Truck Freight Generators & Attractors in the Province of Ontario

March 2014

McMASTER INSTITUTE FOR
TRANSPORTATION
& LOGISTICS

Truck Freight Generators & Attractors in the Province of Ontario

Mark R. Ferguson

Tom A. Lavery

Chris D. Higgins

McMaster Institute for Transportation and Logistics
McMaster University
Hamilton, Ontario

March 2014

mitl.mcmaster.ca

Acknowledgements

We at MITL would like to acknowledge our colleagues at the Ontario Ministry of Transportation (Julius Gorys, Matt Verrall, Rob Tardif and Shan Surershan) for their contributions and input to many aspects of this report. Thank you Gentlemen!

TABLE OF CONTENTS

Tables

Figures

EXECUTIVE SUMMARY

Highlights

- Movements that involve the GTA are prevalent across the vast majority of commodity types and communities across the province. The GTA accounts for about 2/3 of outgoing shipments in the province and about 1/2 of incoming shipments.
- 400 series highways play a critical role in the distribution of freight in Ontario and have played a large role in defining the locations of freight facilities.
- Massive development of significant truck generators in Ontario in recent decades, particularly in the GTA (Central) Region, has coincided with explosive suburban labour force growth in relevant goods movement sectors guided by the 400 series of highways and directed by zoning and planning regulations. Many of these highway sections are among Ontario's most congested.
- There are 19 freight clusters of note in Ontario as identified from trucking survey data. Ten of these are in the GTA Region and nine are outside it although many of the GTA clusters are extremely large. None of these significant clusters are in the northern regions.
- These 19 clusters cover only about 1700 square kilometres so generation of shipments and truck trips in Ontario is much more about spatial focus and concentration than it is about "sprawl."
- These clusters account for about 70% of all originating truck shipments in Ontario.
- At the micro-level, most generation of truck shipments is actually done by large numbers of small generators, many of which may not even generate shipments on a given day.
- Whether a community is an important generator or attractor of trips is a function largely of the extent to which they are production/distribution centres or not, especially from the generators perspective.
- Key trucking municipalities and counties generate proportionally more trucking shipments than they do trucking trips.
- Trucking outflow patterns for shipments from originating geographies are more heterogeneous than inflow patterns. This pattern seems to apply at provincial scales down to local/municipal scales. Likely this is because outflows are more tied to specialized production whereas inflows are more tied to generalized consumption.
- Outside of the GTA Region there are few issues with respect to the movement of freight or the capacity of the network to transport freight

- Important international trucking interactions (e.g. Windsor-Essex with Michigan) and inter-provincial movements (Eastern Ontario with Quebec) can partially be explained through simple proximity and distance decay effects.

- Movement of trucking freight in Ontario is better described as "hub and spoke" (with GTA region being the main hub) than as "hierarchical" but there are some elements of hierarchy. There is a definite urban hierarchy in Ontario but not so much a trucking freight movement hierarchy.

- Trucking shipment data in Ontario show clearly that denser, higher value/finished goods flow more "downstream" to the lower levels of the urban hierarchy while raw, bulk oriented goods flow more "upstream" to the higher levels in the urban hierarchy.

- There is a need for constant/updated road data/surveys given data survey gaps and the speed at which logistics practices are changing. Surveys such as TCOD and CVS differ in their methods/approaches and this generates unique insights but also unique strengths and weaknesses.

- From a policy perspective it is noted that many of the highway and related infrastructure investments that are being made in Ontario have been well-conceived. Constant vigilance is required though to ensure that metropolitan traffic congestion and its impact on trucking movements does not undermine the competiveness of the Ontario economy.

Detailed Summary

This report serves as an overview of patterns of truck trip and shipment generation and attraction in the Province of Ontario and also an examination of some of the data sources that have allowed to us to perform analysis on the topic. Based on a 2010 survey of for-hire carriers, Ontario gives rise to approximately 16.2 million trucking shipments annually and acts as a destination for nearly 14.2 million shipments. Ontario generates about 75% more shipments and receives about 50% more shipments than the next ranking province which is Alberta.

This study complements and supplements a 2010 Transport Canada study that examined the largest, typically GTA (Greater Toronto Area)-oriented and international, freight generators in the province. The current study is focused on trucking and has a lesser relative emphasis on international and GTA-associated freight movements than the prior study. There is a particular focus on truck generation patterns at the level of Ontario Ministry of Transportation (MTO) regions in this study; particularly on the GTA, West and East regions. Note that the GTA Region (also known as the Central Region) includes all of the Golden Horseshoe and extends north to Georgian Bay (See Figure 1-1). The two northern regions are largely grouped into one for the purposes of this study and even then are less significant in freight terms compared to the other regions. The prior study also dealt with a relatively small number of the largest freight generators in the province. As we necessarily are considering smaller generators in this study, there are many more of them to consider and also there is the issue that large numbers of small generators can create very significant flows.

The environment in which trucking operates has changed substantially in recent decades. Goods movement is less oriented to major transportation assets such as seaports and rail terminals than it used to be and more oriented to highway transportation infrastructure. Transport costs are less of a barrier than they used to be and more attention is paid to aspects like time and logistics costs. One implication has been a suburbanization of goods movement infrastructure to locations with the best highway accessibility ratios. This dispersion tendency is at odds with strong forces of agglomeration and clustering of freight activities which is fuelled primarily by a need to achieve scale economies. The outcome of both forces in Ontario has been the rise of intense trucking clusters in the outer edges of metropolitan areas.

Labour Force Evolution of Related Sectors

An historical overview of labour force evolution (1981-2011) across the main MTO regions and their constituents informs this characterization. The analysis shows that there has been explosive growth in the labour force in precisely those areas of Ontario most associated with heavy patterns of truck trip and shipment generation. In these three decades the labour forces of York and Peel Regions have quadrupled and tripled respectively and have done so off what were substantial bases in 1981. Meanwhile, other regions in the GTA such as Durham and Halton have more than doubled their labour forces. Highway orientation explains a lot about where firms have been choosing to locate (and in turn generate truck trips) and also where large numbers of people live. Explosive growth in the outer regions of the GTA has been the dominant theme for all of Ontario although growth has also occurred in the major urban centres of the West and East regions.

With regard to goods movement oriented sectors, consider the picture for manufacturing. In the period from 1991 to 2006 manufacturing employment declined in some of the “older” cities: Toronto (-25%), Hamilton (-20%) and in Niagara (-28%) but performed better in the outer GTA and West Region. Transportation and warehousing is showing strong growth over the fifteen years and this statement is generally true across the census divisions within the GTA region. Examples of this growth include: Peel (135%), York (98%), Durham (87%) and Halton (76%). There is comparable growth in wholesaling across most areas in the GTA as well. Overall there is evidence that the spatial balance of freight and logistics has shifted over time and is now more centralized to the GTA. Meanwhile, the balance within the GTA itself is less centralized.

Dispersion/Concentration of Truck Movements

Truck trip and shipment generation in Ontario is dispersed and concentrated at the same time depending on how it is measured. In spatial terms, about 70% of outgoing truck shipments originates from little more than 1,700 square kilometers of key trucking clusters that are defined at certain strategic locations in the province. This is only a fraction of one percent of the province’s land area. This small land mass is based on ten spatial clusters in the GTA Region, four in the West Region and five in the East Region. With some exceptions, these defined clusters should probably play a prominent part in any future survey efforts that would seek to further characterize some of the important generators of trucking activity that are located across the province. It was determined that any clusters in the two

northern MTO regions were considered as too insignificant to join this provincial list of prominent clusters. Location and proximity to major highways is a key defining element that is common to all the major trucking clusters in the Province with Hwy 401 being the highway associated with the most clusters.

In the context of the distinct business entities that generate demand for trucking services, the pattern is quite dispersed. A very large number of firms are capable of generating freight for trucking on any given day although many do not. In aggregate though, for a given day, the total amount of truck freight from small generators explains most shipments. Only about 5% of outgoing truck trips are from specific locations that generate 50 or more trips per day. About 90% of locations linked to specific addresses in this analysis generated less than five shipments per day.

The diversity of truck generators is captured in a chapter of this report that focuses on generation and attraction of truck movements at the micro-level. This type of analysis is shown to be useful for differentiating the performance and strengths/weaknesses of survey types and for illustrating the character of the areas from which trucks depart and arrive. Maps, supporting tables and satellite images are best reviewed personally by the reader to develop a sense of trucking hubs and clusters.

The results of this analysis tend to call into question the applicability of the term “freight sprawl” in the province of Ontario. If the term were to apply anywhere it would apply in the Peel Region mega-cluster of the GTA but even there the spatial extent is largely defined by existing highway rights-of-way. Analysis of this cluster reveals, however, that words such as focus, concentration and agglomeration are more indicative of what is really going on than the word “sprawl.” There are sound reasons based on economies of scale and economics that these intense clusters have developed. In other trucking clusters such as those of London, Windsor and Ottawa the spatial patterns just do not seem large enough or spread out enough for the term sprawl to apply.

Relative and Absolute Magnitudes by Geography

This research has provided insight into the relative and absolute magnitudes of truck trip and shipment generators in Ontario. Analysis at the spatial cluster level reveals that the Peel mega-cluster is ten times or more larger than most other clusters in the province as measured by the Trucking Commodity Origin Destination Survey (TCOD) or MTO Commercial Vehicle Survey (CVS). After the Peel cluster, there are about half a dozen other clusters in GTA region which are somewhat similar to one another in terms of magnitude although much smaller than Peel. Each member of this smaller tier of GTA clusters is larger than any of the other clusters outside GTA region. Overall, the GTA Region accounts for 2/3 of outgoing daily shipments and just over half of incoming truck shipments. The GTA accounts for about 55% of truck trips in general. The GTA also features by far the best links between trucking and other modes although the results of this analysis show that linkages with other modes account for only a small percentage of trucking trips. Truck trips are far more likely to end at some truck-specific facility.

Some clearly defined truck-based interaction patterns have emerged for the province. About two-thirds of intra-provincial flows are internal to MTO regions while the other one-third flow between MTO regions. The East region receives about three times as many trucking shipments from the GTA region

relative to the trucking shipments it generates for itself. Whether measured by trips or shipments, the dominant type of trucking movement in Ontario is between counties within the province. This category accounts for about 50% of trucking shipments in Ontario. However, some of the key freight counties such as Peel, Middlesex and Essex interact proportionally less with other Ontario counties. Inter-county flows may be important but it is interesting to note that most pairings of counties in Ontario do not generate any trucking flows between one another at all. The level of one shipment per day is not reached until the 60th percentile in the ranking of all flows between counties. The 95th percentile is at 62 shipments per day.

The CVS estimates a much lower level of inter-provincial trucking interaction via trips than the TCOD does via shipments (about 10% versus 17%). There are some interesting regional divergences as well. For GTA it is estimated that 27% of outgoing truck shipments are inter-provincial but only 5% of outgoing CVS trips. Apart from possible survey discrepancies, it suggests a preponderance of smaller, multiple shipments per truck for inter-provincial trips originating from the GTA origin. One other interesting result for the GTA region is that outgoing truck shipments are more inter-provincial whereas incoming shipments are more international.

The West Region, particularly Windsor, stands out for its high rate of international truck movements. About two-thirds of Windsor's truck trips are international. This statement applies to a lesser extent for the West Region as a whole, which is strongly linked to automotive supply chains. The East region stands out for the insignificance of Ottawa as a freight centre given its metropolitan size and also for its inter-provincial interactions primarily with Quebec which is in close proximity. Montreal and Quebec City are on the same natural axis of activity defined by Hwy 401 in Ontario. Ottawa suffers from the trucking perspective because it is fairly distant from this axis while Cornwall is right on it. While the GTA Region does not really stand out in relative terms for international and inter-provincial movements, it is a major player in absolute terms.

Heterogeneity of Trucking Patterns

This research has shown that trucking shipment patterns tend to be more heterogeneous than trip patterns. A statistic that supports this assertion is that a surprising 42% of truck movements captured in the CVS were empty trucks. It appears that measuring movement by trips thus results in a "smoother" and "less lumpy" picture than the one that emerges if focusing on shipments.

The research has shown that outgoing shipments and trips offer more discriminatory power in differentiating truck clusters than do incoming trips or shipments. This observation applies at the inter-provincial level and also at lower levels. Outgoing patterns are more heterogeneous with "higher highs" and "lower lows" in terms of the ranges in generation activity. There is less to choose between truck clusters when incoming statistics are used. Outflows are more closely linked to production whereas inflows are more associated with consumption; the latter of which is more widespread. Outlying regions are more heterogeneous in their truck generators than the core GTA ones. At the county level, the outlying regions have many more counties that generate tiny amounts of truck freight even as the larger

counties of the outlying regions are not so prominent as the likes of Peel and York. At the municipal level, there are several in even the GTA that generate and receive less than 500 trips per day.

Trucking Hierarchies

Provincial counties were grouped into four classes based on the number of annual shipments that each sends out. The top class includes a handful of Ontario counties that send out over 1 million trucking shipments per year. Class 2 covers ten counties that generate over 250,000 shipments while Class 3 covers nine that are between 100,000 and 250,000. A remaining 25 counties generate less than 100,000 shipments per year. A full 70% of trucking shipments in the province are associated with movements between and within the Class 1 and Class 2 counties.

In terms of the character of trucking shipment movements, there is a clear pattern of hierarchy in place between these classes. In every pairing of trucking classes, more trucking revenue is always generated in aggregate in the movements from "higher" to "lower" class counties than is the case for the reverse movements between the same classes. A similar pattern is in place regarding number of shipments with a number of the major trucking centres in the province generating proportionally more shipments than they do trips. The pattern breaks down with respect to tonnages. Tonnages moving back and forth between and within the classes are far closer to equivalence. It appears that trucking hierarchies are best identified through revenue and shipments.

Tonnages cloud the identification of trucking hierarchies and it appears that something similar is true of truck trips as captured through the MTO commercial vehicle survey. There is no doubt that the GTA acts as the major truck trip hub that serves other locales in the province. It boasts large "spoked" interactions with most every municipality/county in the province. Interactions that are small for the GTA are often relatively much larger and significant for the entity at the "other end of the spoke." The best examples of second order generators in the province that interact independently of the GTA and with surrounding smaller centres are London and Windsor. Overall though, in terms of truck trips, the hub and spoke paradigm is more prevalent than the hierarchical one.

Trucking Surveys

This study provides an overview of survey types that have been used to assemble trucking data for Ontario. The MTO commercial vehicle survey is a large intercept survey which conducts nearly 100,000 roadside interviews when it is carried out approximately every six years. 2006 data are used for this analysis. Two versions of the Trucking Commodity Origin Destination Survey are utilized. A 2010 data set captures a national origin-destination matrix at the county level. A 2011 data set is spatially more disaggregated and captures shipment originations and arrivals at the six-digit postal code level. TCOD data are collected by Statistics Canada and mostly involve systematic sampling of actual shipping documents for trucking firms. Low revenue firms and the shipments of private fleets are entirely uncaptured by TCOD.

The key surveys have their problems in the context of this research topic. Because the CVS intercepts trucks only on provincial highways there are some fairly glaring examples in this research that shorter

distance truck trips are getting badly under-represented. Meanwhile, the most troubling aspects of the TCOD data show up at the micro-level when considering the patterns in certain small areas. In particular, there are instances where shipment generation appears to be attributed to head offices and not the actual shipment originations. Certain downtown locations show up as important in TCOD that do not seem too plausible and which are not confirmed by CVS results. Omissions of private fleets cause key freight facilities in Cornwall, for example, to be overlooked by TCOD.

While both surveys and their associated data have deficiencies, using the two in conjunction offers a powerful means of small area analysis of freight generation. Other data sets, that are not strictly freight oriented, have only so much to offer. Direct marketing oriented databases (such as InfoCanada) that identify firms and offer locational information offer most utility for the identification of future survey targets and can be used to characterize the "flavour" of firms located in certain freight clusters. Such databases also suffer from "head office" problems and have trouble capturing the "footprint" of a firm's multiple location facilities.

Among other aspects covered in a concluding section is the potential to design a trucking based survey to fill in some knowledge gaps about truck generators province-wide. This survey would offer insights across relevant economic sectors and consider gaps in other surveys along with potential benefits of freight clustering in some of the provinces secondary generators.

Policy Implications

The implications of this study for provincial policy were broken down by MTO region. In general, the largest policy issue is the impact of traffic congestion on the movement of trucks. Over time this can reduce productivity of existing firms, trigger an exodus of existing firms and/or act as a strong disincentive against new investments. By far the largest congestion issues are experienced in GTA Region with some spillover into the West Region and at the Michigan border. East Region and the two northern MTO regions are seen as particularly unimpacted by congestion but it is noted that vigilance is required to keep highway infrastructure functioning at a high level for all 400 series highways across the province and for select other provincial highways utilized extensively by trucks.

The extent to which the provincial economy is dependent on truck movements cannot be overstated and high quality highway infrastructure is at the core of allowing goods to flow freely. Many of the services that trucks provide cannot be fulfilled by other freight modes.

In terms of other policy observations made:

- There is a need to prepare and plan well for the new trucking clusters of the future which are likely to develop towards the edges of the GTA region or on the eastern edge of West Region in particular. Comprehensive and frequent data collection will compose an integral part of this preparation.

- The need to educate the public about the importance and value to our economy of truck movements was noted along with the current tendency of the public not to be sympathetic to the needs of the trucking mode.
- The province needs to work with other jurisdictions and levels of government on behalf of the trucking mode. For all regions, the proper interactions are required with municipalities to ensure good access to key provincial roads and with Quebec to ensure smooth operation of the Hwy 401 corridor in particular.
- In general it is noted with approval that many of the highway and related infrastructure improvements that are taking place are exactly the ones that should be taking place. In particular, efforts to invest in highways in the Golden Horseshoe region and in the Ontario-Michigan border region are necessary and appropriate to assist in the maintenance and new development of truck generators.

1

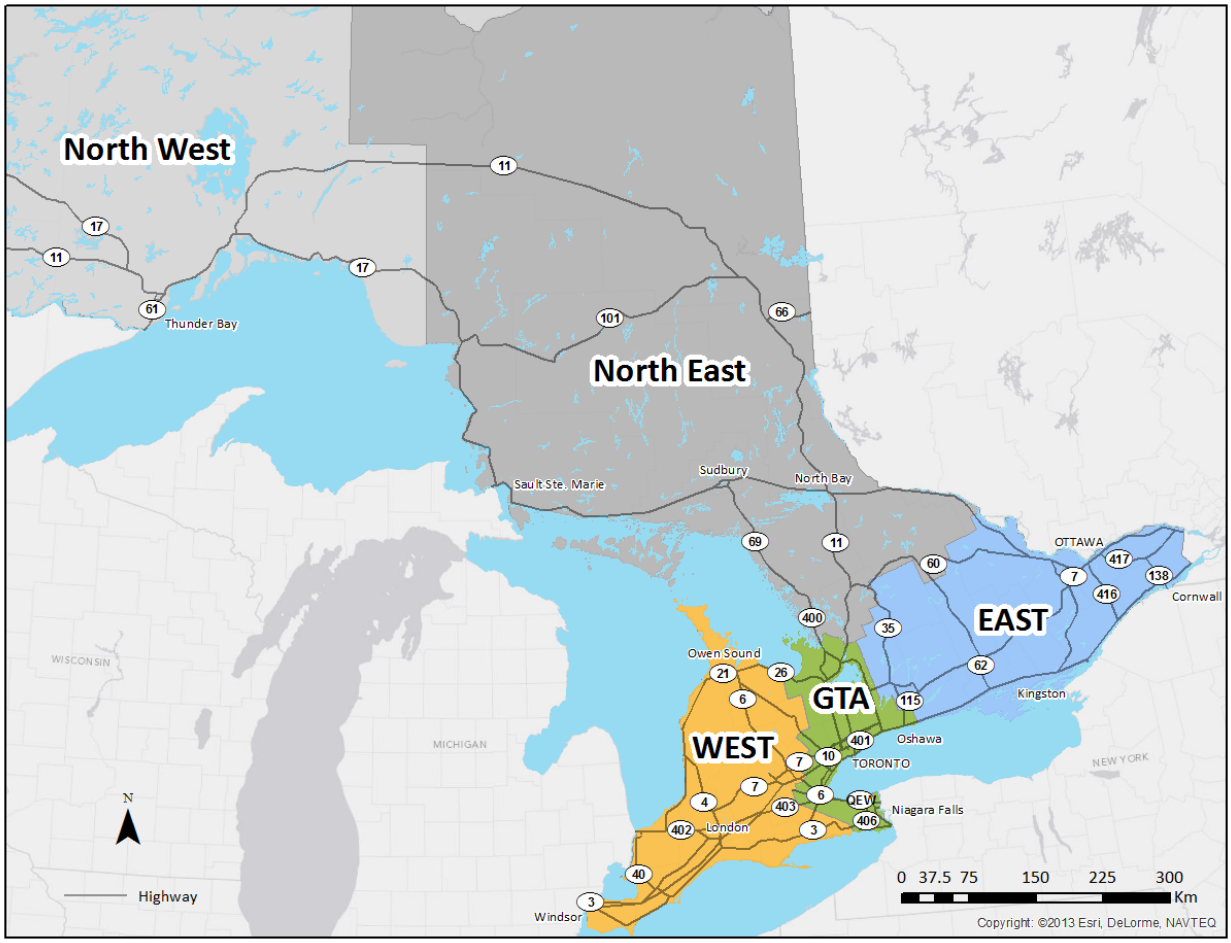
Introduction and Background

The movement of goods is an increasingly important part of Ontario's diverse economic base, with approximately 38 percent of the province's GDP derived from sectors that are considered goods movement intensive. International trade is a critical part of this, responsible for 25 percent of the Ontario economy and supporting nearly 2 million jobs. Though the province maintains a robust intermodal goods movement transportation network, road transportation remains the most essential element in freight and logistics, responsible for over 77 percent of the total tonnage of freight movements (MTO, 2012). Given the significant role of truck freight to Ontario's economic base, understanding how this sector operates and interacts within the province is of great importance for public and industry actors interested in identifying strengths and weaknesses in Ontario's goods movement networks and exploring ways of promoting efficiencies for maintaining and improving the province's competitiveness.

The main purpose of this study is to characterize the nature of truck-trip generators/attractors in the Province of Ontario. The research exploits available data sets to differentiate Ontario counties/ municipalities in terms of their ability to generate or receive truck trips and associated shipments. In addition, efforts are made to understand truck interaction patterns between population centres within the province as well as with other provinces and international locations. Finally, major origins and

destinations of truck traffic in Ontario are examined at the postal code/address level to develop some understanding of localized patterns within larger generators/attractors.

Figure 1-1: Ontario Ministry of Transportation Regions



A secondary objective of this research is to supplement and add additional insight to an extensive study (Transport Canada, 2010) that was carried out to assess major freight generators in the province of Ontario. As it turned out, the largest of the freight generators in the province are very much associated with certain key locations within the Greater Toronto Area. This is no surprise, as the GTA is home to significant transportation, warehousing, and logistics operations and a number of important intermodal and transload facilities and consequently accounts for a majority of freight generators in the province. Given the emphasis on major, often internationally-oriented, facilities in the prior study, there is more of a focus here in giving equal weight to each Ontario Ministry of Transportation region (see **Figure 1-1**). In the prior study, as it turned out, there were few or no freight generators or industrial clusters discussed in non-GTA regions. While perhaps not as dominant in a provincial/international context, some significant truck trip generators in these outlying regions will be discussed in this report. In addition, information about some of the key GTA clusters will be presented in a manner complimentary to the previous study.

The focus here is on trucking, partly because of available data and partly because trucking is of critical importance in the operation of secondary freight generators. Trucking is very relevant to all levels of the urban hierarchy (not just secondary generators) and the ability of trucks to move goods between nearly infinite combinations of origins and destinations is unmatched by the other modes.

A third objective of this report is to provide an overview of survey methodologies that have given rise to the data sets that are analyzed here. Different survey approaches have different strengths and weaknesses and reveal distinct elements of freight generation. We also examine the complementary role of other data types in getting the most out of freight data.

A fourth objective of this research will be to examine truck freight flows in the province of Ontario through the conceptual lens of regional freight flows and transportation corridors and the functional hierarchy of urban areas within a complex system of global, regional, and local freight and logistics. As such this report represents a confluence of a theoretical background based on a literature survey and basic empirical analysis of trucking data that are available in Ontario. Finally, a fifth objective will be to point out some directions for future research based on the learnings of this report.

To reach the objectives outlined above, a suitable document structure has been developed and is briefly described here. This initial chapter ends with two sub-sections of useful background analysis to help put the central research topic in context. Section 1.1 briefly examines ground freight in the Canadian/North American contexts and compares trucking and rail using some basic statistics. Rail is trucking's main competitor for longer distance freight movement on the continent. Section 1.2 provides a detailed overview of how the Ontario labour force has evolved census-by-census since 1981 and offers a particular emphasis on the evolution of goods movement sectors. An understanding of this evolution is very helpful for understanding present day freight/trucking clusters in Ontario, many of which have really developed in that time span.

Chapter 2 offers an overview of the Ontario-specific data sources that have been available for this research and offers some commentary on their relative strengths and weaknesses. Chapter 3 focuses on the measurement of truck shipment/trip generation and attraction at the level of the county and municipality. What are the aggregate inflows and what are the aggregate outflows? How do the regions and their components compare? How important are intra-provincial flows relative to movements outside the province? How do other variables improve our understanding of trucking activity? Chapter 4 focuses on the specific theme of spatial interaction of trucking flows with an emphasis on intra-provincial movements. In addition to the inter-County analysis, an assessment of interaction by class in the freight hierarchy is made. Chapter 5 is all about truck trip and shipment generation at the sub-municipal level. This is an intensive collection of maps and satellite images overlaid with survey data that highlight the nature of generators/attractors at the smallest levels of geography. Finally, Chapter 6 offers some concluding remarks to tie all the research components together.

The Appendices are an integral part of this document. Appendix 7.1 is titled "Transport Costs and the Spatial Organization of Freight and Logistics" and offers a more theoretical discussion on the

organization of freight and logistics activities mostly in the North American context. Issues such as agglomeration and dispersion in the spatial organization of urban freight and logistics, the changing nature of globalized freight flows, and the orientation of these flows within urban regions and along transportation corridors are covered. This major appendix provides some important context to better understand the role of trucking in North American supply chains. Finally, Appendix 7.2 offers some supplementary tables and figures.

1.1 Ground Freight in the Canadian/North American Contexts

Before focusing in on localized trucking contexts in Ontario, it is worthwhile to consider ground transportation of freight in national and international contexts and also to consider the role of rail which is the primary ground competitor to trucking.

Figure 1-2 outlines fundamental characteristics of rail and truck movements based on a national tabulation of data from the 2007 U.S. Commodity Flow Survey. The bar charts are associated with tonnages moved by distance of shipment while the line graph highlights aggregate value of goods moved for those same distance bands. Note that the trucking graph and the rail graph have quite different vertical axes as the aggregate tonnages associated with truck are much larger, particularly for distances less than 500 miles. In the U.S. in 2007, trucks moved more than four times the tonnage that rail did. Contributions of private trucking (by firms not primarily in the business of moving goods) are highlighted by the green bars. The results suggest that private trucking is primarily a shorter distance phenomenon. The line graph for trucking and the pie chart for trucking indicate that the road mode is particularly associated with the transport of high value goods relative to rail. One other interesting aside from the U.S. Commodity Flow Survey is that 78% of the tonnage associated with shipments of all types travels less than 250 miles.

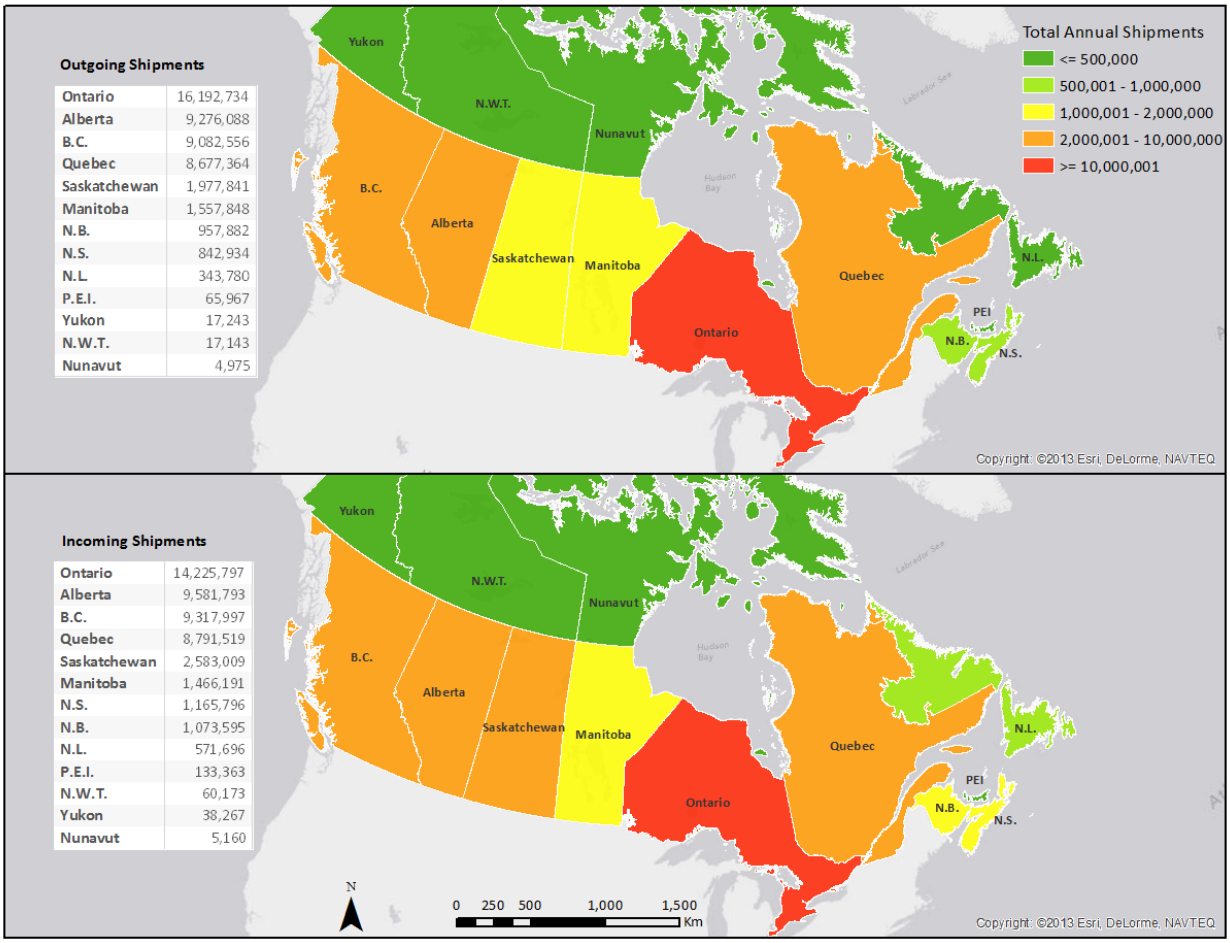
The distance profile for rail is fundamentally different from trucking with most of the activity taking place over distances greater than 100 miles; for trucking, most of the tonnage activity is less than 100 miles. Nonetheless, long distance trucking movements in the U.S. are significant. While trucks move a lot more tonnage in the U.S., the "aggregate work" in freight movement is best measured through tonne-miles (tonne-km in Canada). In this regard, rail has the advantage at about 1.5 trillion ton-miles while truck is at 1.4 trillion ton-miles. These general patterns are applicable in Canada also as outlined below.

Figure 1-3 provides annual estimates of trucking shipment originations and arrivals by Province for the Year 2010 (including international and domestic shipments). The estimates are based on the Trucking Commodity Origin Destination (TCOD) Survey and the results suggest that Ontario is a major trucking centre in the Canadian Context. The Province gives rise to approximately 16.2 million trucking shipments annually and acts as a destination for nearly 14.2 million shipments. These shipment counts will be underestimated on the basis that the TCOD is focused on for-hire trucking activity of domestic firms above a certain size threshold. Ontario generates about 75% more shipments and receives about 50% more shipments than the next ranking province which is Alberta.

Figure 1-2: Comparisons between Trucking and Rail

Source: 2007 US Commodity Flow Survey

Figure 1-3: Annual Provincial Truck Shipment Originations and Arrivals by Province



Source: Statistics Canada, 2010 Trucking Commodity Origin-Destination Survey

Table 1-1 offers some further data to complement **Figure 1-3**. According to the TCOD data, trucking accounts for 125 billion tonne-km in shipments that remain within Canada. The total for all types of trucking would be significantly higher if private fleets were included as well as tonne-km associated with international shipments. A peak year for rail usage in Canada was 2005 and it was associated with 370 million tonnes of cargo and 352 billion tonne-km. Based on these data, as in the U.S., rail does the majority of the aggregate effort in moving freight but trucking is associated with higher tonnages. The comparative results suggest that rail is relatively more important in Canada than it is in the United States. This outcome probably has something to do with long distances that need to be covered in Canada without many intervening population centres of significant scale. With regard purely to trucking patterns, international movements account for approximately 25% of Ontario-related truck tonnages as can be derived from **Table 1-1**. Greater detail on how this comes about is provided in Chapter 3.

Table 1-1: Selected Trucking and Rail Usage Statistics

Mode	Shipment Type	Shipments (millions)	Tonnes (millions)	Tonne - km (billions)
Truck	Internal to Canada	49.5	473	125.0
	Intra-Ontario	12.1	119.4	15.0
	Canada to International	4.3	41.0	43.3
	Ontario to International	2.6	22.5	18.0
	International to Canada	5.0	36.6	43.3
	International to Ontario	2.7	21.8	20.7
Rail	Inter-provincial	3.0*	370.0	352.0
	Intra-Ontario	-	2.6	-
	Canada to International	-	50.0	-
	Ontario to International	-	8.4	-
	International to Canada	-	29.0	-
	International to Ontario	-	5.5	-

* 2011 Estimated number of rail cars for non-intermodal traffic

Sources: 2010 TCOD Survey, 2011 Monthly Railway Carloadings (StatsCan) and 2009 Rail In Canada (StatsCan)

1.2 A Shifting Centre of Gravity

In order to set up the research, this report first conducts a longitudinal analysis of the evolution of freight and logistics in the GTA and other regions. MITL has collected personal industrial occupation information at the Census Division level from the Canadian Census for the years 1981, 1986, 1991, 1996, 2001, 2006 and 2011, and its analysis provides some insight into the evolving roles of these areas within the broader region over time. This information is very much correlated to the development of truck generators over time as well. For some clarification on the locations of specific counties/census divisions see **Figure A.7-4** in the appendix.

These census numbers are reflective of the census division in which the individual employee's residence is located and not the location of their workplace. However, previous research has noted that the decentralization of people and jobs has been a simultaneous and self-reinforcing process in the GTA since the 1950s (Donald, 2002) with employers following their employees to suburban areas and vice versa. We would thus expect these numbers to be indicative of broad shifts in the industrial composition of the region. Furthermore, this approach is the only way to realize a detailed analysis of the industrial divisions in question as information on an individual's workplace location is not available for these years from Statistics Canada. The Canadian Business Patterns data, which might be an alternative, does not extend nearly so far back in time.

Table 1-2: Evolution of Total Labour Force by Region (1981-2011)

-11.40%

1,207,560	1,274,505	1,287,950	1,231,295	1,320,380	1,344,830	1,399,985
271,780	346,455	433,460	476,445	564,190	651,200	711,175
133,035	195,005	288,655	319,335	405,905	500,060	569,895
144,220	176,665	227,795	243,950	279,585	313,870	337,945
208,760	219,285	236,880	232,120	248,225	263,600	266,200
179,475	188,135	202,260	200,020	210,360	225,985	221,210
137,000	154,220	183,155	191,750	213,020	249,765	281,625
109,220	122,425	153,780	167,585	198,605	230,795	238,465
162,215	181,860	212,455	220,920	245,965	272,530	283,680
168,830	182,805	207,310	205,545	216,470	231,410	235,400
147,805	160,780	166,685	178,450	195,510	203,770	186,555
66,615	74,995	88,810	93,735	105,095	114,470	117,480
60,175	63,630	66,990	64,380	64,650	67,450	62,155
51,205	53,465	57,470	57,620	62,230	67,710	71,015
51,050	54,590	57,440	55,630	55,745	57,430	50,885
43,920	46,080	51,635	52,205	55,300	57,820	56,640
42,995	44,065	49,195	50,670	52,910	56,610	56,905
35,510	37,270	43,235	44,460	45,610	48,880	48,085
34,185	35,925	39,360	40,370	41,975	45,695	44,465
33,610	35,155	37,935	39,215	41,460	42,515	42,455
27,530	27,775	33,070	33,050	32,970	34,620	33,990
26,235	27,835	30,255	30,380	31,755	32,105	31,525
15,330	17,335	22,430	24,805	28,360	31,130	31,915
300,645	348,890	395,005	395,895	432,325	456,475	498,370
55,010	61,190	69,735	69,715	71,525	75,205	78,855
49,370	52,245	59,380	59,225	62,100	68,870	67,445
50,785	53,845	58,535	56,405	61,660	65,990	66,330
46,870	50,050	54,400	53,855	53,800	55,245	55,470
39,890	43,685	46,880	48,915	48,915	51,515	51,190
40,945	43,890	45,900	47,395	46,880	49,645	51,785
30,045	33,130	39,760	39,845	38,060	40,575	41,365
23,590	27,820	34,860	37,620	41,135	44,045	47,930
21,735	24,190	30,815	31,315	33,530	37,775	36,130
21,860	25,005	27,615	29,925	31,700	33,645	34,755
15,205	16,940	18,705	19,035	19,540	20,415	20,815
10,335	10,835	11,815	12,275	11,820	12,570	11,890
77,515	80,595	83,920	81,125	77,725	77,775	74,610
72,785	72,930	82,810	81,310	77,500	81,620	83,680
64,285	64,000	61,550	58,440	55,365	56,380	55,520
43,000	44,280	45,510	44,850	41,715	41,365	39,980
36,335	37,430	41,215	40,165	39,625	41,875	42,540
26,095	26,365	28,790	30,345	30,455	31,340	27,920
17,585	19,300	23,995	24,595	26,330	30,430	29,335
14,075	15,190	17,945	18,545	19,045	19,950	20,345
17,735	18,395	18,315	17,525	16,135	16,085	15,525
11,190	11,510	12,735	11,690	10,585	10,065	10,115
10,315	11,150	11,285	11,460	10,910	10,935	9,810
4,455,460	4,913,120	5,499,685	5,575,405	6,074,655	6,574,040	6,851,360

Our initial focus is on the total labour force as this provides the best uninterrupted picture of the changes from 1981. Industry re-classifications have complicated specific sectoral comparisons over that time frame and this will be described further below. In **Table 1-2**, the labour force counts (aged 15 years and over) per census period and county are shown from 1981 to 2011. The 2011 data has been added for the sake of completeness and to reflect some of the dramatic economic events between 2006 and 2011. The 2011 data are based on newly released results from the National Household Survey which has replaced the long census form from prior years. A table similar to **Table 1-2** has been developed to show the actual percentage changes between each time period. This can be seen in **Table A.7-1**.

The biggest gains in labour force are in the outer regional municipalities of the GTA. Not only are they leading in absolute changes, they are also leading in percentage changes. The latter is impressive since they began from a substantial base. Since 1981, the Peel labour force has almost tripled, York's has quadrupled, Durham's has more than doubled and so have Halton's and Simcoe's. The massive growth is testament to the strength of the underlying trends, such as decentralization of freight activities that have been in place. Certainly, there is a lot more trucking activity in this outer layer of regions than there used to be (not directly shown by this data). Some of it may have moved in from elsewhere but most of it has grown in place with the evolution of supply chains as discussed in Chapter 2.

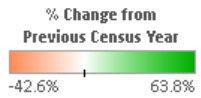
In contrast, the historic urban centres of the Cities of Toronto and Hamilton grew at a much slower pace, though Toronto maintains by far the largest share of the total labour force. Outside of the GTA, census divisions in the west such as Essex, Middlesex, Waterloo, and Wellington (associated with Windsor, London, Waterloo, and Guelph respectively) recorded significant gains. In the east, Ottawa and surrounding counties such as Prescott and Russell and Lanark as well as the Kawartha Lakes all saw considerable growth.

Anemic growth and contraction is also a prominent theme in **Table 1-2**. There are six counties in the north that have smaller labour forces now than in 1981 and one in the West Region (Chatham-Kent) that shows a decline. In the case of the north, losses in primary industries are to blame. In contrast others in the north, Sudbury and Nipissing have fluctuated over time while Muskoka and Parry Sound both saw sizable gains though each remains relatively small in total. Finally, there are numerous counties (with representatives from each region) that show rather modest growth given the thirty-year time span involved.

There is interesting information to be gleaned beyond comparing 1981 to 2006. Data for Stormont, Dundas, and Glengarry (the county home to Cornwall) show two distinct periods of growth, the first between 1986 and 1991, and the second between 2001 and 2006, both of which are separated by years of slight losses. This pattern is repeated for many smaller counties, with a large jump in the total labour force between 1986-1991 followed by stagnation or contraction over the next decade. This pattern has a lot to do with a struggling Canadian dollar in the 1990's and a decline in prices of many important commodities. The resource boom of the last decade, fuelled largely by Asian growth, caused a revival in some counties. The recent economic malaise is clearly evident in comparing 2011 to 2006. The West and North Regions have been hit particularly hard while the GTA region, measured in terms of labour force, has continued to grow at significant rates through the whole episode.

Figure 1-4: Evolution of the Freight-Related Labour Force (GTA Region)

County	Industry	1991	1996	2001	2006
Toronto	Manufacturing	206,125	182,620	186,875	153,705
	Construction	73,895	51,500	56,550	63,225
	Trans & Warehousing	36,920	32,390	50,340	51,325
	Primary Production	6,240	4,620	2,650	4,165
	Wholesale	58,145	60,895	60,575	61,535
Peel	Manufacturing	94,400	96,920	110,125	111,535
	Construction	26,755	22,045	27,610	33,720
	Trans & Warehousing	23,915	27,395	44,875	56,090
	Primary Production	4,375	3,475	2,640	3,220
	Wholesale	26,750	40,670	44,555	49,770
York	Manufacturing	43,995	45,605	57,225	65,310
	Construction	23,665	21,550	25,495	32,680
	Trans & Warehousing	8,545	8,850	13,635	16,910
	Primary Production	4,580	3,240	2,495	3,100
	Wholesale	16,565	23,505	28,535	33,220
Durham	Manufacturing	47,555	45,880	45,575	40,530
	Construction	14,435	12,760	16,615	20,755
	Trans & Warehousing	7,405	8,735	12,020	13,875
	Primary Production	5,120	4,525	3,785	3,395
	Wholesale	9,475	12,695	14,065	16,045
Hamilton	Manufacturing	52,885	46,995	49,005	42,525
	Construction	16,610	12,455	14,960	17,485
	Trans & Warehousing	6,590	7,255	10,880	11,740
	Primary Production	4,750	4,495	3,635	4,155
	Wholesale	9,855	10,705	10,605	12,020
Niagara	Manufacturing	42,085	38,360	36,545	30,505
	Construction	14,265	10,795	11,990	14,090
	Trans & Warehousing	6,580	6,665	9,425	10,445
	Primary Production	8,430	7,820	7,355	7,095
	Wholesale	7,345	8,315	8,110	8,610
Halton	Manufacturing	35,545	33,235	32,150	31,635
	Construction	10,465	8,085	9,385	12,060
	Trans & Warehousing	6,915	7,590	10,730	12,145
	Primary Production	3,375	2,870	2,520	2,620
	Wholesale	11,075	14,760	15,460	18,915
Simcoe	Manufacturing	26,660	28,320	34,725	34,205
	Construction	13,085	11,415	15,435	19,490
	Trans & Warehousing	5,940	7,050	9,710	10,835
	Primary Production	5,965	5,460	4,680	4,305
	Wholesale	7,255	8,515	9,170	10,670
Total		1,034,535	991,035	1,112,715	1,149,660



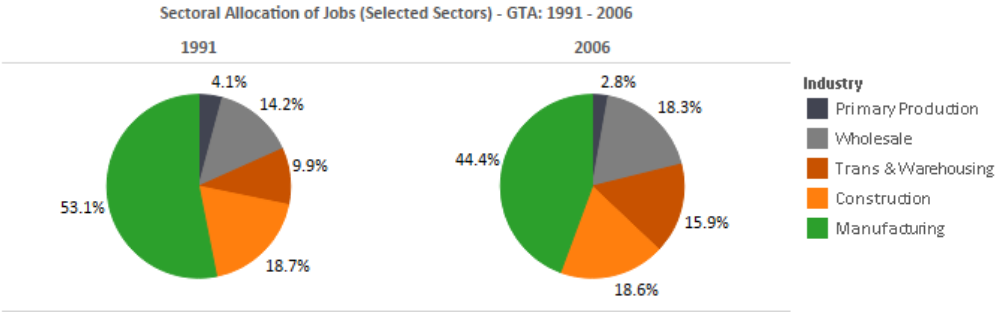
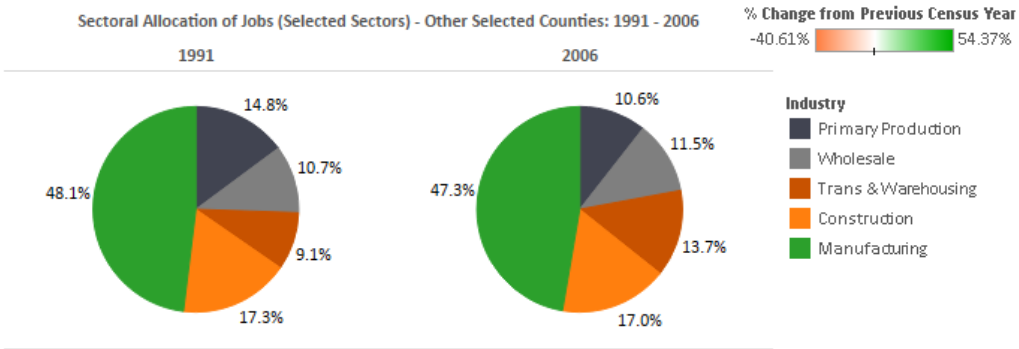


Figure 1-5: Evolution of the Freight-Related Labour Force (Other Regions)

Region	County	Industry	1991	1996	2001	2006
WEST	Waterloo	Manufacturing	54,095	56,870	62,390	60,370
		Construction	14,270	11,185	14,010	16,600
		Trans & Warehousing	5,550	6,790	10,075	11,045
		Primary Production	5,185	4,580	3,820	3,810
		Wholesale	10,575	11,015	11,640	13,900
	Essex	Manufacturing	45,450	48,765	54,115	47,475
		Construction	8,405	9,095	9,375	9,800
		Trans & Warehousing	5,000	4,975	7,680	8,800
		Primary Production	5,840	6,475	7,395	7,460
		Wholesale	5,065	5,590	5,230	5,900
	Middlesex	Manufacturing	30,350	30,040	31,595	31,300
		Construction	13,525	11,060	11,765	13,495
		Trans & Warehousing	5,575	5,970	9,115	9,595
		Primary Production	7,340	6,700	5,415	5,085
		Wholesale	9,180	10,140	9,535	9,650
	Wellington	Manufacturing	19,380	22,185	24,670	25,405
		Construction	6,025	4,480	5,855	6,470
		Trans & Warehousing	2,470	3,290	4,285	4,625
		Primary Production	6,175	5,650	4,575	4,690
		Wholesale	3,485	4,660	4,815	5,395
	Oxford	Manufacturing	12,085	12,120	13,110	13,650
		Construction	2,495	2,320	2,820	3,110
		Trans & Warehousing	1,875	2,275	3,210	3,505
		Primary Production	6,200	6,150	5,075	4,190
		Wholesale	2,290	2,745	2,460	2,650
	Brant	Manufacturing	13,855	14,280	15,950	14,225
		Construction	3,505	2,445	3,295	4,085
		Trans & Warehousing	1,700	2,205	2,650	3,245
		Primary Production	2,665	2,235	2,055	1,905
		Wholesale	3,340	2,925	2,975	3,585
	Haldimand Norfolk	Manufacturing	8,510	10,160	10,660	11,015
		Construction	3,620	2,720	3,490	3,845
		Trans & Warehousing	1,910	2,235	3,025	3,245
		Primary Production	8,555	8,200	7,160	5,830
		Wholesale	2,205	2,050	2,065	2,165
	Chatham Kent	Manufacturing	13,395	13,405	12,895	11,785
		Construction	2,955	2,465	2,945	2,770
		Trans & Warehousing	1,705	1,840	2,415	2,970
		Primary Production	6,315	5,145	4,710	4,145
		Wholesale	2,055	2,655	2,305	2,245
WEST	Lambton	Manufacturing	12,795	10,945	10,085	9,760
		Construction	5,865	4,655	4,880	5,180
		Trans & Warehousing	2,375	2,605	3,055	3,140
		Primary Production	5,005	4,365	3,760	3,725
		Wholesale	2,760	2,370	1,835	1,910
	Elgin	Manufacturing	9,070	9,345	10,445	10,855
		Construction	2,250	2,030	2,130	2,505
		Trans & Warehousing	1,520	1,775	2,730	2,945
		Primary Production	4,785	4,310	3,705	3,245
		Wholesale	1,635	1,735	1,415	1,655
	Perth	Manufacturing	8,975	9,580	10,290	9,285
		Construction	2,485	2,290	2,480	2,710
		Trans & Warehousing	980	1,445	1,635	1,900
		Primary Production	5,270	5,050	4,450	4,170
		Wholesale	1,430	1,445	1,705	2,220
EAST	Ottawa	Manufacturing	22,215	26,720	35,275	20,950
		Construction	19,315	15,955	16,325	18,030
		Trans & Warehousing	9,785	10,745	14,705	14,775
		Primary Production	4,470	3,955	2,650	2,910
		Wholesale	10,045	12,440	10,045	11,515
	Stormont, Dundas and Glengarry	Manufacturing	10,190	9,630	10,410	8,115
		Construction	3,965	3,420	3,430	3,875
		Trans & Warehousing	2,695	2,455	3,695	3,755
		Primary Production	4,475	3,680	3,400	2,715
		Wholesale	2,200	2,110	1,690	2,030
	Hastings	Manufacturing	9,850	8,725	9,715	9,220
		Construction	3,920	2,940	3,505	4,270
		Trans & Warehousing	2,415	2,255	3,400	3,505
		Primary Production	2,255	2,435	2,120	2,030
		Wholesale	2,270	2,185	2,375	1,910
NORTH	Thunder Bay	Manufacturing	11,030	9,790	9,545	7,205
		Construction	5,155	5,000	4,220	4,030
		Trans & Warehousing	5,500	5,360	5,075	4,630
		Primary Production	5,430	5,150	4,585	4,030
		Wholesale	2,800	2,655	2,075	2,045
	Greater Sudbury	Manufacturing	6,360	4,960	4,865	4,770
		Construction	5,855	4,905	4,410	5,145
		Trans & Warehousing	3,345	3,445	3,840	3,645
		Primary Production	8,795	7,880	5,370	6,015
		Wholesale	2,835	3,340	2,470	3,020
Total			598,545	596,170	636,420	624,380



The first part of this sub-section gives a good overall perspective but now we focus on changes in specific freight-oriented sectors. As was indicated above, there are some important methodological observations to be made concerning the data at hand. The classification of industry divisions has changed between census blocks, with 8 divisions for 1981-1986, 18 for 1991-1996, and 20 for 2001-2006 based on two-digit NAICS codes. As such, a full longitudinal analysis of complete industrial occupational divisions is not possible, though the sectors of interest here have to some degree remained static across time. For example, primary production, manufacturing, and construction are essentially unchanged while other divisions such as finance, insurance, and real estate (FIRE) and services can be aggregated to conceptually match the divisions of the 1981 census. Information on wholesale, utilities, and transportation and warehousing employment is not available from the censuses of the 1980s as they are combined with other sectors. It is not until the 1990s onward that the wholesale and transportation and warehousing sectors can be examined over time. Unfortunately the utilities sector is not included as it is not isolated until the 2001 census and beyond. As a result, for this second analysis, we focus on the time period from 1991 to 2006.

