

Logistics Sprawl: Spatial Patterns and Characteristics of New Warehousing Establishments in the Greater Toronto and Hamilton Area

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Presentation Outline

1. Phenomenon of Logistics Sprawl
2. Datasets Used
3. Methodology
4. Results on Warehousing Sprawl in the GTHA
5. Characteristics of New Warehousing Establishments
6. Spatial Relationships within Multi-Establishment Firms
7. Conclusions and Future Research

1. Logistics Sprawl

- Spatial de-concentration of logistics facilities from urban to sub-urban areas (Dablanc & Rakotonarivo, 2010; Dablanc & Ross, 2012)
- Observed in Atlanta, Los Angeles, Paris, Tokyo, Toronto and Zurich (Dablanc & Ross, 2012; Dablanc et al., 2014b; Heitz & Dablanc, 2015; Sakai et al., 2016; Woudsma et al., 2016; Todesco et al., 2016)

1.1 Reasons for Sub-Urbanization

- Firm's Business Strategy
- Land Availability and Affordability
- Proximity to Highways and Intermodal Terminals
- Proximity to Supply Chain
- Ability to Operate 24/7 hours
- Regulatory Environment and Zoning Laws

1.2 Implications of Location Changes

- Impact on Urban Freight Geography
- Increased contribution of freight to congestion
- Increased commercial VKT
- Additional GHG emissions
- Consumption of large tracts of land at the fringe

1.3 Study Motivation

- Logistics Establishments in GTA grew by 108% and Warehousing Establishments grew by 40% (Woudsma et al., 2016)
- Toronto (GGH) has the highest level of Logistics Sprawl (Dablanc, 2016)
- 89% of freight movement in the GTHA are by truck (Metrolinx, 2008)

1.4 Study Objective

- Identify new warehousing establishments
- Analyze spatial patterns of warehousing establishments
- Analyze phenomenon of “warehousing sprawl”
- Identify characteristics of new warehousing establishments
- Analyze spatial relationships within multi-establishment firms

2. Data Used

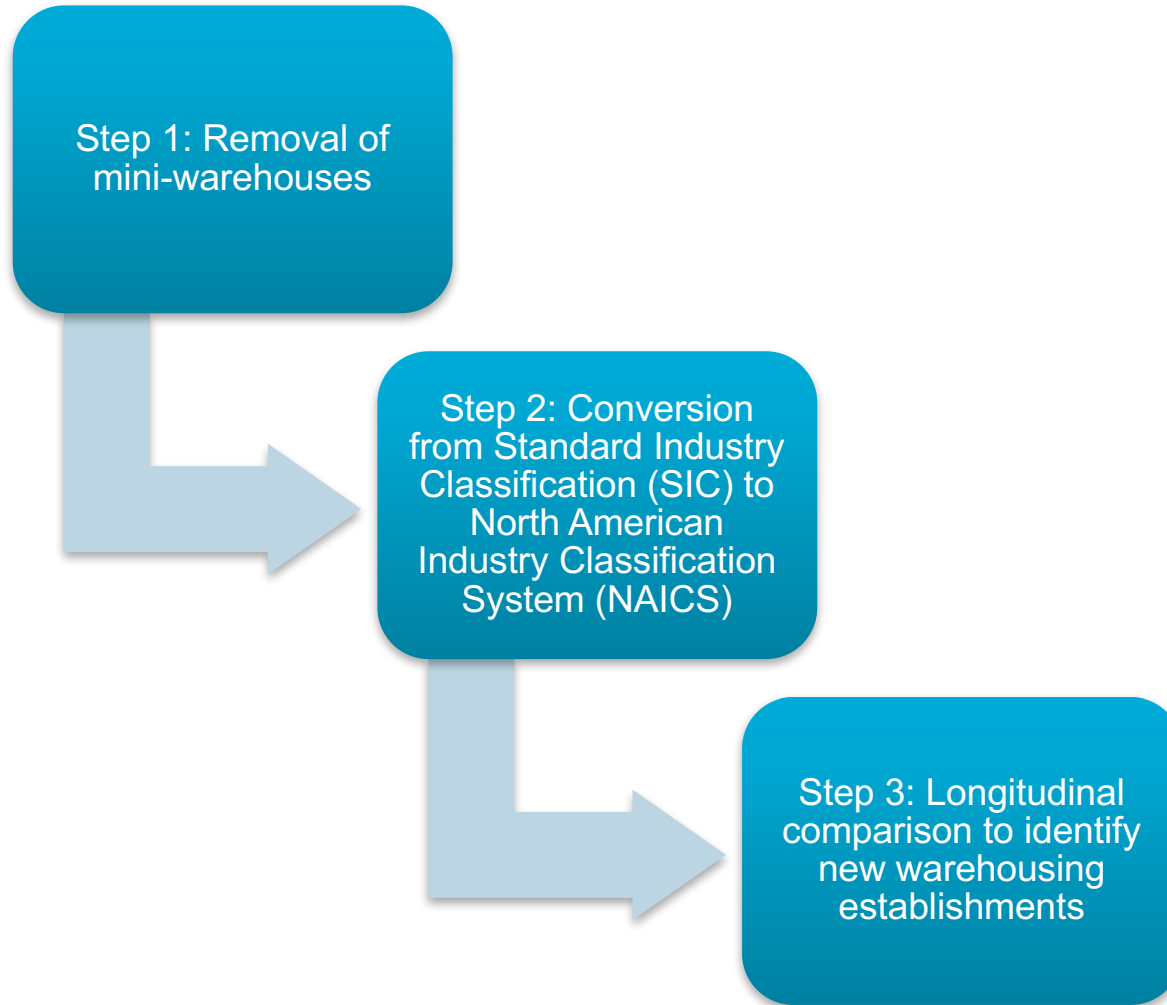
- DMTI Enhanced Points of Interest (EPOI)
- Teranet's Property Parcel dataset
- DMTI's transportation networks
- Google Maps
- InfoCanada Business Establishments dataset
- ESRI Business Analyst App

