible explanation for these unexpected trends for knowledge of urban tree protection by laws in our study neighbourhoods could be that respondents were aware that these policies existed but might not have known about them in detail. The question in the survey that asked respondents about their knowledge of the respective urban tree protection policies simply asked if they did or did not know about the policies, but did not gauge their level of understanding regarding the details of the policies. Some respondents, when asked how they knew about the by-laws, said that they had either heard about the policies very casually, such as through word of mouth or on the internet but not directly from municipal representatives. As well, lack of enforcement might also be a factor that has an influence on resident levels of knowledge for municipal tree protection policies. In Toronto, many lower tier municipalities do not actively regulate tree removal on private property (Conway and Urbani 2008). This suggests that offenders of urban tree protection regulations are not penalised, and will remain unknowing of these policies.

House type was a variable that had an influence on levels of homeowner knowledge for urban tree protection policies. In all study neighbourhoods, the majority of respondents that knew about the by-law also lived in detached houses. This relationship was significant in all neighbourhoods except for the Mississauga study area. This is likely due to almost all respondents living in detached on the ground houses (except for Brampton which had 58.1% detached homes). Perhaps residents that live in on the ground housing types are more aware of

urban tree management strategies as they are more likely to have a tree located on their property. Since they are more likely to have trees on their property, it might also be that they also more likely to remove trees that exist on their property, as it may have been there when the house was bought. Residents that have removed a pre-existing tree on their property may be more likely to know about urban tree protection by-laws, as they may have gone through the permit application process previously. However, these results may likely be an outcome of the way that this research study was structured, as neighbourhoods with a large percentage of on-the-ground, single family homes were selected.

Gender appeared to be a variable that influenced knowledge of urban tree protection policies. In all study neighbourhoods except Mississauga, the majorities of respondents that said they already knew about the urban tree protection policies were male. This is an interesting contrast to the findings of Jones et al (2012), who found that with regards to gender and urban tree protection, women have been suggested to be more linked to be more supportive of environmental protection efforts, suggesting that they might also be more likely to be aware of urban forestry policies. However again, this may simply have been a result of the way that questions were phrased in the survey that was mailed to respondents. Even though the survey was directed at the individuals in each household that were responsible for tree maintenance on the homeowners' property, anyone in the house could have filled out the survey and this trend might simply be a result of coincidence. As well, it might just be that the males in the household be more likely responsible for the actual management and maintenance of trees on the property.

There was a lack of trends in all neighbourhoods with regards to resident support for the various aspects of the urban tree protection policies (permit requirement, replacement tree requirement, and permit cost). A possible cause for the lack of consistent trends may be that residents heard about the policies briefly (i.e - through word of mouth, quickly saw it on the internet), and that though they might be aware that the policies are in place, they might be less aware of the specific criteria that the policies entail.

An interesting aspect of this study that might be worth exploring in greater detail is to see if there is a relationship between percent canopy cover (PCC) and levels of knowledge for urban tree protection policies. An interesting case that highlights this potential relationship in this

project is the study neighbourhood in Brampton. Brampton had the lowest percentage of by-law knowledge among respondents (44%). Also, Brampton had the lowest percentage of average canopy cover (15%) for the municipalities in this study, compared to Toronto with an average canopy cover of 50% (Table 1).

There are several potential reasons for this disconnect between awareness of urban tree protection policies and lower canopy cover. Firstly, the City of Brampton does not currently have an urban forest management plan, which would outline the specific urban forestry goals for the municipality (Ordoñez and Duinker 2013), such as private tree protection by-laws. Essentially, urban forest management plans help transform goals and objectives into actions, and provide accountability for urban forest actions (Ordoñez and Duinker 2013). As Brampton lacks an urban forest management plan, actions such as private tree protection may not be a priority of the City, and may not be managed to an extensive degree.

Brampton also has a limited number of tree planting programs. Summit (1995) suggests that the success of NGO tree planting organizations has the potential not only to increase the number of trees in suburban areas, but also has the potential to generate social support and encouragement for environmentally friendly behaviour. This suggests that if municipal planting efforts increased, then residents might become more aware of the city's efforts to increase urban forest cover, and in turn can become more educated about the strategies that the city is using, such as tree protection policies. Conway and Urbani (2008), found that several lower tier municipalities in Toronto do not have public or private planting programs, nor do they support non-governmental (NGO) planting programs. This suggests that municipalities that lack forms of public engagement for tree planting might also have residents that are not educated about the benefits of trees and actions that municipalities are taking to protect trees.