Figure 1-4 shows the evolution, in terms of employed labour, of the key sectors in GTA region while **Figure 1-5** does the same for the other regions. The pie charts of **Figure 1-4** are effective in showing overall relative declines in key sectors such as manufacturing while the tables of the same figure show the absolute and relative manufacturing declines in places such as Toronto (-25%), Hamilton (-20%) and Niagara (-28%) between 1991 and 2006. Peel, York and Simcoe show significant manufacturing growth which overwhelms any secular decline that might have taken place overall. Primary production is also showing declines in general. Transportation and warehousing is showing strong growth over the fifteen years and this statement is generally true across the census divisions within the GTA region. Examples of this growth include: Peel (135%), York (98%), Durham (87%) and Halton (76%). There is comparable growth in wholesaling across most areas in the GTHA as well, although the Hamilton result is more modest in this regard at 22% growth.

In **Figure 1-5**, which shows the non-GTA regions, one of the most interesting results is the relative stability of the manufacturing sector in the West Region where most of the counties are showing modest growth. In the East and North regions there are mostly declines. Of all the sectors, transportation and warehousing is the one that shows the most consistent and sizable growth across the largest number of counties. This is also evident in the pie charts of **Figure 1-5**. Moving back to **Table 1-2** and doing comparisons with the freight-oriented sectors, it becomes clear that there is considerable growth in the labour force that has taken place which is unrelated to freight. The major source of employment growth is the service sector, which more than doubled in the GTA, East, and West, and grew by more than 50 percent in the North East and North West since 1981. Each region also witnessed a sizable increase in the service sector as a proportion of total employment.

Transportation and warehousing firms appear to locate predominately in large urban areas and along key transport corridors, with the GTA maintaining a dominant presence in this sector. In contrast, manufacturing firms tend to be dispersed throughout the other smaller municipalities. Previous research details a similar pattern in freight employment, with the Region of Peel heavily over-

represented in employment in the warehousing and storage and freight-related support activities sectors compared to other municipalities in Southern Ontario, all of which tend to exhibit a greater or more balanced proportion of manufacturing employment to other sectors (Higgins & Ferguson, 2011). The spatial balance of freight and logistics may also be shifting, centralizing to the GTA. While the recent recession certainly played a part, Canadian Business Patterns data from 2008 to 2011 show that truck transportation employment and business counts have generally declined or remained steady in peripheral municipalities, increasing only in the GTA (Higgins & Ferguson, 2011).

Overview of Data Sources and Related Issues

A series of data sets/surveys are used to drive the analysis. The two main trucking-oriented surveys that are used are the 2006 MTO Commercial Vehicle Survey [CVS] and the 2010 and 2011 Statistics Canada Trucking Commodity Origin Destination Survey [TCOD]. An overview of these two survey data sets and some of the associated strengths and weaknesses are outlined in Section 2.1. In addition, the work is supported by several other data sets that are not directly tied to freight generation but which provide other relevant insights. These include:

- A recent version of the InfoCanada database
- Polk Canada Vehicle in Operation for Summer of 2011
- Labour Force Data from the Canadian Census for the period 1981-2006
- Canadian Business Patterns Data from 2011

A description of each is provided in Section 2.2 along with an overview of their applicability to the current project.

2.1 Commercial Vehicle Surveys

As a brief aside, a good and recent overview of freight survey techniques such as establishment surveys, commodity flows surveys, roadside intercept surveys and others is provided in Allen et al. (2012).

2.1.1 The Trucking Commodity Origin Destination Survey

MITL has worked with two versions of the TCOD data for this project. One is an origin-destination matrix for 2010 at the census division level which was purchased from Statistics Canada. The other is 2011 postal code level data provided by MTO which details where trucking shipments originate and where they arrive in Ontario.

Gagnon and Cook (2007) provide a useful overview of the annual TCOD survey, its underlying philosophy, and how it has evolved. They note that Canada is unusual in how it collects data on freight movements since many other countries, including the U.S., opt for large shipper surveys which capture all the modes. An outcome of the U.S. approach is the large Commodity Flow Survey which captures the behaviour associated with about 50,000 domestic shippers across the United States. Canada, on the other hand, has opted for an approach that targets the carriers of the goods themselves, one mode at a time. The piecemeal nature of this approach means, among other things, that it is more difficult to capture intermodal movements.

Some pertinent observations about the TCOD design are as follows:

- The Statistics Canada Business Register provides the frame for the TCOD survey. In the business register there are four levels of statistical entities: enterprise, company, establishment and location. An enterprise would be associated with a complete or consolidated set of financial statements. At the company level, operating profits can be measured. At the establishment level (e.g. a factory or a plant), basic accounting data such as revenues or wages could be measured whereas at the location level the requirements might be more basic such as the number of employees. In the TCOD survey, the focus is on collecting data at the <u>company</u> level.

- The sampling frame is restricted to trucking companies with revenues of $1.3 million or more. This constraint is implemented to avoid double-counting of certain shipments associated with small owner-operators who sometimes work for larger carriers.

- Shorter distance shipments of 25km or less are included and this is very helpful for a better understanding at the intra-metropolitan level.

- As of 2007 the survey was associated with 1,828 long-distance firms, 351 movers and 1,462 local trucking firms.

- Private fleets of firms, whose primary activity is not trucking, are not included in the survey nor is there any information collected about the value of the goods transported.

- Data about shipments are collected from firms in three ways. A handful of the largest carriers transmit their data electronically and in these cases, 100% of the data are captured. For companies with fewer than 50 origin/destination/commodity combinations (i.e. those that specialize in moving specific types of freight), data are collected via computer assisted telephone interviews. Finally, for remaining companies, data are collected from on-site visits. A systematic sample of shipping documents is undertaken and then a sample of shipments from

each document is taken. This approach reduces problems with low response rates since a government person collects that data on-site.

- According to Gagnon and Cook (2007), on-site visits are used for 79% of firms in the sample.
- A fairly involved four stage weighting process is applied to have the overall sampled results be representative of the population of relevant companies.
- Sampling fractions are considered to be fairly high to the extent of there being 100% coverage for the largest firms whose data are collected electronically. In the 100% context, there would thus be coverage of all shipments including the specific origins and destinations. In other contexts, this information is systematically sampled from shipping documents.

2.1.2 The MTO Commercial Vehicle Summary

The MTO Commercial Vehicle Survey (CVS) is an intercept survey that is carried out at approximately 150 road-side sites on provincial freeways and highways and at border locations. A new set of surveys is conducted every 5-6 years. The number of surveys carried out in aggregate at these locations approaches 100,000. Such a survey is currently in progress at the time of this study; however, the data utilized in this report is from the 2006 CVS.

The amount of detail that is gathered from each survey is quite remarkable and a wide range of variables are captured. These include: considerable detail about the vehicle and the company that operates it, many variables relating to the nature of the cargo on the vehicle and where it was picked up and being dropped off and detailed information about the driver's working circumstances. An entire section of the survey is allocated to collecting information about the “trip” as opposed to the “shipment” as is the case with the TCOD. Matters of interest about the trip include the type of facility from which the current trip departed, where the prior and next stops are located and whether the current trip is a “line haul” or a “peddle run”. The former is described as a trip where the entire cargo moves from origin to destination. A “peddle run”, which has also been referred to as a “milk run” or a “tour”, applies when intermediate stops take place between the initial pick-up and the final delivery. These intermediate stops could involve pickups or deliveries.

2.1.3 Comparison/Discussion

Since the MTO Commercial Vehicle Survey and the TCOD Survey are the two major data sources for this research, it makes sense to compare them and consider strengths and weaknesses. The focus is on the elements that are of relevance to this study since there are many aspects related to each data set that are less important in assessing truck generators/attractors.

For 2011, the TCOD gives us sampled information on nearly 600,000 shipment originations from Ontario and about 400,000 arrivals to Ontario. These numbers are then expanded to provide the final shipment counts. Clearly, there is a substantial sampled base on which to build the final tabulated results. In the upcoming analysis, results are associated with about 2100 distinct six-digit postal codes in Ontario. Those postal codes that generate less than 10,000 tonnes per year have been omitted from the data

that MITL has received. Due to the manner in which data are collected (actual shipping documents of firms in most cases) one would expect a high degree of confidence that the actual origins and destinations of shipments are being accurately captured. As will be shown later though, there can be problems if a head office location is captured rather than the actual shipping origin or destination.

While the collection of shipment origin-destination data for the TCOD survey is done in "backrooms" and with electronic data transmissions, the MTO CVS captures all of its information as the shipments are in transit. As a result, the CVS provides considerable information about the nature of the vehicles that move the freight and how (and if) they are loaded. TCOD data are all about capturing shipments from "A to B" with no measure of how this is accomplished beyond the general focus on trucking as the mode for doing so. Of particular relevance for this study is the fact that the knowledge of the driver in the CVS sample appears to play an important role in understanding where a shipment originated and where it is destined. Even if the driver is able or willing to provide a specific address, there is the issue that the origin of shipment and the origin of a truck leg may be two quite different things. The driver is more likely to have knowledge of the latter. Overall, there is reason to believe that the TCOD data provides more of the specific locational information that is required for this study.

With respect to the issue of tracking actual truck movements, it is probably fair to say that both surveys have been found as lacking (McCabe et al., 2007). For the TCOD, all that is known has to do with actual shipments. There is no information on how many shipments were on a truck or how many truck legs it took to reach the destination or if other modes were involved. A basic form of such information is available from the CVS although this type of information was not shared with MITL. Overall, the CVS is the a better source in terms of measuring actual truck trips as opposed to shipments but there may be uncertainty about the origin and destination of these trips. To improve the locational qualities of the CVS, MTO staff has indicated that a deductive approach is used to "probabilistically" geocode CVS origins and destinations when the actual addresses are not indicated. Knowledge about the industrial geography of a general area and the nature of the commodity being carried can be used to pin point a likely origin or destination for a truck trip.

The CVS intercepts a wide range of vehicles which helps to fill in gaps left by the TCOD. An area in which the CVS is clearly superior is in its coverage of private fleets. The TCOD rules out private fleets in the first instance as it only considers firms that are in the business of transporting goods by truck. The CVS will capture private truck movements although the shorter distance nature of private movements may mean that they are not being captured as often as they should. The CVS of course is carried out on provincial highways and freeways. In addition to private fleets, the CVS will sample small owner-operators that are not captured by the TCOD and will intercept trucks that are owned by U.S. companies. Recall that only Canadian trucking firms are captured by TCOD.

In any case, one of the reasons that the Peel Region Goods Movement Survey and current similar work that is being undertaken for the GTHA are required is that neither the TCOD nor the CVS capture intra-metropolitan movements in detail. These new initiatives directly survey the shippers who actually generate the freight movements and also the drivers are surveyed in detail to establish information about the nature of urban "tours" or "milk runs" where goods are picked up and/or delivered as a route

proceeds. These types of movements will occur in outlying freight generators in the non-GTHA MTO regions but not to the same extent as in the GTHA.

2.2 Other Pertinent Data Sources

2.2.1 InfoCanada Database

The InfoCanada database is sold as an exhaustive list of all businesses in Canada. Along with each record, there is information about the address of the business, the industrial classification of the business in terms of Standard Industrial Classification (SIC) and North American Industrial Classification (NAICS) codes, the number of employees and the revenue among other variables. The raw data from InfoCanada is geocoded at McMaster based on addresses and postal codes as required so that we have exact locations for the businesses.

The InfoCanada data are primarily conceptualized as a direct marketing database to facilitate business-to-business commerce. It has not been designed with goods movement applications in mind. One relevant weakness of InfoCanada is that it does not always succeed in capturing the entire footprint of the operations of a business. In the case of a large company with logistics distribution facilities that are separate from the head office it is quite possible that these non-head office locations are not even captured in InfoCanada. Since these are the facilities likely most relevant for freight movements, this shortcoming is problematic. The data appear to be stronger with branch locations of consumer-oriented firms such as retailers and restaurants. In these cases the range of locations appears to be captured.

The main idea of the use of these data for the current project is to append additional information to trucking freight clusters identified primarily by the survey results. There is little doubt that the data are capable of adding value in this context but it is not able to provide a complete picture. InfoCanada data are likely most useful with smaller industrial firms that operate in single or few locations. Joining InfoCanada data to the postal code level TCOD data results in many postal codes where there is no InfoCanada match and there is the converse problem also. The “footprint” issue mentioned above is likely an important explanation for this result. Nevertheless, the data are quite useful to assist in providing a sense of the composition of many of the individual freight clusters.

2.2.2 Polk Vehicles in Operation

The Polk Vehicles in Operation database is from July 2011 and it is basically a census of vehicles across Canada that are operating at that point in time based on active registrations. MITL has purchased the data separated into commercial and passenger vehicles along with other variables such as Gross Vehicle Weight Rating (GVWR). The purchased count data are at levels as low as census tracts but in this analysis the focus is more on municipalities and counties.

Of the eight classes associated with GVWR, note that Classes 1 and 2 are removed on the basis that these classes are related to vehicles along the lines of cars, pickup trucks, SUVs and light vans. Certainly there is a lot of commercial activity associated with the movements of such vehicles but much of this movement will be service-oriented and not directly related to the movement of significant quantities of freight. Classes 1 and 2 actually make up the majority of registered commercial vehicles but the decision

has been made to focus on larger vehicles for the purposes of this analysis. Of course, there are many large commercial vehicles (e.g. utility trucks, buses) that are not associated with the movement of freight. Unfortunately, there is no way to filter out the noise that would be caused by this issue but it needs to be kept in mind in interpreting results.

2.2.3 Canadian Business Patterns

The Canadian Business Patterns (CBP) data has a similarity to the TCOD survey in that it is based on the Canadian Business Register but otherwise they have little in common. The CBP gives sectorally detailed business and employment data at the county level. There is also a Census Metropolitan Area version that is available. Unlike census data, estimated employee counts relate to the place of work as opposed to the place of residence of employees. In this report, a county level analysis of sectorally detailed trucking sector data is undertaken and described in Section 4.3.3. A more detailed overview of the Canada Business Patterns data is provided in Higgins and Ferguson (2011).

2.2.4 Canadian Census 1981-2006

As a complement to the Canadian Business Patterns database, we have also utilized census information from the years 1981 to 2011. In particular, the focus has been on the evolution of the general labour force in Ontario regions as well as for particular key sectors such as manufacturing and wholesaling among others (for 1991 to 2006). The associated discussion along with some methodological observations took place previously in Section 1.2

3

County and Municipal Characterization of Generators and Attractors

The intent in this section is to drill down within counties and municipalities in Ontario to help understand the dynamics of truck generators. Elements such as total daily inflows and outflows of trips and quantities of shipments at county and municipal levels are considered. Also, higher level issues such as the relative importance and magnitude of inter-provincial and international trucking movements are examined. For those not familiar with the locations of the various Ontario counties, see the map in **Figure A.7-4** for clarification.

3.1 Municipal/County Truck-Oriented Outflows and Inflows

This section focuses on the grand total of trips or shipments that are departing or arriving at individual municipalities and counties. Initially, some general statistics and observations are reported on this class of freight numbers. In the second half of this section, there is a mapped presentation of truck trips at the municipal level using CVS data. Results are presented in daily terms even though our input TCOD data are annual. To obtain estimated daily totals, annual totals have been divided by 300. There is little doubt that this is an arbitrary assumption but business days are not equal and there is some significant activity on weekends.

Here are a few observations that have been derived from the grand outflow and inflow totals of the county level data**:**

- About 2/3 of daily trucking shipments are departing from the GTA region while just over half of incoming shipments are arriving in the GTA region. For CVS data, both incoming and outgoing are at about 55%. The results clearly indicate that the GTA is the most significant region for generation of truck shipments with west region being in second and east region in third.

- Total daily shipment outflows from counties are 62,732 while corresponding inflows are 56,562. The peak county outflow is 17,317 from Peel Region while the corresponding inflow is only 8,990. It is interesting to note that Peel far exceeds Toronto in terms of outflows but the two are quite similar in terms of inflows.

- With regard to CVS trips, total daily outflows from counties are 75,340 while corresponding inflows are 75,264. The largest daily outflow is 12,041 from Peel while the corresponding inflow is 10,517. The difference noted in the point above comparing Peel and Toronto shipments does not seem to apply on the trips side. Peel trips are about 20% larger for both outflows and inflows.

- Of the top 10 counties in terms of shipment outflows, GTA Region has six of them. The West Region has three, the North has one and interestingly, the East Region has none. Of the top 10 counties in terms of shipment inflows results are: GTA (5), West (4), and East (1). Of the top 10 counties in terms of trip outflows, the totals are: GTA (7), West (2) and East (1). For trip inflows the totals are: GTA (8), West (1), and East (1). Probably the most interesting single result here is the number of high ranking western shipment recipient counties. The absence of a major eastern shipment generator is also very interesting. Note in **Figure 3-5** below that Thunder Bay outranks Ottawa as a generator of shipments.

- Outflows are more heterogeneous than inflows. Outflows associated with Peel and Toronto are much larger than the corresponding inflows. Meanwhile, outflows associated with many of the minor counties are smaller than the corresponding inflows. The implication seems to be that the best way to identify an important trucking hub is by outflows since inflows are more evenly spread. For outflows relating to shipments the standard deviation is 2,920 and for inflows it is only 1,845. For the county-level CVS, trip-oriented outflows have a standard deviation of 2,330 while for inflows it is 2,112. Dispersion in the data is less pronounced in CVS. It is likely that trip-oriented variation is smoothed out by the fact that trucks can travel empty whereas there is no such thing as an empty shipment.

- One interesting exercise is to compare the highest county generator/attractor with the lowest ranking to obtain a ratio. With regard to trips the ratios for outflows are: GTA (12.4), West (46.5), East (55.3) and North (40.0). For inflows they are: GTA (3.5), West (71.9), East (41.1) and North (49.8). With regard to shipments the ratios for outflows are: GTA (22.6), West (62.1), East (81.1) and North (217.1). For inflows they are: GTA (7.75), West (37.9), East (53.5) and North

(131). These ratios based on the extremes are generally lowest for the GTA. This result is probably consistent with the highest levels of urbanization being prevalent in the GTA. The most remote of the regions are generally associated with the largest of the ratios even though they do not boast the largest freight generators.

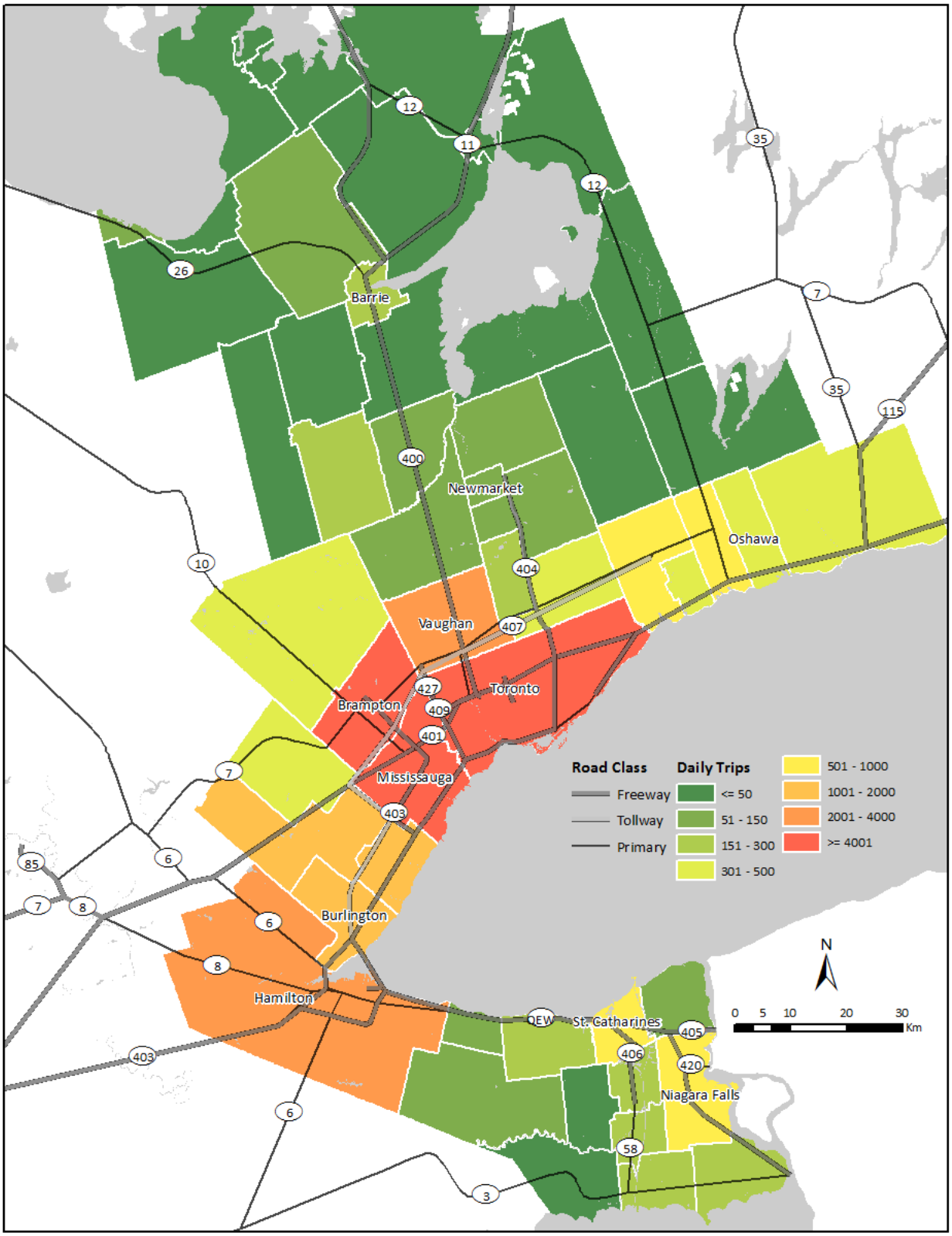
This analysis is continued with a series of municipal overview maps by MTO Region which capture where truck trips originate and where they terminate in Ontario. As mentioned, these maps capture all trips whether they are inter-provincial, international or intra-provincial. **Figures 3-1 and 3-2** cover the important GTA Region while **3-3** details patterns for the East Region and **3-4** the West Region. An identical quantitative breakdown is used across the maps to differentiate the municipalities and maintain consistency across the regions.

Overall, the maps succeed in highlighting that the majority of truck trip originations and arrivals are associated with a small proportion of the overall land area in each region. This statement especially is true for the East and West regions and to a lesser extent for GTA Region. Truck freight patterns are mostly consistent with the degree of urbanization itself: the most highly urbanized areas generate and receive the most truck trips. Taken together, the results highlight the dominant position of the Greater Golden Horseshoe as the primary driver of freight trips in Ontario, though clearly there are several important subcentres in the East and West. Another important theme is that border regions and select areas along key transportation routes such as the QEW, 401, and St. Lawrence Seaway produce a high level of trips.

In terms of specific regional observations, the first thing to note is that the red category, associated with more than 4,000 trips, appears only in the GTA region. Associated with the 2,000-4,000 category we have Brampton (out), Hamilton (out), Vaughan (out and in), Ottawa (out and in), and London (out and in). For the 1,000-2,000 category, there is Windsor (out and in), Cambridge (out and in), Burlington (out and in), Milton (out and in), Oakville (out and in), Oshawa (in), Guelph (out and in), and Kitchener (out and in). For the 500-1,000 category there are 13 municipalities that generate this level of for both outflows and inflows. In the 300-500 category there are 14 municipalities for outflows and 12 for inflows.

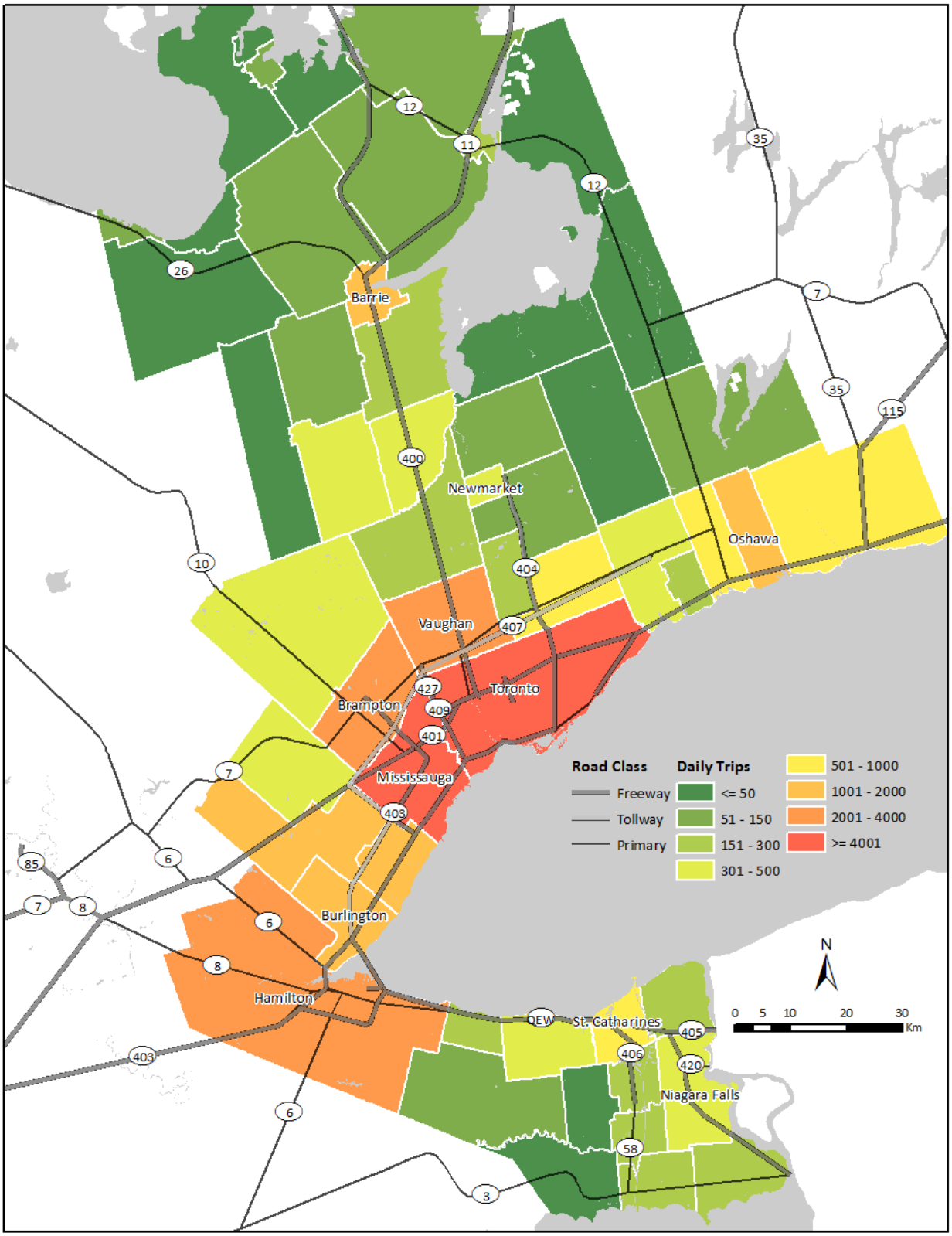
Broad comparisons of total outflows with inflows do not reveal substantial differences although there are some. The GTA map shows slightly higher levels for inflows in certain outlying areas. Niagara Falls maintains a higher share of outgoing trips than incoming while other border municipalities such as Windsor are more balanced. For the East region, Ottawa stands out as the leading freight hub with secondary hubs being located in Kingston, Belleville, Cornwall and Peterborough. For the West region, the Kitchener-Waterloo region, London, Windsor and Sarnia stand out as the primary truck generators.

Figure 3-1: GTA Region - Daily Trip Outflows by Municipality



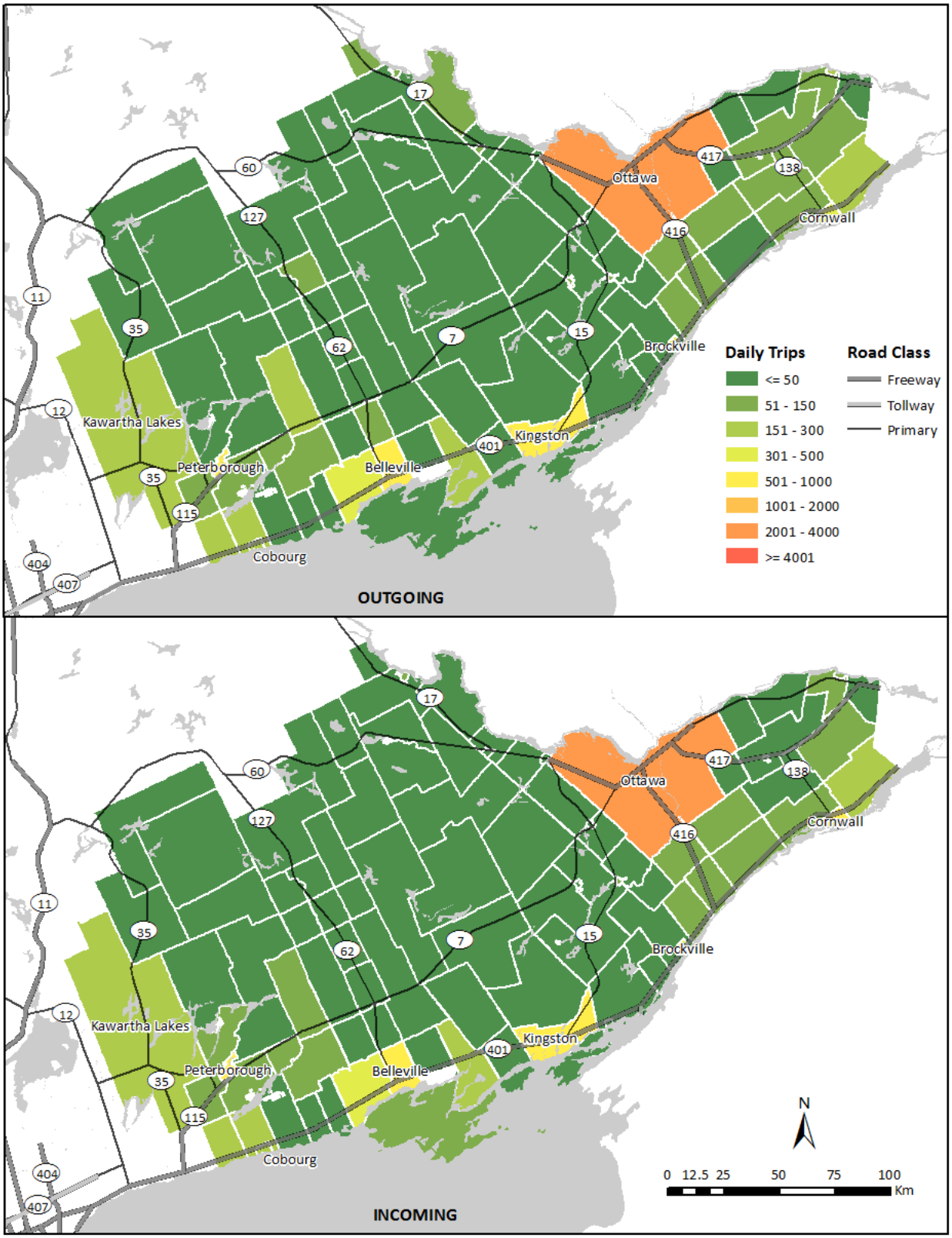
Source: Ontario Ministry of Transportation, 2006 Commercial Vehicle Survey

Figure 3-2: GTA Region – Daily Trip Inflows by Municipality



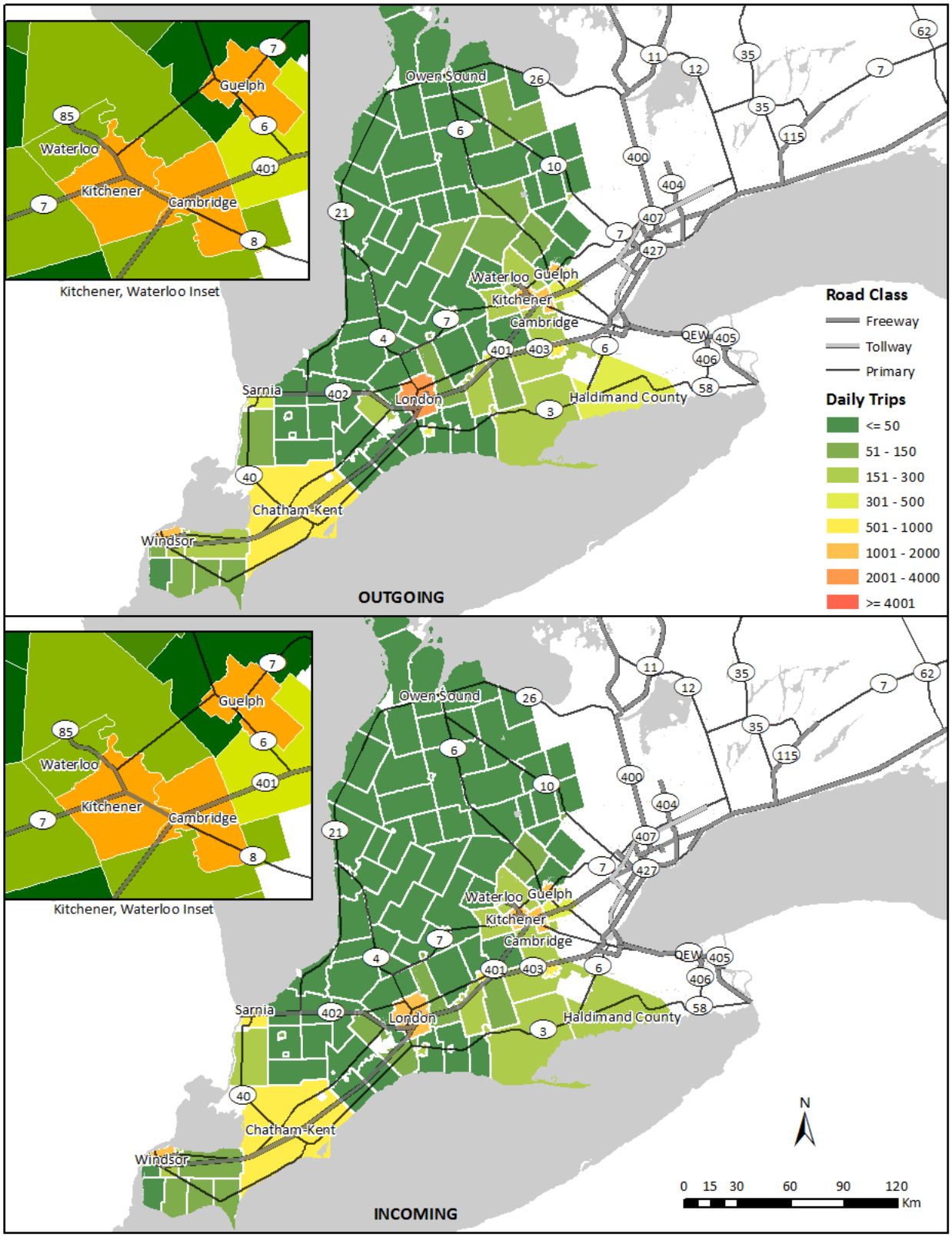
Source: Ontario Ministry of Transportation, 2006 Commercial Vehicle Survey

Figure 3-3: East Region - Daily Trip Outflows and Inflows by Municipality



Source: Ontario Ministry of Transportation, 2006 Commercial Vehicle Survey

Figure 3-4: West Region – Daily Trip Outflows and Inflows by Municipality



Source: Ontario Ministry of Transportation, 2006 Commercial Vehicle Survey

3.2 An Examination of Truck Freight Flows by Origin and Destination Types

While Section 3.1 examined total truck trips, this section breaks them down by whether trips originate/terminate locally, in another province or in another country. Also, TCOD shipments (as opposed to CVS trips only) are examined in this respect also.

Table 3-1 establishes some important base percentages which describe trucking interactions at intra-County, inter-county, inter-provincial and international levels. This is done for Ontario as a whole and for the MTO regions. There is a percentage breakdown of outgoing TCOD shipments and CVS truck trips and the same for incoming.

Table 3-1: Percentage Base Rates of Interaction Types by Survey

TCOD

	Shipment Type	GTA	WEST	EAST	NORTH	ONTARIO
Outgoing	Same County	12.22%	19.30%	12.67%	20.91%	14.45%
	Other Ontario Counties	50.17%	47.18%	46.68%	66.32%	50.02%
	Inter-provincial	26.69%	9.75%	29.63%	8.12%	21.67%
	International	10.93%	23.76%	11.01%	4.65%	13.85%
		100%	100%	100%	100%	100%
Incoming	Same County	16.42%	20.77%	12.22%	11.21%	16.57%
	Other Ontario Counties	51.84%	57.94%	53.44%	63.70%	54.80%
	Inter-provincial	12.03%	5.10%	23.50%	20.53%	12.32%
	International	19.71%	16.19%	10.84%	4.56%	16.31%
		100%	100%	100%	100%	100%

CVS

	Shipment Type	GTA	WEST	EAST	NORTH	ONTARIO
Outgoing	Same County	8.92%	12.57%	10.10%	43.30%	12.80%
	Other Ontario Counties	75.07%	53.61%	53.52%	43.88%	64.49%
	Inter-provincial	4.53%	10.67%	30.70%	7.88%	9.79%
	International	11.47%	23.16%	5.69%	4.94%	12.92%
		100%	100%	100%	100%	100%
Incoming	Same County	8.77%	16.24%	9.48%	44.19%	13.37%
	Other Ontario Counties	75.69%	52.92%	53.66%	41.83%	64.78%
	Inter-provincial	3.80%	9.52%	31.19%	9.01%	9.42%
	International	11.74%	21.32%	5.66%	4.97%	12.43%
		100%	100%	100%	100%	100%

With regard to the province as a whole, the most interesting divergence between the two surveys is that a much lower percentage of TCOD shipments (50.2% for outgoing and 54.8% for incoming) are associated with other counties in Ontario than is the case for CVS trips (about 65% for both outgoing and incoming). Regardless, for both TCOD and CVS, inter-county interactions are the dominant type despite the differences in degree. Inter-County CVS trips are particularly noticeable in the case of the GTA region. A second major theme is that CVS features much less apparent interaction with other provinces than does TCOD (an average of nearly 10% for CVS versus an average of about 17% for TCOD). For GTA region 27% of outgoing TCOD truck shipments are inter-provincial but only 5% of outgoing CVS trips are inter-provincial. Apart from possible survey error, the best explanation would seem to be that multiple trips are often involved in getting goods to another province by truck.

Similar general trends are in place at the regional level but the regions introduce some of their own unique patterns as well. The highest relative levels of inter-provincial activity are due to the East region and account in general for about 30% of East region truck shipments and trips. Incoming shipments is the one inter-provincial dimension that is lower. For West region a theme that stands out is the much higher level of international interaction averaging over 20% across the dimensions of shipments and trips. One dimension in which the GTA is relatively more international though relates to incoming shipments (certainly not for incoming trips though). While the conventional wisdom emphasizes the utility of trucking for short distances, it is worth noting that intra-County interactions account for a bit less than 15% of trucking activity overall. Intra-County interactions are most important in the north regions. Many northern and eastern counties also have very high percentages for inter-County flows. One conclusion is that higher order freight centres have more inter-provincial and international interactions in the mix which translates into lower relative intra-Ontario interactions.

In terms of possible explanations for inter-County and inter-provincial divergences, the fact that CVS captures trips on provincial highways will, in many cases, be associated with a trip to another county almost by definition. But this bias towards longer trips does not seem to extend to the inter-provincial domain. It is quite possible that inter-provincial truck shipments are associated with higher valued goods that are packed tightly and efficiently into the truck. While the number of inter-provincial shipments as captured by TCOD is significant, it is actually harder to intercept/sample such a truck through the CVS because there are not many of them relative to the number of shipments or to the number of trucks on the road for that matter. In terms of the international context, there is not much difference in the CVS/TCOD percentages and this may have something to do with the fact that the international borders are in closer proximity than inter-provincial boundaries for many of the key provincial freight areas. The international result for CVS is a "halfway" result between the high inter-County percentages and the lower inter-provincial ones. In light of this discussion, one reasonable conclusion is that CVS is underestimating intra-County trips.