2.1 NAICS 493 establishments

- North American Industry Classification System
NAICS 493 Warehousing and Storage proxy for all logistics facilities (Dablanc et al., 2014)

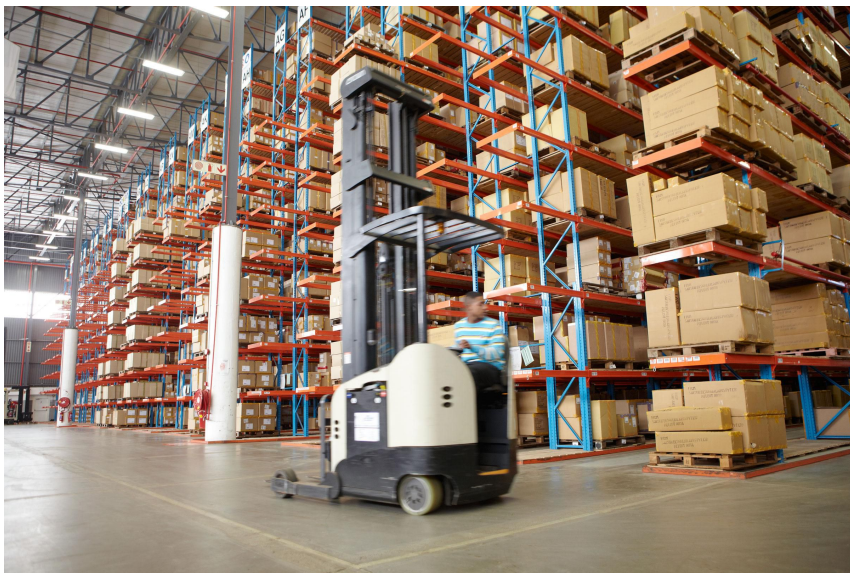
NAICS Sub-Category	Description
NAICS 49311	General Warehousing and Storage
NAICS 49312	Refrigerated Warehousing and Storage
NAICS 49313	Farm Product Warehousing and Storage
NAICS 49319	Other Warehousing and Storage

3.1 Methodology: Dataset Development



3.1.1 Removal of mini-warehouses

- About 50% of data wrongly classified
- NAICS 53113 Self-Storage Mini-Warehouses