As well, Brampton is a city that is undergoing rapid development. Due to the high rates of suburban development and urban sprawl, urban forests are subject to a greater degree of fragmentation (Miller 2012). If this is the case with Brampton, then the decreased patches of urban forest might mean that residents do not have direct and easy access to the benefits of urban trees. So, they might also be unaware of the regulations that go along with tree maintenance, such as urban tree protection policies. For example, if a recent homeowner lived in a

neighbourhood where there were few trees on residential properties, than that individual might be less likely to remove trees and remain unaware of the permit application process. Furthermore, if larger areas such as neighbourhoods have a lower than average canopy cover, then neighbourhood awareness might also be lower, as neighbours might not be able to educate others to the existence of these policies. In our results, when asked about how they came to learn about the urban tree protection policies, it was not uncommon for respondents to say something like "heard about it from a friend", or "through word of mouth". So, if there is a lack of knowledge for these policies, then there will be less communication regarding these policies between residential actors.

For the questions in the survey that asked residents about their tree activities (plant, remove, or prune trees) on their properties in the next three years, similar trends were found that indicate gender, ownership, house type as household level variables that might influence tree maintenance activities. Residents that live in a detached, single family home rather than a semi-detached or townhome residence had a positive association with planting activities (Greene et al, 2012). This seems to be the case with the study neighbourhoods in this study – a majority of the respondents that said they planned to plant in the next three years also owned their houses. However a large percentage of respondents that also lived in single family, detached homes also stated that they were unlikely to plant or remove trees on their property in the near future.

Ownership of a private residential property is likely to have a positive association with tree planting (Greene et al, 2011). The pattern of ownership and tree maintenance activities was similar to the pattern with house type and tree maintenance activities. The majority of respondents that said they would plant in the near future owned their houses, but there were a greater percentage of respondents that also owned their houses and stated that they were not going to plant or remove trees on their properties in the next three years. Again, since this study selected for higher income neighbourhoods where residents were likely to have owned their houses, our results are more reflective of these individuals, and less reflective of residents that do not own their houses.

This study was limited in a couple of respects. Since we selected study neighbourhoods that were more likely to know about urban tree protection policies (i.e – older neighbourhoods

with higher canopy cover and average household income), results may not be entirely representative of all residents, such as those from middle income households. As well, neighbourhoods with a high percentage of single family, on the ground houses were selected, so our results are only representative of residents within those housing types. Further research will likely be required to better understand levels of knowledge for urban tree protection for residents from different income classes and with different housing types, which will provide a better picture of awareness for urban tree protection policies across different socioeconomic backgrounds.

Conclusions

This study aimed to gauge the levels of resident awareness of urban tree protection policies in the Greater Toronto Area (Mississauga, Brampton, and Toronto). As well, this study also set out to understand resident levels of support for the permit requirement, replacement tree requirements, and application cost as outlined in the three urban tree protection by-laws. Finally, residents plans to plant, remove, and prune trees on their property were also assessed, as well as if these plans had changed in response to an extreme ice storm event in December 2013 that caused widespread damage in our study area.

We found that overall, a majority of respondents were aware of the municipal urban tree protection policies in their respective neighbourhoods. Lack of awareness for urban tree protection by-laws might have a relationship with lower average canopy cover, as shown with the study neighbourhood in Brampton. Further research will be required to determine if this link between canopy cover and awareness of urban forestry efforts exists. Gender, house type, and house ownership were the household level variables that appeared to have an influence on resident knowledge of municipal urban tree protection policies. However more research will likely be required to determine whether these trends are existent or if they are perhaps a result of the ways that this study was structured (i.e – selected for study areas with higher average income and large percentage of single family houses).

This study found that residents in the selected neighbourhoods generally had one of two sentiments when asked about their support for the various requirements of the urban tree protection policies (permit requirement, replacement tree requirement, application cost). They

either thought that requirements were outlined as appropriate in the policies, or felt that tree removal activities on private residential property is not a municipal responsibility and should not be regulated by the city. There were no consistent trends between respondent levels of support for urban tree policy requirements.

Finally, this study found that residents were unlikely to plant new trees or prune existing trees in the next three years, but will likely prune them. When asked if these plans had changed as an outcome of the December 2013 ice storm, a large percentage of residents stated that their plans to plant, remove, and prune remained the same. Crosstabulation analyses revealed that gender, house type, house ownership, and income to be the household level demographics that had an influence on residents tree maintenance plans. Additional research will be required to fully understand levels of awareness and support for urban tree protection policies from residents that come from many different socioeconomic contexts.