Figures 3-5 to 3-8 offers spatially detailed breakdowns of outgoing and incoming trips and shipments. It is important to discuss the nature of these figures from the design point of view because a similar approach is used for other figures later in the report. In each figure, absolute trips are represented by the lines which are scaled by the upper axis. Absolute trips are presented in logarithmic form to provide more visual detail for counties with lower levels of flows. Separate lines are generated for observations

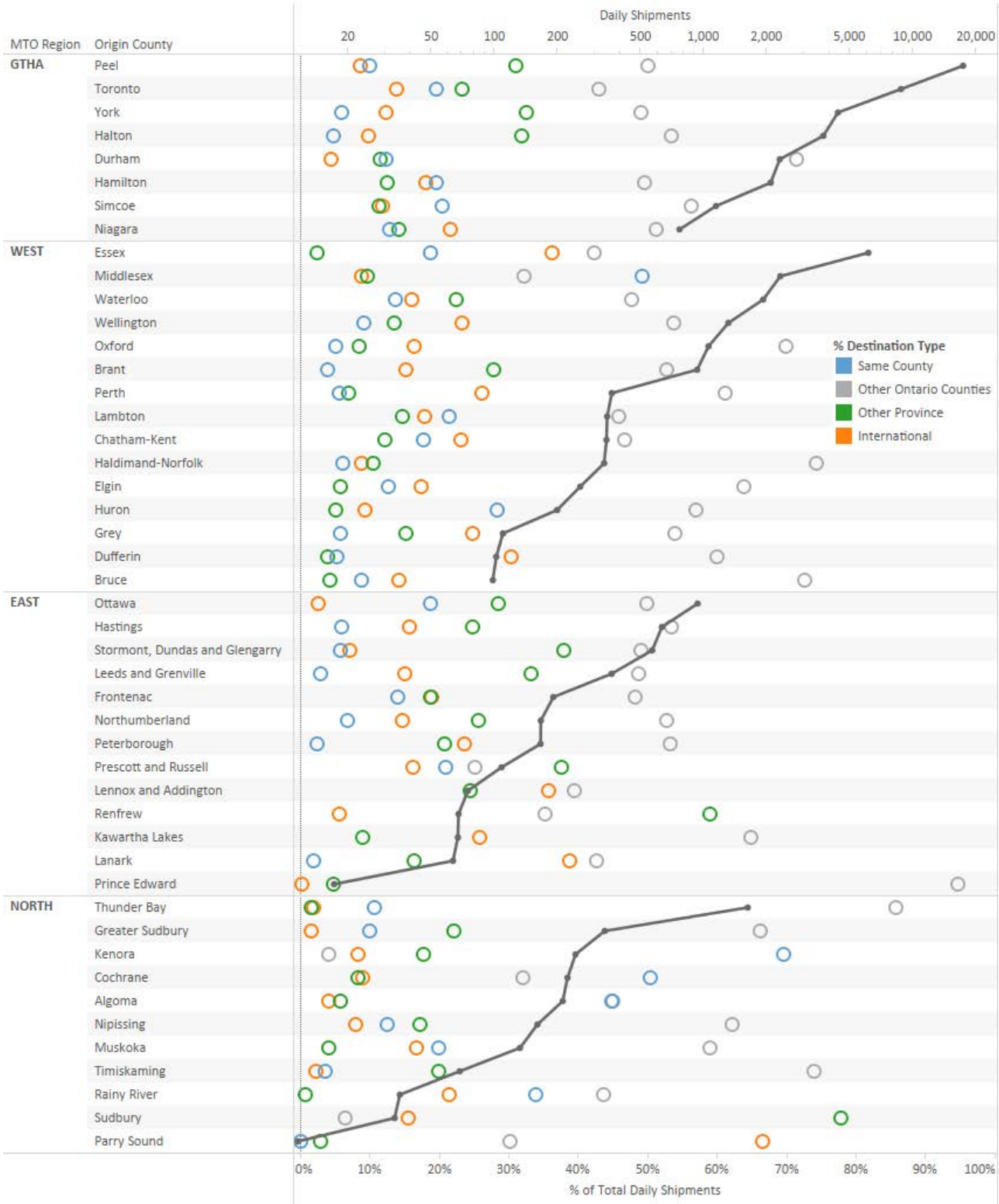
associated with each MTO region. All relative information in the figure is presented as point symbols which are governed by a linear percentage scale on the bottom. If all symbols along a row are summed, the total will be 100%. In this way, the importance of each category to an area is consistently represented across the areas to facilitate to "apples to apples" comparisons. To summarize: the lines provide total trips/shipments for the given area and the symbols describe the percentage allocation of trips across categories for the given area (e.g. county/municipality).

Of the four figures, the first two are based on TCOD data presented at the **county** level and the latter two are based on the MTO CVS at the **municipal** level. In terms of interpreting the coloured dots, which are associated with the percentage axis at the bottom, it is useful to bear in mind the base rates outlined in **Table 3-1**. For each survey there is a figure that deals with originations and another that deals with arrivals. Shipments or trips are classified by whether they are entirely within the same county, or if they interact with another geography: i.e. some other county in Ontario, another province or another country.

Overall, in terms of interaction types, **Figures 3-5** to **3-8** are showing the same overall trends as **Table 3-1** but there are some notable sub-regional patterns. With regard to the TCOD charts, it is interesting that key freight generation counties show lower proportional interactions with other Ontario counties. Peel, Middlesex and Essex for example are all less than 50% in this regard while many less significant counties in freight terms have much higher inter-County percentages.

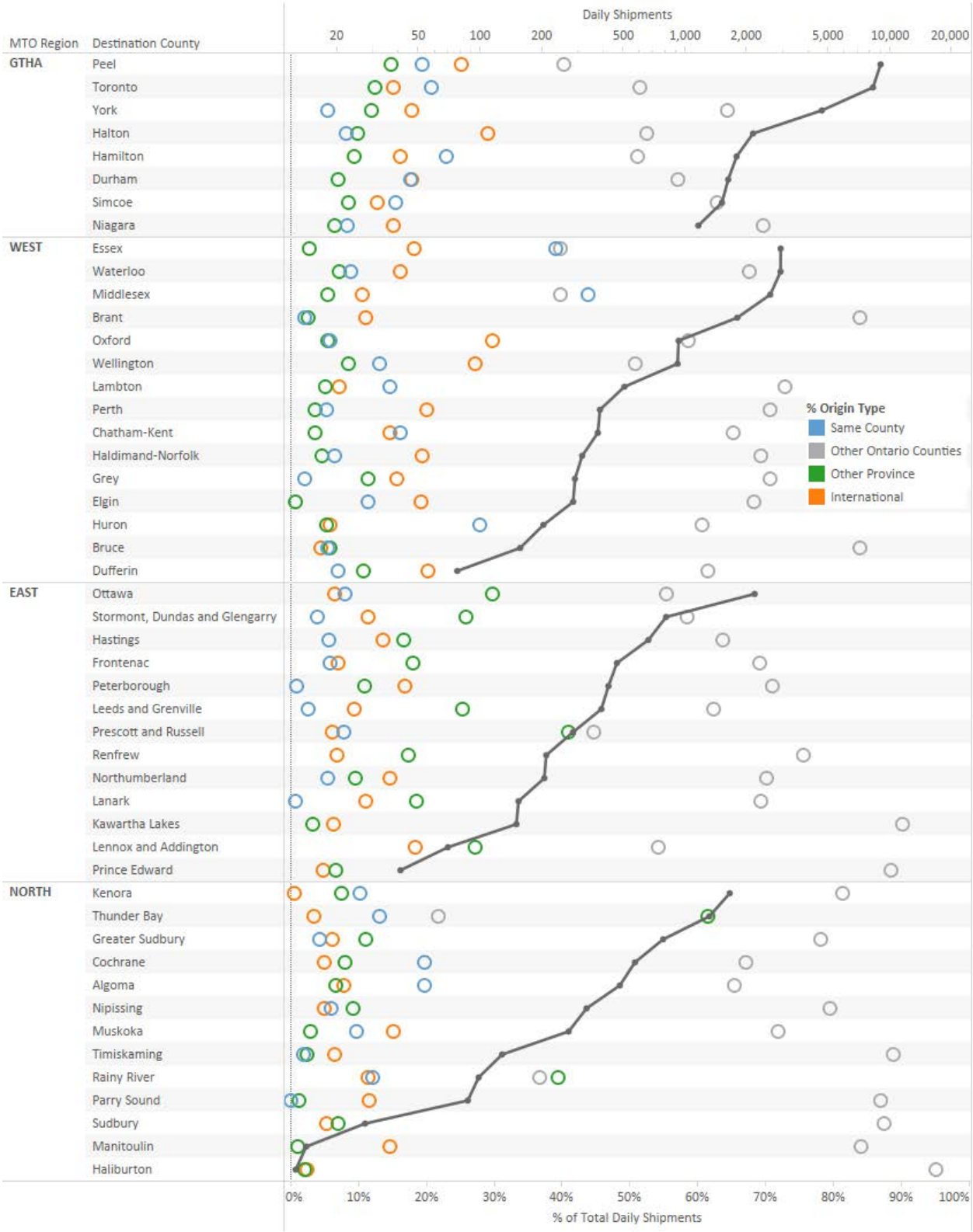
The major share of flows in the charts is intra-Ontario (blue circles + grey circles) and this applies to inflows and outflows. The only clear-cut exception is that Thunder Bay receives more inflows from other provinces than from Ontario. Given its location relative to the rest of Ontario this is not surprising.

Figure 3-5: Outgoing Truck Shipments by Destination Type (TCOD)



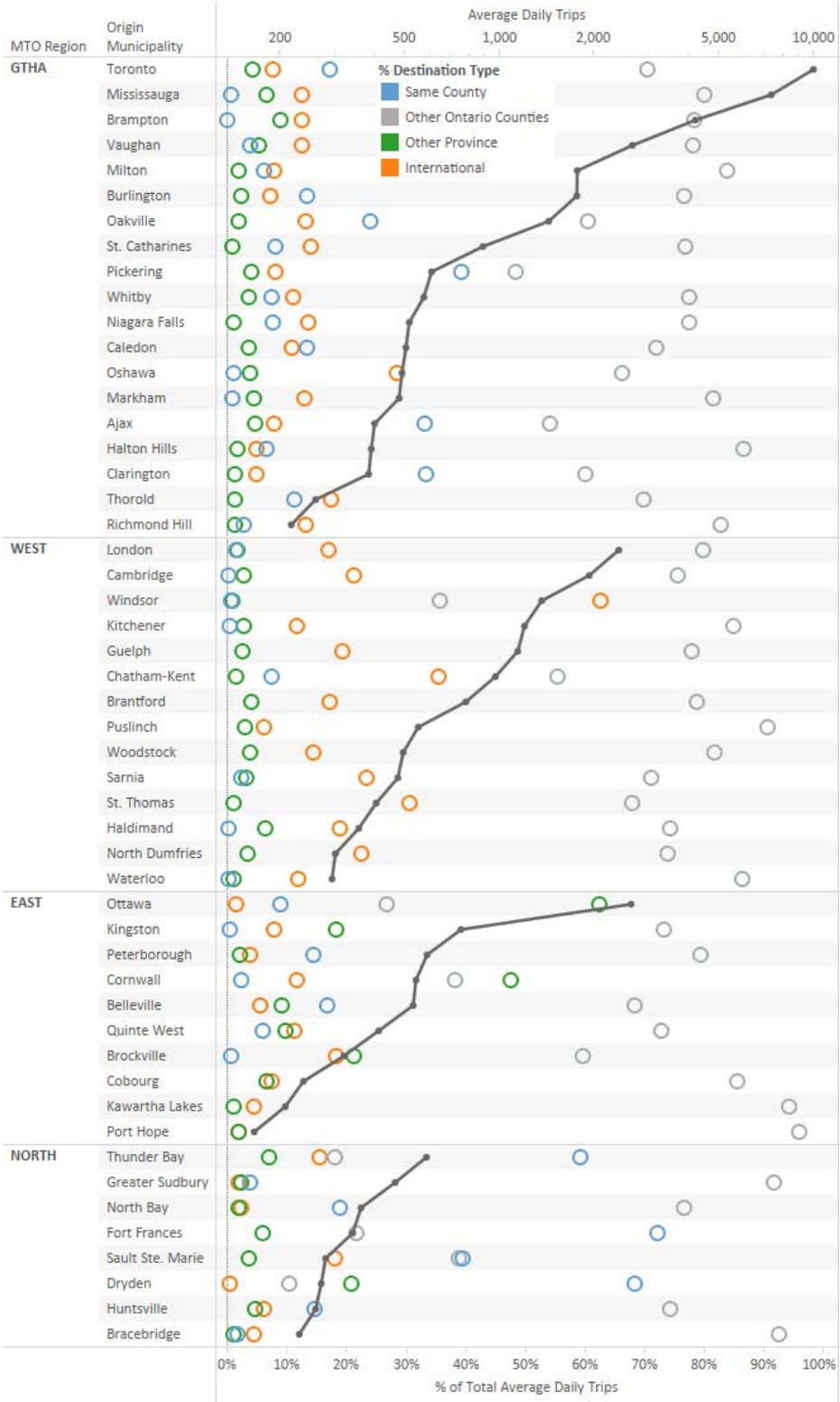
Source: Statistics Canada, Trucking Commodity Origin-Destination Survey, 2010

Figure 3-6: Incoming Truck Shipments by Origin Type (TCOD)



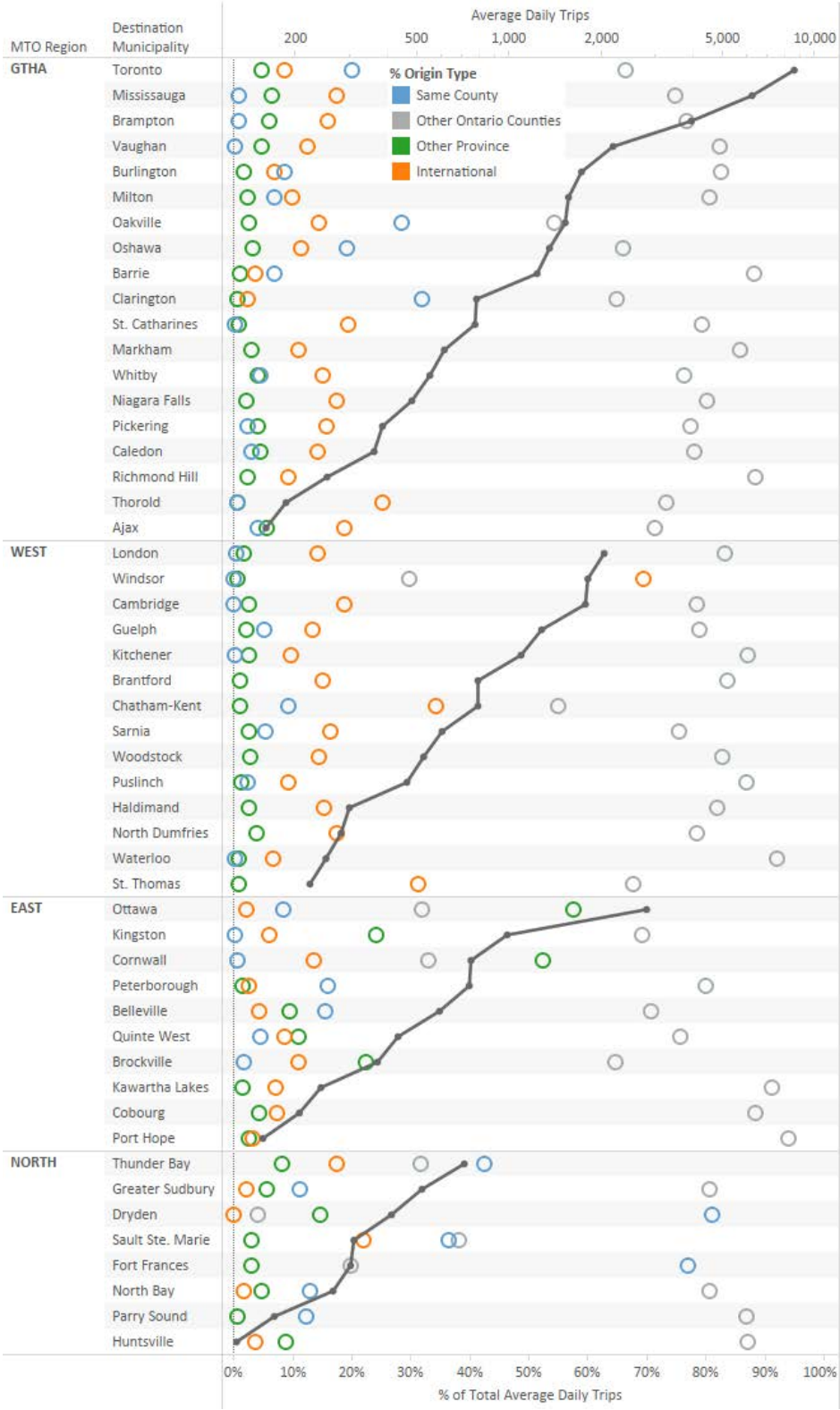
Source: Statistics Canada, Trucking Commodity Origin-Destination Survey, 2010

Figure 3-7: Outgoing Truck Trips by Destination Type (CVS)



Source: Ontario Ministry of Transportation, MTO Commercial Vehicle Survey, 2006

Figure 3-8: Incoming Truck Trips by Origin Type (CVS)



Source: Ontario Ministry of Transportation, MTO Commercial Vehicle Survey, 2006

In comparing **Figures 3-5** to **3-6** for the GTA region, there is an interesting reversal in place. Outgoing TCOD shipments are more associated with inter-provincial movements than international truck shipments are. For incoming shipments though, the relationship is mostly reversed. Incoming shipments are more likely to be arriving from an international location. This pattern may reflect some dependence on U.S. imports while other provinces are dependent on finished goods that are exiting the freight heartland of Canada. In **Figure A.7-5** there is a complementary chart that shows outgoing shipments on an absolute (as opposed to relative) basis for the main interaction types.

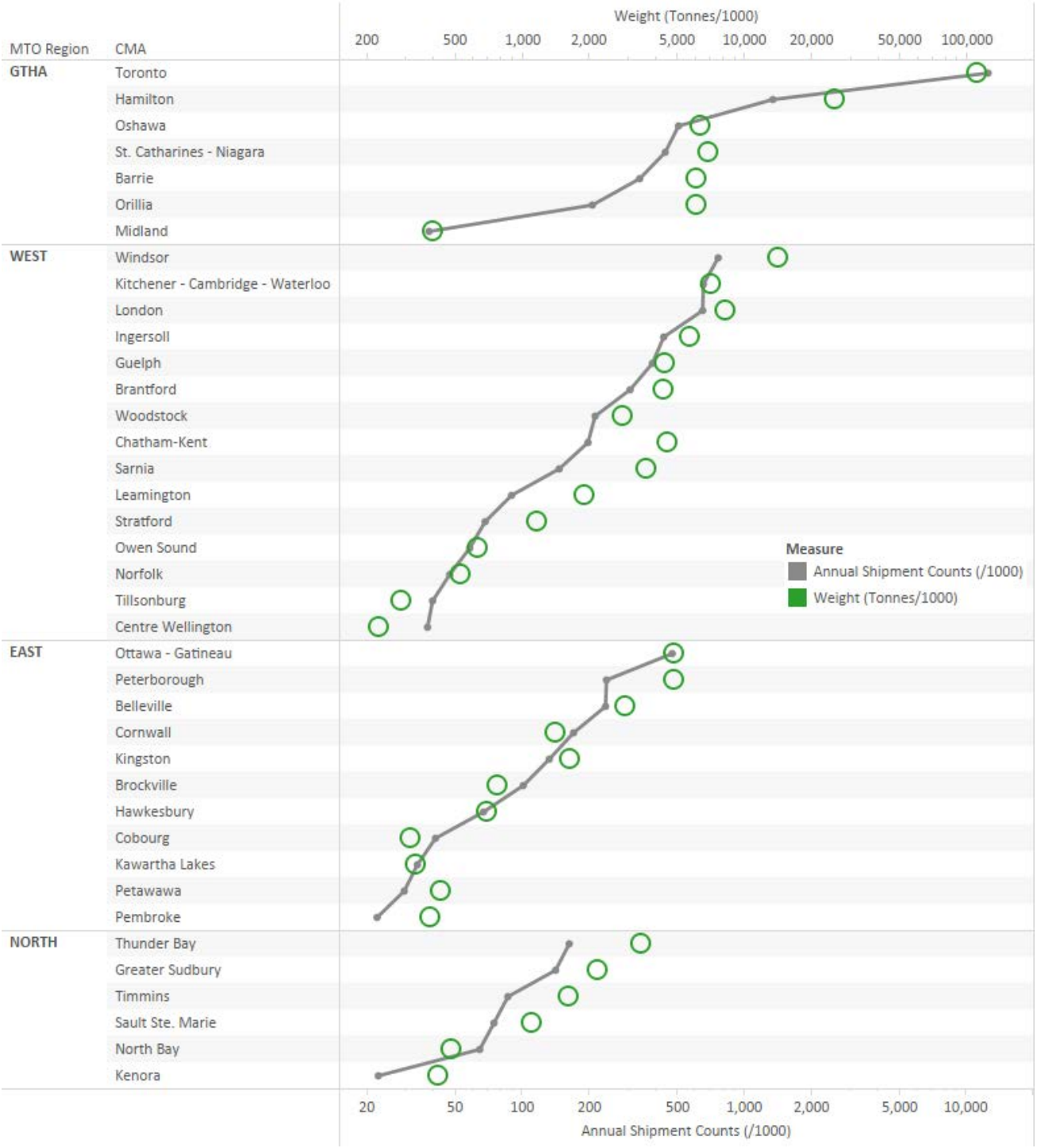
Figures 3-7 and 3-8 are illustrating similar themes but are doing so using the CVS data and at the more disaggregated census subdivision/municipality level. This gives a different look. For one thing, it further emphasizes the huge gulf in trucking freight activity that can occur between the top and bottom municipalities in a region. The City of Toronto is overall the largest municipal freight generator but it falls considerably short of the combination of Mississauga and Brampton, which form the core of Peel Region. **Figure A.7-6** shows outgoing CVS trips by municipality on purely an absolute basis and offers another way to look at the data.

In all figures, Windsor stands out very clearly for its international trips (more so than Essex did at the county level) in that 64% of outgoing trips and 70% of incoming trips are associated with the United States. The international orientation of automotive supply chains will explain much of this outcome. If anything, the municipal charts show even more clearly that inflows are more internationally oriented than outflows. In the international aspects of the municipal charts it is quite noticeable that places involved in the automotive supply chain seem to stand out. Examples include Oshawa, Windsor and St. Thomas. The assembly plant in St. Thomas was actually closed in 2011 which postdates the CVS data used here.

One interesting note is that when viewed at the municipal level, the leading freight municipalities in the East and West Regions (Ottawa and London) rank more highly than the majority of municipalities in the GTA region. This effect is blurred with the aggregation to counties. Finally, in a confirmation of observations made about **Table 3-1**, the Western and Central gateway municipalities of Windsor and Niagara Falls are much more internationally-oriented while those in the East such as Cornwall and Ottawa are oriented to inter-provincial trade.

As a supplement to the prior four graphics, **Figure 3-9** is done at the Census Metropolitan Area (CMA) level using 2011 TCOD data and illustrates relationships between tonnages and shipments for outgoing truck freight. This is the only illustration in this report that looks at truck generators at the CMA level. The results are based on the postal code level TCOD data which omits those codes producing low levels of shipments. Using the CMA representation it is clear from the graphic that Toronto dwarfs all other CMA's in terms of truck shipment generation. In considering the relationship between tonnages and shipments, there is obviously a generally high level of correlation between the two. Nevertheless, there does seem to be a relationship where the mid-ranking CMAs in many of the regions appear to send out heavier shipments as opposed to a larger number of shipments. This statement seems to apply to the GTA Region, West Region and North Region.

Figure 3-9: Outgoing Shipments and Tonnages by Municipality (TCOD - 2011)



3.3 Other Important Elements of Truck Generators/Attractors

3.3.1 Commercial Vehicle Registrations

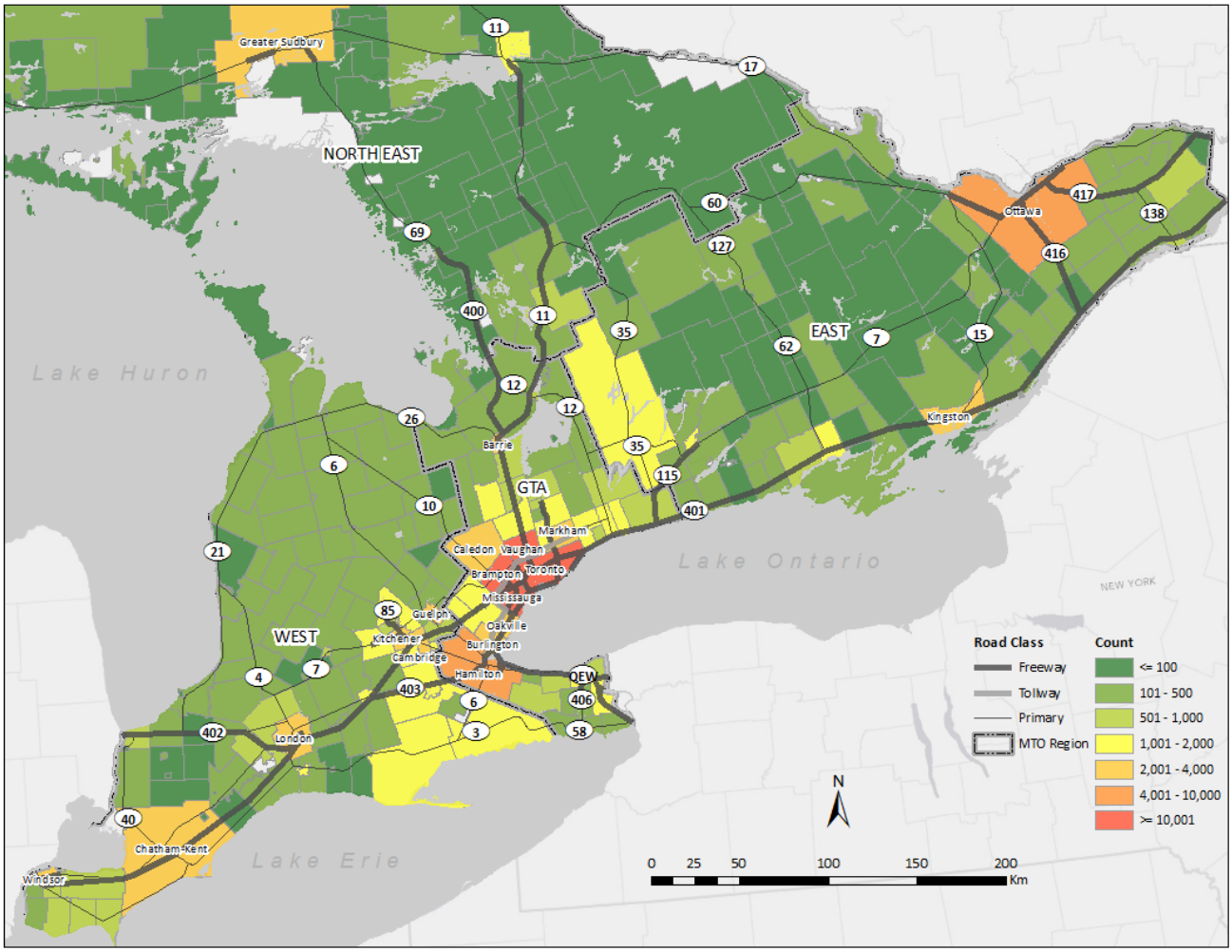
The map in **Figure 3-10** illustrates Class 3 to 8 commercially registered vehicles in operation based on the census subdivision in which they are registered while **Figure 3-11** provides a county level summary of these registrations. These classes cover the medium and heavy range of vehicles by weight. The information is classified by the Gross Vehicle Weight rating of the vehicles to determine if there are any interesting spatial variations. Class 3 to 5 vehicles are mostly associated with city delivery functions with the vehicles getting progressively larger with the class. Vehicles throughout these classes could be walk-ins that allow the driver easy entry/exit for delivery activities. Class 6 includes vehicles such as single axle vans ("straight" trucks) which would not be walk-ins. Class 7 includes lighter semi-tractors and home fuel trucks while Class 8 is associated with heavy tractor trailers. Scattered throughout the classes are vehicles that might not be so relevant for goods movement such as utility trucks in Class 8 or city transit buses in Class 7.

Some observations to be made from the two figures and their supporting data are:

- A total of nearly 215,000 Class 3-8 commercial vehicle registrations are captured across the province with about 54% of these residing in the GTA region.
- It is worth noting that Class 1 and 2 vehicles (not shown) account for a high percentage of the overall commercial registrations. In particular there are 159,153 Class 1 and 277,000 Class 2 vehicles which is about 2/3 of all commercial registrations.
- Among Classes 3 to 8, some of the largest municipal totals shown on the map include: Toronto (25.8K), Mississauga (18.1K), Brampton (11.9K), Vaughan (11.1K) and Ottawa (9.2K) and Hamilton (7.5K). After Hamilton there is a large gap down to the next ranking centre which is London at 3.8K. Registration levels are surprisingly high in Chatham-Kent. This result must reflect a favourable location half-way between London and the border with the United States.
- About 54% of the total Class 3-8 registrations in Ontario belong to the largest Class 8 vehicles. These would mostly be associated with the classic “18-wheeler” types of trucks which feature distinct diesel power units and trailers. There is a slight trend that the percentage of Class 8 trucks declines with the prominence of a county as a freight generator. There are some counties in the North that generate few trips and seem to defy this relationship.
- About 63% of Peels registrations are in the Class 8 category which is notably higher than other counties in the GTA.
- Several counties in West region, most notably Middlesex at 20%, stand out for Class 7 trucks. Also Simcoe County stands out for GTA region. Class 7 vehicles appear less prominent in the most heavily urbanized counties.

- The top 3 counties for Class 5&6 vehicles (Toronto, Ottawa, York) are all heavily urbanized and 13-14% of the vehicles fall into this category. The bottom three counties (Oxford, Elgin and Manitoulin) are not heavily urbanized and all are at less than 5%. Percentages tend to be a bit lower overall for Class 4 vehicles but those counties with higher levels tend to be more urbanized. The urbanization pattern appears to be weakest with Class 3 vehicles where the highest percentage counties are not urbanized.

Figure 3-10: Class 3 to Class 8 Commercial Vehicles in Operation by Municipality (2011)



Source: Polk Canada, 2011 Vehicles in Operation

3.3.2 Associated Facility and Commodity Types

Figure 3-12 provides insight into the types of destination facilities associated with CVS truck trips and how usage of these facility types differs by MTO region. In general, the majority of trips for most any facility type are associated with the GTA because that is by far the largest region for freight. Still there are some interesting patterns.

Figure 3-11: Commercial Vehicles in Operation by GVWR Class and Geography

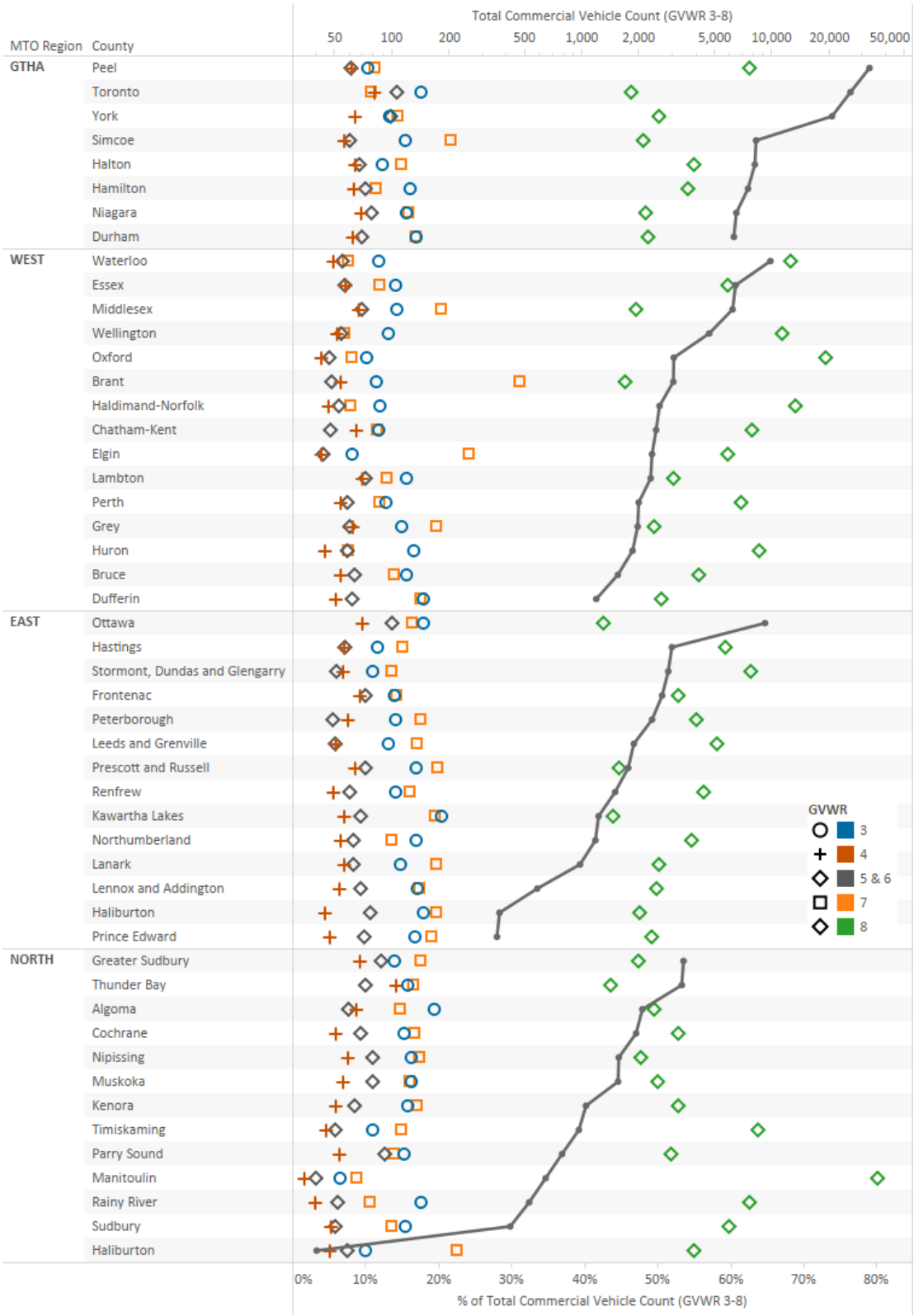
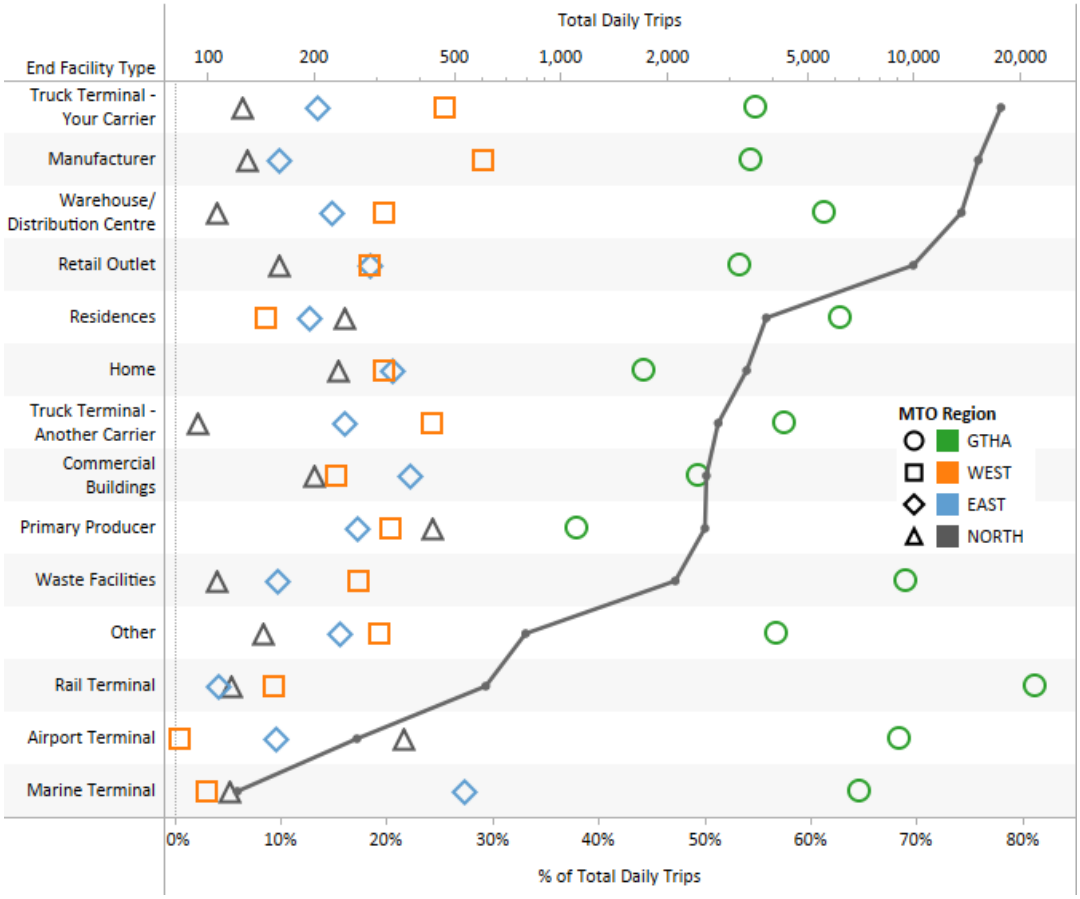


Figure 3-12: Daily Truck Trips by Destination Facility Type and Region



The largest four destination types are truck terminals, manufacturers, warehouse/distribution centres and retail outlets. These are all at 10,000 daily trips or over. There is a middle level of other facility types such as residences and commercial buildings. The lowest level relates to facilities of other modes (rail, airport and marine) with daily trip totals being measured at 500 and less. The rail terminal destination stands out as being uniquely GTA oriented at an over 80% share for that region and the shares of GTA for other modes are high as well.

The West region stands out for being most dependent on facilities that are quite truck-oriented such as truck terminals and manufacturers and it has particularly low shares for airport and marine. The East region has a fairly balanced profile across most facility types but stands out for having a fairly high share of marine-destined trips. The East has the most favourable location relative to the St. Lawrence Seaway. The East does not stand out as being as trucking or manufacturing oriented as the West. The pattern for the North seems mostly unremarkable except that it accounts for a high share (about 25%) of those trips destined for primary producers.

The picture with respect to commodities is shown in **Figures 3-13** and **3-14**. The former is for visual effect and shows very graphically that truck movements in Ontario are all too often empty at about 42%

of the time. This is a rather amazing statistic. If a truck is intercepted after dropping off an inbound load (e.g in Brampton) and picking up an outbound load (e.g. Hamilton) then the truck will be recorded as empty. The 43% result is likely inflated by the fact that "empty" is a default survey response for drivers instructed, generally for reasons of security, not to share information about their load. Modification of the survey questions could potentially reduce this source of error.

Figure 3-13: Prevalence of Commodity Types Carried by Truck in Ontario

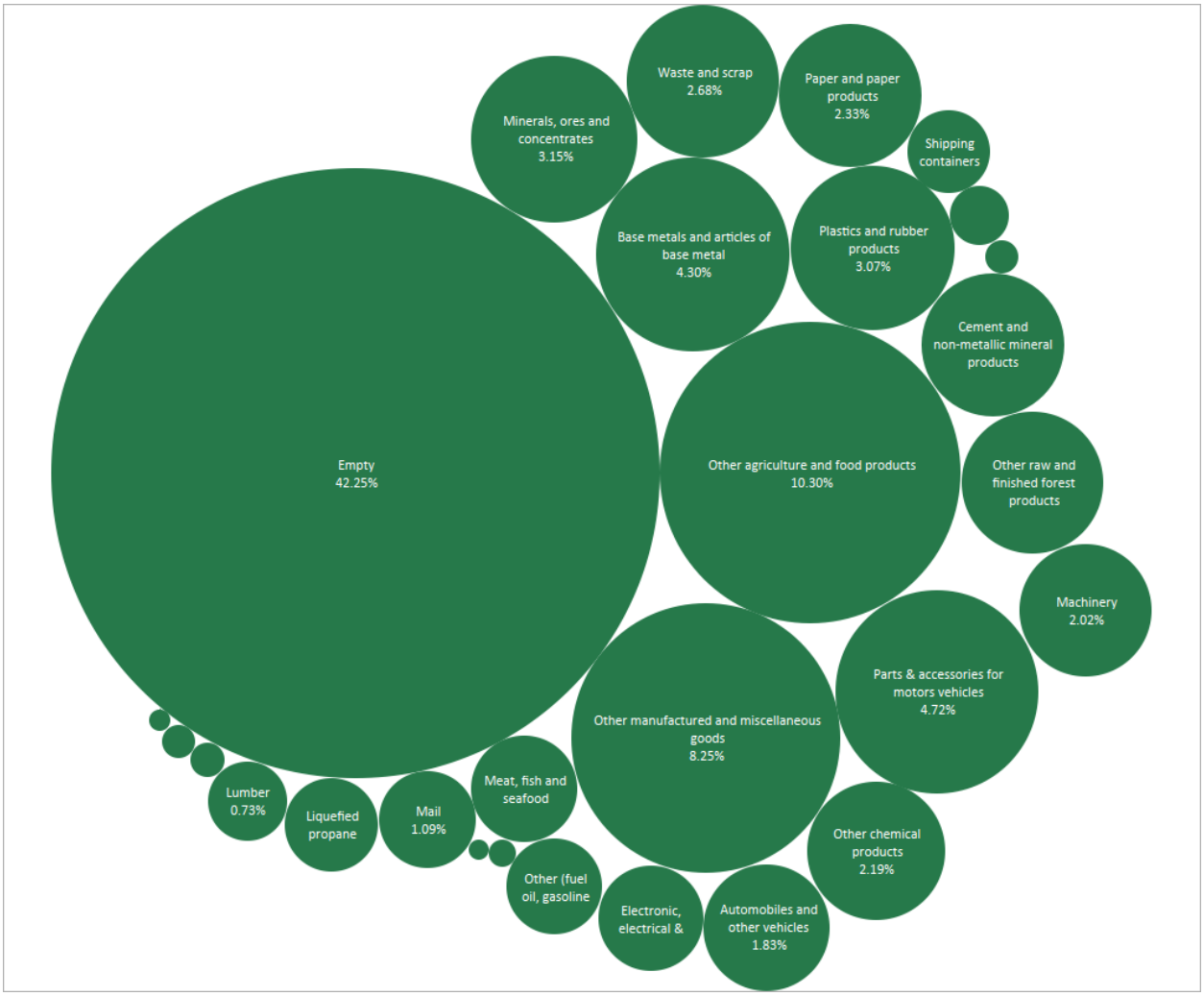
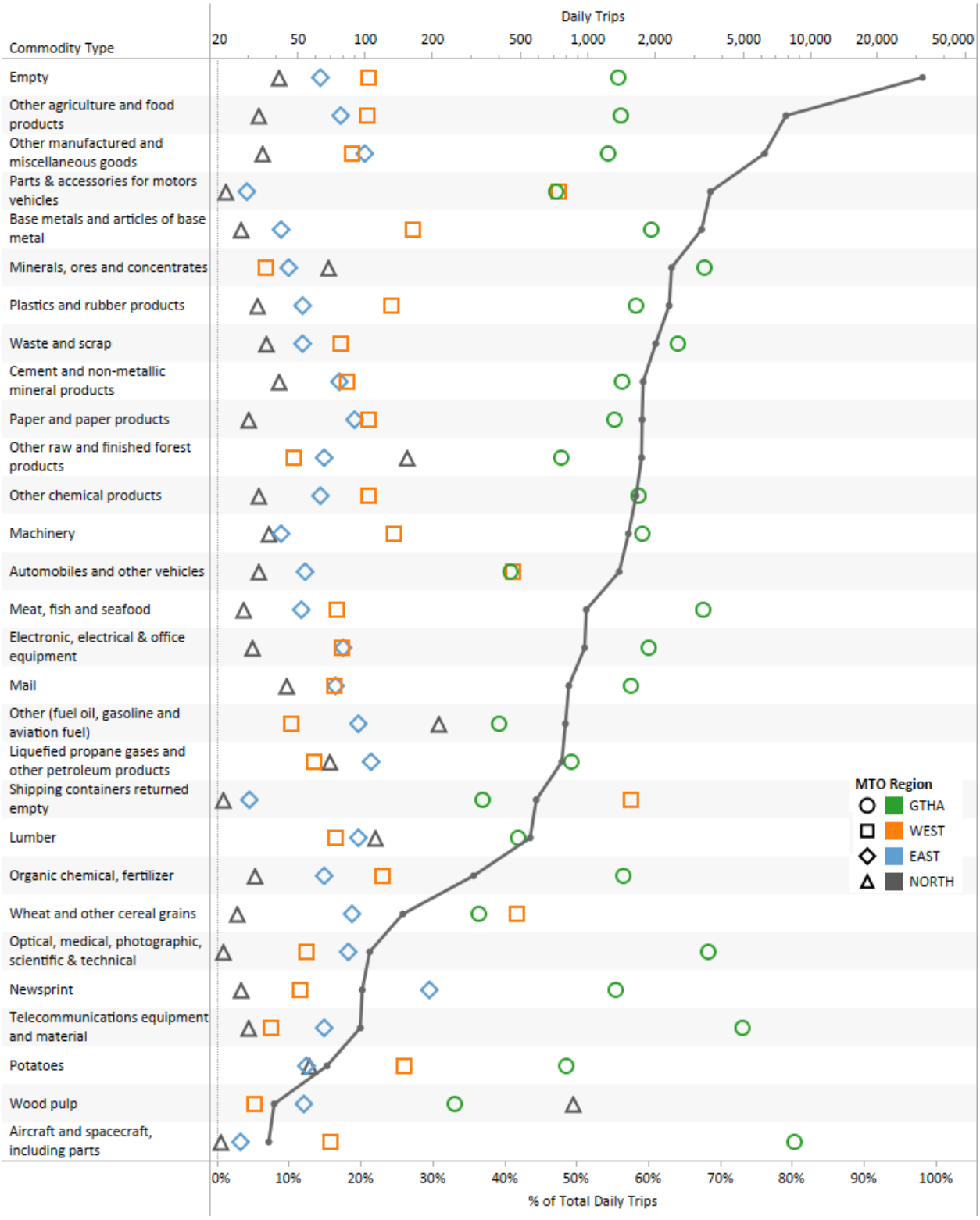


Figure 3-14: Distribution of Truck Trips by Commodity Type and MTO Region



Percentages for all other commodities are shown as well. **Figure 3-14** is of the same format as **Figure 3-12** but provides detail with respect to commodities as opposed to destination facility types. There are no commodities that really stand out in **Figure 3-14** and some of the commodity types are somewhat related. As before, movements that involve the GTA are prevalent across the vast majority of commodity types. The only commodities where the West region exceeds the GTA relate to automobiles, wheat and other cereal grains, and empty shipping containers. Regionally, the GTA stands out more for hi-tech commodities but at the same time it is quite prominent for raw commodities and food products. There is more emphasis in the North on raw goods and meanwhile the pattern for the East does not stand out as being remarkable in any way.

Table A.7-2 in the Appendix offers a cross-tabulation of trips by commodity and end-facility types by select census divisions in Ontario. It gives an idea of how the two variables behave in a bivariate sense.

3.3.3 Locations and Types of Trucking Firms

Figure 3-15 provides details on the locational patterns of trucking firms in Ontario by type of firm. This graphic has been derived from the 2011 Canadian Business patterns data. One thing that stands out immediately is that at nearly 5,000 trucking firms, Peel has more than five times the number of trucking firms than the next ranking county in the province. Relative to most counties this ratio is in the range of 50 to 100 times. In **Figure A.7-7**, in the Appendix, a similar graphic has been developed but with the emphasis on jobs as estimated from the Canadian Business Patterns data.

In terms of specific observations that can be made about patterns of trucking firms by type, one is that the North region is most associated with having a high percentage of firms dedicated to the movement of bulk goods. There are several counties that are in the range of a 40 to 50% share of all trucking firms in this regard. The GTA and West Regions are generally at the lower end of the bulk firm spectrum with many counties between 10 and 20% of trucking firms. Less-than- truckload trucking stands out as the category that generally accounts for the lowest percentage of firms by region. From the point of view that LTL operations require a certain significant scale to succeed, this outcome makes sense.