Warehouse



Mini-Warehouse

3.1.2 Identification of new NAICS 493 establishments

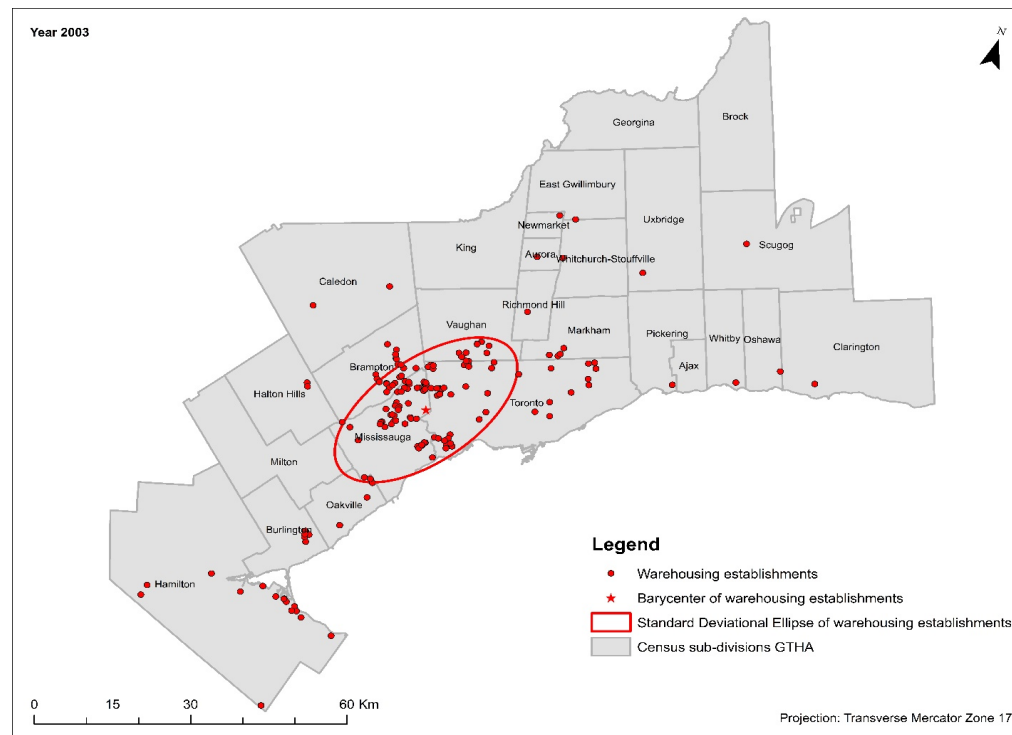
- **Appeared Establishments:** Present in year n but not in year $n-1$ or in the datasets of the years prior to year $n-1$.
- **Disappeared Establishments:** Present in year $n-1$ but not in year n or in the datasets of the years later than year n .
- **Relocated Establishments:** Present in both the years $n-1$ and n but has a different address.

3.2.1 Methodology: Centrographic Analysis

Step 1: Calculate the barycentre of establishments

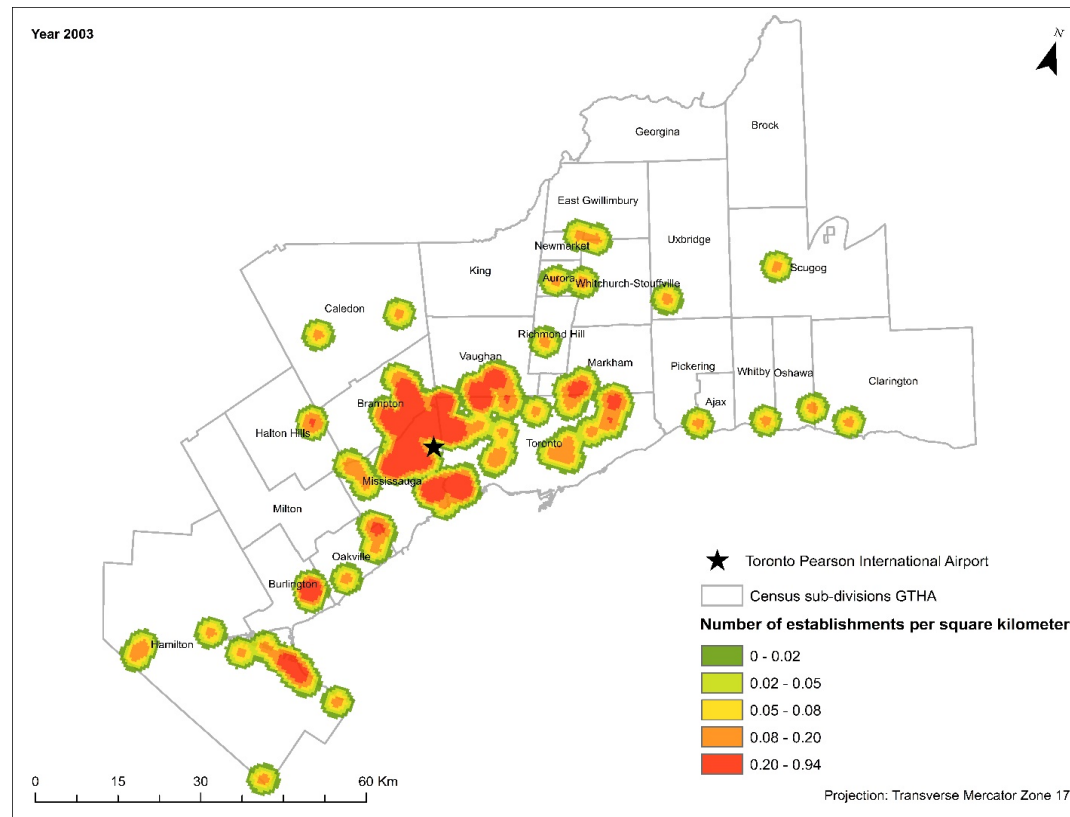
Step 2: Calculate average distance of all establishments from the barycentre