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Appendix A– Response Rates for Household Level Demographic Information

Neighbourhoods	British Isles	European	South Asian	East and Southeast Asian	Caribbean	Canadian	Other
Brampton	42.60%	24.85%	6.51%	4.14%	6.51%	14.20%	6.51%
Mississauga	50.51%	43.43%	1.52%	2.53%	1.52%	11.11%	0.51%
Etobicoke	46.15%	47.51%	1.81%	3.62%	0.90%	6.33%	2.71%
North York	24.04%	41.53%	3.83%	19.67%	2.19%	7.65%	7.65%
Scarborough	47.51%	31.67%	2.71%	7.69%	4.07%	13.12%	1.81%

Table 1A: Percentages of respondent ethnicities.

Neighbourhoods	Born in Canada
Brampton	56%
Mississauga	81%
Etobicoke	75%
North York	55%
Scarborough	62%

Table 2A: Percentage of respondents born in Canada.

Neighbourhoods	Less than 1 Year	2 – 4 Years	5 – 9 Years	10 – 14 Years	15 – 19 Years	20 or more years
Brampton	2%	4%	12%	11%	13%	57%
Mississauga	0.49%	8%	13%	10%	14%	53%
Etobicoke	2%	7%	13%	17%	13%	48%
North York	0%	3%	14%	9%	11%	64%
Scarborough	1%	4%	14%	11%	12%	58%

Table 3A: Respondents' length of residence at their current homes.

Neighbourhoods	$0 – $29,000	$30,000- $59,000	$60,000 – $89,000	$90,000 – $119, 000	$120,000 – $149,000	$150,000 – $179,000	Over $180,000
Brampton	8%	30%	25%	17%	12%	4%	4%
Mississauga	5%	12%	16%	17%	11%	8%	31%
Etobicoke	4%	2%	10%	10%	13%	13%	48%
North York	1%	6%	15%	19%	13%	7%	40%
Scarborough	3%	15%	19%	18%	12%	13%	20%

Table 4A: Respondents' reported average household incomes.

	Number of family members aged 65+				
Neighbourhoods	0	1	2	3	4
Brampton	52.78%	14.44%	56.67%	2.78%	1.11%
Mississauga	56.28%	18.09%	25.13%	0.00%	0.50%
Etobicoke	48.47%	21.40%	28.38%	1.31%	0.44%
North York	42.78%	18.18%	39.04%	0.00%	0.00%
Scarborough	45.45%	16.02%	38.10%	0.43%	0.00%

Table 5A: Numbers of individuals aged 65 or older per household in each study neighbourhood.

	Number of family members ages 45 - 64				
Neighbourhoods	0	1	2	3	4
Brampton	39.08%	18.39%	88.51%	1.15%	0.57%
Mississauga	38.02%	18.23%	42.19%	1.04%	0.52%
Etobicoke	37.72%	17.98%	44.30%	0.00%	0.00%
North York	45.90%	17.49%	34.43%	1.64%	0.55%
Scarborough	39.91%	17.98%	41.67%	0.44%	0.00%

Table 6A: Numbers of individuals aged 45 - 64 per household in each study neighbourhood.

	Number of family members ages 18 - 44				
Neighbourhoods	0	1	2	3	4
Brampton	48.00%	19.43%	53.14%	7.43%	2.29%
Mississauga	53.68%	17.89%	24.74%	3.68%	0.00%
Etobicoke	57.64%	21.83%	17.47%	1.75%	1.31%
North York	61.33%	22.10%	8.84%	6.08%	1.66%
Scarborough	59.47%	23.79%	13.22%	2.64%	0.88%

Table 7A: Numbers of individuals aged 18 - 44 per household in each study neighbourhood.

	Number of family members age 18 and under				
Neighbourhoods	0	1	2	3	4
Brampton	75.53%	11.76%	29.41%	7.65%	1.18%
Mississauga	64.55%	13.76%	16.40%	4.23%	1.06%
Etobicoke	74.34%	10.62%	10.62%	3.10%	1.33%
North York	79.56%	5.52%	13.26%	1.66%	0.00%
Scarborough	80.27%	7.17%	8.97%	2.69%	0.90%

Table 8A: Numbers of individuals aged 18 and under per household in each study neighbourhood.