With regard to local freight firms, the most urbanized counties generally have the higher share of such firms. A declining trend in the blue squares can be observed moving from top to bottom in **Figure 3-15**. Some of the more tourist/vacation oriented counties in the North region (e.g. Muskoka, Haliburton and Parry Sound) interrupt this pattern somewhat. In addition, there is a similar pattern for long-distance truckload firms though not as clearly defined. Some of the highest shares for truckload are associated with accessible counties in East and West regions such as Waterloo, Brant, and Stormont, Dundas and Glengarry (Cornwall). These counties are not heavily populated at least in relation to those of the GTA. Finally, with regard to specialized firms it is not easy to discern a general pattern. Perhaps there is a slight tendency for such firms to be associated with less populated regions and counties.

Figure 3-15: Truck Firm Types by Region and County (2011)

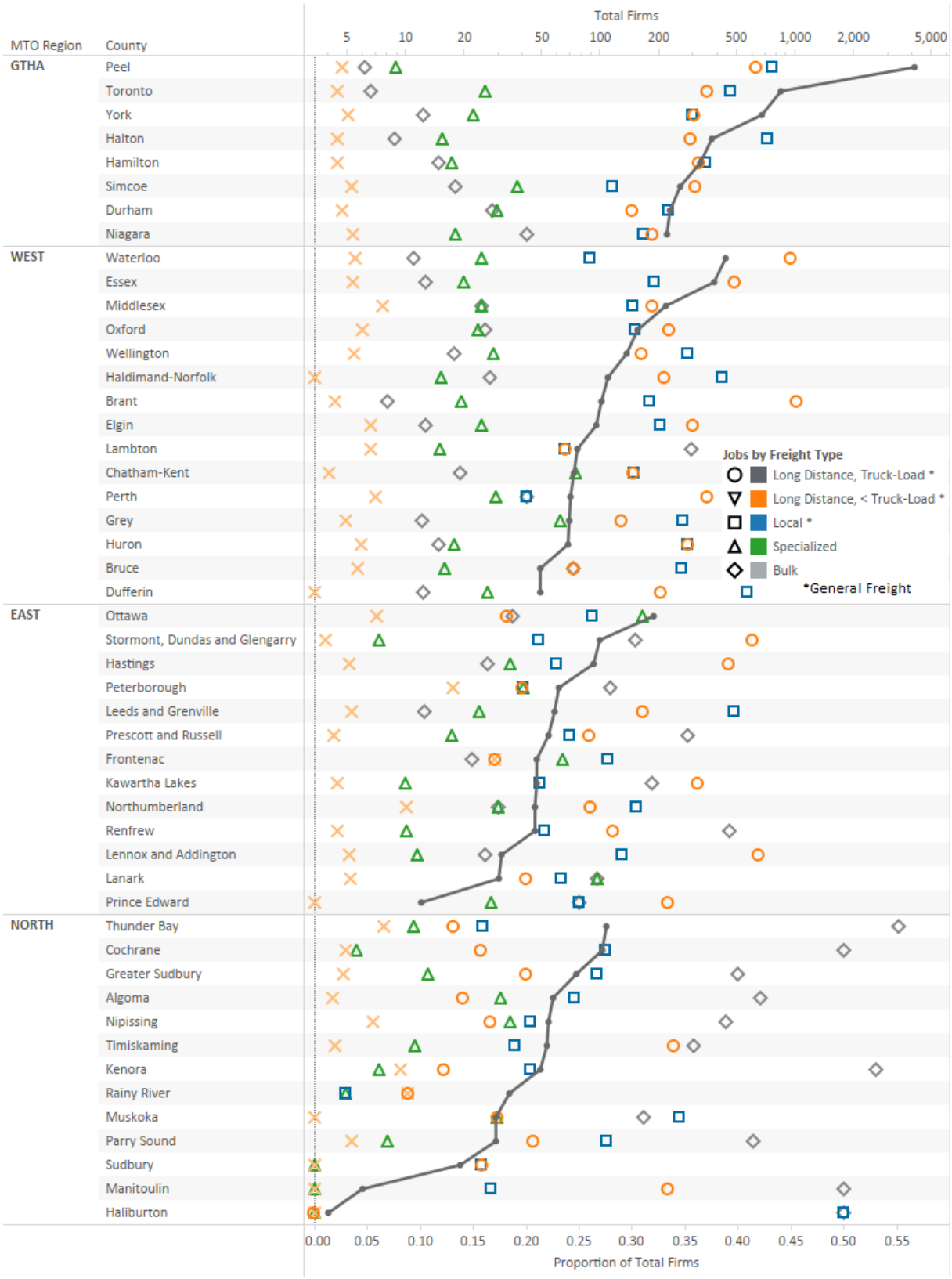


Table 3-2: County Level Indexes for Key Bivariate Relationships

Region		TCOD SHIP OUT/LABOUR FORCE	TCOD SHIP OUT/IN	TCOD INTL OUT/IN	TCOD/CVS OUT	TCOD/CVS IN	CVS OUT/POLK CLASS 8
GTHA	Peel	2.75	1.74	0.70	1.73	1.14	0.92
	Toronto	0.67	0.95	1.02	1.05	1.29	1.29
	York	0.90	0.85	0.68	1.39	1.59	0.56
	Halton	1.54	1.56	0.61	0.83	0.54	1.86
	Durham	0.76	1.28	0.38	1.09	0.64	1.28
	Hamilton	0.82	1.06	1.37	0.72	0.59	1.34
	Simcoe	0.51	0.68	0.73	1.41	0.62	0.38
	Niagara	0.35	0.60	0.98	0.31	0.51	1.45
WEST	Essex	3.09	1.88	4.36	3.21	1.53	0.92
	Waterloo	0.73	0.59	0.68	0.56	1.04	0.96
	Middlesex	1.04	0.80	0.77	1.01	1.49	1.47
	Oxford	1.92	1.02	0.65	0.98	0.91	0.90
	Wellington	1.18	1.29	1.28	0.73	0.62	1.07
	Brant	1.42	0.47	0.74	1.08	2.30	1.17
	Haldimand-Norfolk	0.61	0.96	0.51	0.73	0.83	0.48
	Perth	0.88	0.86	1.29	1.03	1.47	0.54
	Elgin	0.58	0.82	0.86	0.49	0.85	0.71
	Chatham-Kent	0.63	0.83	1.52	0.42	0.63	0.98
	Lambton	0.53	0.62	1.80	0.51	0.72	1.05
	Huron	0.64	0.88	1.63	1.33	1.69	0.24
	Bruce	0.29	0.57	2.05	1.32	4.00	0.16
	Dufferin	0.34	1.19	2.07	0.51	0.63	0.63
	Grey	0.23	0.34	0.63	0.44	1.80	0.48
EAST	Ottawa	0.21	0.39	0.17	0.43	1.03	1.04
	Hastings	0.99	0.86	1.15	0.60	0.67	1.12
	Stormont, Dundas and Glengarry	1.06	0.63	0.46	0.66	0.84	0.89
	Leeds and Grenville	0.73	0.84	1.56	0.55	0.57	1.14
	Frontenac	0.26	0.37	1.17	0.30	0.61	0.86
	Peterborough	0.25	0.35	0.57	0.16	0.43	1.46
	Northumberland	0.42	0.73	0.85	0.33	0.50	1.48
	Kawartha Lakes	0.18	0.40	1.90	0.39	0.82	0.60
	Lennox and Addington	0.38	0.97	2.19	0.42	0.43	1.14
	Prescott and Russell	0.25	0.34	1.05	0.24	0.90	1.07
	Lanark	0.19	0.37	1.50	0.25	0.84	0.97
	Renfrew	0.14	0.29	0.27	0.15	0.62	0.97
	Prince Edward	0.14	0.38	0.03	0.44	0.80	0.42
NORTH	Thunder Bay	2.15	1.11	0.72	1.98	1.50	1.05
	Greater Sudbury	0.43	0.39	0.11	10.00	10.00	0.00
	Nipissing	0.40	0.44	0.82	0.44	1.13	0.92
	Algoma	0.39	0.40	0.24	0.38	1.03	1.00
	Muskoka	0.45	0.44	0.57	0.23	0.84	1.39
	Cochrane	0.56	0.35	0.75	0.55	1.53	0.74
	Timiskaming	0.44	0.48	0.20	0.28	0.46	0.75
	Rainy River	0.33	0.33	0.71	0.05	0.18	3.69
	Manitoulin	0	0.48	0.00	0.36	0.81	0.08
	Sudbury	0.34	1.10	3.74	0.07	0.06	3.70
	Parry Sound	0.06	0.12	0.80	0.03	0.32	1.54
	Haliburton	0	0.01	0.12	0.00	0.36	0.28
	Kenora	0.80	0.13	2.02	0.36	2.76	2.29
		Minimum		50th Percentile		Maximum	

3.3.4 Analysis of Important Bivariate Relationships Using Indexes

In **Table 3-2**, a useful technique for analyzing bivariate relationships is illustrated for freight-related data available at the county level. Each column in the table is associated with the calculation of an index and how two variables compare with one another. There is a numerator variable and a denominator variable where both are expressed as a percentage distribution across the counties and then the index is derived as ratio of the numerator as a percentage over the denominator as a percentage. A neutral result for this index is 1.0. A result of 0.25 is equally as meaningful as a 4.0 result on this index.

Most of the numerator variables are associated with TCOD shipments in some manner and there does seem to be a general pattern where some of the more noteworthy generators are associated with large index values.

In the first column of results, it can that many prominent counties generate truck shipments to a much larger degree than their total 2011 labour force would suggest. The two that stand out are Peel (2.75) and Essex (3.09). Also, a few counties in the West show some strength. It is interesting to note that most counties in the GTA are quite low on this index and are not generating a large number of shipments relative to their labour forces. With the notable exception of Thunder Bay (2.15), most all counties of the East and North generate low levels of truck shipments given the size of their labour forces. The index pattern in column two for outflows of shipments over inflows of shipments shows something of a similar pattern but with fewer extreme results. What seems to make key freight counties stand out is their high rate of shipment outflows relative to shipment inflows. Secondary counties across the province tend to be more noteworthy for their inflows.

The pattern is quite a bit different when international shipment outflows and inflows are compared in column three. For this sub-type of outflows, GTA counties are far less prominent and key West counties are much more prominent. The converse also applies that international inflows are relatively more important for GTA counties and less so for many West counties.

In column four, which relates to outflows of truck shipments over outflows of truck trips, we see that many key GTA and West counties are much more shipment oriented than trip oriented. Meanwhile, in many counties of the East and North there appear to be a lot of truck trips taking place given the number of shipments. This result says something about the prevalence of bulk cargoes for example. Column five is again shipments over trips but for inflows and the resulting pattern is not so distinct. It is interesting to note that secondary counties of the GTA are much more trip-oriented than shipment oriented as it relates to inflows. There are some fairly extreme index values in this column that need to be interpreted cautiously since they are based on quite small volumes of shipments and/or trips.

The final column of results introduces Polk Class 8 commercial vehicles relative to truck trip outflows. There appear to be a swath of secondary West counties that generate fairly insignificant numbers of trips relative to Class 8 vehicles in operation. For the most part, the GTA generates a fair number of outflows relative to vehicles in operation. Some of the largest indexes in this regard, with values greater than 3.0, occur in smaller counties of the north where the absolute numbers are fairly small.

Although not shown in **Table 3-2**, the same analysis was done for Polk Class 8 vehicles over shipment outflows. The main finding was that the noted freight centres of the province had ratios above 1.0 and the smaller centres had ratios that sometimes went well below 1.0. Some noteworthy high indexes included: Peel (1.59), Halton (1.56), Essex (2.94) and Thunder Bay (2.08). Most counties had ratios below 1.0 with many falling in the 0.25 to 1.0 range and a few geographically isolated counties having much lower. Another note is that generation of shipments at the county level is far more heterogeneous than vehicle registrations. The standard deviation of the percentage distributions is about 50% larger in the case of shipment generation.

Patterns of Trucking Spatial Interactions

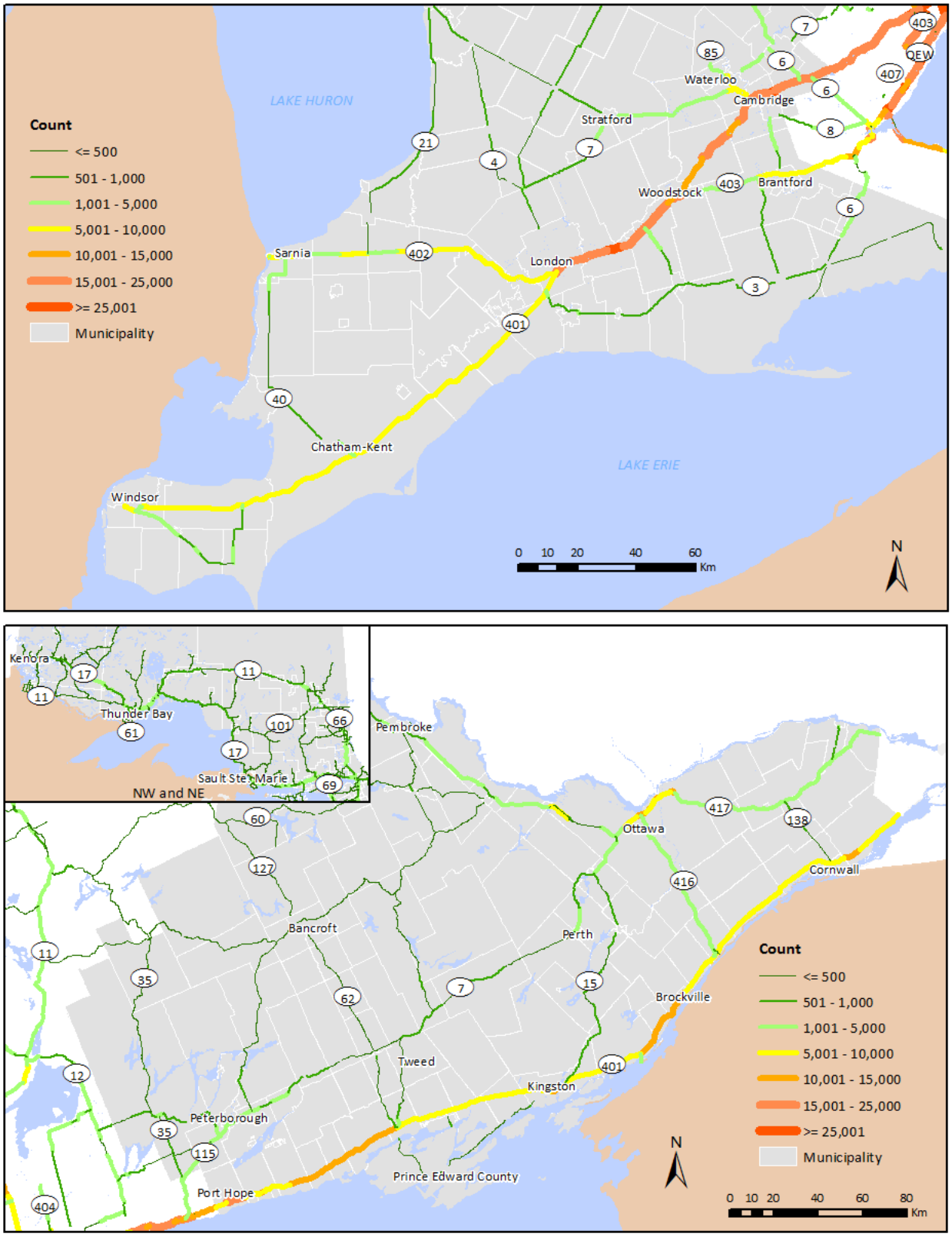
This chapter focuses on detailed interaction patterns within Ontario that are based on truck movements. This is an important area of focus since previous chapters have shown that the majority of freight movements by truck are intra-provincial. Also, it is important to view truck movements in an origin-destination context rather than simply in terms of aggregate arrivals or originations.

4.1 Truck Traffic in Ontario

Of course one implication of trucks moving from their origins to their destinations is that traffic accumulates on road networks. **Figures 4-1 and 4-2** provide details on how the demand for trucking in Ontario manifests itself. These figures are based on Average Annual Daily Truck Traffic [AADT] counts that have been collected by the Ontario Ministry of Transportation at key points on the provincial road network and capture the traffic flow associated with medium and heavy trucks**.** The focus is on three of the key MTO regions. The GTA is covered in **Figure 4-1** and the East and West regions are covered in **Figure 4-2**.

Figure 4-1: Annual Average Daily Trucking Traffic Flows (GTA Region)

Figure 4-2: Annual Average Daily Trucking Volumes: East and West Regions



Though it comes as no surprise, these maps confirm the fundamental role played by the 400-series highways in facilitating truck movements throughout the province, while smaller regional highways see comparatively much less truck traffic. What is particularly noteworthy is the shift in the magnitude of truck traffic along the network. As the centre of gravity in freight and logistics, the GTA is home to the greatest truck flows. But flows outside of the GTA give some indication of important links and nodes in the road-based freight network.

London in particular stands out as something of a terminus in freight flows between the Western and GTA regions, though the split between Hwys 401 and 402 heading west after London account for some of the changes seen in **Figure 4-2**. The remainder of highway 401 maintains between 5,000 to 10,000 daily truck trips all the way to Windsor and the US border. Similarly, the lower panel shows that in the East, Hwy 401 carries more than 5,000 truck trips to the Quebec border, peaking at levels over 10,000 trips in certain areas. One interesting finding is the separation between Ottawa and the rest of this high-flow East-West network along the 401 from Windsor to Cornwall and the Quebec border. Highways 416 to the 401 and 417 to Quebec do attract somewhere between 1,000 to 5,000 daily truck trips, suggesting the city plays some role in attracting and producing truck trips in the East.

Some summary observations that can be made about truck traffic on the 400-series of highways in particular are as follows:

- Large sections of Hwy 401 in the GTA experience greater than 25,000 truck trips per day (peaking at 39,000 trips per day) but representing less than 10% of the massive traffic volumes along those sections.
- Truck volumes are also large in Mississauga and Hamilton on Hwy 403 (>30,000 and >23,000 trips per day respectively), in Brampton on Hwy 410 (>17,000), in Vaughan on Hwy 400 (>13,000) and in Ottawa on Hwy 417 (>11,000). Along the QEW within the GTA, truck volumes are larger than 10,000 trips per day.
- Hwy 401 in Southwest Ontario serves 5,000 to 10,000 daily truck trips which represent >20% and >30% of all traffic past Highways 6 and 402 respectively.
- Highway 401 carries more than 5,000 truck trips per day to the Quebec border and this accounts for >40% of all traffic east of Hwy 416. The volumes peak at over 10,000 truck trips per day in specific areas such as Brockville and Kingston.

Table 4-1: Inter-County Flows of Truck Shipments (TCOD)

MTO Region / Destination County

MTO Region	Origin County	GTHA								WEST							EAST				
		Peel	Toronto	Halton	Hamilton	York	Niagara	Durham	Simcoe	Waterloo	Middlesex	Wellington	Oxford	Essex	Brant	Chatham-Kent	Ottawa	Peterborough	Hastings	Frontenac	Stormont, Dundas and Glengarry
GTHA	Peel	1,752	1,624	353	270	1,236	219	353	340	733	336	129	66	442	141	62	403	104	142	136	165
	Toronto	911	1,722	139	114	406	113	115	135	233	135	45	35	123	60	24	255	40	41	62	103
	Halton	392	321	177	106	140	66	46	57	102	40	40	63	47	54	24	75	11	34	7	37
	Hamilton	207	117	101	411	53	139	18	24	37	29	11	22	113	25	7	15	2	8	3	1
	York	388	324	77	62	259	71	83	119	92	69	35	20	130	28	5	136	22	21	19	35
	Niagara	71	21	15	38	32	99	7	13	13	7	7	6	11	10	2	13	0	2	4	6
	Durham	161	569	41	19	357	8	287	96	22	31	27	11	15	6	4	29	43	25	10	7
	Simcoe	63	81	13	7	218	5	79	235	22	10	8	4	7	3	1	19	5	5	1	3
WEST	Waterloo	120	97	49	27	56	14	23	22	263	39	39	34	45	43	13	40	9	20	5	10
	Middlesex	141	97	27	26	23	62	25	8	17	1,141	12	68	32	16	59	3	1	5	2	4
	Wellington	128	125	42	9	50	7	16	15	75	75	121	6	29	8	4	19	4	4	8	4
	Oxford	120	151	42	34	16	6	12	11	18	96	20	55	73	6	0	6	1	2	0	1
	Essex	207	180	65	15	84	9	85	11	430	24	11	102	1,145	1,037	6	10	31	43	7	5
	Brant	102	39	25	23	37	24	19	11	58	25	14	7	13	38	12	10	6	2	4	8
	Chatham-Kent	22	26	3	5	12	2	0	2	5	7	1	5	30	6	61	1	1	1	0	2
EAST	Ottawa	59	56	10	6	47	6	5	8	2	7	5	1	2	6	0	175	0	21	19	60
	Peterborough	29	4	2	1	17	2	6	1	4	1	1	0	3	1	0	1	4	2	2	
	Hastings	73	113	12	7	20	4	8	6	13	10	5	1	1	3		12	5	38	8	6
	Frontenac	28	10	3	1	8	0	0	0	0	5	2	0	0	1		10	0	5	27	2
	Stormont, Dundas and Gle..	52	16	10	1	32	5	3	3	10	2	10	1	5	2		72	0	12	10	33

Average Daily Shipments

0 — 1,752

Table 4-2: Daily Inter-County Flows of Trucks (CVS)

MTO Region / Destination County

MTO Region	Origin County	GTHA								WEST							EAST				
		Peel	Toronto	Halton	Hamilton	York	Niagara	Durham	Simcoe	Waterloo	Middlesex	Wellington	Oxford	Essex	Brant	Chatham - Kent	Ottawa	Peterborough	Hastings	Frontenac	Stormont, Dundas and Glengary
GTHA	Peel	111	928	1,443	821	281	451	278	587	1,071	385	646	189	185	229	60	137	197	269	231	170
	Toronto	623	1,723	725	669	743	289	587	708	519	155	287	133	65	148	42	115	175	122	120	39
	Halton	1,519	810	717	156	331	251	115	131	108	97	52	46	58	53	17	14	27	36	21	4
	Hamilton	736	627	188	133	195	541	88	85	78	56	2	2	78	22	20	12	3	10	9	7
	York	46	364	331	185	122	114	206	479	225	80	156	64	38	66	44	40	74	42	45	23
	Niagara	395	265	210	552	112	184	54	40	152	38	54	35	25	62	3	6	13	11	2	3
	Durham	169	256	69	80	170	46	553	28	88	37	64	58	51	19	11	21	78	78	10	14
	Simcoe	22	23	59	59	30	28	19	123	54	54	16	19	36	6	47	7	4	2	4	3
WEST	Waterloo	1,013	447	209	324	233	150	81	79	8	262	6	7	111	9	45	27	15	25	15	10
	Middlesex	510	205	74	73	124	48	70	78	247	34	118	263	0	102	11	9	20	12	3	2
	Wellington	494	299	143	198	120	85	48	27	32	48	79	0	16	35	20	5	9	9	1	5
	Oxford	173	143	41	19	61	28	36	18	13	269	1	3	88		18	3	1	7	1	0
	Essex	157	84	56	21	55	29	52	32	85	58	24	63	10	22	57	7	6	1	0	1
	Brant	206	185	43	11	85	40	19	23	2	96	7	1	21		18	2	10	13	10	4
	Chatham - Kent	132	32	16	20	42	13	17	51	60	6	7	56	2		73	0	5	4		2
EAST	Ottawa	95	70	13	5	26	5	26	8	7	2	4	1	1	1	1	235	14	29	62	20
	Peterborough	161	122	29	7	118	6	105	6	19	5	5	0	9	6	3	11	365	103	5	
	Hastings	235	121	22	9	73	7	112	9	21	8	8	5	4	9	1	23	106	140	9	22
	Frontenac	190	70	5	19	40	4	33	10	11	6	1	0		4		31	12	10	3	21
	Stormont, Dundas and Gl..	77	21	1	4	16	4	8	2	6	4	4	1	1	0	0	127	0	37	67	21

Average Daily Trips

0 — 1,723

4.2 Inter-County Flows

A good starting point in the characterization of overall interaction patterns is **Table 4-1**, which provides a succinct origin-destination summary of daily inter-County shipment flows based on the TCOD data. Of course, shipments do not translate to trips on a one-to-one basis so there is not a direct linkage between this table and the traffic patterns of **Figures 4-1 and 4-2**. This is not a comprehensive table of all flows between counties but it shows the most important ones for the three most important regions. An estimated total of just over 40,442 daily shipments by truck are taking place between locations in Ontario. Over 75% of these flows are captured in **Table 4-1**. The counties in **Table 4-1** are organized by MTO region to provide greater clarity about the structure of the truck flows. Intra-County flows are coded as grey and larger inter-County flows are coded as darker green.

Overall, the patterns exhibited in **Table 4-1** make intuitive sense. There is a clear pattern that the most intense freight interactions are in the upper left of the matrix and involve movements between the primary counties within the GTHA. The omission of shorter private fleet movements in TCOD perhaps has this strong pattern appearing even weaker than it otherwise might have appeared. There are some significant intra-County flows of shipments and in several cases (e.g. Ottawa, Middlesex, Hamilton) these "diagonal" flows are the largest ones by a significant margin; but for most counties this is not the case. The row and column totals confirm the recurring pattern that outflows are more heterogeneous than inflows, indicating that true freight generators are more unique and harder to come by than freight attractors. **Table 4-1** leaves little doubt that Peel Region is a true freight generator.

There is some evidence in **Table 4-1** of regions operating somewhat independently in terms of truck movements. The internal shipment flows in the West Region in particular are significantly larger than the flows to and from the main centres of GTA Region. Middlesex and Essex stand out in this regard. There is a noteworthy significant flow from Essex to Brant counties although the reverse certainly does not apply.

In **Table 4-3** it can be seen that the aggregate internal flows in the two northern regions also exceed the interaction with the GTA Region. For the East Region though, this is not the case. The east is more dependent on the GTA for shipments than it is on itself. **Table 4-3** also shows that about 64% of intra-Provincial flows are internal to MTO Regions. The remaining 1/3 flow between MTO Regions.

It is worth paying some attention to some of the small or non-existent TCOD flows that have not made their way into **Table 4-1** for the most part. This aspect is best described by percentiles based on all possible combinations of inter-County flow pairings in Ontario. It turns out that the level of 1.0 daily shipment per day is not reached until the 60th percentile of ranked inter-County flows. Five shipments per day is reached at about the 73rd percentile and 10 shipments is reached at the 81st percentile. The 95th percentile is 62 shipments per day and the 99th percentile is 321 shipments per day. The key takeaway is that the majority of inter-County shipment volumes are trivial. There are only a relatively small percentage of origin-destination combinations that are associated with significant shipment volumes.

Table 4-3: Flows between MTO Regions (TCOD and CVS)

			TCOD		
MTO Region	GTHA	WEST	EAST	NORTH	Total
GTHA	16,092	4,847	2,682	1,614	**25,236**
WEST	3,242	6,448	457	349	**10,496**
EAST	888	202	878	51	**2,019**
NORTH	321	52	21	2,298	**2,692**
Total	**20,543**	**11,550**	**4,037**	**4,312**	**40,442**
			CVS		
MTO Region	GTHA	WEST	EAST	NORTH	Total
GTHA	22,985	7,520	3,130	880	**34,515**
WEST	8,329	4,036	516	177	**13,058**
EAST	2,868	408	3,084	104	**6,464**
NORTH	1,127	134	101	4,063	**5,426**
Total	**35,310**	**12,098**	**6,832**	**5,224**	**59,464**

Table 4-2 is a direct counterpart to **Table 4-1** except it is done for the CVS. This is a trip-oriented matrix as opposed to a shipment matrix. It accounts for 44,943 of the 59,464 total daily intra-Ontario trucking trips captured by CVS. There is clear evidence in this matrix that the CVS survey is not ideal for capturing shorter truck movements. There are some diagonal elements, for example in the West region, where intra-County shipments are impossibly low. Note also that the estimated CVS Peel to Halton flow is about 12 times the intra-Peel flow, which does not seem plausible in comparison to the corresponding TOCD results. For TCOD that same ratio is about 0.2! So there are massive differences. Clearly there are "beehives" of intra-County activity that evidently do not extensively involve the use of provincial roads and which the CVS is therefore incapable of capturing.

4.3 Inter-Municipal Flows

Figures 4-3 and 4-4 are carried out at the municipal level (rather than the county level) using the CVS data and offer a different means to illustrate certain points about the interaction patterns. **Figure 4-3** illustrates patterns for the most significant flows originating from GTA municipalities and **Figure 4-4** achieves a similar result for East, West and North Regions (the north here is a merger of the MTO NW and NE regions). Each of the major municipal origins in the region are considered in turn and sorted by prominence with the municipal destination of the originating flow taken into account. The estimated absolute number of trips is noted and a colour coding is provided which allows the region associated with the destination to stand out.

With respect to **Figure 4-3**, a total of 19,104 daily truck trips originating from the GTA are captured. The majority of associated dots are green which indicates that most of the inter-municipal trip interaction patterns are intra-GTA. The magnitudes of the "green" interactions are on average higher which further

emphasizes the importance of intra-GTA movements. Consider also the fact that the CVS misses out most short distance trips. About 77% of the displayed trips are intra-GTA. The only other significant share of GTA originating trips is with the West Region at about 17% of originating flows. Nonetheless, there is representation of interaction with all four other MTO regions in **Figure 4-3** but with the northern regions the amount is minimal (e.g. 65 daily trips to Sudbury). Some key GTA municipalities such as Toronto, Mississauga, Brampton and Vaughan seem particularly well-connected with West Region municipalities. Toronto and Mississauga are the only municipalities that send significant trips to all MTO Regions. Several municipalities (Burlington, Milton, Oakville, St. Catharines, Pickering and Niagara Falls) are shown to send significant trips only to other GTA municipalities. This latter point is evidence of hierarchical behaviour in truck trips where key GTA facilities are likely being used as intermediate steps for shipments on their way to the final destination.

Figure 4-4 dedicates a column of results for each of the three non-GTA regions. Total originating trips captured in the Figure include 4954 associated with the West Region, 2112 with the East Region and 703 from the two regions in the North. From most every municipality in the province, municipalities in the GTA are a prominent destination. In other words, the GTA Region is shown to contain the key trucking hubs in the province. This is further reinforced by the fact that the colour of the West Region (orange) does not appear in the East Region column and the colour of the East Region (blue) does not appear in the West Region column. East and West municipalities interact with other municipalities in the same region or with municipalities in the GTHA Region but that is the extent of the major flows. Possibly GTA cross-docking operations are used to link East and West for freight movements and the two legs are considered distinct trips by the CVS. Geographically fine TCOD interaction data, which tracks shipments but was not available for this analysis, would capture this type of behaviour as a single shipment.

London appears to play the role of most significant freight hub in the West Region. It has significant interactions with five other western centres as well as a host of GTHA centres. Kitchener-Waterloo-Cambridge appears less prominent. Based on the colour coding, there is no single significant freight hub that stands out in the East Region as a conduit for East Region freight like London does in the West. Ottawa is by far the largest population centre but it has the disadvantage of not being centrally located on the Toronto-Montreal corridor along Hwy 401. This is further evidence of the earlier statement that the East Region as a whole is more dependent on the GTA Region than it is dependent on itself for freight flows. Ottawa is a bit too isolated to play the role for the East that London does for the West. Cornwall appears less prominent in these 2006 data than perhaps it is now and its strongest interaction within Ontario appears to be with Ottawa rather than the GTHA Region. Interactions with Quebec, of course, are not considered with the provided CVS data.

Owing to the shortage in municipalities of a significant economic scale and issues of isolation, many of the interactions depicted from the northern regions are trivial in size and would not rate mentioning if observed in the other regions. The level of truck interactions is generally low in all contexts and gets lower as we consider origins further to the periphery of Ontario and the truck linkages with the GTA. Possibly, rail is more relevant in many of those contexts. Nevertheless, the data for the northern region shows interactions with each of the other MTO regions, especially the GTA region.

Figure 4-3: Key Truck Interactions Originating from GTA Region Municipalities

Origin	Destination	
Toronto	Toronto	1,723.0
	Hamilton	670.3
	Vaughan	431.3
	Brampton	322.6
	Burlington	310.3
	Milton	265.3
	Cambridge	262.1
	Mississauga	257.5
	Oshawa	236.8
	Clarington	190.3
	Guelph	147.4
	London	146.3
	Markham	144.0
	Kitchener	141.4
	Peterborough	130.3
	Kingston	118.6
	Ottawa	114.9
	Whitby	107.8
	Puslinch	103.2
	Brantford	99.8
	Oakville	98.5
	St. Catharines	76.7
	New Tecumseth	63.3
	Greater Sudbury	62.8
	Niagara Falls	59.8
	Halton Hills	50.9
Mississauga	Hamilton	560.6
	Toronto	512.0
	Burlington	391.0
	Milton	384.6
	Cambridge	281.3
	Guelph	255.9
	Kitchener	234.9
	London	226.4
	Oakville	148.0
	Kingston	146.4
	Oshawa	114.7
	Brantford	113.0
	Puslinch	107.0
	Ottawa	91.3
	Peterborough	88.2
	Halton Hills	78.7
	St. Catharines	71.2
	Cornwall	70.0
	Greater Sudbury	65.0
	Belleville	63.0
	Niagara Falls	49.1
Hamilton	Toronto	635.4
	Mississauga	474.7
	Brampton	240.6
	St. Catharines	168.0
	Oakville	148.2

MTO Region
- GTHA
- WEST
- EAST
- NORTH

Origin	Destination	
Hamilton	Hamilton	134.7
	Vaughan	125.4
	Niagara Falls	79.0
	Cambridge	46.1
Bramption	Toronto	362.7
	Hamilton	239.4
	Milton	198.7
	Cambridge	183.7
	Guelph	175.0
	Burlington	149.6
	Kitchener	134.6
	London	114.1
	Kingston	82.7
	Belleville	67.1
	Brantford	61.2
	Windsor	59.3
	Puslinch	57.3
Burlington	Mississauga	422.2
	Toronto	277.8
	Oakville	223.0
	Brampton	131.6
	Vaughan	90.6
Milton	Mississauga	434.1
	Toronto	299.8
	Brampton	229.7
	Vaughan	81.8
	Oakville	62.6
Vaughan	Toronto	218.4
	Hamilton	116.7
	Milton	108.5
	Burlington	85.8
	Guelph	67.5
	London	63.5
	New Tecumseth	62.4
	Cambridge	60.3
	Peterborough	54.4
	Kitchener	48.0
Oakville	Toronto	190.0
	Mississauga	170.1
	Oakville	149.7
	Burlington	138.6
	Hamilton	81.0
	Milton	47.1
St. Catharines	Hamilton	233.2
	Mississauga	85.7
	Toronto	53.5
	Burlington	46.2
Pickering	Oshawa	140.5
	Clarington	95.3
Niagara Falls	Hamilton	90.0
	Mississauga	69.1
	Toronto	50.7

Source: Ontario Ministry of Transportation, 2006 Commercial Vehicle Survey

Figure 4-4: Key Truck Interactions Originating from Non-GTHA Municipalities

West

Origin	Destination	
London	Mississauga	263.1
	Brampton	195.2
	Toronto	183.1
	Sarnia	104.3
	Cambridge	88.0
	Brantford	74.2
	Guelph	73.9
	Kitchener	71.7
	Vaughan	66.7
	Hamilton	64.1
	New Tecumseth	59.5
Cambridge	Mississauga	252.4
	Toronto	209.6
	Brampton	139.0
	Hamilton	114.0
	London	112.1
	Vaughan	76.1
	Oakville	50.0
	Windsor	48.3
	Burlington	44.7
Kitchener	Mississauga	209.5
	Toronto	129.7
	Brampton	128.6
	Hamilton	107.5
	London	83.1
	Vaughan	71.1
Guelph	Brampton	156.2
	Toronto	142.4
	Hamilton	113.4
	Mississauga	100.2
	Vaughan	41.8
Brantford	Toronto	130.5
	Mississauga	101.9
	Brampton	69.7
	Vaughan	56.5
Puslinch	Toronto	134.7
	Mississauga	84.8
	Hamilton	43.6
	Brampton	42.4
Chatham-Kent	Brampton	81.1
	Chatham-Kent	73.3
	Mississauga	46.6
Waterloo	Mississauga	56.1
	Brampton	44.8
	Hamilton	40.0
Brant	Toronto	48.3
	London	40.8
Sarnia	London	88.5
Windsor	Mississauga	43.7
	London	41.8
St. Thomas	Hamilton	67.8
North Dumfries	Mississauga	43.8

MTO Region
- GTHA
- WEST
- EAST
- NORTH

East

Origin	Destination	
Ottawa	Ottawa	235.3
	Toronto	69.9
	Mississauga	62.6
	Kingston	56.0
	Brockville	34.3
	Brampton	28.8
	Vaughan	19.6
	Belleville	13.9
Kingston	Brampton	99.6
	Mississauga	88.2
	Toronto	70.0
	Brockville	58.9
	Vaughan	31.9
	Ottawa	28.9
	Hamilton	18.9
Peterborough	Mississauga	88.4
	Toronto	85.5
	Havelock	44.1
	Oshawa	27.0
	Brampton	23.4
	Belleville	22.6
	Quinte West	16.1
	Vaughan	14.8
	Whitby	14.5
Belleville	Belleville	61.8
	Mississauga	57.8
	Toronto	40.3
	Brampton	37.9
	Peterborough	28.1
	Kingston	22.7
	Vaughan	22.2
	Oshawa	18.7
	Quinte West	15.9
Quinte West	Toronto	48.3
	Mississauga	44.8
	Brampton	29.9
	Belleville	19.3
	Oshawa	15.4
	Whitby	14.2
Havelock	Peterborough	59.7
	Markham	45.9
	Vaughan	18.4
	Mississauga	16.8
	Toronto	13.1
Cornwall	Ottawa	73.9
	Mississauga	30.8
	Brampton	18.2
Brockville	Mississauga	28.0
	Ottawa	23.0
	Toronto	22.2
	Belleville	17.4
	Vaughan	14.0

North

Origin	Destination	
Greater Sudbury	Toronto	54.9
	Mississauga	49.3
	Thunder Bay	41.2
	Sault Ste. Marie	23.3
	Brampton	19.8
	Hamilton	14.9
	Vaughan	11.4
	Ottawa	6.9
	Peterborough	5.2
	Caledon	4.7
	Pickering	4.2
	Whitby	3.7
	London	3.4
	Oakville	3.2
	Huntsville	3.1
	Clarington	3.1
	Burlington	2.3
North Bay	Greater Sudbury	27.7
	North Bay	26.2
	Brampton	20.2
	Toronto	16.4
	Ottawa	15.0
	Huntsville	11.9
	Sault Ste. Marie	9.2
	Mississauga	8.8
	Guelph	3.0
	Markham	2.8
	Hamilton	2.6
Dryden	Dryden	75.8
	Fort Frances	10.7
	Thunder Bay	4.5
Thunder Bay	Thunder Bay	49.7
	Mississauga	13.9
	Sault Ste. Marie	6.1
	Greater Sudbury	4.9
	Toronto	2.4
	Vaughan	2.1
Sault Ste. Marie	Greater Sudbury	38.1
	Thunder Bay	6.8
	Mississauga	4.9
	Hamilton	4.8
	Toronto	4.3
	Oshawa	2.1
Huntsville	Brampton	9.5
	Markham	9.5
	Toronto	7.9
	North Bay	6.7
	Mississauga	6.4
	Greater Sudbury	3.7
	Guelph	2.0
Fort Frances	Thunder Bay	15.8
	Dryden	12.0

Figure 1-2 emphasized the short distance nature of many truck movements as does the TCOD summary O-D matrix in **Table 4-1**. The inter-Municipal results provide further evidence that the CVS survey fails to capture the vast majority of short-haul truck movements. In **Figure 4-3** there are many surprising absences of intra-municipal flows. For example, intra-Mississauga and intra-Brampton flows, which one would expect to be significant, do not appear on the list. There are several other examples as well. On the other hand, probably because Hwy 401 bisects the City of Toronto for a significant distance, there is a large intra-Toronto flow that is captured. This in fact is the largest CVS flow of all. Flows that are associated with longer distances, and therefore, provincial highway use, appear to be much better captured. One caveat is that Hwy 407 is non-provincial and this may account for some apparent deficiencies in the origin-destination patterns.

4.4 Hierarchies to Measure Trucking Interaction Patterns in Ontario

Trucking interaction patterns between Ontario counties can also be interpreted by classifying counties and then interpreting interactions between the newly created aggregate entities. Natural breaks in outgoing shipment generation were used to develop the classes. Class 1 counties included Peel, Toronto, Essex, York and Halton all of which send out more than one million shipments per year. Class 2 covers 10 counties that each send out over 250,000 shipments per year. Class 3 covers a further nine counties that generate over 100,000 shipments per year while the remaining 25 counties are less than 100,000 annual shipments sent out. Bear in mind also that generation of shipments is viewed as more significant than receipt of shipments which explain the focus on outgoing shipments.

The results of this classification and aggregation exercise are shown in **Table 4-4** across the range of variables that are captured by the 2010 TCOD survey: shipments, tonnage, distance and trucking firm revenue. These totals include intra-County quantities. A full 70% of the shipments and 71% of the tonnage are associated with movements between and within Class 1 and Class 2 counties.

Possibly the most interesting set of results relates to tonnage per shipment. In general, the lower the originating county is on the class hierarchy, the higher the tonnages that are moved per shipment. Another pattern is that the greater the number of steps down in the hierarchy between originating class and destination class, the smaller the typical shipment. The lowest tonnage per shipment is 3.26 associated with average movements from Class 1 counties to Class 4 counties. Meanwhile, the biggest tonnage per shipment of all is 22.37 for movements between and within Class 4 counties. Although these data are not broken down by commodities, the implication seems to be that higher-value, higher-order goods are flowing downstream and lower-order, unfinished or raw goods are moving upstream. Note that TCOD captures revenue generation of trucking firms, not the value of the goods.

Table 4-4: Shipment Patterns and the County Hierarchy

	Class 1	Class 2	Class 3	Class 4
Shipments				
Class 1	3,792,586	2,113,799	684,644	673,988
Class 2	1,200,106	1,377,787	297,901	628,993
Class 3	287,818	206,710	181,000	100,785
Class 4	185,735	118,028	50,766	231,901
Tonnage				
Class 1	25,259,720	18,076,111	4,199,861	2,195,129
Class 2	15,903,062	25,666,205	3,964,692	2,798,798
Class 3	3,603,637	2,786,736	3,312,105	935,740
Class 4	2,275,206	2,292,970	956,265	5,187,783
Tonnes/Shipment				
Class 1	6.66	8.55	6.13	3.26
Class 2	13.25	18.63	13.31	4.45
Class 3	12.52	13.48	18.3	9.28
Class 4	12.25	19.43	18.84	22.37
Distance (million km)				
Class 1	224.4	466.5	193.5	279.4
Class 2	153.7	104.5	57.1	242.1
Class 3	68.8	50.4	20.6	27.4
Class 4	54.8	29.0	11.4	20.6
Distance/Shipment				
Class 1	59.16	220.68	282.56	414.61
Class 2	128.08	75.87	191.56	384.84
Class 3	238.93	243.79	113.66	271.87
Class 4	294.89	245.92	225.36	88.71
Revenue ($ millions)				
Class 1	825.55	847.02	223.48	191.36
Class 2	322.47	370.1	94.78	102.57
Class 3	113.43	82.88	83.82	38.81
Class 4	81.62	53.7	19.17	91.75
Revenue ($) per tonne-km				
Class 1	0.62	0.21	0.2	0.24
Class 2	0.19	0.32	0.17	0.16
Class 3	0.11	0.19	0.32	0.17
Class 4	0.1	0.11	0.1	0.33

The class table on revenue gives some insight into how for-hire trucking firms generate their business in Ontario. About $3.54 billion in revenue was generated in 2010 from intra-Ontario shipments and nearly 60% of this was from shipments that originated in Class 1 counties. As with tonnages and total shipments, the largest revenue generators are for movements between and within Class 1 and Class 2 counties. In terms of revenue generation, there is a clear class hierarchy. In any pairing of classes, more revenue is always generated from a higher to lower class movement (e.g. Class 1 to Class 2) than is generated between the same pairing in reverse. Generally, across the different pairings, about twice as much revenue is generated from the former as compared to the latter.

The same type of relationship is evident with regard to number of shipments and if anything the difference is even more dramatic between some pairings. For example, Class 1 to 4 generates almost four times as many shipments as Class 4 to 1. The revenue ratios in this context are not as high. In reference to tonnages, however, this rule breaks down. Generally, there is more tonnage moving from the higher order to the lower order pairings but not by much and in some cases it is almost a 1 to 1 relationship. Certainly, there is ample evidence that revenue is more tied to the number of shipments than to aggregate tonnage. As derived from **Table 4-4**, there is a 0.94 correlation between revenue and shipments and 0.84 between revenue and tonnage.

In terms of distance-oriented variables in **Table 4-4**, aggregate distance is most strongly related to revenue with a correlation of 0.76. In terms of distance per shipment the most obvious aspect that stands out are the shorter distances associated with intra-class movements. This suggests more spatial clustering when movements are within the same class. Revenue per tonne-km expresses how much economic value is generated per unit of "effort" in moving freight. By far the most lucrative in this regard are intra-class 1 movements but movements within the other classes are paying well also. Consider though that this measure of effort via line-haul costs does not take into account any fixed terminal costs associated with a shipment.

5

The Micro-Character of Generators/Attractors

This structure of this report has evolved in something of a top-down manner where freight generation associated with trucking was first examined at the national level before moving to the sub-provincial levels. The purpose of this chapter is to focus on the micro-level to understand more about the localized nature of freight generation in Ontario. There are some visuals in this section that capture entire MTO regions - in these cases, "micro" means that significant municipal clusters are broken into their main components. There are other visuals that are operating at the sub-municipal level. Detailed analysis of clusters at this level involves the use of specific addresses from CVS and individual postal codes from TCOD. It is worth noting that the majority of the analysis in this chapter relates to outgoing freight, as opposed to incoming, as we believe that outgoing movements are better able to differentiate places in terms of their importance from a freight perspective.

5.1 Is Freight Generation by Truck Concentrated or Dispersed?

When considering the micro-level, it is useful to evaluate the dispersion pattern of freight generation as it relates to trucking. The great strength of trucks is that they can go just about anywhere and one might expect to see evidence of this in terms of actual geographic patterns in the data. Does the

majority of freight associated with truck movements come from a small number of large shippers/generators or is it more an accumulation of a large number of small shippers?

The results in **Table 5-1** suggest that the truth probably lies closer to the latter. The top half of the table deals with the CVS and truck trips from specific addresses while the bottom half deals with TCOD shipments from specific postal codes. In the CVS table, the results suggest that daily trucking freight outflows are about 50% driven by locations that generate between 5 and 50 truck trips per day. Outflowing trips are about 43% driven by the large number of locations that generate less than 5 trips per day. Meanwhile, a little over 5% of total outgoing trips are from locations that generate 50 or more trips per day. Smaller shippers seem to generate much more traffic overall.