Step 3: Obtain the Standard Deviation Ellipse (SDE)

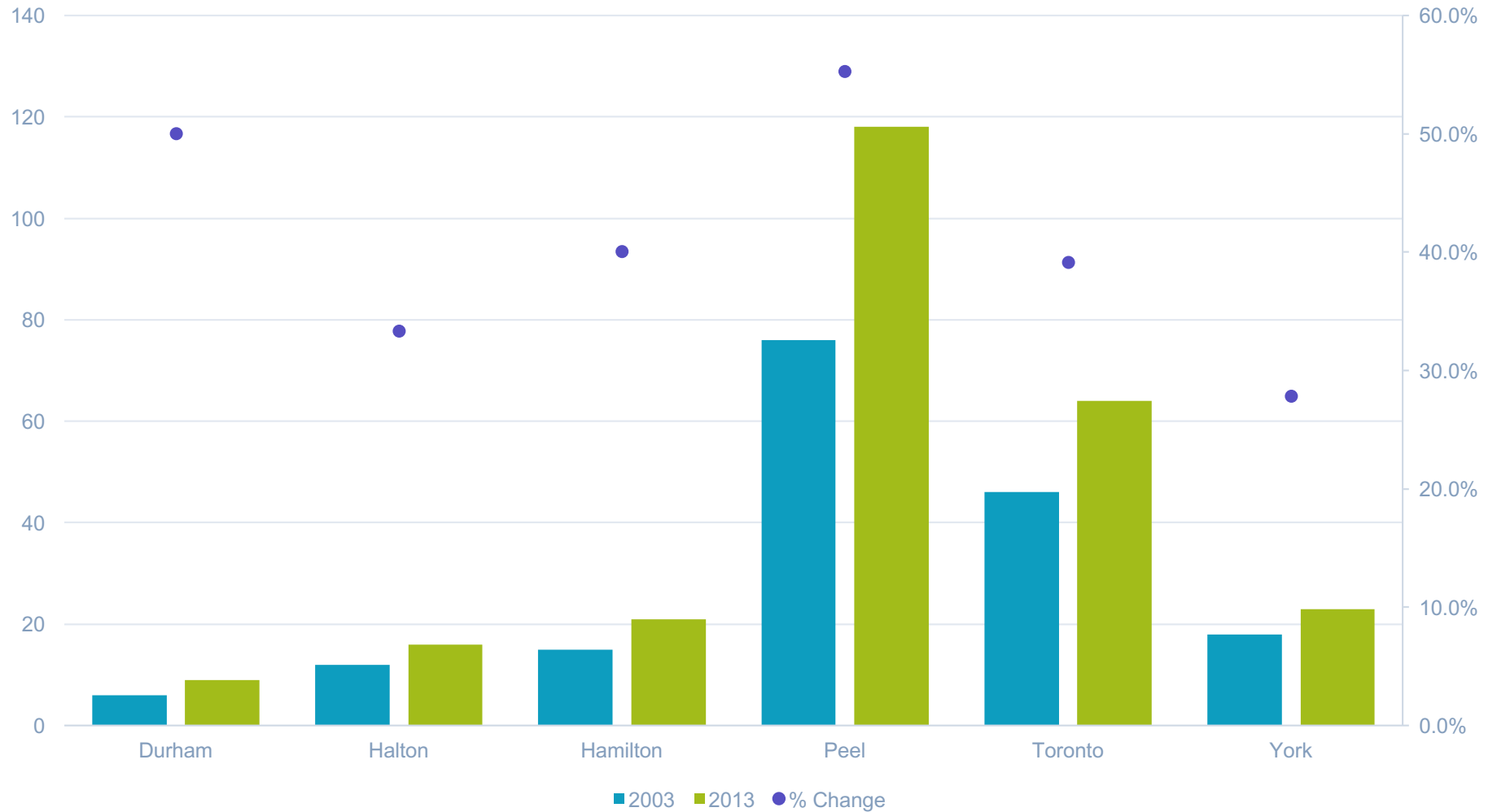


3.2.2 Methodology: Kernel Density Estimation