In interpreting these CVS results, it is important to note that only specific, identifiable addresses are used to generate these totals. The idea is that we are trying to hone in as finely as possible on the actual freight generating entity. In total we were able to identify 14,396 locations with addresses in Ontario that generated outflows. These locations were extracted from a database of about 58,000 records where addresses were a subset of all the included geographic identifiers. Other geographic identifiers in the larger data set included place names, postal codes, streets without addresses and general areas identified by street/highway intersections. There are also quite a few cases where addresses outside of Ontario are omitted from the final list. Our interest lies in the Ontario addresses.

Table 5-1: Daily Freight Generation Patterns by Precise Origins

Trip Count Bins	Locations	% of Total Locations	Trips	% of Total Trips
0-1	8,846	61.45%	1,627	6.02%
1-2	2,081	14.46%	3,017	11.17%
2-5	2,257	15.68%	7,053	26.11%
5-10	773	5.37%	5,332	19.74%
10-25	303	2.10%	4,412	16.33%
25-50	117	0.81%	4,061	15.04%
50-100	15	0.10%	994	3.68%
100+	4	0.03%	513	1.90%
Total	14,396	100.00%	27,009	100.00%

Shipment Count Bins	Locations	% of Total Locations	Shipments	% of Total Shipments
0-5	167	18.02%	526	1.21%
5-10	186	20.06%	1,337	3.09%
10-25	266	28.69%	4,323	9.98%
25-50	140	15.10%	4,954	11.43%
50-100	86	9.28%	6,012	13.88%
100-250	53	5.72%	8,574	19.79%
250-500	18	1.94%	6,115	14.11%
500-100	6	0.65%	3,515	8.11%
1000+	5	0.54%	7,971	18.40%
Total	927	100.00%	43,327	100.00%

If the results with respect to outgoing trips are biased towards the smaller shippers, then the bias with respect to actual shipping origins is even more tilted towards minor addresses. Over 90% of locations that generate outgoing freight in Ontario are associated with less than 5 shipments per day and 2/3 of these are from locations that generate on average less than 1 trip per day. Clearly there are a large number of locations in Ontario that are capable of generating a trip but on many days they do not. In aggregate, these types of locations generate more trips per day across the province than do those locations that generate more than 50 trips per day.

In interpreting these CVS results, it is important to note that only specific, identifiable addresses are used to generate these totals. The idea is that we are trying to hone in as finely as possible on the actual freight generating entity. In total we were able to identify 14,396 locations with addresses in Ontario that generated outflows. These locations were extracted from a database of about 58,000 records where addresses were a subset of all the included geographic identifiers. Other geographic identifiers in the larger data set included place names, postal codes, streets without addresses and general areas identified by street/highway intersections. There are also quite a few cases where addresses outside of Ontario are omitted from the final list. Our interest lies in the Ontario addresses.

If the results with respect to outgoing trips are biased towards the smaller shippers, then the bias with respect to actual shipping origins is even more tilted towards minor addresses. Over 90% of locations that generate outgoing freight in Ontario are associated with less than 5 shipments per day and 2/3 of these are from locations that generate on average less than 1 trip per day. Clearly there are a large number of locations in Ontario that are capable of generating a trip but on many days they do not. In aggregate, these types of locations generate more trips per day across the province than do those locations that generate more than 50 trips per day.

The 2011 TCOD data in the lower half of **Table 5-1** are not quite comparable in the sense that they are associated with the shipment generation patterns of individual postal codes in Ontario. Postal codes are of course a lot more aggregated than specific addresses. The results are based on 927 distinct postal codes in Ontario that generate more than 10,000 tonnes of outgoing truck freight annually or about 33 tonnes per day. As a result, the TCOD table is also not quite comparable in that it is much more truncated at the lower end. Somewhere between 1/4 and 1/3 of the outgoing TCOD shipments are likely missing from this table based on comparisons with the 2010 TCOD origin-destination matrix that we have. Bearing caveats in mind, it can be seen that about 2/3 of the postal codes that generate significant freight volumes by truck generate less than 25 shipments per day. If the data were not truncated at the lower end, this percentage would be considerably higher. And of course, for each of these postal codes, there may well be multiple firms that are contributing to the totals -- 25 shipments might be split among 10-15 firms that can generate freight on a given day.

5.2 Regional Views with Sub-Municipal Detail

As noted in Section 5-1, most of the completed CVS surveys were not linked to a specific address. As part of its efforts to geocode as many of the observations as possible, MTO carried out a probabilistic

type of analysis which sought to assign as many survey responses as possible to locations. Secondary variables such as the trucking company or commodity involved were used to make inferences about the origin and destination of certain address-less shipments. In other words, there were assumptions involved. MITL is utilizing this expanded data set which provides a more complete picture of trip originations at the level of specific locations.

The idea of the approach utilized in this section is to derive some sub-municipal insight but to condense the thousands of associated freight locations into something more easily comprehended. A spatial filtering algorithm was utilized which essentially moves the majority of the originating trips to central locations where those trips are aggregated with other nearby originating trips. The central, anchoring locations are derived as having the largest number of outgoing trips based on the data. Depending on the distance tolerance used in the spatial filtering algorithm, the density of the aggregated points can be controlled. For a given map scale, it is possible to develop a set of sized and coloured circles which have little or no overlap and which capture all the outgoing trips.

We have spatially aggregated using a 2km and 1km radius. The former is better suited for viewing larger areas on a map and the latter for viewing smaller areas. The same two radii are used to portray the TCOD postal code data. Some aggregation takes place in even the TCOD case as adjacent postal codes can be very close together. Note that this latter set of TCOD data (as we received it) omits all unique postal codes that generate less than 10,000 tonnes per year. We estimate that this filter omits about 30% of shipments. In order to facilitate the best comparison possible between shipment and trip data, the aggregated CVS data were filtered to omit 30% of the trips at the lower end of the distribution. We chose to filter the CVS data <u>after</u> aggregation rather than before because TCOD data were already aggregated to some extent when presented as postal codes. In **Figure A.7-8** (in the Appendix), there is an example done for West region where the filtering took place before aggregation. **Figure A.7-8** shows that doing the filtering before allows many more small rural outflows to stay in. Filtering after, on the other hand, puts more emphasis on the larger urban clusters reaching a full size that includes the contributions of small shippers.

Figures 5-1 and 5-2, which have originating trips and shipments grouped to a 2km radius, give a good overview of the GTA Region. The freight dominance of Peel Region is very evident. There are also some prominent nodes that follow a north-south line along Hwy 400 towards the lakeshore. These stand out a bit better on the TCOD map but are also present on the CVS figure. There is an eastern cluster just to the east of Hwy 404 which seems comparable, in terms of trip originations, to the Hamilton cluster. Two other important clusters that are evident are a Hwy 401 cluster at Milton and a QEW cluster in Burlington. There are several other places in the built up area of the region which generate small to moderate freight flows based on trip originations. The figures are quite effective at showing linear clustering of trip generators along major highways within the GTA region. Probably the most pronounced difference between the two figures is that the TCOD map shows significant generators in the northern part of the GTA region in places like Barrie and Orillia. Broadly, the two representations are similar and more so in the urban areas but the TCOD data shows more heterogeneity within each cluster than does the CVS data. The TCOD data has more large nodes and also more small nodes.

Figure 5-1: Sub-Municipal Trip Originations in the GTA Region (CVS)

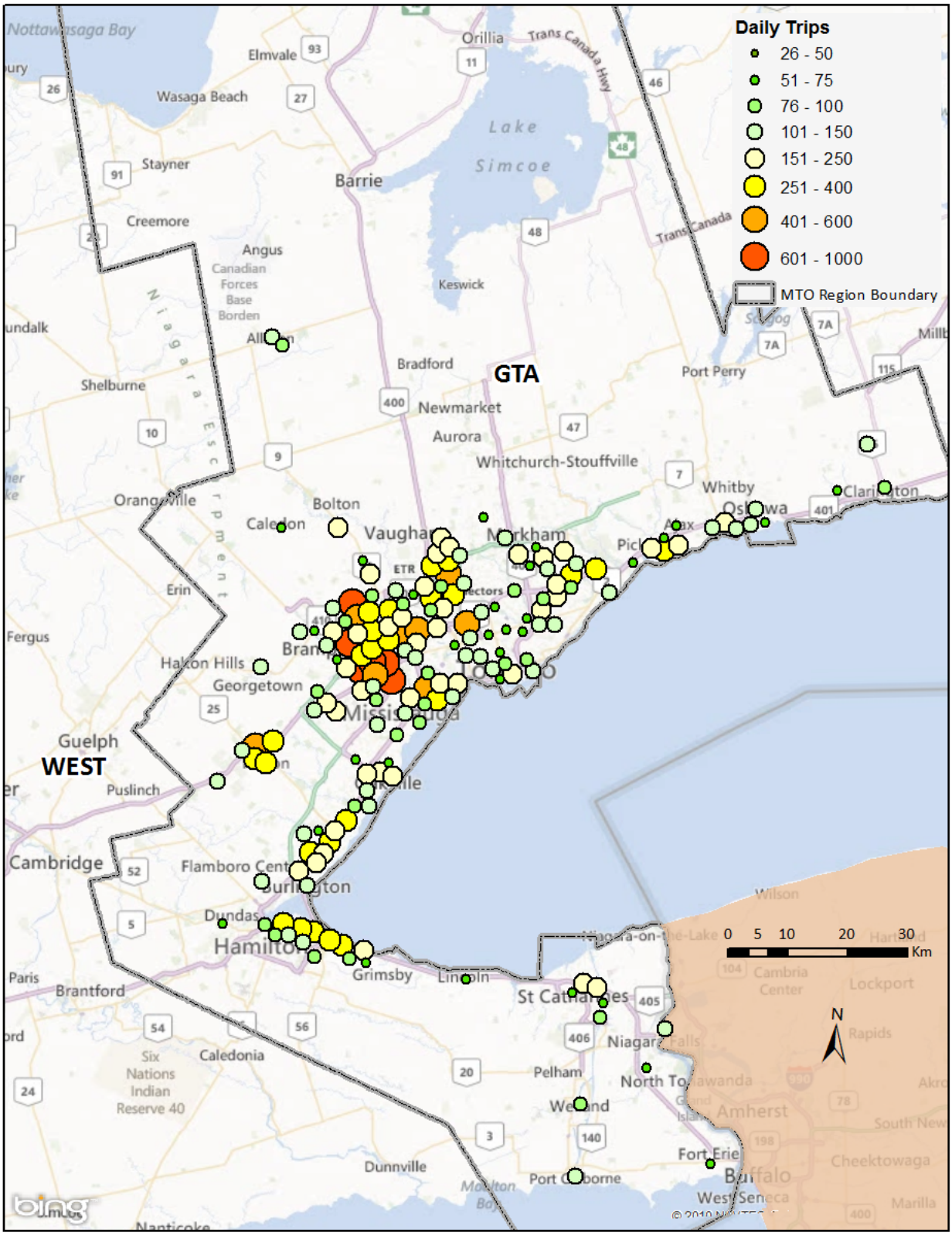


Figure 5-2: Sub-Municipal Shipment Originations in the GTA Region (TCOD)

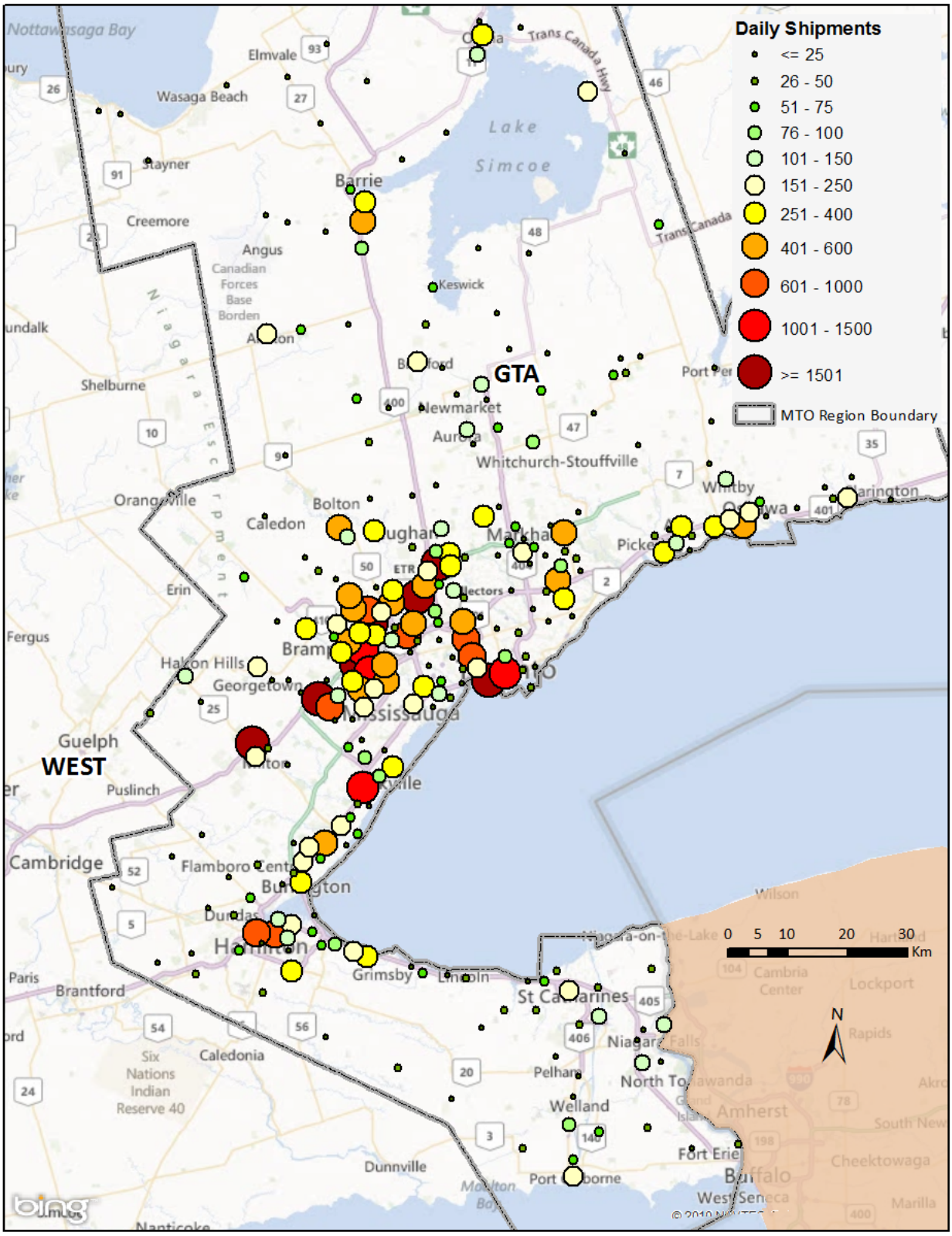


Figure 5-3: Sub-Municipal Trip Originations in the GTA Region (Insets)

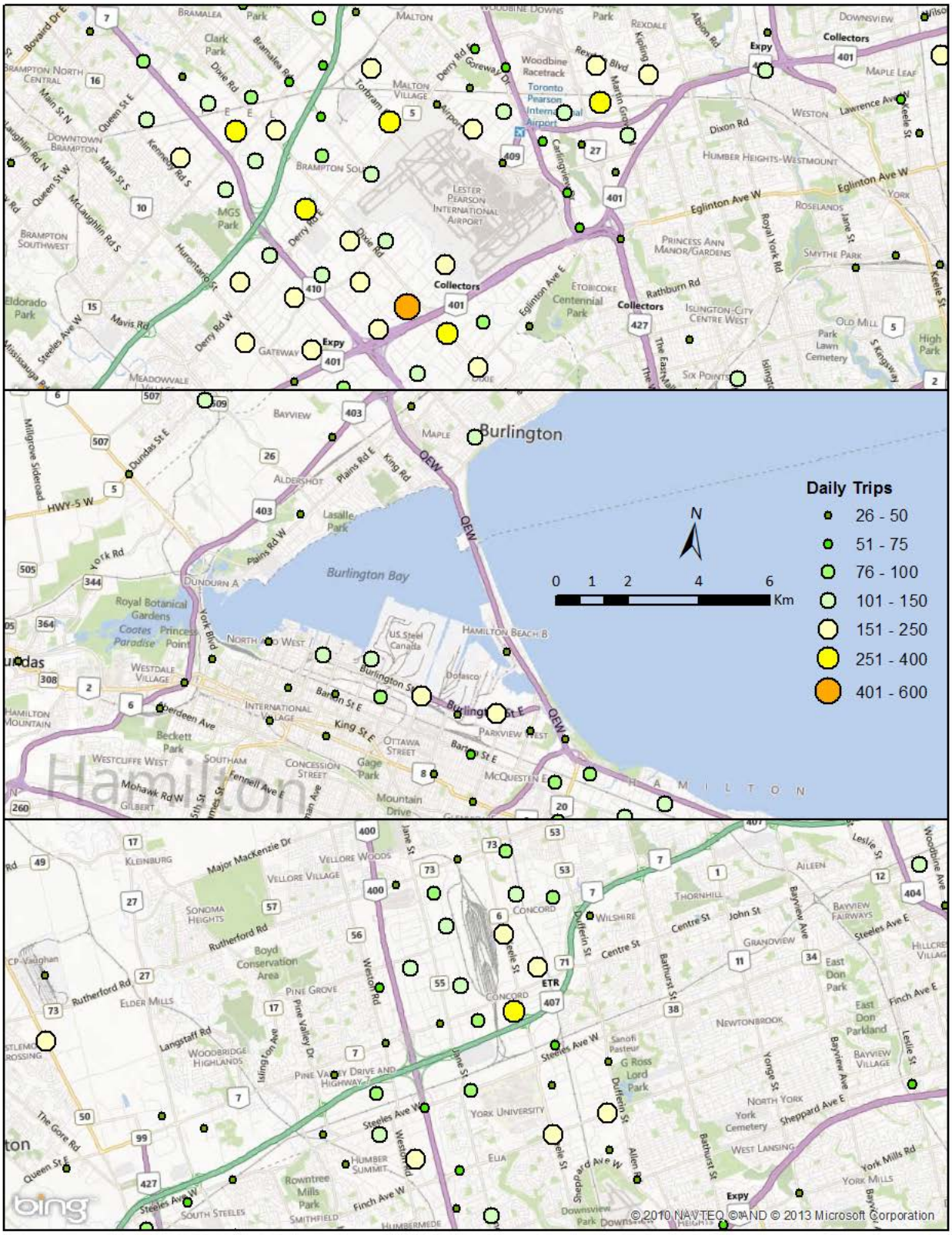


Figure 5-4: Sub-Municipal Shipment Originations in the GTA Region (Insets)

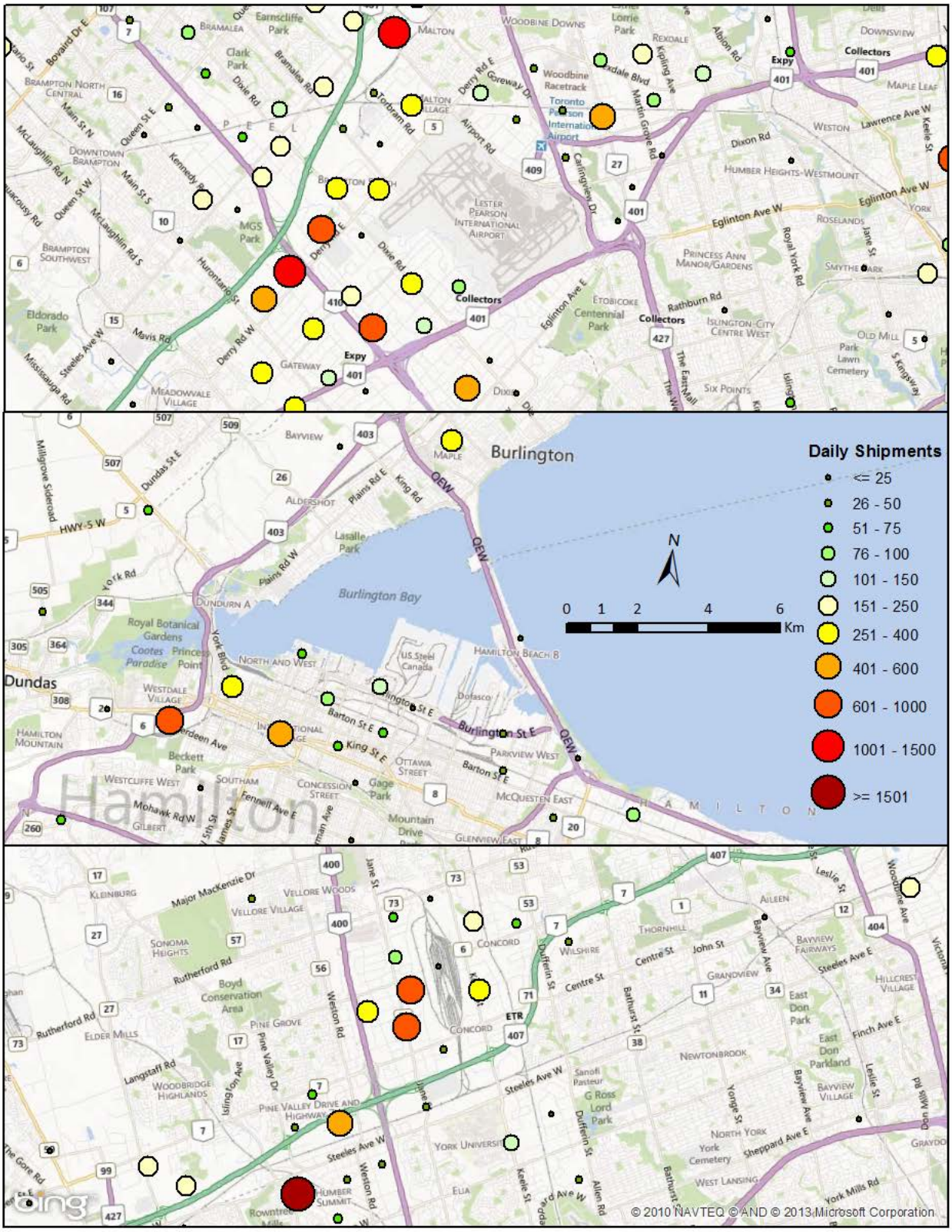


Figure 5-5: Sub-Municipal Trip Originations in the East Region (CVS)

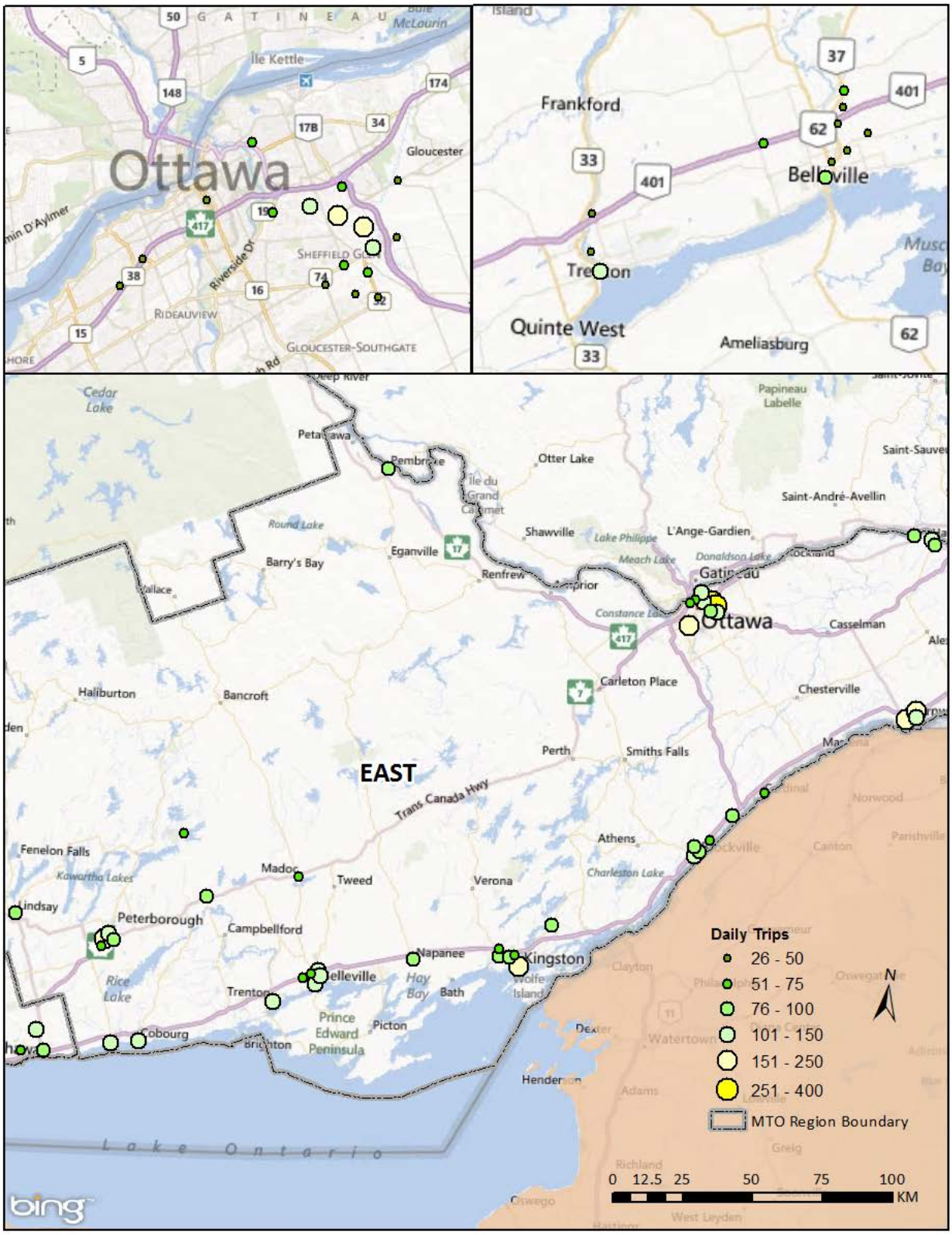


Figure 5-6: Sub-Municipal Shipment Originations in the East Region (TCOD)

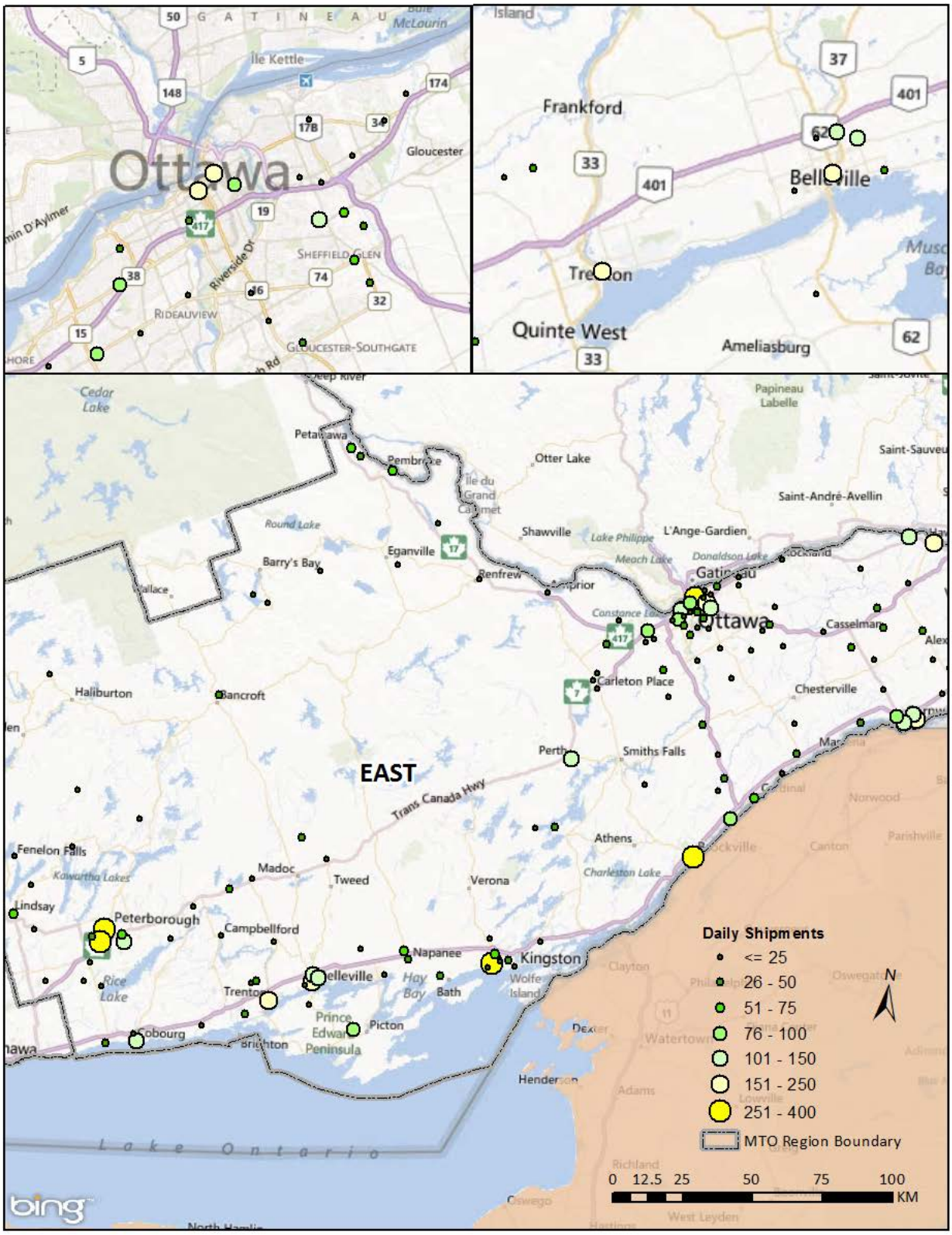


Figure 5-7: Sub-Municipal Trip Originations in the West Region (CVS)

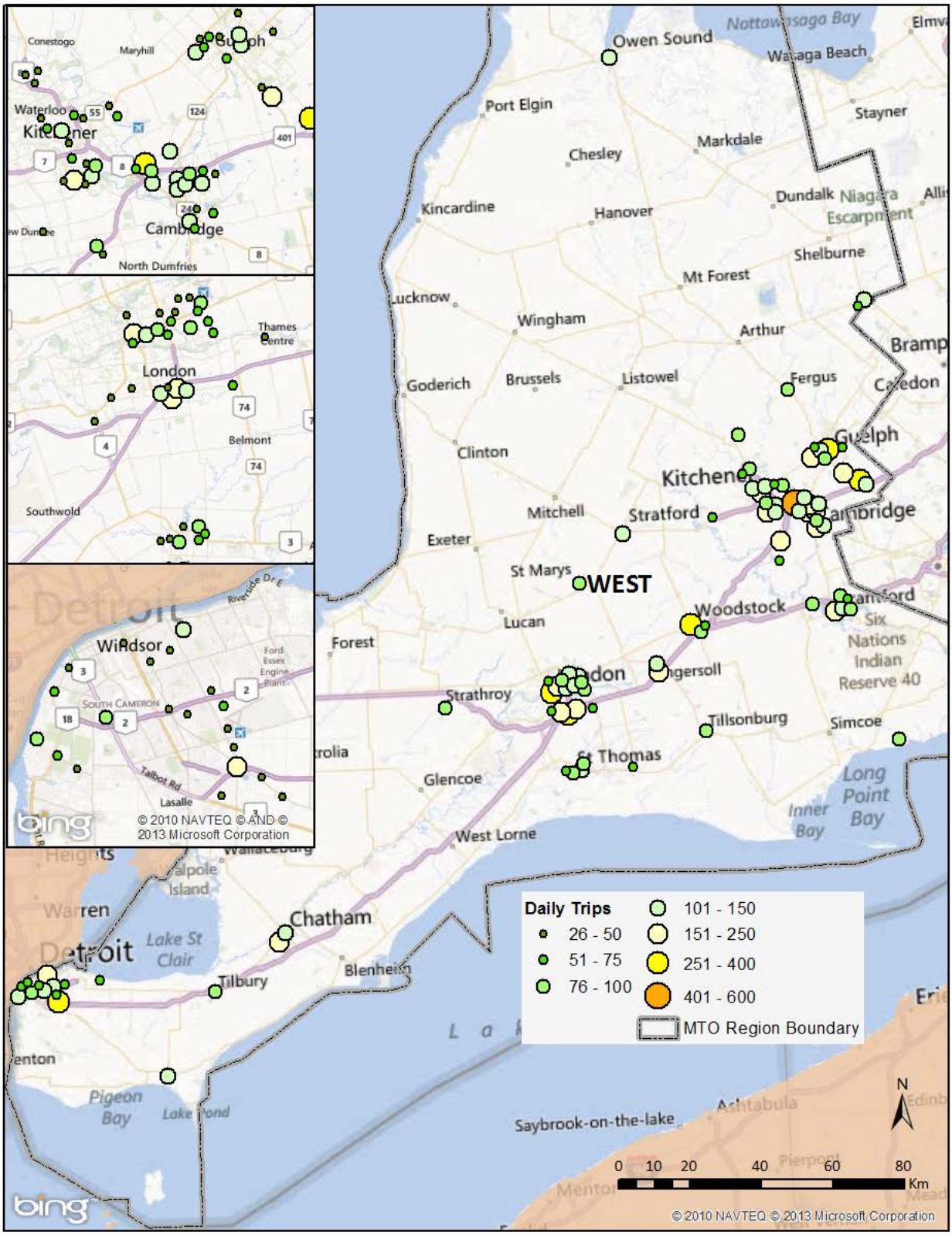
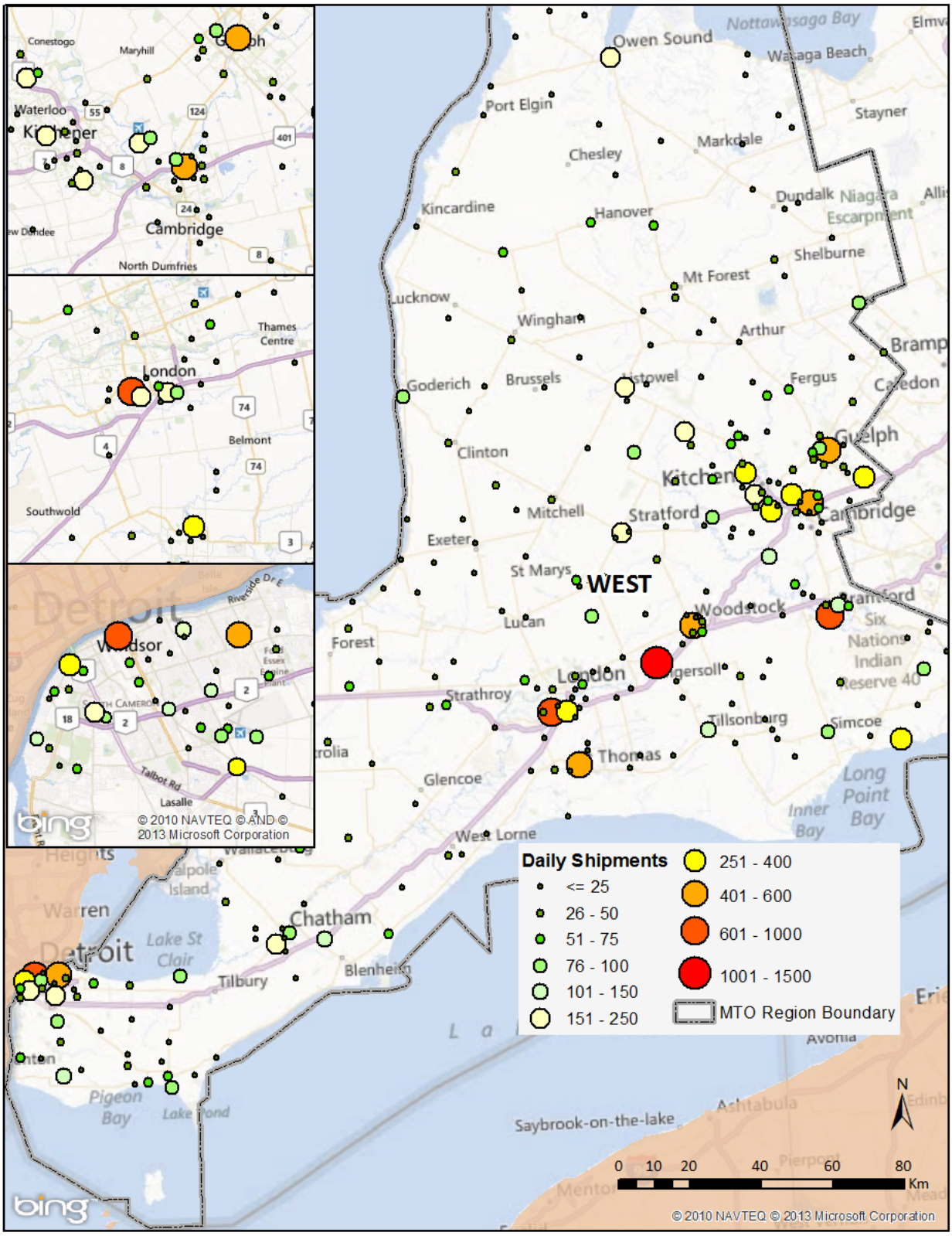


Figure 5-8: Sub-Municipal Shipment Originations in the West Region (TCOD)

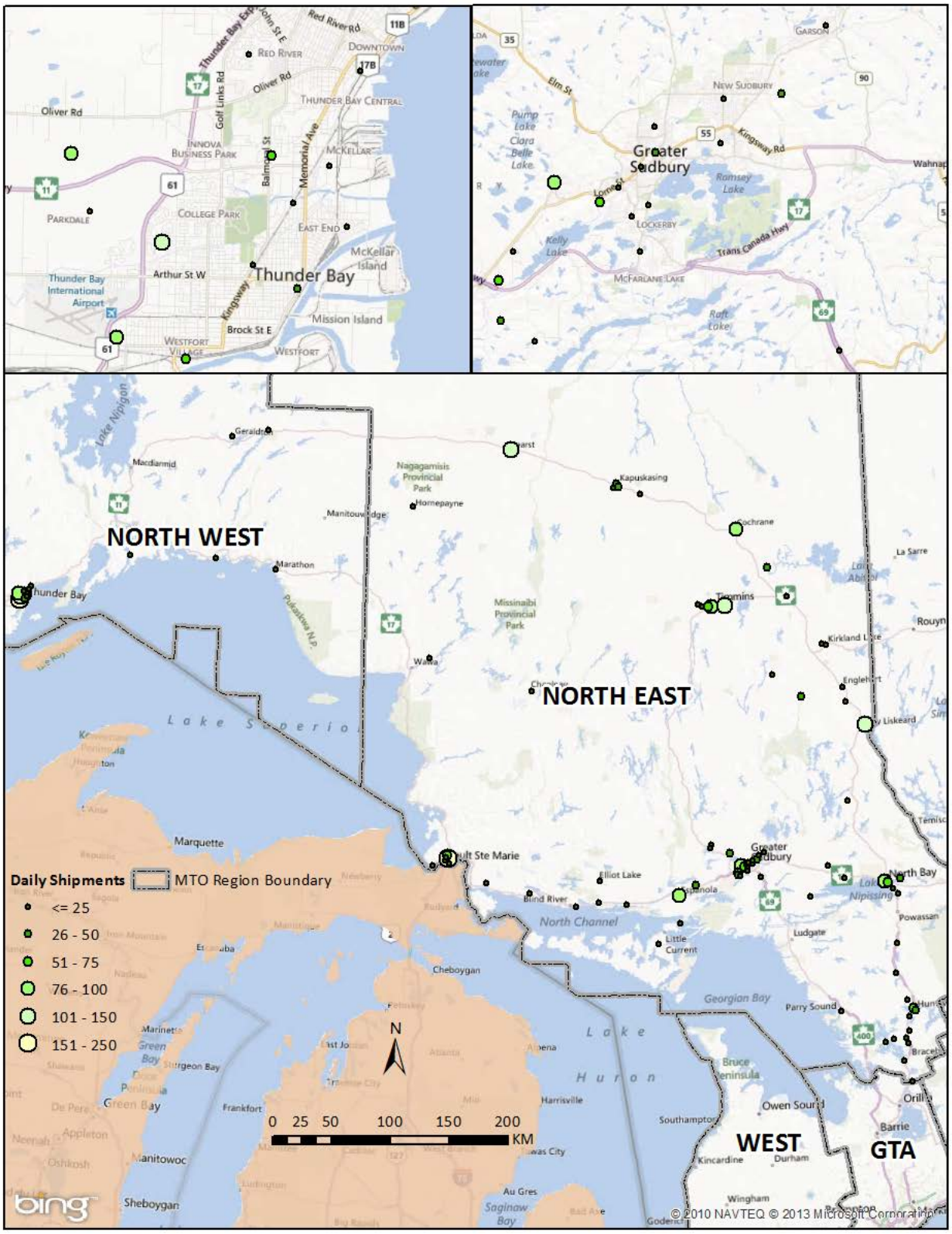


Figures 5-3 and 5-4 focus on specific insets within GTA Region using a 1km radius. There is an inset centred on Peel Region, another centred on Hamilton and a final one centred on the CN MacMillan rail yard near Hwy 407 and Hwy 400. The area near the intersection of Hwys 401 and 410 and to the west of Pearson Airport is the most intense focus of trip and shipment generation and this cluster stands out more on the TCOD map. A secondary cluster in the region just north of Hwy 407 is also clear, and seems to stand out better on the CVS map. The intensity of trip generation is noticeably less in the area south of Hwy 407 and west of Hwy 427 and just north of the Airport. There are substantial differences in the Hamilton cluster for CVS versus TCOD with the latter looking far less significant. One difference is that the CVS is pre-recession and the TCOD is post-recession and actual steel production halted at the U.S. Steel site. Nevertheless, there has to be a concern that the TCOD data are missing localized shipments as they are being attributed to some other head office address in the case of Arcelor Mittal or possibly the carrier involved has not been sampled. The linear nature of the Hamilton-Stoney Creek cluster is quite impressive in the CVS case. It follows closely along the QEW and then extends along Burlington Street and its heavy industry upon reaching Hamilton. The CN McMillan cluster for CVS is more oval shaped as there are multiple important highways nearby and it seems to be anchored by the rail facility. Again the cluster appears to be more developed in the CVS case.

Figures 5-5 and 5-6 focus on the East Region and combine the 2km and 1km radii in a single figure with insets. The same applies for West Region. The maps use a common scale as GTA region and there is a complete absence of certain colours associated with the intense activity. At the 2km level for the east, it seems clear that there are two things that generate truck trips: a strategic location along a busy highway freight corridor or a location in a significant metropolitan centre. For the East Region, it is mostly the former that applies, with Ottawa being the only significant metropolitan centre. In Ottawa there is an interesting divergence with respect to originating freight with the downtown emphasized much more in the TCOD survey and the highway orientation being dominant with CVS. The latter clusters are oriented to industrial parks generally in close proximity to the Hwy 417 (Trans-Canada). Along the 401, there are noticeable clusters that pop up at Cornwall, Brockville, Kingston, Belleville, Trenton and Cobourg. While Peterborough is not on Hwy 401 it is on the Trans-Canada Highway on its route to Ottawa and it has a significant urban population. The noteworthy cluster there is thus perhaps not surprising. Significant localized nodes in smaller centres appear generally more pronounced with TCOD as has been the pattern.

In **Figures 5-7 and 5-8**, some of the same stark differences between CVS and TCOD persist although the broad pattern in freight generation is similar. Note that **Figure 5-7** for CVS can be compared with **Figure A.7-9** in the Appendix which also relates to CVS as discussed earlier. In particular, the TCOD is generally showing more large generation locations and also more small generation locations immediately adjacent. Some of the higher intensity colours that we saw in GTA region but did not see in the East Region have reappeared in these figures, especially on the TCOD side. An overall pattern in both figures is that significant truck freight clusters in West Region are oriented to Hwy 401. A significant generation node near Ingersoll, presumably at the CAMI plant, stands out much more in the shipments case than the trips case. There are clear significant clusters at Kitchener-Cambridge, London and Windsor.

Figure 5-9: Sub-Municipal Shipment Originations in the Northern Regions (TCOD)



The Guelph cluster is somewhat Hwy 401 oriented. Less important clusters are located along Hwy 401 at Woodstock and Chatham, along Hwy 403 at Brantford and along Hwy 402 at Sarnia. The Windsor cluster, as noted, is strongly driven by its interaction with the border. The local Detroit-Windsor automotive cluster is truly international in how it functions. One of the major Windsor nodes is in downtown Windsor so there has to be concern that this is a head office problem as opposed to actual movement of shipments in that vicinity.

Figure 5-9 offers our only overview of the north which houses two MTO regions: The Northwest region anchored by Thunder Bay and the North East Region anchored by Sault Ste. Marie, Sudbury and North Bay. The TCOD results are shown in the map and two insets and what is immediately obvious is that the clusters of the North regions do not come close to matching the intensity of the clusters in southern Ontario. Comparison with corresponding maps from the other regions suggests that the main centres of the north: Thunder Bay and Sudbury are similar in freight generation terms to some of the lower to mid-tier freight generators in the rest of the province. Quick comparisons with **Figure 3-7** confirm this viewpoint. The two northern centres are similar to the likes of Belleville, Woodstock, and Oshawa in terms of truck trips generated.

5.3 Localized Views with Addresses and Postal Codes

In this section, an array of visuals and tables are developed for localized areas of interest in each MTO region. A key element of the analysis in this section is that trip or shipment data are not aggregated in any way. Everything that is shown relates either to specific addresses or specific postal codes. The two main analyses that take place are one that combines specific addresses derived from CVS with InfoCanada information and a second which combines satellite images and detailed localized CVS and TCOD information.

Initially, we focus on the description and results of the first analysis. It is important to note that specific addresses make up the minority of the actual data captured through the survey process. As a result there are some significant gaps, some of which show up spatially. For each of the MTO regions, a separate operation is carried out to provide the specific information. In each case there is a detailed pie chart map of specific addresses and also a table which supports and complements the map. The two are intended to function as a pairing for each region. The maps are focused on outgoing trips since earlier analysis in this report has tended to emphasize this variable for best characterizing freight generators. However, both outgoing and incoming trips are captured in the table.

5.3.1 Address-Specific Analysis

There are some important points to consider about the maps. The diameter of a given pie on a map is affected only by the volume of outgoing trips that are attributable to the specific address. No other nearby locations are considered in affecting this diameter - it is address-specific. Meanwhile, we are interpreting these specific addresses as "anchors" for the immediate area in terms of freight generation. As such, we are using the information from the InfoCanada data to describe the "character" of the areas in a 2km circle around each anchor address.

Character has to do with how the companies within the 2km are classified based on NAICS code. In relation to goods movement, six distinct two digit codes are considered in particular and are related to: Wholesale, Manufacturing, Transportation and Warehousing, Construction, Primary Industries and Utilities. The estimated total jobs of a firm are assigned to these classes based on how that firm is NAICS-coded. The job totals across the classes are derived by summing over the firms within the 2km radius. Should a firm be within 2km of more than one anchor address then its jobs are assigned to the closest address. The actual derived job totals are displayed in an associated table while the maps capture these amounts as proportions. It is important to consult the tables for the absolute numbers so as not to be misled by the size of the pie in the map.

InfoCanada data is not without its flaws. For example, many of the key "anchor" addresses derived from CVS do not actually appear in the InfoCanada data. This is because these data are designed for direct marketing purposes as opposed to capturing localized facilities of firms that operate in many geographies. This statement is particularly true in distribution contexts not associated with end customers. Nevertheless, a lot of relevant firms are captured within the data and it sheds light on these.

Figures 5-10 and **5-11** and **Tables 5-2** and **5-3** represent the results of the process described above for the GTA Region. **Figure 5-10** provides an overview for the entire region and the location of key specific addresses while **Figure 5-11** shows the same information but for zoomed insets of key areas within the GTA Region. **Table 5-2** and **5-3** provide a complete listing of the top 50 addresses shown graphically on the maps and are linked to the maps with the "ID" field -- these are the numbers associated with the pies on the maps and the key specific addresses. These specific addresses have been individually researched on the web to confirm that they seem like legitimate freight generating locations. Since the figures deal only with these specific addresses note that for this analysis certain key places such as "Intermodal Drive" or "Ford Drive", which can actually be associated fairly easily with specific locations, are not included. In general, these types of inferences without an address number are difficult if not impossible.

The first thing that stands out about **Figure 5-10** is significant gaps of enormous spatial extent, particularly between Mississauga and Hamilton. These gaps occur in places that prior analysis in this report has shown to be significant generators of truck freight. Of course the analysis in **Section 5.1** has illustrated that an area can still generate significant freight as an aggregation of many smaller flows from multiple addresses. For the most part we believe this to be the explanation of the gaps. There are large numbers of generators in the apparently empty areas but the CVS has not been able to associate significant trips with any one significant address. The Ford Plant has been omitted from the analysis for reasons mentioned above and meanwhile there are a range of medium generators in Oakville/Burlington that generate in the range of 15-35 trips from specific addresses. These levels were not high enough to achieve the higher bar set by other generators in the region. In particular, the tables for GTA region cover the range from 144 down to 37 daily departures in the top 50. To provide further proof of these assertions, consider **Figure A.7-9** which shows that there are numerous smaller trip generating locations in the areas with the large gaps. This map also employs the same technique as **Figure 5-10** with InfoCanada data to illustrate the industrial character of each area.

Figure 5-10: Outgoing Trips by Key GTA Region Freight Addresses

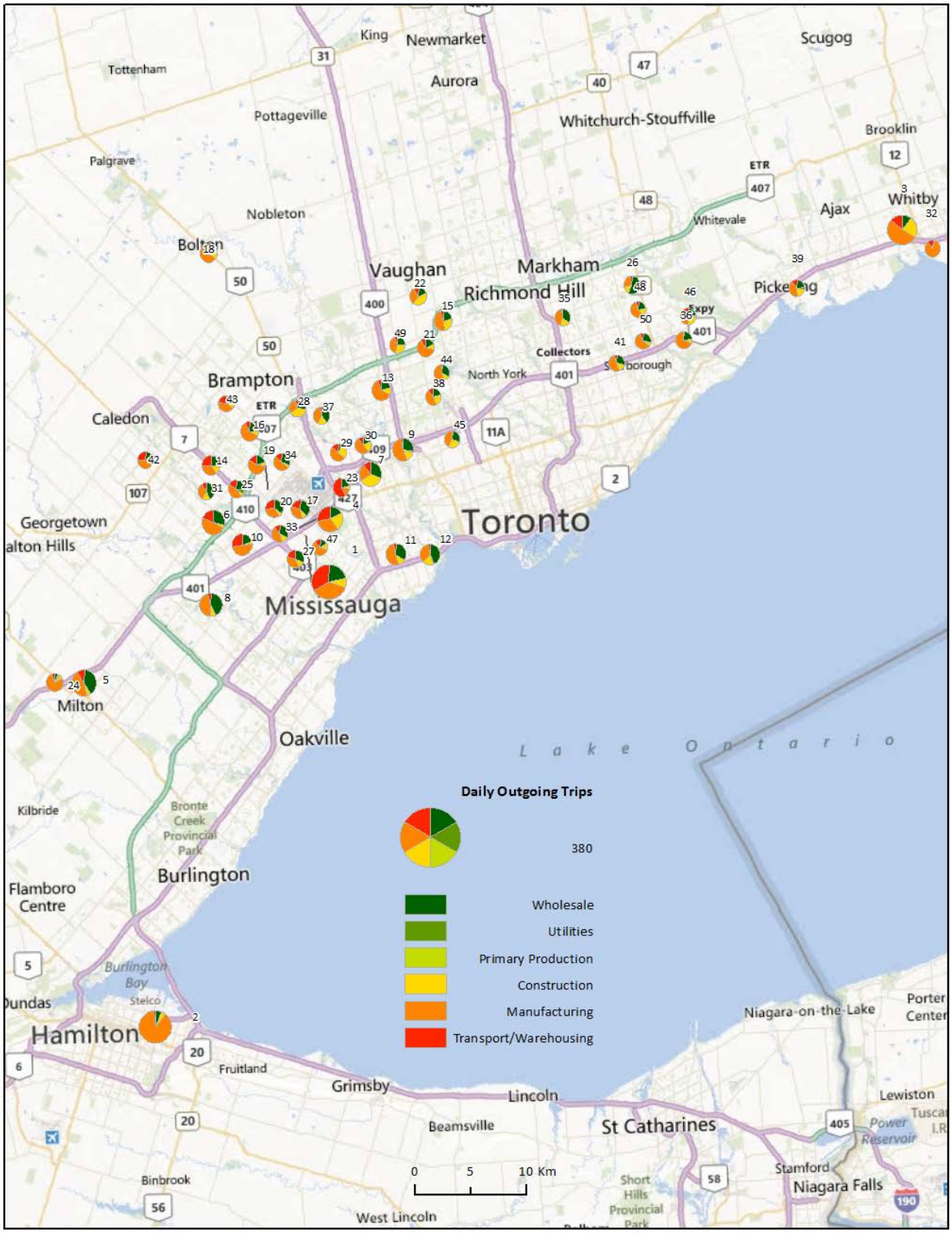


Figure 5-11: Outgoing Trips by Key GTA Region Freight Addresses (Inset Maps)

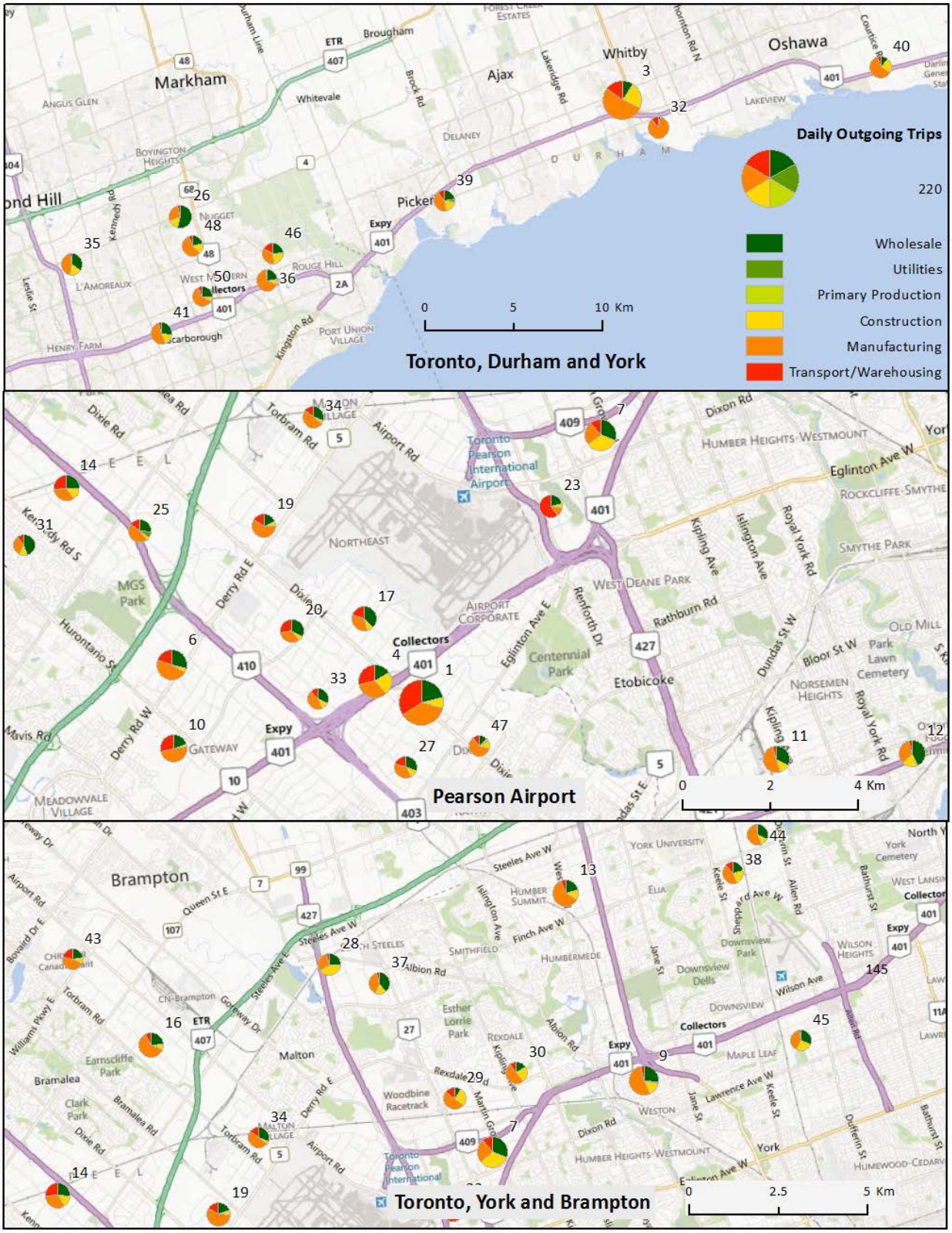


Table 5-2: GTA Region - Mapped Freight Generators and Vicinity (Part 1)

				Freight -Oriented Employment in Vicinity of Major Shipping Address					
ID	Address	Key Node Company	Cluster Employment	Whl	Utl	Pri	Constr	Man	Tran/Ware
1	5425 Dixie Road, Mississauga	Interport Sufferance Warehouse Limited	11,991	1,118	0	0	440	1,942	1,816
2	1330 Burlington Street East, Hamilton	ArcelorMittal Dofasco Inc	18,644	730	0	0	687	12,372	261
3	100 Nordeagle Avenue, Whitby	Sobeys Group Inc	5,173	32	2	0	82	186	52
4	1335 Shawson Drive, Mississauga	Manitoulin Transport Inc	3,286	277	0	0	387	577	498
5	2701 Highpoint Drive, Milton	Sobeys Group Inc	5,259	977	0	12	133	1,063	248
6	300 Statesman Drive, Mississauga	Robert Transport Inc	14,198	1,903	0	2	279	3,098	1,296
7	110 Iron Street, Toronto	Vitran Logistics	11,572	2,033	0	0	2,222	1,648	721
8	6363 Millcreek Drive, Mississauga	Loblaw Companies East	22,339	2,719	65	6	541	2,944	329
9	140 Wendell Avenue, Toronto	Recyc-Mattresses	16,543	1,205	6	74	685	2,391	167
10	6800 Maritz Drive, Mississauga	Supply Chain Management, Inc	12,374	1,177	35	0	234	2,826	1,767
11	48 North Queen Street, Toronto	Machine Shops	34,058	4,405	0	78	1,614	6,751	590
12	165 The Queensway, Toronto	Gambles Ontario Produce Inc	8,333	1,249	37	2	516	961	143
13	85 Signet Drive, Toronto	Globe Wholesale Meats	36,787	4,129	6	85	2,474	12,060	1,237
14	265 Rutherford Road South, Brampton	Brampton Mattresses	11,414	2,116	0	6	1,192	2,754	2,140
15	751 Bowes Road, Concord	Clarke Transport	20,630	2,808	0	10	3,646	6,629	798
16	12 Barton Court, Brampton	Martin Brower of Canada.Co	17,619	2,386	0	37	794	6,120	746
17	6050 Dixie Road, Mississauga	Armbro Transport Inc	8,728	1,613	0	2	427	1,479	873
18	20 Holland Drive, Caledon	Mars Canada Inc	10,693	831	2	2	1,545	3,683	484
19	6895 Bramalea Road, Toronto Pearson International	Federal Express Canada Ltd	9,552	1,443	0	27	499	4,307	1,235
20	1330 Meyerside Drive, Mississauga	Cardinal Health Canada Inc	16,491	3,229	0	0	641	3,153	2,619
21	101 Doney Crescent, Vaughan	Midland Transport Limited	13,438	1,584	0	4	840	5,522	809
22	591 Basaltic Road, Vaughan	JD Smith And Sons	14,316	1,640	0	0	3,927	3,100	800
23	9 Meteor Drive, Toronto	Winmar Toronto	25,960	1,930	2	4	527	1,269	5,328
24	2999 James Snow Parkway, Milton	Gordon Food Service	3,269	128	0	110	163	1,881	150
25	300 Biscayne Crescent, Brampton	Omega Moulding Company	10,330	1,087	375	2	232	1,987	626

Table 5-3: GTA Region - Mapped Freight Generators and Vicinity (Part 2)

				Freight-Oriented Employment in Vicinity of Major Shipping Address					
ID	Address	Key Node Company	Cluster Employment	Whl	Utl	Pri	Constr	Man	Tran/Ware
26	351 Passmore Avenue, Toronto	Group SEB Canada Inc	10,364	3,410	0	6	949	1,641	239
27	5200 Maingate Drive, Mississauga	TST Overland Express	10,699	1,983	0	35	727	2,370	1,367
28	93 Claireville Drive, Toronto	BAPS Shri Swaminarayan Mandir	6,361	1,175	0	0	1,863	1,401	213
29	62 Vulcan Street, Toronto	Purolator Courier Ltd	9,226	513	0	0	1,586	2,834	832
30	75 Rexdale Boulevard, Toronto	XTL Transport Inc	14,591	548	0	4	804	1,708	375
31	238 Glidden Road, Brampton	Canada Colors & Chemicals Ltd	5,658	456	0	0	146	329	109
32	220 Water Street, Whitby	MTC Clearance Centre	5,993	49	0	0	15	1,454	195
33	1200 Britannia Road East, Mississauga	Canadian Springs	7,052	1,438	0	0	501	1,933	543
34	7099 Torbram Road, Mississauga	Polaris Transportation Group	15,955	2,238	35	15	382	3,597	1,031
35	3420 Pharmacy Avenue, Toronto	Webcom	28,039	3,035	0	70	1,528	3,707	273
36	1315 Morningside Avenue, Toronto	The Interprovincial Group	6,001	397	0	2	165	1,203	35
37	26 Claireville Drive, Toronto	I-D Foods	11,546	1,726	35	4	694	1,757	176
38	1133 Finch Avenue West, Toronto	Cooney Transport Ltd	11,035	959	2	0	1,060	2,097	534
39	1502 Bayly Street, Pickering	FedEx Freight Canada	17,501	1,160	177	4	1,093	2,115	581
40	1 McKnight Road, Clarington	Waste Management of Canada	784	38	0	0	67	201	15
41	50 Emblem Court, Toronto	Y M Yeung Trading Co Ltd	21,399	1,712	8	4	1,113	3,257	296
42	170 Van Kirk Drive, Brampton	Day Ross Dedicated Logistics	7,600	351	0	2	466	1,196	712
43	2000 Williams Parkway, Brampton	Daimlerchrysler Canada Inc	14,729	1,492	0	0	710	2,970	1,515
44	1150 Finch Avenue West, Toronto	Imperial Oil Limited	20,911	2,969	0	6	1,056	4,988	181
45	123 Bentworth Avenue, Toronto	Georgia-Pacific Canada	27,900	2,214	35	2	1,868	2,851	162
46	50 Thornmount Drive, Scarborough	Juici Patties	3,151	207	0	15	214	292	160
47	4567 Dixie Road, Mississauga	Canada Post Corporation	13,446	605	0	177	556	2,692	481
48	3450 McNicoll Avenue, Toronto	Owens Corning Canada Inc	12,078	1,478	0	0	1,215	4,089	411
49	10 Freshway Drive, Vaughan	Rochester Aluminum Smelting Canada	14,572	2,130	0	2	2,513	3,433	589
50	211 Nugget Avenue, Toronto	Automatic Coating Limited	36,634	2,079	2	17	612	4,724	552

Figure 5-12: Outgoing Trips by Key West Region Freight Addresses

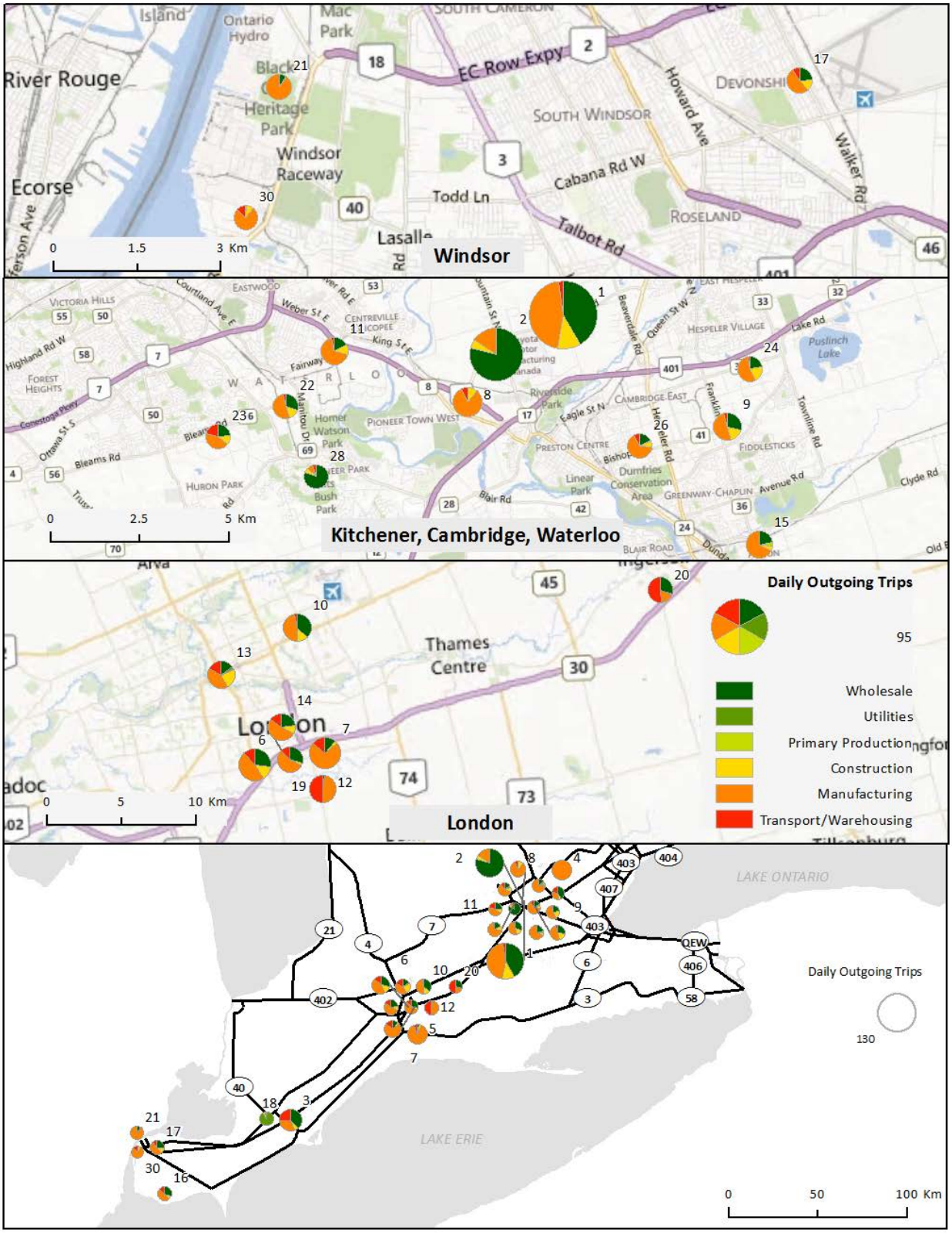


Table 5-4: West Region - Mapped Freight Generators and Vicinity

				Freight -Oriented Employment in Vicinity of Major Shipping Address					
ID	Address	Key Node Company	Cluster Employment	Whl	Utl	Pri	Constr	Man	Tran/Ware
1	1105 Fountain Street North, Cambridge	National Grocers	973	291	0	0	78	316	15
2	300 Maple Grove Road, Cambridge	Challenger Motor Freight Inc.	535	294	0	0	20	59	0
3	400 National Road, Chatham-Kent	United Parcel Service Canada Ltd and One World Logistics	5,232	705	6	0	125	568	466
4	950 Southgate Drive, Guelph	DENSO Manufacturing Canada	40	0	0	0	0	15	0
5	389 South Edgeware Road, St. Thomas	L.E. Walker Transport	7,619	114	35	2	294	5,343	339
6	2724 Roxburgh Road, London	Ryder Integrated Logistics	5,073	643	0	0	331	1,117	283
7	1497 Wilton Grove Road, London	Elgin Motor Freight	1,773	189	0	0	39	1,235	228
8	125 Maple Grove Road, Cambridge	Cambridge Campus - Transport Training Centres of Canada	10,869	73	0	0	830	5,971	495
9	170 Werlich Drive, Cambridge	Dynamex Canada Ltd	10,803	1,394	0	0	836	2,482	216
10	600 Clarke Road, London	La Cie Mccormick Canada Co	18,491	4,064	0	0	1,419	5,169	327
11	190 Goodrich Drive, Kitchener	Mobile Storage Rentals	8,345	369	15	0	225	1,400	70
12	1100 Green Valley Road, London	Ingredion Canada Inc	372	8	0	0	0	175	183
13	150 Simcoe Street, London	Labatt's Brewries Ontario	42,425	676	70	68	1,045	1,795	786
14	40 Enterprise Drive, London	Pepsi Bottling Group	3,872	541	0	0	247	1,261	362
15	160 Orion Place, Cambridge	Gerdau AmeriSteel	6,572	822	0	196	232	2,552	34
16	200 Clark Street, Essex	Atlas Tube Inc.	873	83	0	0	24	128	39
17	2500 Airport Road, Windsor	Wolverine Freight System	11,226	1,208	15	35	698	2,527	478
18	650 Riverview Drive, Chatham-Kent	Union Gas Limited	2,347	12	750	0	37	19	12
19	1095 Wilton Grove Road, London	Sears Canada Inc	1,454	375	0	2	60	705	159
20	274129 Wallace Line, Oxford	Verspeeten Cartage	900	220	0	15	2	131	375
21	5550 Maplewood Drive, Windsor	ADM Agri-Industries Ltd	3,814	262	35	0	25	2,500	26
22	100 Sasaga Drive, Kitchener	Flanagan Foodservice Inc	5,975	808	0	0	388	1,438	89
23	120 Mcbrine Drive, Kitchener	BLM Transportation Group	6,972	1,032	0	0	490	1,825	912
24	75 Lingard Road, Cambridge	Dedicated Logistics Systems	5,641	572	0	0	513	1,413	63
25	405 Laird Road, Guelph	MacKinnon Transport	4,804	387	175	35	160	2,211	2
26	1001 Bishop Street North, Cambridge	Frito-Lay-Canada	17,387	910	75	0	399	3,335	428
27	101 Glasgow Street, Kitchener	AirBoss Rubber Compounding	27,976	429	177	2	385	1,859	320
28	530 Manitou Drive, Kitchener	Lear Canada	1,701	657	0	0	52	64	40
29	101 Brock Road South, Puslinch	Nestlé Waters Canada	1,819	504	0	0	90	380	270
30	599 Sprucewood Avenue, Windsor	Syncreon Automotive	1,854	12	0	15	118	916	150

Peel Region clearly does not suffer from this problem with many addresses showing up as significant generators of truck traffic. The associated **Tables 5-2** and **5-3** show that many of these locations also receive a lot of truck traffic as attractors. A significant majority of the key addresses in the region show up in an east-west oriented region that is loosely bounded by Hwys 407 and 401. The only significant generator that shows up outside the Toronto CMA but within the GTA region is Arcelor Mittal in Hamilton. On the basis of truck trip generation from specific addresses at least, the region hardly qualifies as a "Golden" Horseshoe.

One conclusion that can be drawn from this examination is that freight generators can be compared on the significance of individual addresses as well as on aggregate generation totals. An area that scores high on both is probably a more significant generator. On this basis there are multiple locations in the Toronto CMA, but outside of Peel Region, that appear more significant than the generators in Hamilton and Niagara, for example.

As was mentioned, the colouring of the pies says a lot about the characteristics of freight-oriented activities in each vicinity. The just-mentioned Hamilton address at Arcelor Mittal (2) stands out as the anchor of the most purely manufacturing oriented cluster in the region as is shown by the orange colour of its pie. Firms near Gamble's Ontario Produce (12) at the Ontario Food Terminal and Group SEB Canada (26) at Steeles Avenue and Markham Road in Toronto are the most oriented to wholesale in the region based on proportion, though employment totals are smaller than other addresses. Transport and Warehousing activities are clustered in Peel region while other areas maintain a greater focus on manufacturing and construction. The areas around Pearson International Airport produce a rich mix of activities. While the pies on the maps themselves appear small, employment totals for the area are quite large, suggesting a number of smaller and diversified firms.

The results for the West region are based on the Top 30 truck generating addresses from the CVS and results in a range of 131 down to 21 in terms of daily truck departures. Even to reach the top 30 in West region, the bar is not as high as it is in GTA region to reach the top 50. Had the much smaller lower bound been used in the GTA maps, there would be many fewer gaps. At these lower levels the patterns in West region shows that it is not suffering from any of the apparent gaps that are so noticeable for the Burlington-Oakville-Hamilton areas.

Focusing strictly on the West region, the overview map of the region (**Figure 5-12**) shows four distinct clusters of significant addresses in the Kitchener-Waterloo area, London, Windsor and the vicinity of Chatham. All of these are very much oriented to Hwy 401 which bisects the region. Two major clusters in London are located away from the 401. The first is in South London near the airport (10) and is home to a large number of manufacturing and wholesale jobs while the second (13) is associated with Labatt's Breweries. In terms of specific addresses, little of significance shows up in Windsor although it is interesting to note that those that do show up are in close proximity to expressways rather than the downtown orientation of some of the earlier TCOD results. The areas associated with the three key addresses in Windsor are quite manufacturing oriented. In relative terms, manufacturing is prominent in Kitchener-Waterloo-Cambridge but there appears to be more of a wholesaling presence than is the case in the other centres of the region. Major wholesale freight generating areas include those centred

on National Grocers (1) and Challenger Motor Freight (2). The key addresses identified in the Kitchener-Waterloo-Cambridge area are quite oriented to Hwy 401 whereas the earlier analysis in this chapter does not emphasize this aspect as much. As would be expected, a majority of clusters oriented to transportation and warehousing are located near major roadways. Areas with high proportions of these trips are around the addresses of the United Parcel Service (3), Ingredion Canada (12), and Verspeeten Cartage (20) along highway 401.

Results for the East Region are shown in **Figure 5-13** and **Table 5-5** and for this region, only the top 20 specific generating addresses are included. This list extends from 77 outflows down to 13 daily outflows. Of the three main regions then, the bar is lowest in East region. The Ottawa region stands out as the home of many of the significant generators and the majority of these addresses are positioned in close proximity to the Trans-Canada Highway; not in the city centre of Ottawa as TCOD has pointed out. The immediate vicinities at these addresses are fairly well balanced between manufacturing, wholesaling, transportation and warehousing and construction. As in the West, a large proportion of transportation and warehousing jobs are located in Ottawa near the Trans-Canada Highway with much less in other areas, though Cornwall is an exception (9). While Cornwall has not stood out too much in the prior analysis relating to overall freight flows, it does stand out in terms of significant addresses. Supply Chain Management Inc. is the largest generator of trucks in the entire East Region. Kingston and Belleville do not have strong representation in terms of single generators. Peterborough is more prominent in that regard.

One other observation relating to the addresses captured in **Tables 5-2** to **5-5** is that there are a significant number of transportation companies captured that are in the business of moving or facilitating the movement of goods. Probably about 1/3 of the firms in the lists are transportation firms. It may be true that a particular trip is originating at a terminal associated with the carrier but the true source of the freight generation is quite possibly not at the carrier location but at a firm engaged in the business of producing or distributing goods. On the other hand, the CVS data are clearly doing a good job of capturing movements associated with firms that operate private fleets. To some extent carriers might be capturing the true origins of certain shipments but we expect that carriers are not involved in many members of the lists.

Figure 5-13: Outgoing Trips by Key East Region Freight Addresses

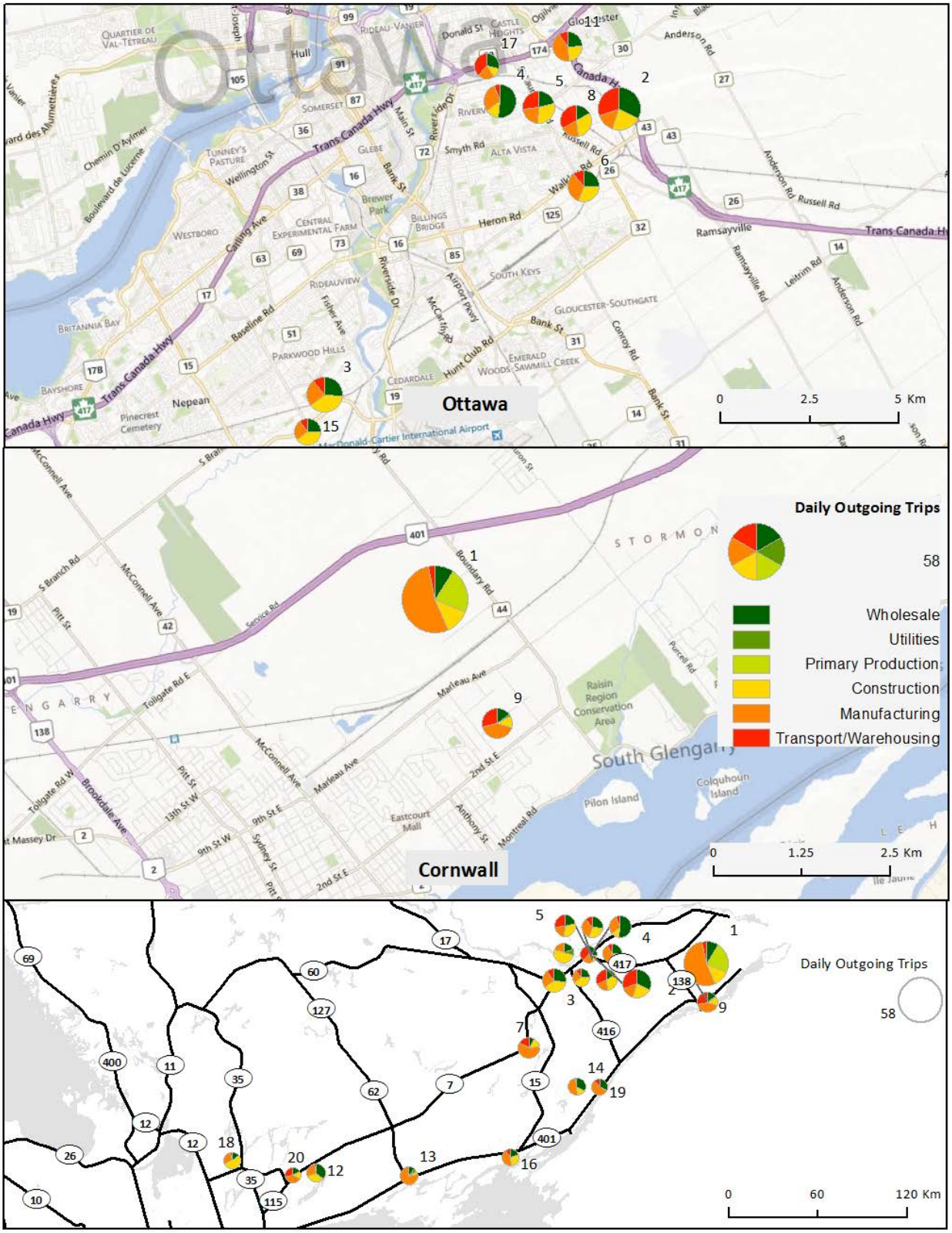


Table 5-5: Outgoing Trips by Key East Region Freight Addresses

				Freight -Oriented Employment in Vicinity of Major Shipping Address					
ID	Address	Key Node Company	Cluster Employment	Whl	Utl	Pri	Constr	Man	Tran/Ware
1	2401 SCM Way, Cornwall	Supply Chain Management Inc.	243	6	0	15	8	36	2
2	2625 Sheffield Road, Ottawa	National Grocers Co Ltd	2,376	274	0	0	192	123	256
3	369 West Hunt Club Road, Ottawa	Thermoshell Inc & Bluewave Energy Ltd.	14,319	819	0	2	1,174	752	332
4	869 Belfast Road, Ottawa	Pepsi Bottling Group	5,538	779	6	0	195	446	84
5	1132 Old Innes Road, Ottawa	Wilson's Truck Lines	4,095	312	0	0	424	319	391
6	2480 Walkley Road, Ottawa	Giant Tiger Stores Limited	9,628	1,118	35	0	1,313	1,453	479
7	10 Industrial Road, Perth	Wills Transfer Ltd	4,244	120	6	2	185	807	229
8	1890 Bantree Street, Ottawa	Maheral Freight Works Ottawa Inc.	2,832	222	0	0	442	258	457
9	850 Education Road, Cornwall	Villeneuve Tank Lines	3,896	320	50	0	283	909	640
10	1985 Merivale Road, Ottawa	Petro Canada	3,186	340	175	0	919	364	0
11	1740 Comstock Road, Ottawa	Dhl Express	8,407	631	0	2	632	1,078	252
12	781 Lansdowne Street West, Peterborough	Minute Maid Company Canada Inc	9,101	230	0	19	197	173	24
13	245 Putman Industrial Road, Belleville	Canada Building Material	5,296	473	210	35	264	3,495	35
14	1475 California Avenue, Brockville	Procter & Gamble Inc	1,435	70	0	0	33	106	4
15	1961 Merivale Road, Ottawa	Esso Oils & Lubricants Ltd	3,260	247	0	0	391	251	102
16	1 Lappans Lane, Kingston	Novelis Inc	10,281	625	0	2	960	1,334	341
17	800 Belfast Road, Ottawa	Cyr Distribution Inc	14,828	455	15	8	206	357	615
18	31 Highway 35, Kawartha Lakes	Rona Inc.	4,381	20	0	0	67	39	4
19	250 Laurier Boulevard, Brockville	Shell Canada Products Ltd	2,680	237	0	0	10	390	88
20	740 Rye Street, Peterborough	E G Gray Transportation Ltd	8,635	416	0	16	430	1,008	749

5.3.2 Localized Satellite Analyses

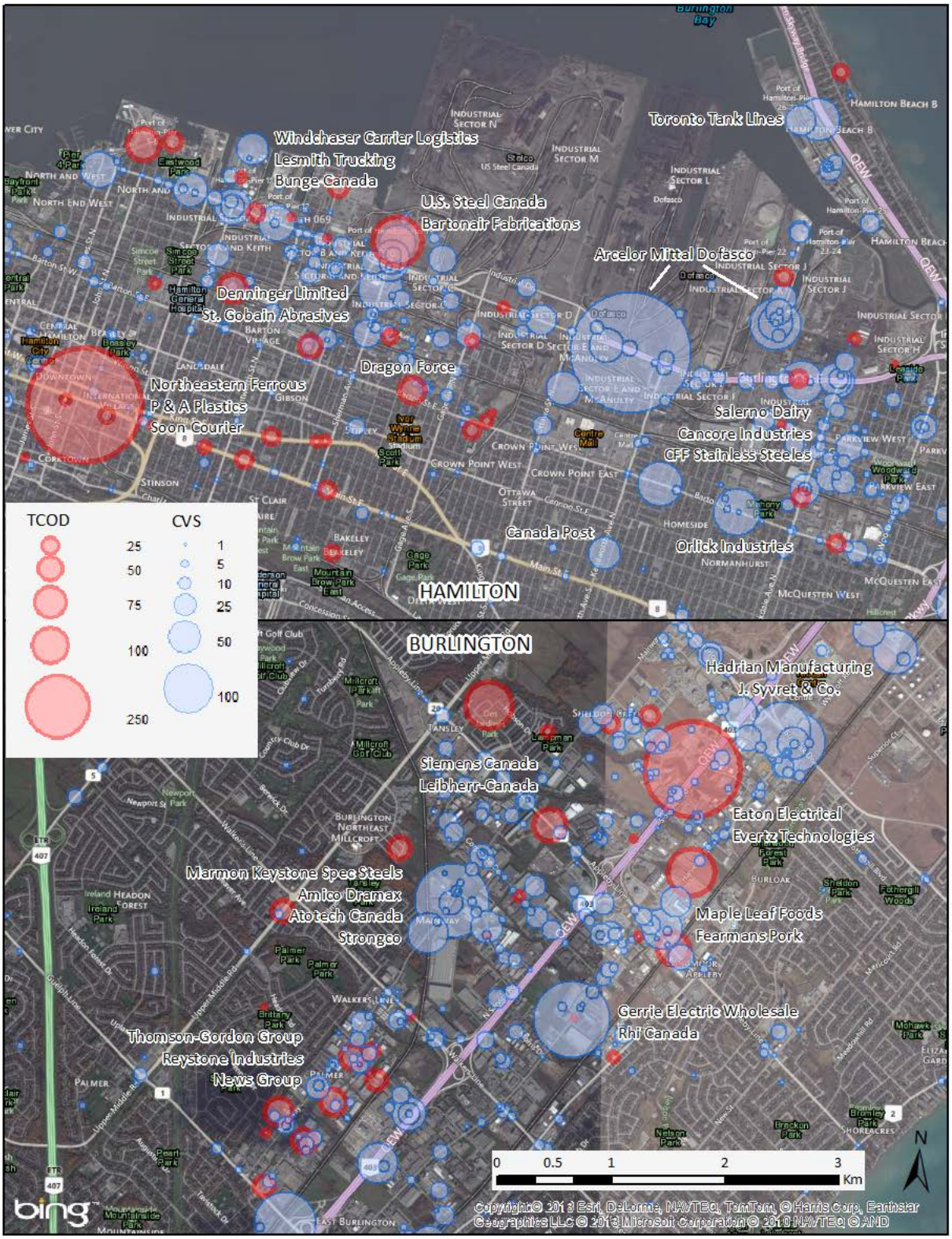
In the final form of analysis, which is the most localized of this report, satellite images that cover in the vicinity of 40 km^2 each are employed to analyze specific points of truck freight origination. In the previous section the focus was on specific-addresses but only a small list of addresses was represented. As such, the areas covered could be much larger. Here, the most spatially detailed CVS and TCOD information we have has been utilized and the number of points in even relatively small areas can be overwhelming. Note that the level of spatial detail in this context does not correspond to knowing the address. One other distinction between this analysis and the prior one is that outgoing and incoming trip/shipment totals have been aggregated together to compensate for the fact that much of the prior work is more focused on generators. InfoCanada data have been used to derive selected company labels on the images to help provide some context. The process has been somewhat subjective and involved mostly a GIS exercise where the InfoCanada data were overlaid on top of the TCOD and CVS freight locations. An effort was made to list the most significant freight-oriented firms that could be discerned from the InfoCanada data.

Figures 5-14 to **5-17** provide selected detailed pictures for two locations in each region. For each region, there is little doubt that other locations could have been chosen. For the GTA region the chosen location representatives are Hamilton and Burlington. This is not so much because they are the most significant generators within the region but rather because the results are sparse enough to be digestible. Had we represented the core of Peel region instead, the amount of points would indeed be visually overwhelming.

TCOD data are represented in red and CVS data in blue. Overall, there are many more CVS points captured than TCOD points. Partially this is because the TCOD data are aggregated to postal codes and because postal codes under 10,000 tonnes of freight per year have been omitted. Also, as described, the CVS data have been linked to individual locations through a probabilistic MTO modelling process and many of these locations are estimated with small daily trip totals. In an overall sense, the TCOD map patterns and the CVS map patterns are similar in terms of their footprint but there are some specific differences which will be described below.

In **Figure 5-14**, Burlington and Hamilton from the GTA region are portrayed. As was the case in Windsor, there is a prominent TCOD node located in the centre of the downtown of Hamilton which is likely a cause for concern. The CVS data shows a fairly strong linear association with Hamilton's industrialized Burlington Street corridor while the TCOD has more of a square look focused on the western part of the lower city. There is another set of TCOD nodes in the east close to the Hwy QEW. It is interesting to note that the area of most significant CVS trip generation in the vicinity of Arcelor Mittal is one with a pronounced gap in the TCOD results.

Figure 5-14: Specific Trip and Shipment Originations for Key Freight Areas (GTA Region)



In **Figure 5-15**, significant detail is provided for London and Windsor which are two of the key urban centres in West region. The London graphic shows very clearly that there a large number of specific freight generating locations concentrated in areas of industrial land use near Hwy 401. The outlines of residential areas are quite evident and appropriately there are few CVS trips associated with such areas. The clustering takes place on both sides of Hwy 401 which is consistent with the most land possible having good access to this important thoroughfare. In the Windsor graphic, the most attention-grabbing aspect is the large apparent amount of shipment activity associated with a Chrysler facility in the downtown. Most likely this address would be associated with head office activities as opposed to levels of shipment generation suggested by the graphic. The CVS data are far less oriented to downtown locations and more oriented to key transportation corridors in the area as is TCOD data at other non-CBD locations.

Figure 5-16 highlights Ottawa and Cornwall from the East region. The Ottawa visual zooms in on the main freight node that was identified through the CVS analysis in **Figure 5-5**. As was the case previously, the CVS pattern are much more dispersed and nicely cover the footprint of the apparent area of industrial development near the highways. As has been observed elsewhere, residential areas are a source for few truck trips. The adherence of the cluster to the shape of the highway route is striking.

The case of Cornwall is an interesting one. Woudsma (2012) has detailed how the provision of low-cost serviced land, an available and receptive employment base with a low penetration of unionized labour, business-friendly policies, low cost and high quality of living, and a location outside of the regional planning program underway in the Greater Golden Horseshoe have all helped to transform Cornwall into a significant hub of freight and logistics activity. The 2006 CVS data appears to be doing a better job of capturing the nature of this hub than the 2011 TCOD postal code data. A clear TCOD miss is the SCM Logistics facility which is associated with the distribution operations for Wal-Mart. SCM has its own fleet of trucks and drivers to serve Wal-Mart's needs but apparently has not been captured by TCOD through its survey process. In smaller communities that have a handful of key generators, there is greater risk for this type of omission to be a serious one.

Finally, for the North region, **Figure 5-17** complements **Figure 5-9** by showing some detail of the generators/attractors within West Sudbury and South Thunder Bay. There is certainly clear evidence in the Sudbury satellite image, unlike the others that have been shown to this point, of primary processing (e.g. nickel) activity at the Vale Canada site. Overall, the number of CVS dots is smaller in Sudbury than in the other examined generators and their size is generally fairly small as well. TCOD data appear to be offering a comparable representation of activity in Sudbury as CVS. Thunder Bay, in relative terms, appears to be capturing more CVS activity than Sudbury of the type that is seen in the south. In this picture of Thunder Bay, there are well-defined industrial areas that are clearly visible with the aerial imagery and distinct from residential areas of the city.