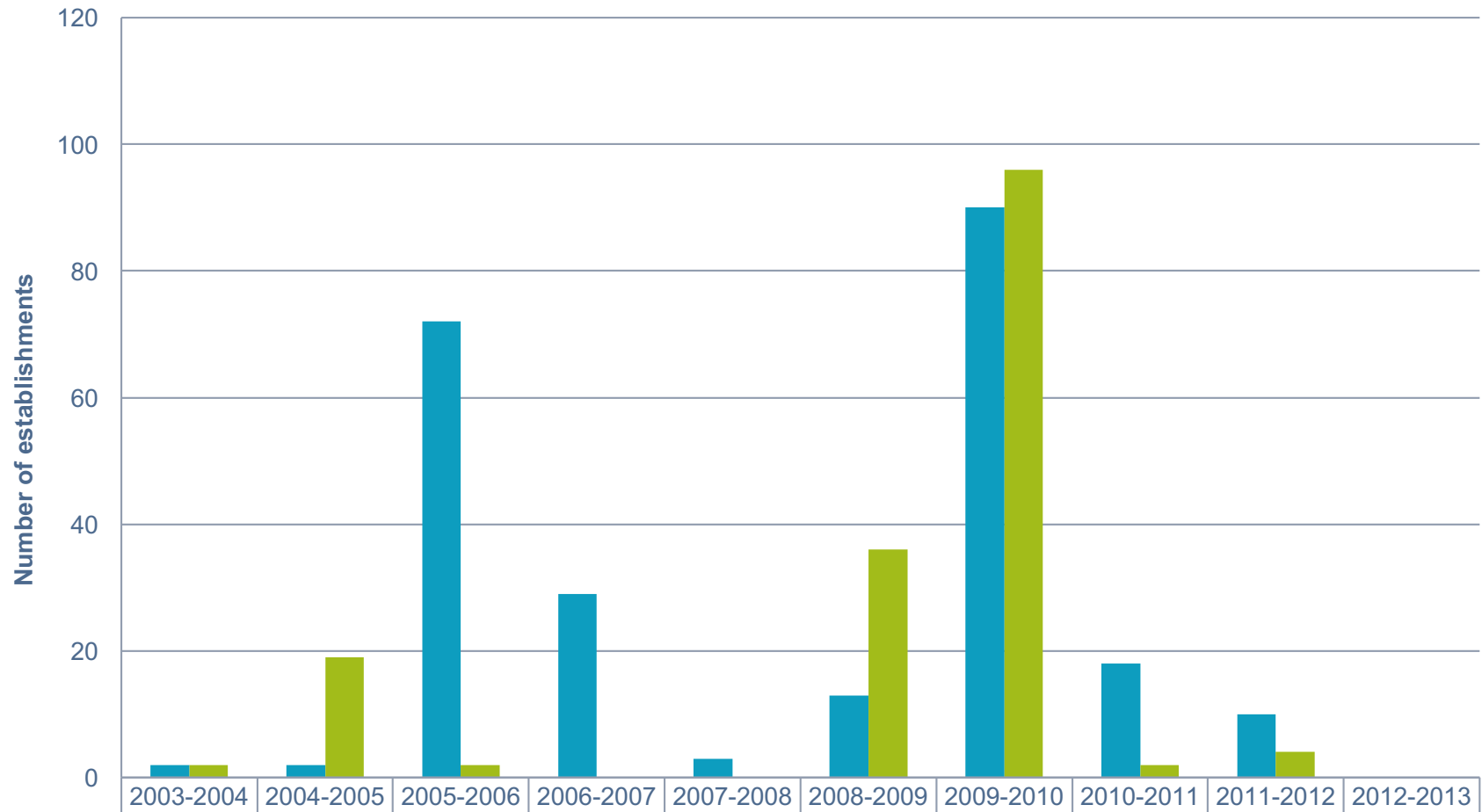
- Produces a smooth, continuous surface
- Each location is assigned a density value irrespective of arbitrary administrative boundaries