Figure 5-15: Specific Trip and Shipment Originations for Key Freight Areas (West Region)

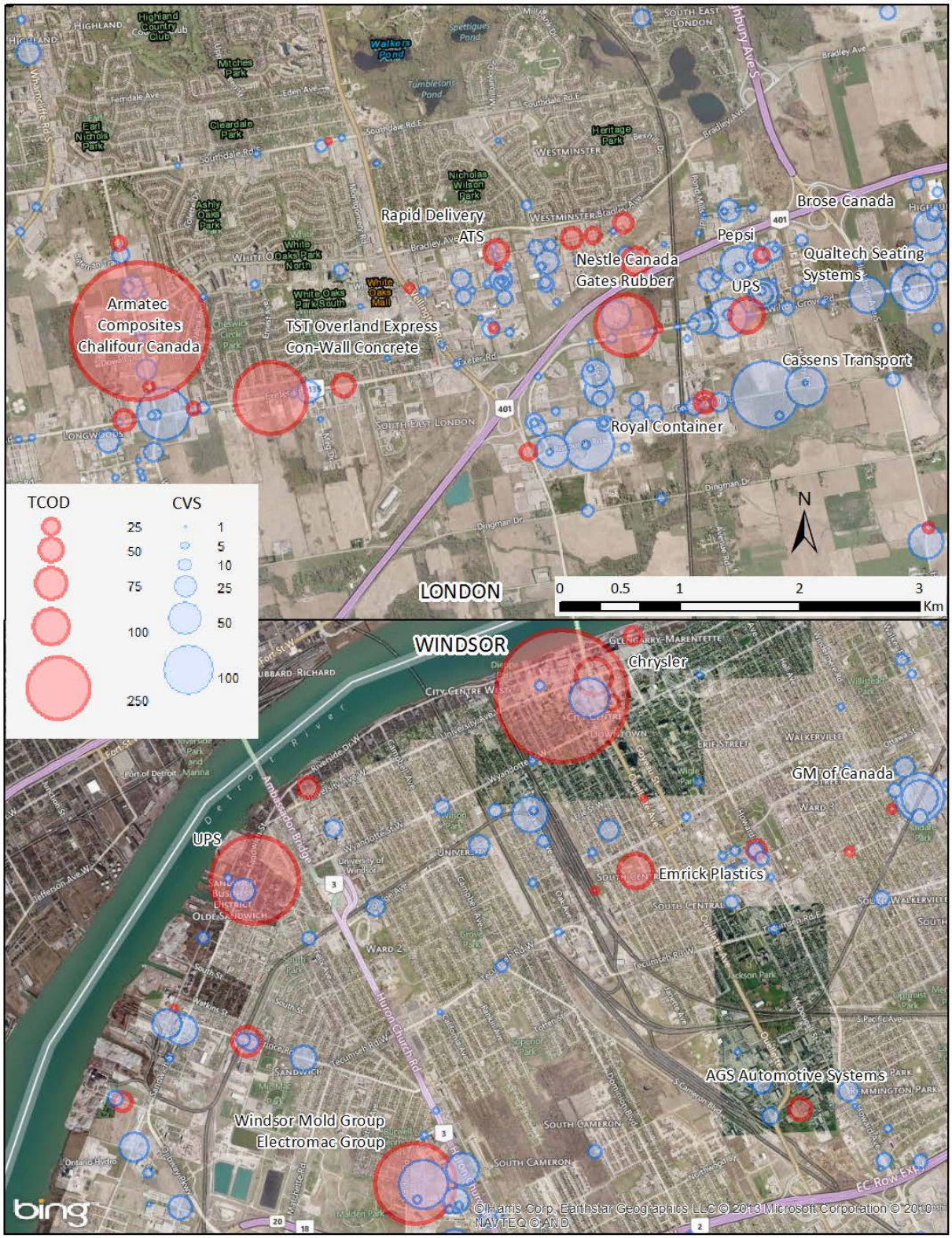


Figure 5-16: Specific Trip and Shipment Originations for Key Freight Areas (East Region)

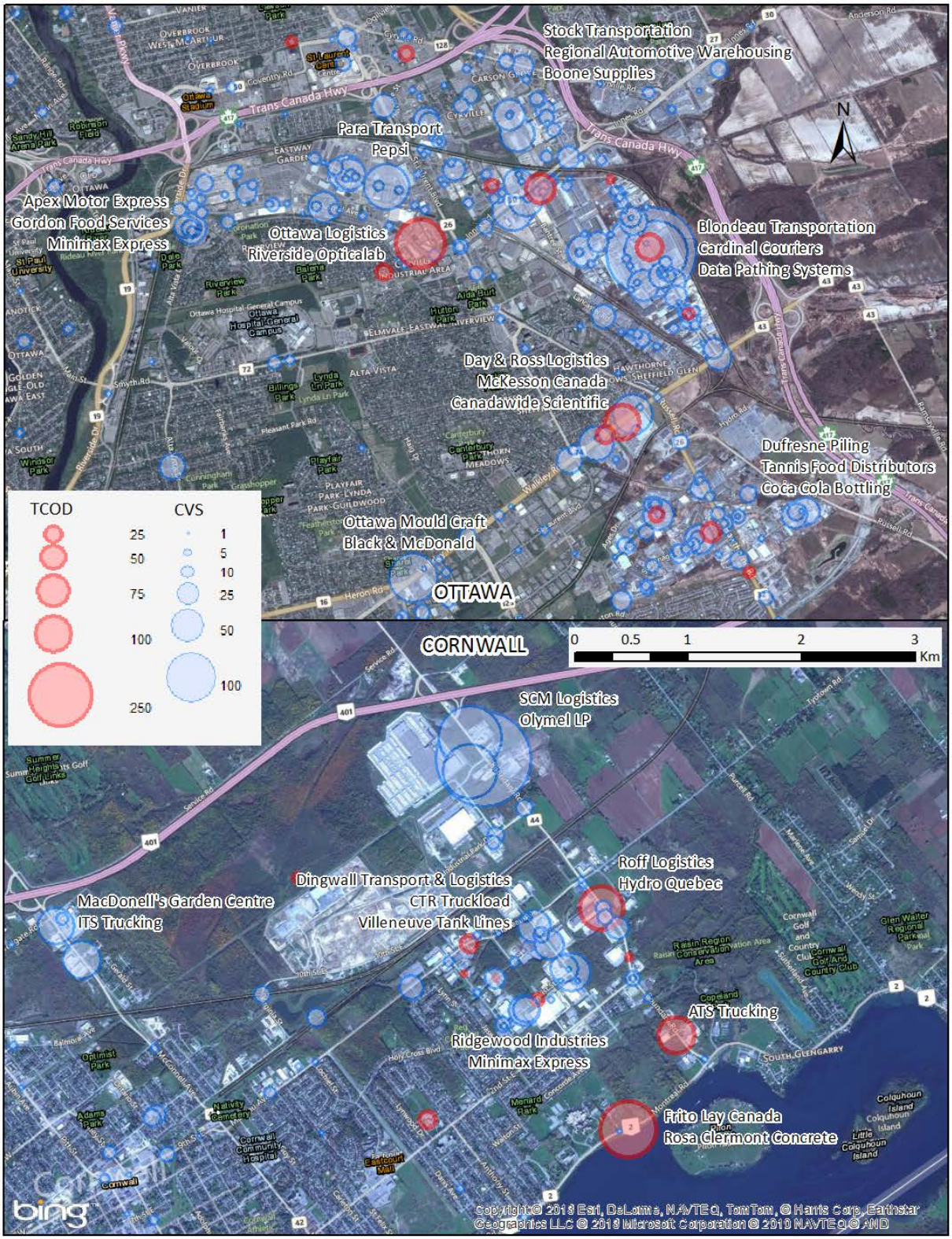
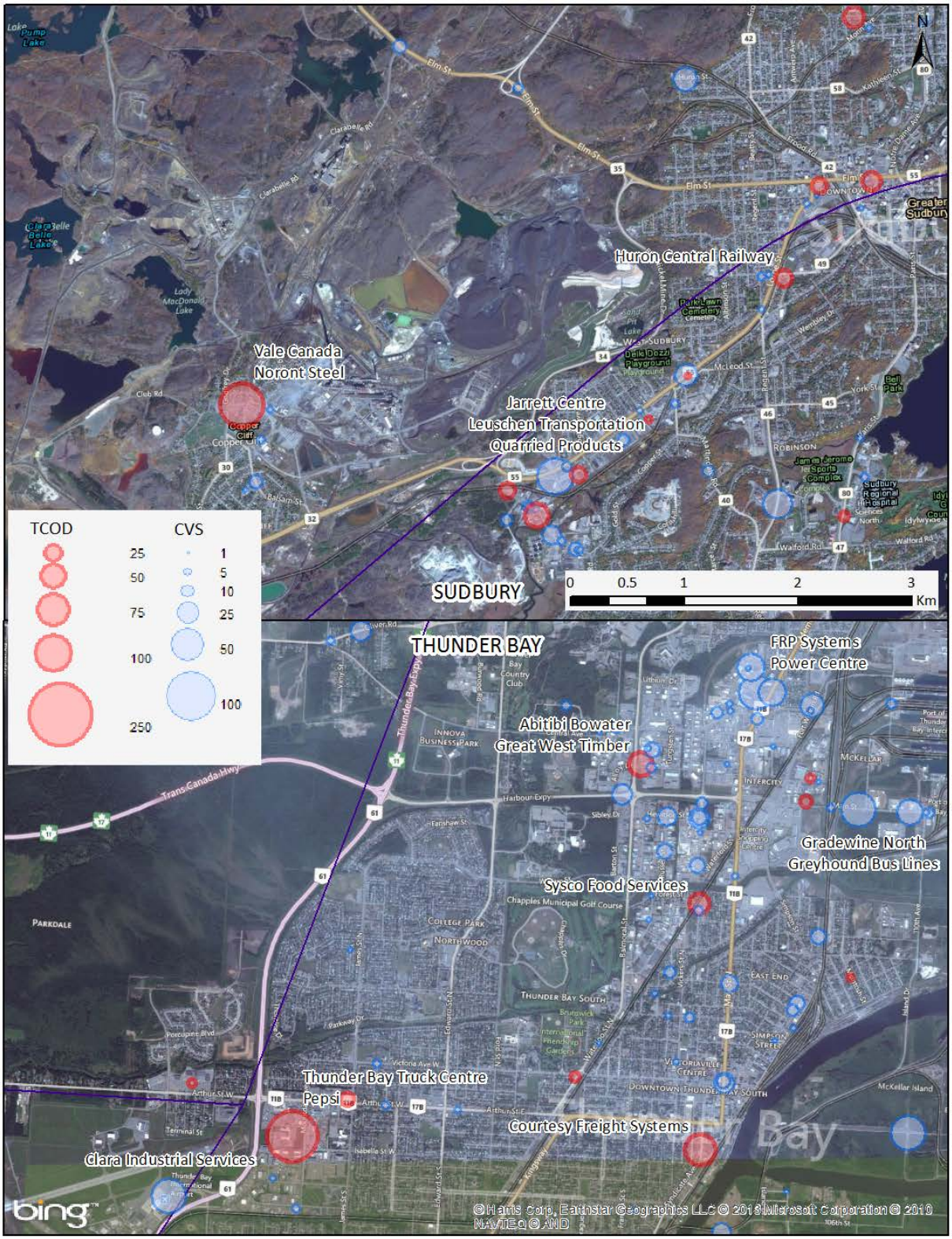


Figure 5-17: Specific Trip and Shipment Originations for Key Freight Areas (North Regions)



Conclusions

This concluding chapter is divided into three sections. The first has to do with summarizing the learnings in this report with respect to the substantive area of truck generators/attractors and associated patterns and also some survey and data related observations. The second section focuses on future research directions and the third focuses on policy implications for the province of Ontario.

6.1 Trucking Patterns in Ontario and Other Insights

6.1.1 Observed Trucking Clusters

Extensive mapping and other types of exercises have revealed a list of significant trucking clusters in the province. These are confirmed by analysis of the spatial patterns from both the CVS and TCOD surveys. For the GTA region these have been already outlined in some detail (Transport Canada, 2010). Here we list the main GTA clusters but also the representatives from other MTO regions:

GTA Region:

- The Peel Hwys 401, 407,410 and 427 Mega-Cluster
- Hwys 427,401, 407,400 Cluster
- The QEW-Hwy 403 Halton to Mississauga Cluster
- The Hwys 407 and 400 MacMillan Yard Cluster
- Toronto Keele-Weston Road-Downtown Cluster
- The Hwy 401 Durham Cluster
- The Hwy 401 Milton Cluster
- Hwys 404,401,407 East Toronto Cluster
- Hwy QEW-Hwy 427 Cluster
- The North Hamilton- Stoney Creek QEW Cluster

West Region:

- The Windsor Cluster
- Kitchener-Cambridge Hwy 401-Hwy 8 Cluster
- London Hwy 401 Cluster
- The Guelph Hwy 6-Hwy 7-Hwy 401 Cluster

East Region:

- Ottawa Hwy 417 Cluster
- Belleville-Trenton Hwy 401 Cluster
- The Peterborough Hwy 7 Cluster
- The Cornwall 401 Cluster
- The Kingston 401 Cluster

Generally, we have restricted this list of clusters to those that are confirmed by review of both the CVS and TCOD surveys. While broadly the surveys show the same picture, on occasion they do not. For example, the CVS appears to show a distinct north London cluster but it is not confirmed by TCOD. As has been mentioned, TCOD tended to feature downtowns more than CVS. Also, there are several other

minor clusters in the project which are not included in this list. For the North West and North East regions, we do not believe that there is sufficient scale to really define the minor concentrations at Sudbury, North Bay and Sault Ste. Marie as "clusters" but there are some truck generators at those locations.

Having delineated the identities of the actual main trucking clusters in Ontario, **Table 6-1** provides a summary of outgoing and incoming interactions associated with each cluster. To derive the totals shown, a detailed GIS exercise was undertaken where polygons were developed to define the spatial extent of each cluster and then the TCOD and CVS totals for each were calculated. An element of subjectivity was involved here and in some cases municipal or other political boundaries were ignored as appropriate. This table makes for interesting viewing and shows that most of the key trucking generators in Ontario are packed into little more than 1700 square kilometers. The dominance of the Peel cluster is obvious in all respects. One other point is that these clusters capture nearly 70% of Ontario's outgoing shipments to all destinations, 57% of incoming shipments and about 50% of trips either outgoing or incoming. Some of the clusters outside of the GTA region in particular are associated with fairly large areas but just do not have the same level of intensity as core GTA clusters.

6.1.2 The Relative Magnitudes of the Generators/Attractors

Movements within the GTA are extremely concentrated, owing to its advanced transportation infrastructure across all modes, a strategic location in the centre of the region and a large population and employment base. Outside of the core GTA, the regional centres of London in the West and Ottawa in the East are also important, with each attracting significant flows from their surrounding smaller municipalities and generally serving as an anchor for flows in their respective regions. Gateway municipalities such as Windsor, and to a lesser extent, Cornwall and Niagara Falls also generate significant numbers of trips, signifying their roles as facilitators of international and interprovincial trade. Nevertheless, the research reaffirms that the gravity of the central GTA in freight and logistics is very strong. Despite Ottawa and London serving as regional anchors, freight flows to and from the GTA Region dominate compared to other locations within Ontario. **Table 6-1** is a worthwhile reference to clarify relative magnitudes.

Overall, the GTA region dominates accounting for about 2/3 of daily outgoing trucking shipments and just over half of incoming truck shipments. Truck trips in and out of the GTA region account for about 55% of the outgoing and incoming Ontario total. 54% of Class 3-8 commercial vehicle registrations reside in the GTA Region. The GTA has six of the top 10 counties in terms of shipment outflows. The dominance of the GTA extends over the vast majority of commodity types.

One other factor that helps to explain the primacy of the GTA region in trucking is that the level of trucking interactions with rail are by far higher in the GTA than in any other region. Certainly, there is no disputing that the GTA region has by far the best highway, rail and air infrastructure. The West region stands out for being the most dependent on facilities that are quite truck-oriented, such as truck terminals and manufacturers, and it has particularly low shares for airport and marine. One thing that has been quite striking, based on the results of the CVS survey, is the very small share of trucking trips in

general that are linked at their endpoints to other modes. The results highlight that there is no substitute for trucking, especially at the intra-metropolitan level.

One Ontario census division, Peel Region, accounts for 28% of all outgoing truck shipments and a significant 16% of outgoing trips. While still very important, Peel stands out less as a recipient of truck shipments and trips. Peel has about 50 to 100 times the number of trucking firms relative to most counties and about five times more than the second ranking county.

Table 6-1: Significant Identifiable Truck Generation Clusters in Ontario

			Daily Shipments (TCOD)		Daily Trips (CVS)	
MTO Region	Cluster Name	Area (km^2)	Outgoing	Incoming	Outgoing	Incoming
GTA	Peel Hwys 401, 407 and 427 Mega-Cluster	292.98	10,928	6,064	11,054	9,262
	Hwys 427, 401, 407 and 400 Cluster	89.62	3,991	805	1,879	1,523
	The QEW and Hwy 403 Halton to Mississauga Cluster	107.71	2,528	875	2,841	2,853
	Hwys 407 and 400 MacMillan Yard Cluster	23.64	1,920	537	1,526	1,144
	Toronto Keele, Weston Road and Downtown Cluster	59.75	1,580	4,195	1,452	1,474
	Hwy 401 Durham Cluster	154.39	1,425	815	1,715	2,061
	Hwy 401 Milton Cluster	25.27	1,336	570	1,429	1,294
	Hwys 404, 401 and 407 East Toronto Cluster	149.17	977	922	2,328	2,152
	QEW and Hwy 427 Cluster	46.59	458	221	1,821	1,639
	North Hamilton - Stoney Creek QEW Cluster	40.4	406	630	1,828	2,115
WEST	Windsor Cluster	118.08	1,355	818	1,419	1,871
	Kitchener - Cambridge Hwy 401 and Hwy 8 Custer	147.72	752	785	2,775	2,559
	London Hwy 401 Cluster	44.03	807	470	788	679
	Guelph Hwys 6, 7 and 401 Cluster	111.13	734	476	1,678	1,699
EAST	Ottawa Hwy 401 Cluster	17.26	107	206	963	1,010
	Belleville - Trenton Hwy 401 Cluster	100.17	401	322	793	865
	Peterborough Hwy 7 Cluster	47.88	74	401	358	452
	Cornwall Hwy 401 Cluster	50.39	195	318	551	728
	Kingston Hwy 401 Cluster	99.96	95	288	615	791
	Total for Clusters	1,726.14	30,066	19,721	37,814	36,169

6.1.3 Shipment Orientation

A useful finding of this research is that key trucking freight generators in the province (such as Peel Region and Essex County) are more shipment-oriented than they are trip-oriented. This does not mean that they don't generate many truck trips; it means that they generate disproportionately more trucking shipments than they do truck trips. This shipment orientation also applies against other variables such as

Class 8 vehicle registrations and labour force size. Simply put, there are many more shipments coming out of these key freight generators in Ontario than would be expected, all things being equal. On the other hand, there are many lagging freight generating places in the eastern and northern regions of Ontario. Ottawa comes across as a weak centre for freight given its size. Partly, outlying counties in the north and east are generating fewer shipments than might be expected because they are sending out many more large shipments of bulkier goods. Thunder Bay is by far the most shipment-oriented generator in the north.

6.1.4 Heterogeneity of Trucking Patterns

Another persistent theme that has been observed repeatedly in this research is that trucking outflow patterns are more heterogeneous than inflow patterns. This result is observed at the national level, for example, where the provinces are much more spread out in terms of the truck shipments they generate than they are in terms of the truck shipments they receive. Within Ontario, the standard deviation of county shipment outflows is much larger than the same measured for inflows. For trips there is a less pronounced result that has come about possibly from the offsetting contributions of empty trucks (amazingly at about 42% of trips). The obvious explanation for the overall heterogeneity observation would be that, other things being equal, inflows are more closely linked to consumption whereas outflows are more closely linked to production. Whereas nearly everyone aims to consume, production is much more concentrated due to factors like the benefits of clustering and economies of scale.

Having observed these facts about the reduced heterogeneity of inflows, it seems almost contradictory to note that eight of the top ten counties for trip inflows reside in GTA region. The result comes about because counties of the GTA receive trips at a fairly uniformly high rate. One other note about heterogeneity of trucking patterns relates to intra-regional variation. There is much more heterogeneity in the patterns of the secondary regions than there is in the primary GTA region. There is a bigger relative gulf between the top and bottom county generators in the secondary regions than there is in the GTA.

6.1.5 Trucking Flow Hierarchies and the Urban Hierarchy

With regard to questions of the urban hierarchy there is no doubt that one is in place in Ontario and in many other jurisdictions around the world. Analysis of trucking data in Ontario has helped to clarify some elements of this urban hierarchy and confirm the three theories of development (see Section 7.1.4) within a significant region such as the Quebec-Windsor corridor. The Location and Accessibility Paradigm has been partly validated through obvious truck-oriented hubs that have developed in places like London, Trenton-Belleville and Cornwall. These are places with strategic locations along an important transportation corridor. The Specialization and Interdependency Paradigm could be best represented by the development of a freight cluster in Windsor-Essex heavily associated with serving highly interdependent automotive supply chains. Peel Region is probably the best realization of the Distribution Paradigm in Ontario in that no one would debate that Peel is a key articulation point for numerous supply chains that are often international in stature.

Related to the issue of urban hierarchy is that matter of whether trucking flows in Ontario are hierarchical in nature. Bearing in mind that the data used for this analysis has been aggregated across commodities/sectors and spatially in some cases, there are nevertheless some fairly clear observations that can be made on this topic. There is no doubt that the Toronto CMA (and in particular specific areas within) acts as a hub for truck movements within Ontario and beyond. Meanwhile, there are large "spoked" interactions with most every municipality/county in the province. In cases where these spoked flows are not large for Toronto, they are significant for the other member in the pairing. In a perfect hierarchical scenario, the lower order cities and towns would not have trucking interactions with Toronto but instead would interact strictly with the closest higher order centre. There is some evidence of this in terms of some strong interactions within the West region in particular but the West region also interacts strongly with Peel, Toronto and other key census divisions within GTA region. While it is not correct to say that hub and spoke defines goods movement by truck in Ontario, it does seem to explain a lot of the activity. So there may be an urban hierarchy in Ontario but the basic nature of truck trip and shipment activity that serves this hierarchy is not itself apparently hierarchically organized.

In terms of the interaction between trucking activity and the urban hierarchy, there is more that can be said. When the urban hierarchy is defined in terms of ranking counties into four classes by outgoing shipments there are some very strong patterns that depend on the urban hierarchy. In particular, about 70% of tonnage and shipments are associated with movements between and within the top two classes. Such movements explain a high proportion of trucking revenue also. Small tonnage shipments are much more associated with higher class counties and high tonnage shipments are much more associated with lower class counties. Higher value, higher order goods seem to be flowing "downstream" while lower-order, unfinished goods are flowing "upstream." However, more data on the nature of the commodities being shipped from origins and destinations would be required to further substantiate this relationship.

6.1.6 Concentrated Versus Dispersed Generation of Truck Trips and Shipments

Efforts were made in this research to understand whether truck trips and shipments, in the aggregate, come from many dispersed but small generators or a few very large generators or somewhere in between. Specific addresses gathered from the CVS and TCOD surveys indicate that most of the work is being done by the smaller generators. Only about 5% of outgoing trips are from specific locations that account for 50 or more trips per day. Truck trip generators are thus more typically small and on some days may not generate any trips but the aggregate effect of such a large number of truck generators results in an enormous amount of truck traffic. Work with TCOD shipments was somewhat hampered by an aggregation across postal codes. Nevertheless, it was found that about 2/3 of the captured postal codes generated less than 25 shipments per day.

6.1.7 Sprawl and Agglomeration

The current state of truck generators in Ontario can partly be understood as the result of a process of decentralization and agglomeration that has unfolded over time across North America. Thirty years of sectoral labor force data has been used to gain insight into this process. In this time span, the changes in some prominent freight-oriented counties have been dramatic. Since 1981, the Peel Region labor force

has tripled, York's has quadrupled and a doubling has been observed in the regions of Durham and Halton and Simcoe County. Particularly in the cases of Peel and York, the growth has been impressive in absolute and percentage terms. Consider that the percentage growth has been off an already significant base. The GTA region has been growing, in labour force terms, right through the financial crisis and subsequent recession. In the fast growth counties, the growth in transportation and warehousing and wholesaling has been correspondingly strong averaging about 100% by county and sector over the 1991-2006 time period. The results showed strong growth in similar themes for some of the secondary generators as well such as Essex, Middlesex, Waterloo and Wellington counties. There is not the same massive, absolute growth that has occurred though in the key census divisions of the GTA and in fact there are some freight areas, particularly in the north, that have declined if anything. Overall, the results suggest that there has been a relative shift towards the GTA Region, and Peel in particular, in terms of its relative importance in core freight sectors. But the picture with respect to manufacturing is more balanced.

"Sprawl" of freight facilities and trucking generators seems like too strong a word for the patterns that have emerged in Ontario. For the most part, the patterns are simply adhering to the rights-of-way established by freeways, highways or tollways (in the case of Hwy 407) and the transport cost advantages they entail. Sprawl definitely seems like an inaccurate term for relatively modest freight concentrations that have occurred at highway locations in London, Ottawa, Windsor and several locations along Hwy 401. Presumably, if sprawl applies anywhere it is in the development of the massive clusters in Peel and York Regions. Certainly there has been a net decentralization process that has taken place. However, detailed analysis of trucking-based clusters through mapping and aggregation techniques has revealed that focus, concentration and agglomeration are probably more accurate words to describe what has emerged. While the Peel and other key GTA clusters are spatially large (many logistics functions do require more land than manufacturing), they are also associated with a high density and intensity of activity. The recent work of Sheffi (2012) on logistics clusters illustrates nicely all the reasons why this high level of intensity is a logical thing. Clusters in other regions, to the extent that they exist, are also spatially quite focused. There are of course reasons beyond theories of transport costs and urban hierarchies that influence the location choices of firms and a significant one is local zoning and land use planning regulations that favour the concentration of these activities in defined locations.

6.1.8 Proximity and Distance Decay

It is well known that trucking dominates the other modes over short distances but this conclusion relates more to proximity and the observed patterns of activities. Essex County stands out as being quite internationalized in its trucking activity due to its close proximity to Detroit and the integration of automotive supply chains. Meanwhile, there are many counties in the East region that are much more inclined to inter-provincial interactions by truck. Essentially, these inter-provincial movements are translating largely into interaction with Quebec since all other provinces are far enough away to greatly reduce the potential for such interaction. Proximity to Quebec is mostly unique to the East region of

Ontario. Meanwhile, GTA region, which is in an intermediate location, does not particularly stand out in relative terms for either inter-provincial or international interactions by truck. In absolute terms, the region clearly stands out much more.

6.1.9 Survey Shortcomings

Both of the key trucking surveys in this research were found to have their own Achilles heels. For CVS the most glaring deficiencies showed up in the spatial interaction sections. Analysis of the CVS inter-County origin-destination matrix revealed fairly appalling under-representation of shorter distance trips as a result of the sample being gathered only on provincial highways. Side-by-side comparison of the TCOD and CVS matrices in this regard, showed clear superiority of the former.

The most troubling shortcomings of the TCOD showed up in analyzing the micro-character of freight clusters. In this aspect, the TCOD results often seemed out of step with plausible locations for freight generation via truck. The TCOD highlighted several downtown locations as important that were not correspondingly captured by CVS. The likely problem seems to be that freight movements are being erroneously attributed to head office or administrative locations. In sampling the shipping documents of carriers during site visits or via electronic transmission of shipping data, it seems likely that inappropriate origin or destination addresses are being captured. The TCOD also suffers from some key omissions where a surveyed trucking firm is not involved with an important source of truck trips or a private fleet is used. In smaller towns or freight centres, this problem can be quite noticeable. The "missing" Wal-Mart distribution centre in Cornwall, Ontario is one obvious example.

The CVS and TCOD have been used here in complementary roles. The CVS does a good job capturing individual movements from all carriers, though it is generally focused on large trucks stopped and surveyed along major roadways and as such, misses the role played my smaller, more localized carriers moving goods within urban areas. The TCOD captures the flows of large carriers over a predetermined threshold and offers a comprehensive view of major flows, though it too may miss the movements of smaller carriers. Age of the data is also a factor, as rapidly developing centres such as Cornwall are not fully represented (while Walmart opened its distribution centre in 2000, new large distribution developments such as Shoppers Drug Mart (2010) and Target (2013) are not included). Nevertheless, we believe the above analysis serves as a useful tool for understanding the role of freight generators both large and small in the complex network of goods movement in southern Ontario.

6.1.10 The Utility of Marketing Databases for Goods Movement

Having worked with several data sets in this study, one thing that is clear is that there is no substitute for survey data that captures the interactions of trucking activity in terms of trips and/or shipments. The TCOD and CVS data were by far the most important data in driving the utility of this research. At the outset of the research there were thoughts that detailed firm level InfoCanada data, which offers detailed sectoral and employment estimates for each firm could be used as some sort of "confirmation" of the patterns seen in the CVS data. As the work unfolded though, it became clear that the best

confirmation tool was the TCOD survey. A spatially detailed version became available later in the analysis. As it turned out, the main use of the InfoCanada data in this research was to help characterize the industrial character of small areas in places that generated a lot of truck activity. Probably the most important use of such a database is in identifying freight-generating firms to survey. This capability might prove useful in further work that could be done to characterize freight generators throughout the province and in fact has been useful in assisting the latest efforts by the University of Toronto in running a freight-oriented survey of the GTHA.

6.2 Future Research

6.2.1 A Future Survey for Regional Generators/Attractors

There is an opportunity to design and carry out a survey that will fill in some gaps in knowledge about truck generators province-wide. This survey would likely use a shipper-based approach to better address aspects such as shorter-distance trips, how trucking interacts with other modes, differences in patterns between shipments and trips and the contributions of private fleets. In designing this survey, a further careful review of the CVS, the TCOD and the available metropolitan-focused surveys (such as the as Peel Region Goods Movement survey and the current GTHA survey) would be undertaken to identify the best questions and design to drive new insight. No doubt there will be challenges as, for example, shippers do not always understand well the movements of their goods after the goods leave the building. The survey could be structured so that when there is knowledge about movements such as "tours", those types of questions could be pursued in more detail.

One objective would be to achieve appropriate representation from relevant economic sectors and from the targeted geographic clusters that have been identified through this analysis. A tool such as InfoCanada and its detail about firm locations and industrial classification codes would be useful in this regard. If selected spatial clusters are targeted as seems appropriate, then it will be worthwhile to pose questions on how membership in a local freight cluster has an impact on business. What are the benefits of being in close proximity to other cluster members? What are some of the main differences between the various trucking clusters in Ontario? One other aspect to this opportunity is that MITL expects to carry out a provincial survey of firms and government entities to help develop an understanding of the future deployment of commercial fleets powered by electric vehicle technology. There is thus the potential to benefit from a similar undertaking that might be taking place during an overlapping time span.

6.2.2 The Use of More Detailed Freight Data

We believe that more detailed work is possible even with some of the data that are already available. Conclusions that have been derived so far are based on sectorally aggregated data trip and shipment data. However, it makes sense to in some ways "redo" the analysis of this report on a sectoral basis. A much finer understanding of freight generators and attractors will be possible using, for example, origin-destination information that is sectorally based. Such an analysis will help to understand more about the nature of supply chains in Ontario and to understand more about the freight movement mechanics of specific manufacturing and wholesaling sectors among others. It will be interesting to consider whether

the hub and spoke concept that has been seen to mostly apply in Ontario work equally as well on a sectoral basis. A future survey of Ontario-wide truck generators could be designed to provide maximum leverage in answering these types of questions.

6.2.3 Leveraging the Canada Business Register

In recent projects we have come across two Statistics Canada surveys that have their sampling frames determined by the Canada Business Register: Canadian Business Patterns and the Trucking Commodity Origin Destination Survey. A brief discussion of the Business Register is provided in Higgins and Ferguson (2011) but suffice it to say that this is a comprehensive list of firms which operate a formal payroll. One interesting note derived from pursuing this research was that the Canada Business Register is conceptualized at four levels relating to firms: the enterprise, company, establishment and location. There are precise definitions for each and the TCOD survey chose the company level as the best one from which to derive survey respondents. From the point of view that the TCOD targeted carriers and their shipping documents this was likely a sound strategy. For a survey of shippers, however, we wonder about the benefits of looking into establishment and location concepts to see if the survey can get closer to the actual freight generating entities. And then there is the question of how these Business Register concepts interplay with marketing databases such as InfoCanada. Some research into the Canada Business Register and consultation with the federal government on the topic could yield insights on survey methodology for truck generators.

6.3 Policy Implications

The purpose of this concluding section is to identify possible geographical policy implications arising from this report for the Ministry. This is done by Ontario Ministry of Transportation regions.

6.3.1 GTA Region

Of all MTO regions, this region has experienced the most massive growth in goods movement and related freight infrastructure over the past thirty year. The new freight clusters that have developed in the region are very highway oriented indicating that considerable investments in improving the provincial highway system are well-placed. The 400 series of highways in the GTA region in particular are very much the primary transportation arteries that sustain the provincial economy. There are clearly no "public transit options" for trucks.

Metropolitan traffic congestion has become a paramount concern in the GTA region; traffic volumes have increased over time and at locations where AM and PM peak periods of traffic have widened. Trucks now encounter congestion in the middle of the day at times when they used to be free to go about their business relatively unimpeded. The congestion issue is particularly pressing along Highway 401 where daily volumes of medium and heavy trucks are as much as 38,000 at Highway 400 and 42,000 at Dixie Road, and where additional distribution centres are being established in locations to the west such as Mississauga and Milton.

The GTA region certainly does not want to be in a position where it forsakes potential lucrative outside investment because the region is seen as being too congested. Investments in GTA highways must continue; it is at the core of Ontario's overall competitiveness. Some would argue that recent investments are really just keeping pace with freight infrastructure development as opposed to getting ahead of the curve. It is not only from the perspective of goods movement attraction and generation that these investments be made; there is significant volumes of truck movements through the region also.

It makes sense to consider areas in the GTA region outside of the Toronto CMA for investment in non-400 series highways as well. For example, truckers that service the Honda plants in Alliston, in the northern sections of the GTA make intensive use of the lower tier of provincial highways in getting components to the assembly line and from the plant to American markets.

Recent investments in the QEW all the way around to Niagara are facilitating enhanced movement of goods by truck to and from the North Hamilton-Stoney Creek QEW cluster including the Port of Hamilton. Further investment would permit secondary freight generators in the GTA region to compete on an equal footing; it could also encourage the development of new freight clusters in upcoming decades that will relieve the core-GTA clusters to some extent. Trucking will be very important for these newer clusters.

While there is not much public sympathy for the movement of trucks, this report has shown how integral these movements are. GTA-related movements in particular are focused on large numbers of high value shipments.

The value of cargo on any given truck is $500,000 on average and can reach into the millions of dollars for high-order goods such as pharmaceuticals or auto components. Meanwhile, a significant percentage of road space is occupied by discretionary personal trips with one person in a vehicle. These incremental trips are much less valuable to the economy but quite integral to congestion.

All levels of government in the GTA are making a concerted effort to provide alternatives to car use. What also is needed is education to make the public and government more accepting of the critical role that trucks play in servicing the economy and its population. This role of trucks cannot be played by other freight modes.

6.3.2 West Region

International trucking movements are most important to the West region, particularly in Windsor-Essex. As such, investments in the new bridge and the Windsor-Essex Parkway are very important for expediting truck movements to, from and through the border. However, it is useful to note most truck movements in West Region are internal to the province and support considerable economic activity in their own right.

Much of the discussion about truck freight for the West region starts and finishes with Hwy 401, its most important freight artery. Also, non-trucking modes are relatively less prevalent in non-GTA regions so

trucking becomes even more important. The Kitchener-Cambridge Hwy 401 and Hwy 8 cluster is right on the western edge of the GTA region and is therefore the most impacted by fairly intense congestion on the 401 that can extend further out to the west. In this sense there are traffic interdependencies between regions that impact the West Region as well. Solving any GTA problem will thus also help the West Region.

Other clusters along the 401 to the west (e.g. London Hwy 401 cluster) are far less impacted by congestion although truck volumes remain fairly high at between 15,000 and 25,000 trucks per day. West of London, congestion is typically a non-issue other than near the border.

Overall, the trucking clusters and generators are smaller and less complex than in the core clusters of the GTA. From a provincial perspective, the main priorities are to keep Hwy 401 and 402 and other select provincial roads functioning at a high level and to work with relevant municipalities to ensure good access between key highways and nearby trucking clusters.

6.3.3 East Region

In terms of trucking generators and attractors, the East Region of Ontario is still relatively minor but much more important than was the case even ten years ago. Cornwall has evolved into a significant logistics centre and as an alternative to establishing logistics infrastructure in Quebec or in the eastern approaches to the GTA. Only the earlier parts of this rise that were captured by the data used for this analysis and is one of the better examples for highlighting the importance of frequent collection of trucking survey data.

While the West Region is most internationally oriented, the East Region is most inter-provincially oriented in terms of truck movements given proximity to Montreal. In many ways, Montreal is probably more important to goods movement in the East Region than Ottawa as the latter is not on the Hwy 401 corridor. In this respect, provincial co-ordination between Quebec and Ontario as it relates to the smooth inter-provincial movements of good by truck are quite important.

The data have revealed that the various centres of the East Region are very dependent on truck movements to and from the GTA region, more so than movements within the centres of the East Region. Accordingly, most of the story about trucking movements in East Region is oriented to Hwy 401. Truck volumes along the 401 approach one-quarter of total traffic (much higher share than in GTA region) and there is increased logistics activity in the region; that said, there are no highway capacity issues for the foreseeable future based on overall traffic volumes.

6.3.4 North West and North East Regions

One of the most significant findings from the objective analysis of the survey data for this report is that the North West and North East Regions do not have trucking clusters per se, at least not by the standards of other regions in the province. There are some significant truck generators in these regions

but they are not based on agglomerations of large numbers of firms and also the outbound goods transported are more likely to be bulk commodities.

There are few distribution centres in the northern regions given an absence of large population centres to serve. From a provincial perspective, the smooth functioning of these patches of trucking activity is enhanced through continued maintenance of high-quality highway infrastructure but there is far less urgency because the economic stakes are not so high and there are fewer stakeholders affected. Highway improvements would be undertaken not for traffic congestion but for other reasons such as safety or economic development.

Appendices

7.1 Transport Costs and the Spatial Organization of Freight and Logistics

Transportation involves an element of friction, and this friction results in a number of costs, such as fuel, labour, and time costs. These costs have historically been understood as fundamental drivers of urban growth in cities for both people and firms, where a desire to minimize frictions associated with distance results in a tendency towards density and an agglomeration of activities. For goods movement, this has traditionally resulted in a concentration or clustering of freight and logistics around major transportation assets, such as seaports or rail terminals. However, the costs associated with transportation, both for the movement of goods and people have fallen precipitously over the last century and this has had a marked change in the shape of cities and regions.

For ocean freight, Rietveld and Vickerman (2004) detail how the real costs of shipping fell by 49 percent between 1910 and 1990. Though somewhat surprisingly, generalized costs have not decreased since 1960 despite the widespread adoption of containerized shipping and dramatically increased ship capacities. One explanation for this is that the benefits of containerized freight have been mainly associated with time costs, where containers offer an accelerated shipping process that thereby

increases reliability and reduces inventory and depreciation costs, resulting in lower generalized costs overall (Rietveld & Vickerman, 2004). But the speed of ocean freight transport remains low.

Compared to ocean shipping, air freight offers much greater speeds and has attracted a significant market for the transportation of high-value, time-sensitive goods. Capacities have greatly expanded over the past few decades. For example, FedEx's first-generation planes carried 6,500 pounds while today's Boeing 747 freighters can carry up to 270,000 pounds (Sheffi, 2012). This added capacity has resulted in costs for airfreight that have fallen by 75 percent between 1940 and 1980 (Rietveld & Vickerman, 2004). Inland transportation has seen similar declines. In the Netherlands, the real cost per ton kilometre of rail and road transportation decreased by over 77 percent and 80 percent respectively over the past century. Rietveld and Vickerman (2004) argue that these numbers are largely representative of trends in the broader US and European Union.

In North America, trucking has experienced rapid growth in recent decades. Highly developed provincial and interstate highway systems allow a single driver to travel about 800 kilometres in a typical day and 150,000 kilometres or more per year for owner-operators and other non-unionized drivers, a feat that would have been impossible in the middle of the last century (Bryan et al., 2007). Load sizes have also increased. Fifty years ago, truck trailers in the US were 32 feet long, but have grown over the ensuing decades to 35, 40, 42, 48, and now 53 feet long. Furthermore, multi-trailer 'road trains' are becoming increasingly popular, enabling one tractor and one driver to move more freight and resulting in a lower cost per tonne-kilometre (Sheffi, 2012). While there is some limit to load sizes, economies of scale in terms of the size of trucking firms entails opportunities for better management, such as improved shipment coordination for less empty hauls, allowing companies to thrive with margins as low as 2.5 to 5 percent of revenues (Transport Canada, 2005).

These changes appear to have made transport costs less of a barrier to freight and logistics than they were previously. Glaeser and Kohlhase (2004) have found that for more than 80 percent of global shipments, costs associated with transportation represent less than 4 percent of total value. Such a scenario has had a substantial impact on the flows of international trade and the overall importance on location in the relationship between freight and logistics and urban areas.

One outcome of low distance-based transportation costs is a shift in the attention paid to other costs and new ways of minimizing them. For example, time costs, which include the cost of depreciation of inventory in transit or in storage at a warehouse, have emerged as a significant cost for firms. Though these costs might be assumed to be moderate or even insignificant, Rietveld and Vickerman (2004) have found a higher willingness to pay for time reductions or increases in temporal reliability than one might expect. However, this conclusion is greatly dependent on the type of commodity, with perishable or high-value goods such as electronics exhibiting a much greater emphasis on time dependence.

The decline in the importance of transport costs, especially when combined with new Information and Communications Technologies [ICT] has led some observers to proclaim the 'death of distance' (Cairncross, 1997). Such a statement is of course premature, at least at present (Rietveld & Vickerman, 2004). Transportation costs have not disappeared and are monitored keenly by truck carriers with razor

thin margins. In fact, a relative increase in the cost of trucking is one factor fuelling a rail boom in the last decade. Nevertheless, trucking remains hugely important to the economy and friction continues to shape the agglomeration of freight and logistics activities, even in the decentralized locations of suburbia and exurbia.

7.1.1 Agglomeration and Dispersion

The prevalence of low transportation costs has resulted in an apparent paradox in modern freight and logistics, with increasing tension between the forces of agglomeration, or the clustering of activities on the one hand, and the decentralization or dispersion of these same activities on the other. Both have significant implications for patterns of truck movements that are the ultimate result.

Dispersion of Freight and Logistics Activities

As summarized by Hall et al. (2006), "Improvements in transport technologies, the massive enlargement of infrastructure and falling transport costs, not least thanks to cheap oil, changed the role of transport in the second half of the 20th century … putting transport out of consideration in economic geography". In this context of globalized trade and low freight costs, firms are presented with what Rodrigue (2004) refers to as "increased locational flexibility" in the siting of freight and logistics facilities. Decisions are no longer made primarily on considerations of distance alone, but rather a more complex conceptualization of friction that has come to mainly consider time and cost and how they relate to broader supply chain circulation activities such as loading, unloading, and transshipment (Rodrigue, 2013).

It has also resulted in the need for more logistics facilities and an increasing emphasis placed on their efficient spatial organization within a distribution network (Dablanc & Ross, 2012). In response, Sheffi (2012) has noted that large firms are increasingly making use of 'computerized network analysis' for finding optimal locations for new distribution centres within their supply chains. With a low friction of distance, there is a tendency for freight and logistics locations to become 'placeless', spatially detached from metropolitan areas and sited on a location chosen purely for reasons of economic efficiency (Rodrigue, 2013). According to Hesse (2004, p. 166) "Once the spatial scale increases, such commodification of land leads to a certain "abstraction" from the concrete place, in favor of the network structure".

In terms of the spatial organization of freight and logistics within this context, researchers have noted a distinct trend towards suburbanization or a process that has been termed 'freight sprawl' (Hesse, 2004; Cidell, 2010; 2011; Dablanc & Ross, 2012). As transport costs have fallen, firms have a greater opportunity for choosing an optimal median location that makes sense for reaching a much broader geographical market area. Today, that location is increasingly on cheap and large parcels of land located as close as possible to major transportation infrastructure, which is primarily accessibility to highway nodes and airports (Woudsma et al., 2008). Logistics distribution functions are also moving inland away from traditional seaports (Dablanc & Ross, 2012).

Empirical evidence of the process of geographic dispersion and decentralization in freight and logistics has been documented in 47 of 50 large metropolitan areas in the United States by Cidell (2010). In Atlanta, Dablanc and Ross (2012) found that suburban and exurban zip codes accumulated many more distribution centres between 1998 and 2008 than those closer to the city centre. Similar findings were also seen in a case study of Chicago by Cidell (2011).

Clustering of Freight and Logistics Activities

On the other hand, powerful forces remain that promote agglomeration and the development of freight and logistics clusters. Some basic influences that bound firms to specific locations are the quality of the local workforce, quality of life considerations, local planning policies, the historical accumulation of transport infrastructure, labour practices, and market size, all factors that contribute to the 'distinctiveness' of certain cities and act as attractors in a globalized economy (Hall & Hesse, 2013). For firm-level economic considerations, Sheffi (2012) notes that clusters of freight and logistics enjoy unique operational advantages that are rooted in the interchangeability of transportation and logistics assets. This refers to the fact that the services performed in transporting a package are essentially identical regardless of what the package contains and which transportation service supplier completes the task. From this, clusters offer two advantages.

The first is economies of scale that produce lower costs and better service when firms move freight between areas that generate or absorb large amounts of freight, such as between logistics clusters. These scale economies thereby attract more shippers who then create more shipments and make the carriers even more efficient. The second advantage is the ability to share infrastructure. When firms are physically close to one another, they enhance each other's performance as a result of more physical resources such as warehousing space or an intermodal terminal. Both advantages create a self-reinforcing multiplier effect, making the cluster more attractive as it grows (Sheffi, 2012).

Clusters also have a large impact on the types of operations performed by certain carriers. Sheffi (2012) makes a distinction between Consolidated Operations [CO] and Direct Operations [DO] shippers, with CO services collecting smaller consignments from several customers to make a full shipment, and DO services transporting discrete consignments to their destinations and charging the full price to the single firm. Consolidated shippers benefit from clustering by nature of the large amount of potential customers in the vicinity of the cluster, resulting in increased service frequency, more efficient load planning, and consolidated pickups and deliveries. Direct shippers also benefit by shipping between clusters through less empty return hauls and opportunities for cooperation between firms for the consolidation of loads for direct transport. Beyond shippers, producers also benefit from increased competition, lower costs, and higher levels of service, regardless of their consolidated or direct shipment preferences, thereby enticing them to locate near freight and logistics clusters as well.

7.1.2 Three Scales of Freight Flows

This change in transport costs has had a substantial impact on the nature of trade and freight flows, which can be conceptualized according to three scales of interaction that affect urban areas: global, regional, and local.

At the global level, complex networks of international gateways, typically exemplified by containerized shipping at major sea ports at both the production and consumption ends of the supply chain, are now the interfaces for globalized trade and are primarily responsible for rapidly growing quantities of freight. Once inland, these flows begin to circulate by rail, inland waterways, or long-distance trucking within expanding networks of regional distribution centres and other transport terminals. Downstream freight is broken down into smaller shipments for consumption throughout the region and upstream shipments are consolidated into larger flows for longer-distance travel. All freight flows ultimately begin and end at the local level where the 'first' or 'last mile' occurs. This leg of the transportation network is overwhelmingly accommodated by trucking.

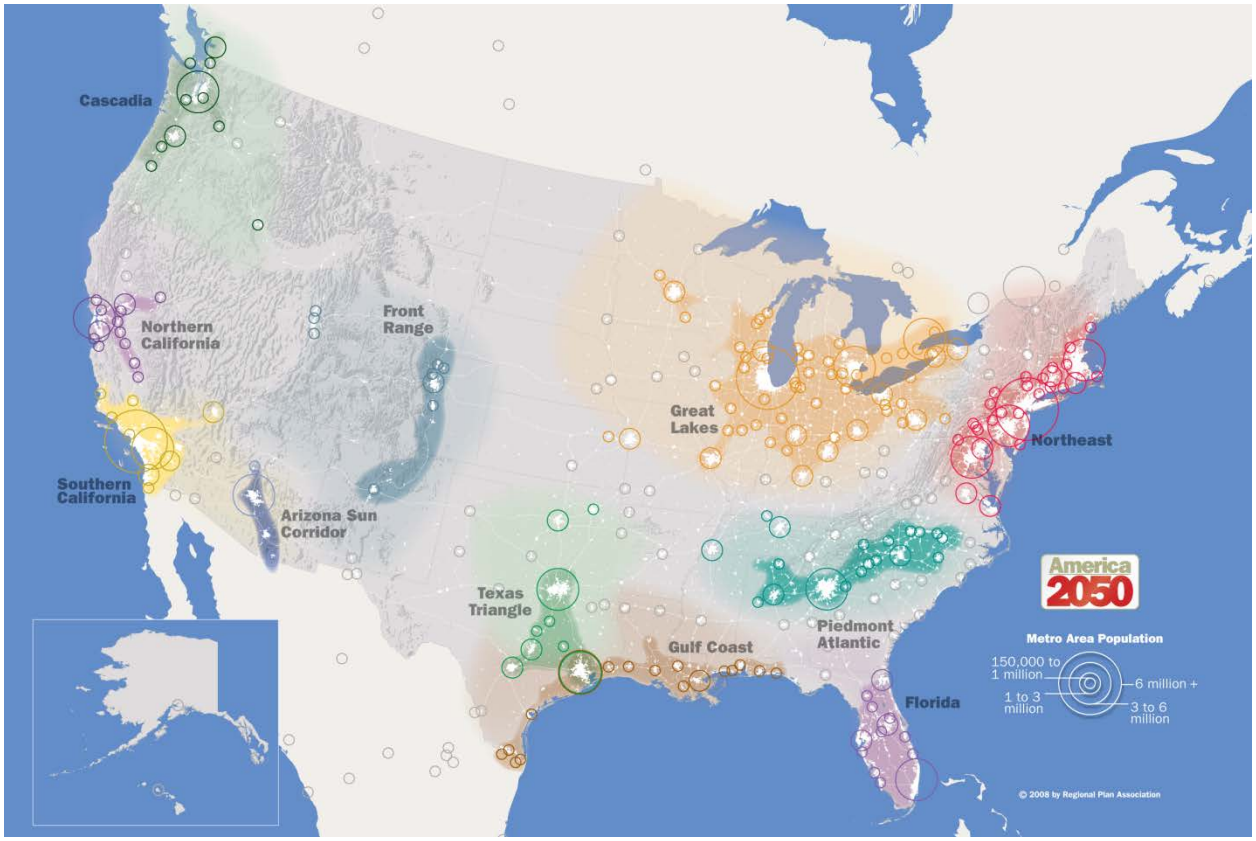
In general, it is at the regional level that all three of these scales converge and overlap, resulting in an incredibly complex system of freight interactions within a given area. Containers hauled by train end up at a regional intermodal terminal, some of which are destined for local delivery by truck while others continue on to other destinations. Trucks may also carry flows of production materials that act as inputs for industry within the same region or the same city, with the assembled products consolidated for truck or rail transportation to regional, national, or international customers. Likewise, local level flows might include the distribution of goods deconsolidated for delivery or shipments to and from businesses within the same city or even the same business cluster. This density of flows presents a challenge for researchers interested in understanding the nature of flows within an area and will necessarily shape the conclusions of the present project.

7.1.3 Freight and Mega-Regions

One distinct outcome of globalization is the regionalization of urban growth and the growing importance of these economic areas in local, national, and global economies (Rodrigue, 2004). Scale is important however, as the spatial area of what constitutes a region has grown considerably in globalization and in an age of low transport costs. As metropolitan areas continue to expand, the traditional boundaries between them have begun to blur, and this process has resulted in a new scale of geography commonly referred to as 'megaregions'.

Rodrigue (2004) defines regions as an extended but cohesive territory and a space in which economic transactions and the circulation of people, goods, and information takes place. What is key in the mega-region concept is the central role of the transportation system that facilitates such circulation between metropolitan areas. According to Ross (2009), a mega-region is the explicit networking of large metropolitan centres and their surrounding areas, spatially and functionally tied together through environmental, economic, and infrastructure interactions. From these broad foundations, researchers from the Regional Plan Association's 'America 2050' infrastructure policy and planning program have outlined 11 distinct mega-regions in North America as shown **Figure A7-1**. Here darker colours represent the primary mega-region boundary with their respective hinterlands, or areas of influence, in lighter shading. One of these is the 'Great Lakes Mega-region', an area stretching from Kansas City and Minneapolis in the west to Toronto and Pittsburgh in the east, with Chicago and Detroit at the centre.

Figure A7-1: North American Freight Mega-Regions



What Is A Mega-Region?

A second approach in the local context is that of the Quebec City-Windsor region (**Figure A7-2**). This region now forms the backbone of the Ontario-Quebec Continental Gateway partnership between the governments of Canada, Ontario, and Quebec to further develop and promote this corridor for trade and economic growth. In the context of Ontario, the accumulation of infrastructure is focused on the Highway 401 corridor, which runs from Windsor to the Quebec border, where it becomes Autoroute 20 and continues on to Montreal and beyond. Of interest is the divergence between mega-regional definitions in the classifications of Ottawa, Montreal, and Quebec City, with the America 2050 team placing them outside of the Great Lakes mega-region and within the hinterland of the Northeast or Boston-Washington mega-region. In contrast, the Quebec City-Windsor concept views these metropolitan areas as the eastern terminus of its region. However, investigating the reasons for disparity further is beyond the scope of the present project.

7.1.4 Mega-Regions, Corridors, and Transport Cost

Regardless of the approach, it is clear that there are significant forces at work linking these metropolitan areas. Given the emphasis on networked interactions, it is no surprise then that one commonality between mega-regions is their orientation and development along corridors where transport, economic, and demographic processes are linearly articulated (Rodrigue, 2004). Corridors, defined by Rodrigue

(2004) as the accumulation of infrastructure and flows, offer accessibility and connectivity advantages that have shaped the spatial structure of urban regions both in North America and around the world.

Figure A7-2: The Quebec City-Windsor Corridor

Truck Flows, Regions, and Corridors

The mega-region concept is particularly well suited to the analysis of freight flows, as these flows tend to largely be disconnected from a single city. In fact, two previous studies have examined freight flows within the Boston-Washington or Northeast region (Rodrigue, 2004) and the Piedmont-Atlantic region that surrounds metropolitan Atlanta (Dablanc & Ross, 2012). Truck freight flows in particular have been found to be exemplary indicators of the extent of economic regions (Dablanc & Ross, 2012), largely owing to its particular characteristics and distinct role when compared to other modes.

In Canada, trucking clearly offers many advantages at the short to medium-range level. Though its costs in terms of labour, fuel, and the number of hours required to move a shipment can make it uncompetitive for longer hauls, it is the primary mode of travel for the vast majority of movements at the intra-metropolitan scale, offering unbeatable locational flexibility and lower costs for shorter distance travel when compared to rail, marine, and air transport (Ferguson & Lavery, 2012). This is backed up by data on the spatial characteristics of each mode within the supply chain from the 2007 US Commodity Flow Survey (USDOT, 2010), with shipments by for-hire truck services travelling an average

distance of 599 miles compared to 728 by rail, 923 by deep-draft water shipping, and 1,304 miles by air. When accounting for private truck fleets, the average distance travelled by truck falls to 206 miles.

Given the nature of trucking within the framework of complementarities between different modes, its shorter conveyances are very strongly linked to intra-regional flows and interactions with transportation networks, which as the next section will show, form the basis for regional development.

The Hierarchy of Urban Areas along a Corridor

Though freight and logistics has tended towards decentralization, there are still several forces at work that favour agglomeration and the formation of clusters at a local scale. But in the age of low transport costs and globalized trade, there remains an uneven geography of inland distribution. Even as freight facilities continue to move farther out into the hinterlands of urban areas, there are a number of additional incentives that shape their spatial distribution and organization within a functional hierarchy at the regional scale along a transport corridor. To better understand this, we first examine some locational theories in transport geography.

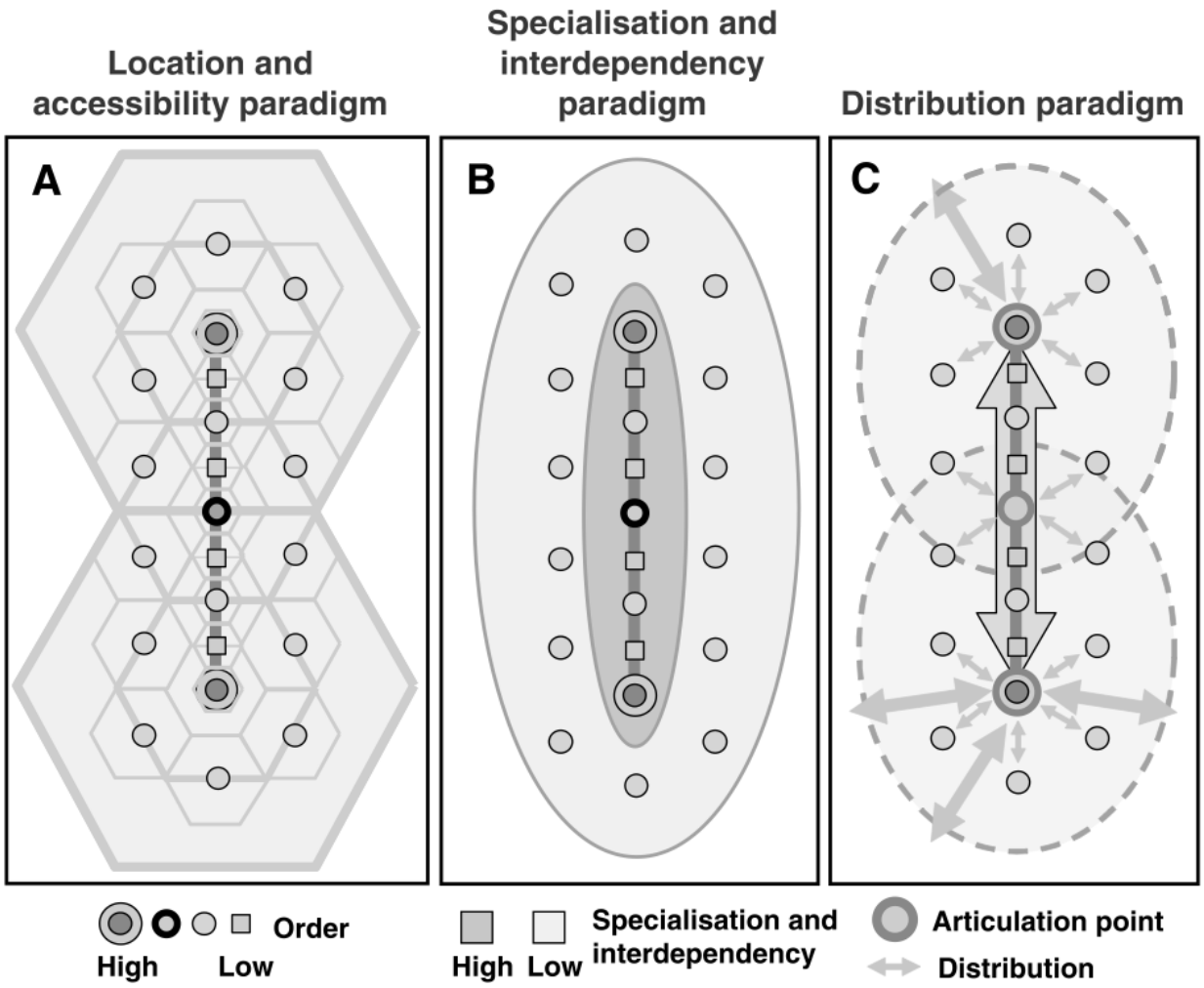
Rodrigue (2004) offers three paradigms of geographical theory that relate to the relationship between urbanization, transportation corridors, and the facilitation of economic interactions within and between the different areas of a mega-region:

Location and Accessibility Paradigm: In this conceptualization, locations within the region are considered according to a hierarchy of functions organized around a transportation corridor. Transportation costs are assumed to create this pattern of spatial organization, with higher levels of accessibility along the main transportation corridor resulting in a concentration and accumulation of activities (**Figure A7-3**, Panel A).

Specialization and Interdependency Paradigm: Beyond transportation, this paradigm considers that some cities may also exhibit regional specialization and comparative advantages in some economic functions. Accessibility and economies of scale in both production and consumption support the development of mega-regions in which parts are increasingly developing to be specialized and interdependent. This paradigm is bolstered by the transportation corridor, which facilitates economic interactions within and between the different areas of the mega-region and thus acts as the regional transportation system (**Figure A7-3**, Panel B).

Distribution Paradigm: Both of the preceding paradigms are inadequate for explaining the growing links between regional urban development along transportation corridors and globalized trade. In the distribution paradigm, cities act as articulation points in global supply chains, serving as the interface between global, national, and regional systems of accumulation and distribution (**Figure A7-3**, Panel C).

Figure A7-3: Three Paradigms for Urban and Regional Freight Interactions



Given these guiding paradigms, we would expect to see a hierarchical sorting of functions among the different areas that make up an economic region, each of which are connected by the transportation network. Previous research focused on urban hierarchy has found evidence of such organization through data on public transit and passenger air travel, finding a strong correlation between the size of the economy in a particular place and its interaction with other urban areas (Guerrero & Proulhac, 2012). Empirical research of freight flows has also found an interesting hierarchical organization in terms of manufacturing and wholesale trade in France. In general, Guerrero and Proulhac (2012) found that manufacturing flows tended to travel 'upstream', from smaller towns and cities to larger cities, while wholesale trade flows tended to travel 'downstream' from larger cities to smaller ones. Such a finding lends credence to the paradigms noted above, with regional specialization for production bolstered by the agglomeration of activities in urban areas and a complex and interlocking system of distribution for consumption.

7.2 Supplementary Tables and Figures

Figure A.7-4: Map of Ontario Counties/Census Divisions

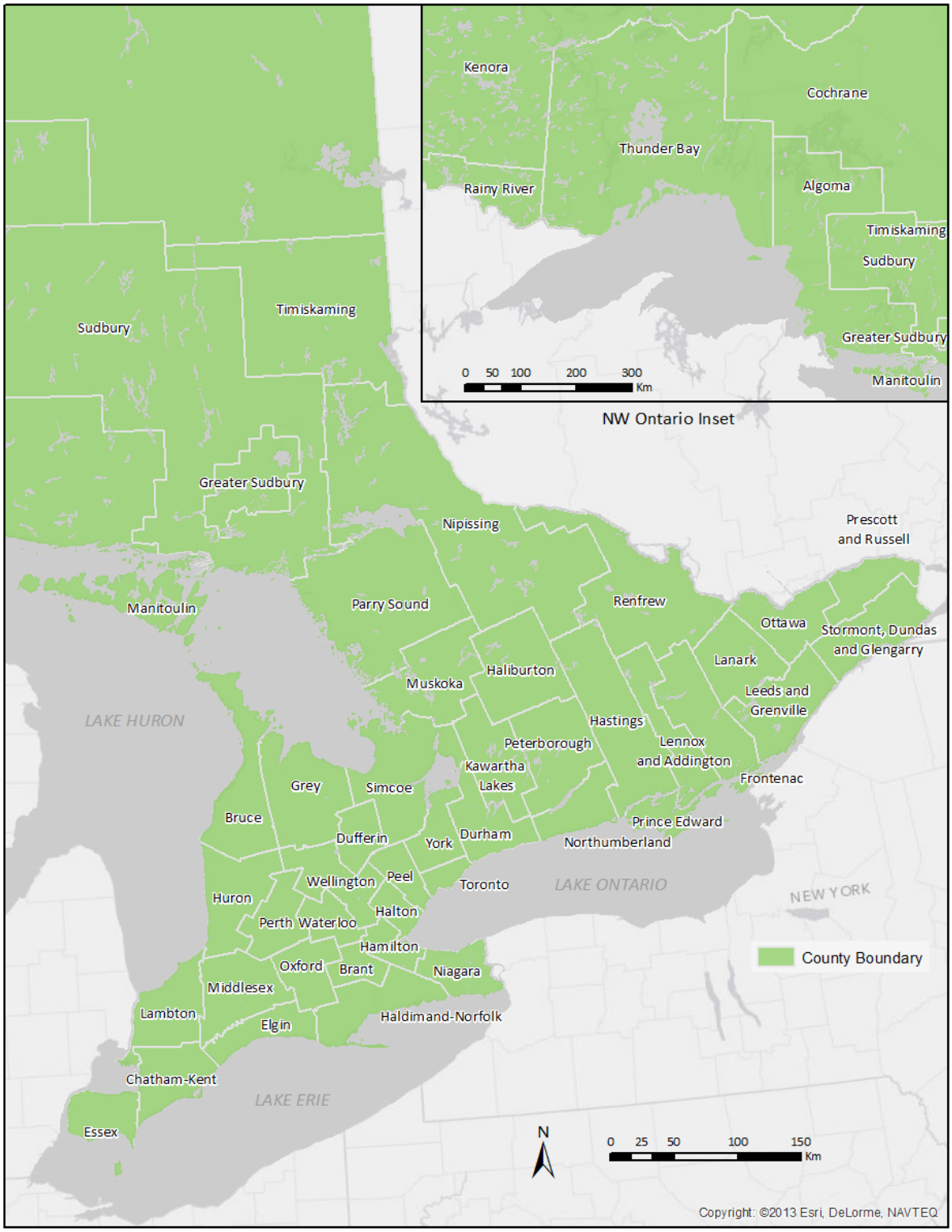
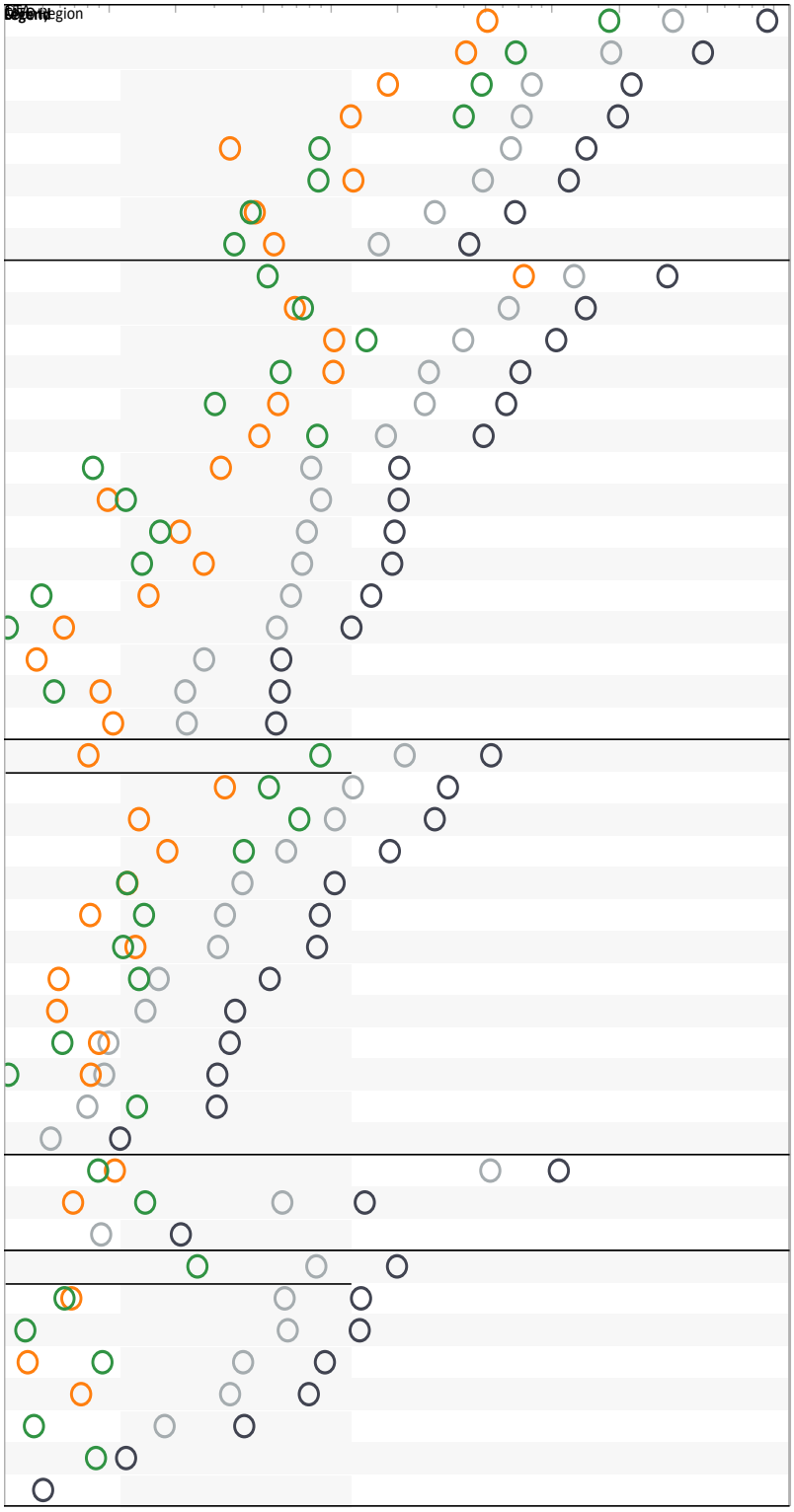


Table A.7-1: Percentage Increases in Labour Force by County and Five Year Period

-11.40%

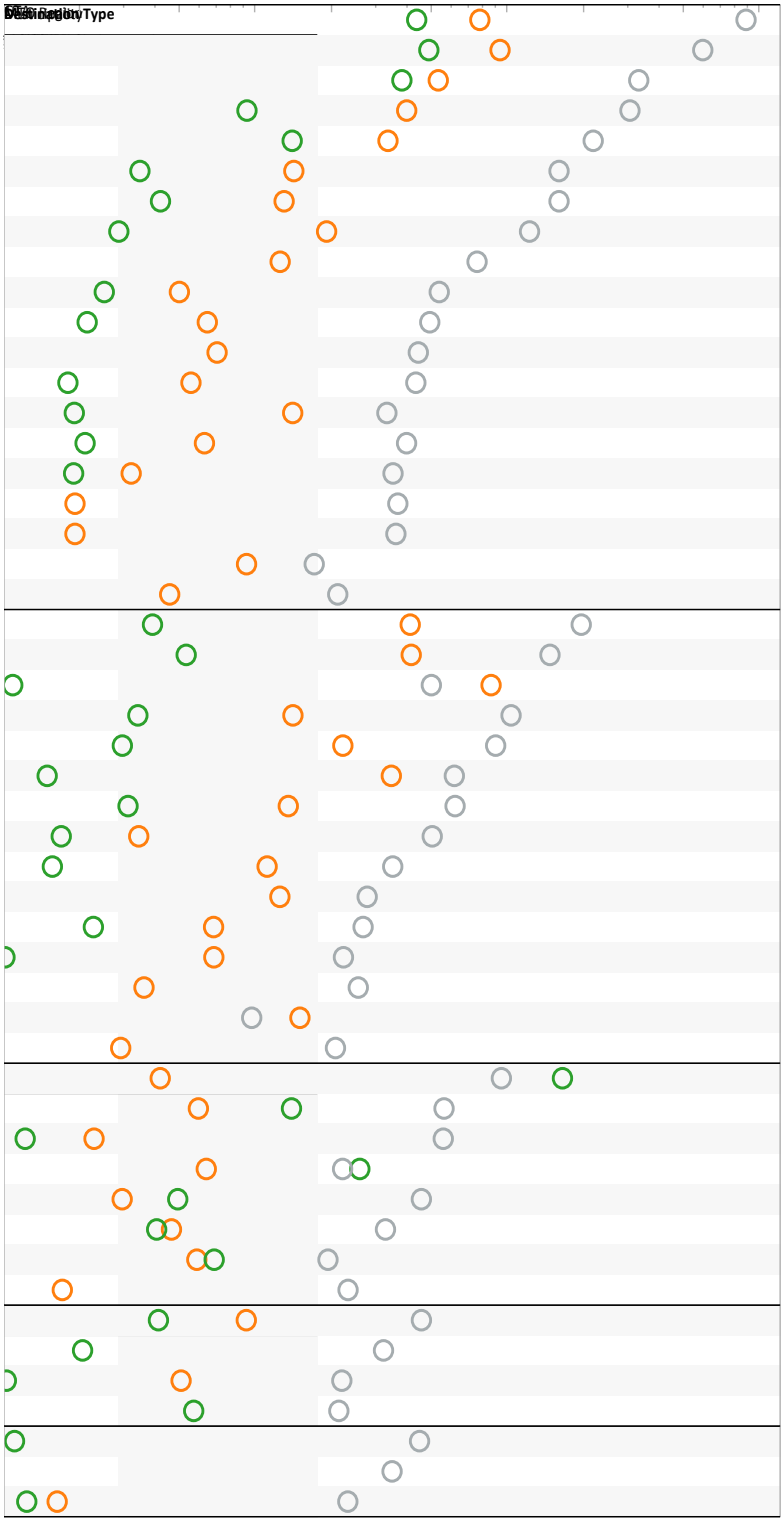
5.54%	1.05%	-4.40%	7.24%	1.85%	4.10%
27.48%	25.11%	9.92%	18.42%	15.42%	9.21%
46.58%	48.02%	10.63%	27.11%	23.20%	13.97%
22.50%	28.94%	7.09%	14.61%	12.26%	7.67%
5.04%	8.02%	-2.01%	6.94%	6.19%	0.99%
4.83%	7.51%	-1.11%	5.17%	7.43%	-2.11%
12.57%	18.76%	4.69%	11.09%	17.25%	12.76%
12.09%	25.61%	8.98%	18.51%	16.21%	3.32%
12.11%	16.82%	3.98%	11.34%	10.80%	4.09%
8.28%	13.40%	-0.85%	5.32%	6.90%	1.72%
8.78%	3.67%	7.06%	9.56%	4.22%	-8.45%
12.58%	18.42%	5.55%	12.12%	8.92%	2.63%
5.74%	5.28%	-3.90%	0.42%	4.33%	-7.85%
4.41%	7.49%	0.26%	8.00%	8.81%	4.88%
6.93%	5.22%	-3.15%	0.21%	3.02%	-11.40%
4.92%	12.06%	1.10%	5.93%	4.56%	-2.04%
2.49%	11.64%	3.00%	4.42%	6.99%	0.52%
4.96%	16.00%	2.83%	2.59%	7.17%	-1.63%
5.09%	9.56%	2.57%	3.98%	8.86%	-2.69%
4.60%	7.91%	3.37%	5.72%	2.54%	-0.14%
0.89%	19.06%	-0.06%	-0.24%	5.00%	-1.82%
6.10%	8.69%	0.41%	4.53%	1.10%	-1.81%
13.08%	29.39%	10.59%	14.33%	9.77%	2.52%
16.05%	13.22%	0.23%	9.20%	5.59%	9.18%
11.23%	13.96%	-0.03%	2.60%	5.15%	4.85%
5.82%	13.66%	-0.26%	4.85%	10.90%	-2.07%
6.03%	8.71%	-3.64%	9.32%	7.02%	0.52%
6.78%	8.69%	-1.00%	-0.10%	2.69%	0.41%
9.51%	7.31%	4.34%	0.00%	5.32%	-0.63%
7.19%	4.58%	3.26%	-1.09%	5.90%	4.31%
10.27%	20.01%	0.21%	-4.48%	6.61%	1.95%
17.93%	25.31%	7.92%	9.34%	7.07%	8.82%
11.30%	27.39%	1.62%	7.07%	12.66%	-4.35%
14.39%	10.44%	8.37%	5.93%	6.14%	3.30%
11.41%	10.42%	1.76%	2.65%	4.48%	1.96%
4.84%	9.04%	3.89%	-3.71%	6.35%	-5.41%
3.97%	4.13%	-3.33%	-4.19%	0.06%	-4.07%
0.20%	13.55%	-1.81%	-4.69%	5.32%	2.52%
-0.44%	-3.83%	-5.05%	-5.26%	1.83%	-1.53%
2.98%	2.78%	-1.45%	-6.99%	-0.84%	-3.35%
3.01%	10.11%	-2.55%	-1.34%	5.68%	1.59%
1.03%	9.20%	5.40%	0.36%	2.91%	-10.91%
9.75%	24.33%	2.50%	7.05%	15.57%	-3.60%
7.92%	18.14%	3.34%	2.70%	4.75%	1.98%
3.72%	-0.43%	-4.31%	-7.93%	-0.31%	-3.48%
2.86%	10.64%	-8.21%	-9.45%	-4.91%	0.50%
8.10%	1.21%	1.55%	-4.80%	0.23%	-10.29%
10.27%	11.94%	1.38%	8.95%	8.22%	4.22%

Figure A.7-5: County Freight Shipment Originations by Destination Type and MTO Region



Source: Statistics Canada, Trucking Commodity Origin-Destination Survey, 2010

Figure A.7-6: Municipal Freight Trip Originations by Destination Type and MTO Region



Source: Ontario Ministry of Transportation, MTO Commercial Vehicle Survey, 2006

Table A.7-2: Trips for Selected Counties by Commodity and End-Facility Type

		End Facility Type						
County	Commodity Type	Truck Terminal	Warehouse/ Distribution Centre	Manufacturer	Commercial	Residential	Primary Producer	Other Terminal
Peel	Empty	1,940	817	547	212	294	26	92
	Finished Goods	1,343	902	639	243	121	6	81
	Primary	289	255	358	124	352	7	33
	Agriculture	331	641	115	381	13	11	40
	Waste and scrap	38	26	16	3	110	1	3
	Mail	41	41		13			18
	Total	**3,982**	**2,681**	**1,675**	**976**	**891**	**52**	**267**
Hamilton	Empty	731	252	465	160	323	127	52
	Finished Goods	101	147	119	155	60	3	14
	Primary	49	99	202	63	104	8	8
	Agriculture	53	108	56	185	15	14	3
	Waste and scrap	41	17	33	9	148	4	
	Mail	15	16		12			17
	Total	**990**	**638**	**874**	**585**	**650**	**156**	**94**
Durham	Empty	498	227	162	163	335	77	7
	Finished Goods	145	140	381	170	80	0	
	Primary	41	64	101	80	128	8	4
	Agriculture	25	68	6	215	2	2	
	Waste and scrap	21	1	11		154	1	
	Mail	6	13		14	6		
	Total	**735**	**513**	**660**	**642**	**705**	**88**	**11**
Niagara	Empty	494	210	280	128	226	103	5
	Finished Goods	104	116	206	167	70	1	3
	Primary	65	67	122	68	56	11	1
	Agriculture	35	75	30	223	5	8	2
	Waste and scrap	17	19	26	3	70	3	
	Mail	8	7	0	4	0	0	
	Total	**723**	**494**	**664**	**593**	**428**	**126**	**10**
Ottawa	Empty	477	248	54	178	194	29	7
	Finished Goods	143	173	41	280	69		5
	Primary	46	47	45	94	79	9	2
	Agriculture	38	169	16	204	5	1	7
	Waste and scrap	8	6	1	6	87	0	
	Mail	5	20		18			1
	Total	**718**	**663**	**157**	**780**	**433**	**38**	**22**
Essex	Empty	494	63	299	37	90	24	9
	Finished Goods	389	151	394	62	28	6	19
	Primary	70	48	142	20	19	17	
	Agriculture	12	32	24	61	0	2	
	Waste and scrap	0	1	8		1		
	Mail	1	13		4			
	Total	**966**	**308**	**867**	**184**	**138**	**49**	**28**
Middlesex	Empty	430	101	177	67	120	13	3
	Finished Goods	256	165	165	120	42	1	3
	Primary	62	48	87	56	24	2	
	Agriculture	39	88	21	129	4	12	
	Waste and scrap	22	5	2	2	19	0	
	Mail	9	13		9			
	Total	**818**	**421**	**452**	**383**	**209**	**27**	**6**
Greater Sudbury	Empty	57	45	14	45	15	13	
	Finished Goods	39	14	10	59	13	9	
	Primary	12	11	17	28	14	5	
	Agriculture	12	26	7	28	1		
	Waste and scrap	1		5		11	0	
	Mail	3	5		0			
	Total	**124**	**101**	**53**	**160**	**53**	**28**	
Grand Total		**9,057**	**5,820**	**5,402**	**4,302**	**3,507**	**564**	**439**

Figure A.7-7: Estimated Trucking Employment Job Type, Region and County (2011)

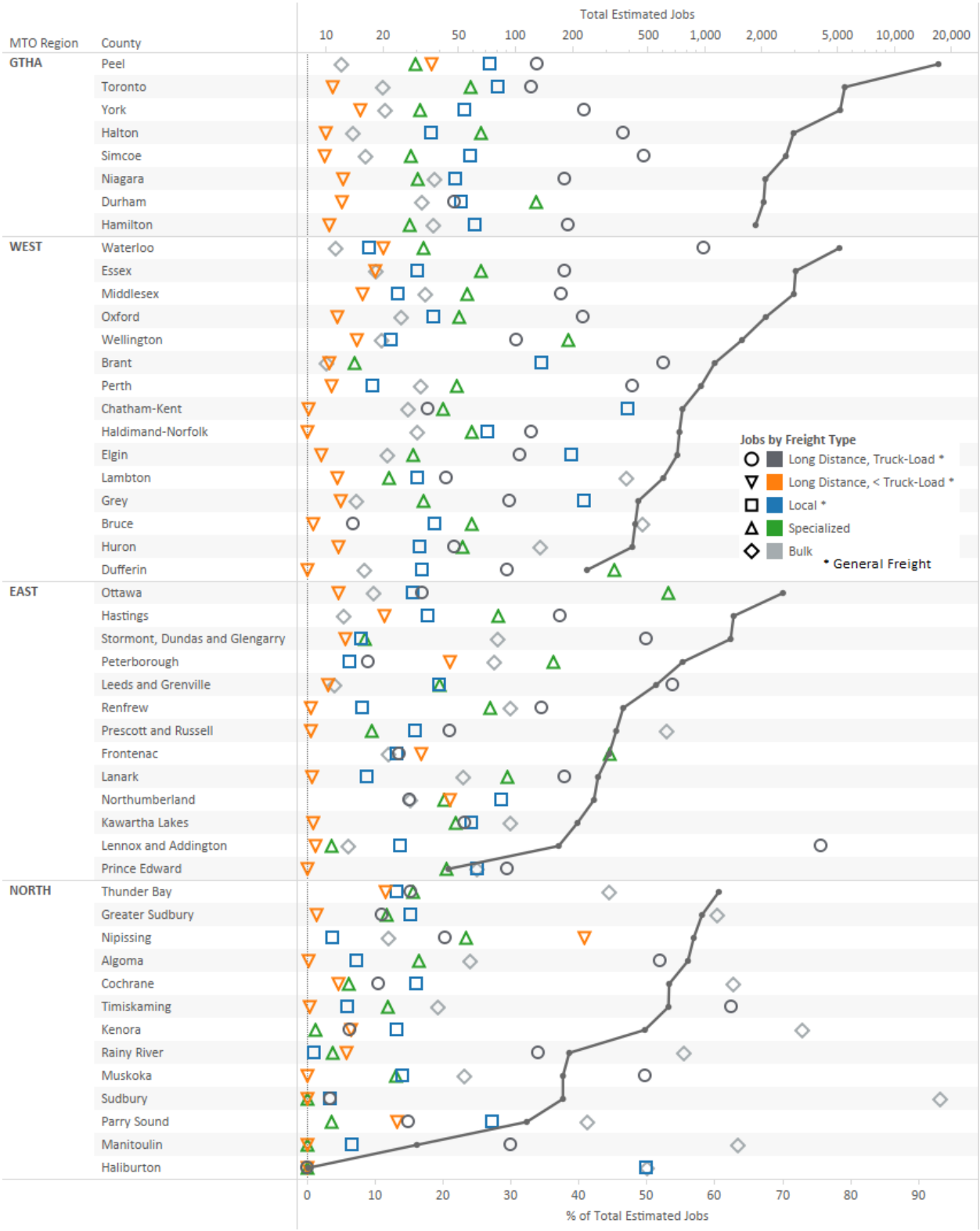


Figure A.7-8: Sub-Municipal Trip Generation (Filtered Prior to Aggregation)

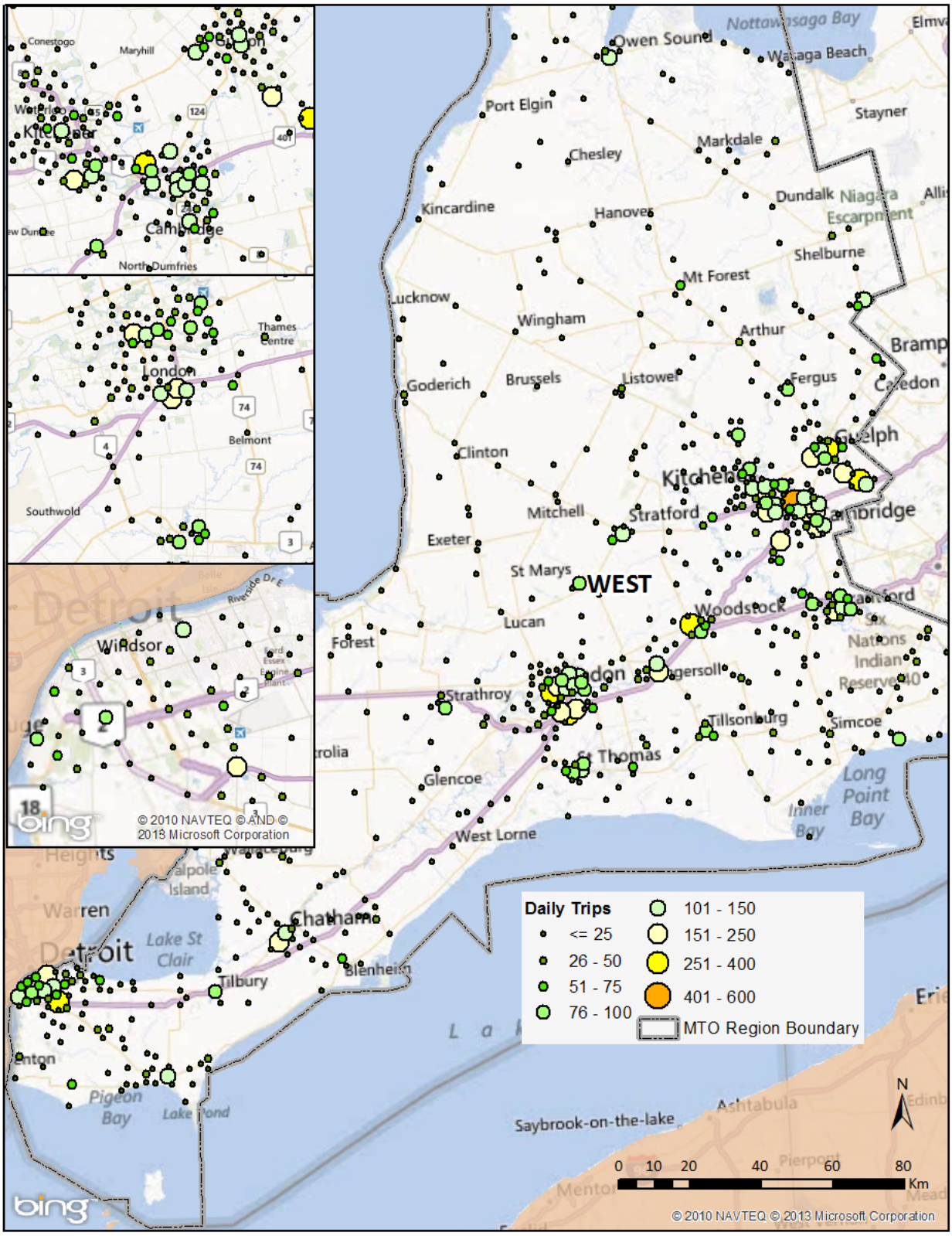
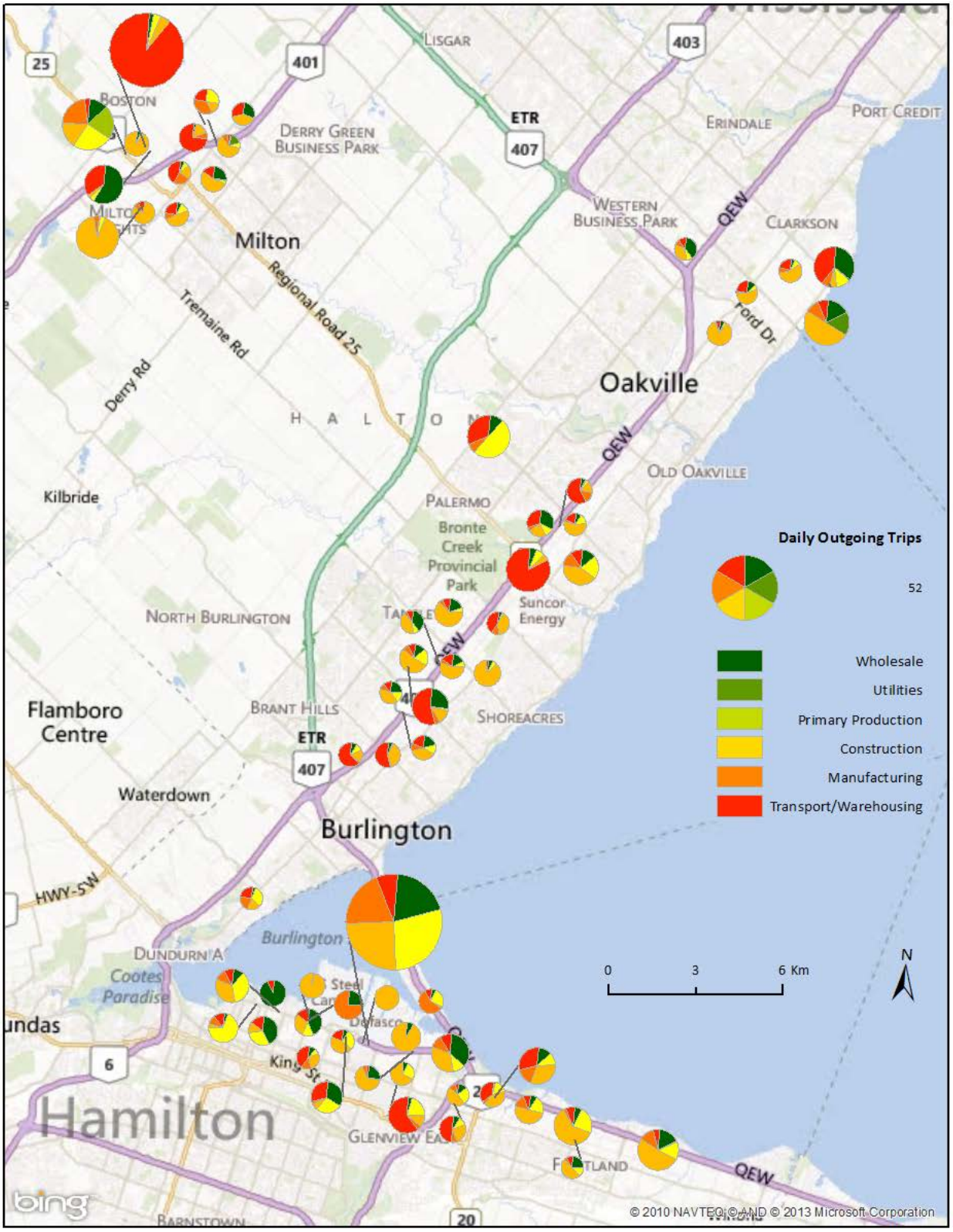


Figure A.7-9: CVS Trip Generators in GTA Region (Halton and Hamilton)



8.0 REFERENCES

Allen, J., Browne M., & Cherrett, T. (2012). Survey Techniques in Urban Freight Transport Studies. Transport Reviews, 32(3), 287-311.

Bryan, J., Weisbrod, G, & Martland, C. (2007). Rail Freight Solutions to Roadway Congestion. NCHRP Report 586. Washington, DC: Transportation Research Board.

Cairncross, F. (1997). The Death of Distance: How the Communications Revolution Will Change Our Lives. London: Orion Publishing Group Ltd.

Cidell, J. (2010). Concentration and Decentralisation: The New Geography of Freight Distribution in US Metropolitan Areas. Journal of Transport Geography , 18 (3), 363-371.

Cidell, J. (2011). Distribution Centers Among the Rooftops: The Global Logistics Network Meets the Suburban Spatial Imaginary. International Journal of Urban and Regional Research , 35 (4), 832-851.

Dablanc, L., & Ross, C. (2012). Atlanta: A Mega Logistics Center in the Piedmont Atlantic Megaregion (PAM). Journal of Transport Geography , 24, 432-442.

Donald, B. (2002). Spinning Toronto's Golden Age: The Making of a 'City that Worked'. Environment and Planning A, 34, 2127-2154.

Ferguson, M. R., & Lavery, T. A. (2012). Seaway Under-Utilization: Are Regulations to Blame? Hamilton, ON: McMaster Institute for Transportation and Logistics.

Gagnon, F. and Cook, K. (2007). Collecting Electronic Data from the Carriers: The Key to Success in the Canadian Trucking Commodity Origin and Destination Survey. Paper presented at the ICES-III Conference, Montreal, June 18-21.

Glaeser, E., & Kohlhase, J. (2004). Cities, Regions and the Decline of Transport Costs. Papers in Regional Science , 83, 197-228.

Guerrero, D., & Proulhac, L. (2012). Freight Flows and Urban Hierarchy: Some Evidence from France. World Conference on Transportation Research.

Hall, P., & Hesse, M. (2013). Reconciling Cities and Flows in Geography and Regional Studies. In P. V. Hall, & M. Hesse (Eds.), Cities, Regions and Flows (pp. 3-20). New York: Routledge.

Hall, P., Hesse, M., & Rodrigue, J. P. (2006). Re-exploring the Interface between Economic and Transport Geography. Guest Editorial. Environment and Planning A , 38, 1401-1408.

Hesse, M. (2004). Land for Logistics: Locational Dynamics, Real Estate Markets, and Political Regulation of Regional Distribution Complexes. Tijdschrift voor Economische en Sociale Geografie , 95 (2), 162-173.

Higgins, C. D., & Ferguson, M. R. (2011). An Exploration of the Freight Village Concept and its Applicability to Ontario. Hamilton, ON: McMaster Institute for Transportation and Logistics.

McCabe, S., Kwan, H, and Roorda, M. (2007). Comparing GPS and Non-GPS Survey Methods for Collecting Urban Goods and Service Movements. University of Toronto, Centre for Urban Freight Analysis.

MTO. (2012). Building Competitiveness: A Proposed Multimodal Goods Movement Strategy for Ontario. Transportation Policy Branch. Toronto: Ministry of Transportation of Ontario.

Rietveld, P., & Vickerman, R. (2004). Transport in Regional Science: The "Death of Distance" is Premature. Papers in Regional Science , 83, 229-248.

Rodrigue, J. P. (2004). Freight, Gateways and Mega-Urban Regions: The Logistical Integration of the BostWash Corridor. Tijdschrift voor Economische en Sociale Geografie , 95 (2), 147-161.

Rodrigue, J. P. (2013). Supply Chain Management, Logistics Changes and the Concept of Friction. In P. Hall, & M. Hesse (Eds.), Cities, Regions and Flows (pp. 58-74). New York: Routledge.

Ross, C. L. (2009). Introduction. In C. L. Ross (Ed.), Megaregions: Planning for Global Competitiveness (pp. 11-17). Washington, DC: Island Press.

Ross, C. L., & Woo, M. (2009). Identifying Megaregions in the United States: Implications for Infrastructure Investment. In Megaregions: Planning for Global Competitiveness (pp. 53-82). Washington, DC: Island Press.

Sheffi, Y. (2012). Logistics Clusters: Delivering Value and Driving Growth. Cambridge: MIT Press.

Transport Canada. (2010). Assessment of Access to Intermodal Terminals and Distribution/Transload Facilities in the Province of Ontario: Identification of the Clusters and Facilities. Ontario-Quebec Continental Gateway Initiative.

Transport Canada. (2005). Operating Costs of Trucks in Canada, 2005. File Number T8080-05-0242. Ottawa, ON: Transport Canada.

USDOT. (2010). 2007 Commodity Flow Survey. US Department of Transportation. Washington, DC: US Government Printing Office.

Woudsma, C. (2012). Freight, Land and Local Economic Development. In P. V. Hall, & M. Hesse (Eds.), Cities, Regions and Flows (pp. 226-244). New York: Routledge.

Woudsma, C., Jensen, J. F., Kanaroglou, P., & Maoh, H. (2008). Logistics Land Use and the City: A Spatial-Temporal Modeling Approach. Transportation Research Part E , 44, 277-297.