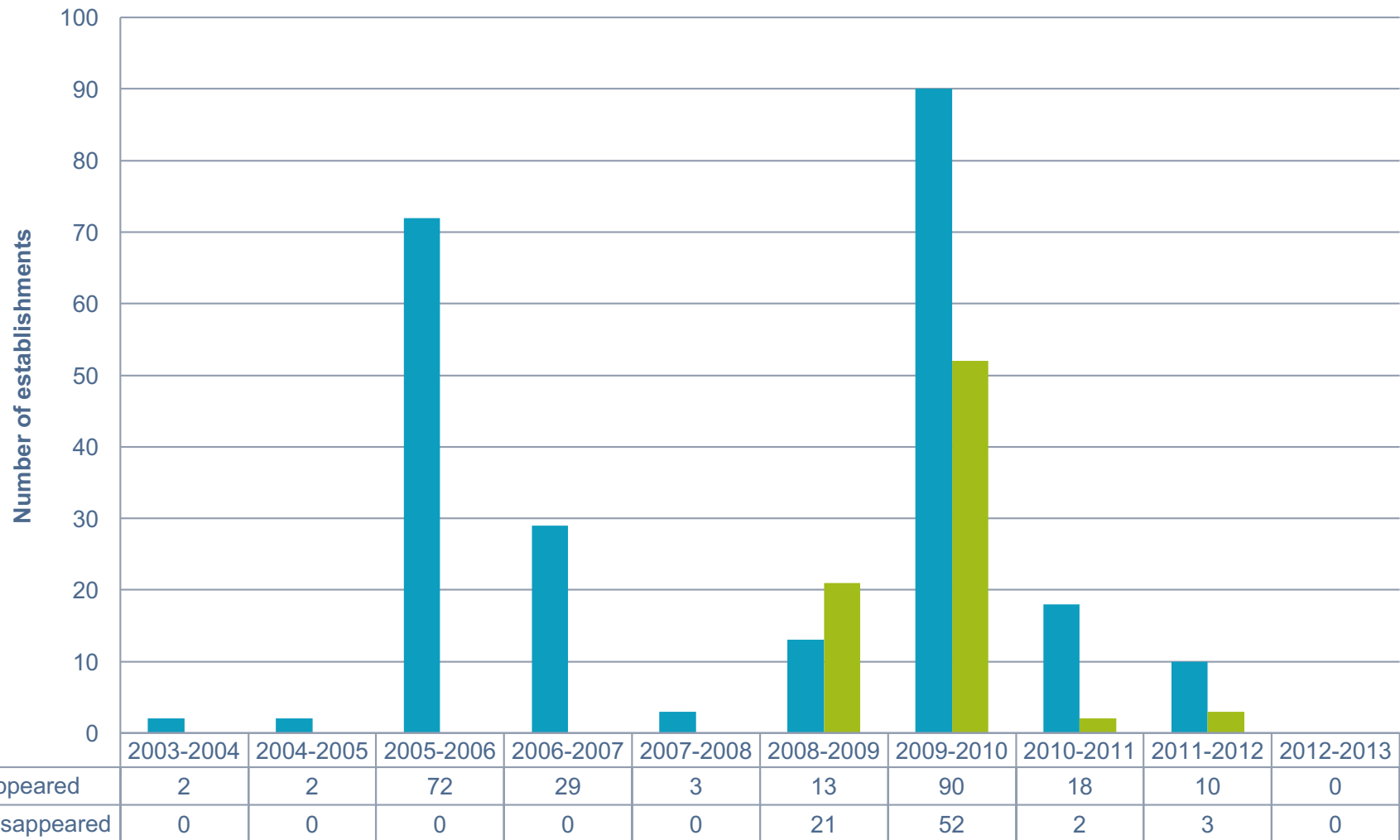
4. Results: Growth in NAICS 493



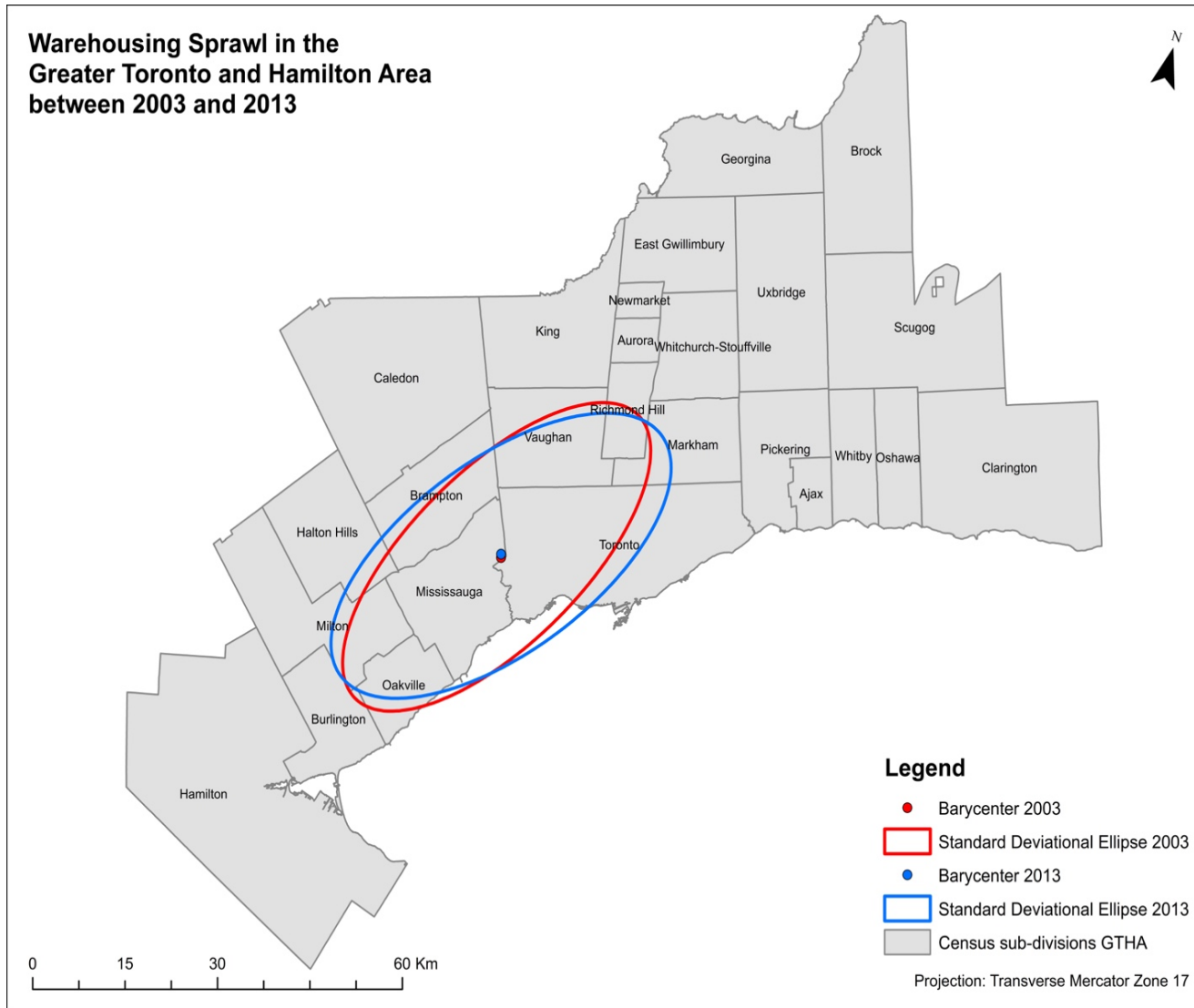
4.1 Appearances and Disappearances of NAICS 493



4.2 Appearances and Disappearances within new NAICS 493 established between 2003-2013



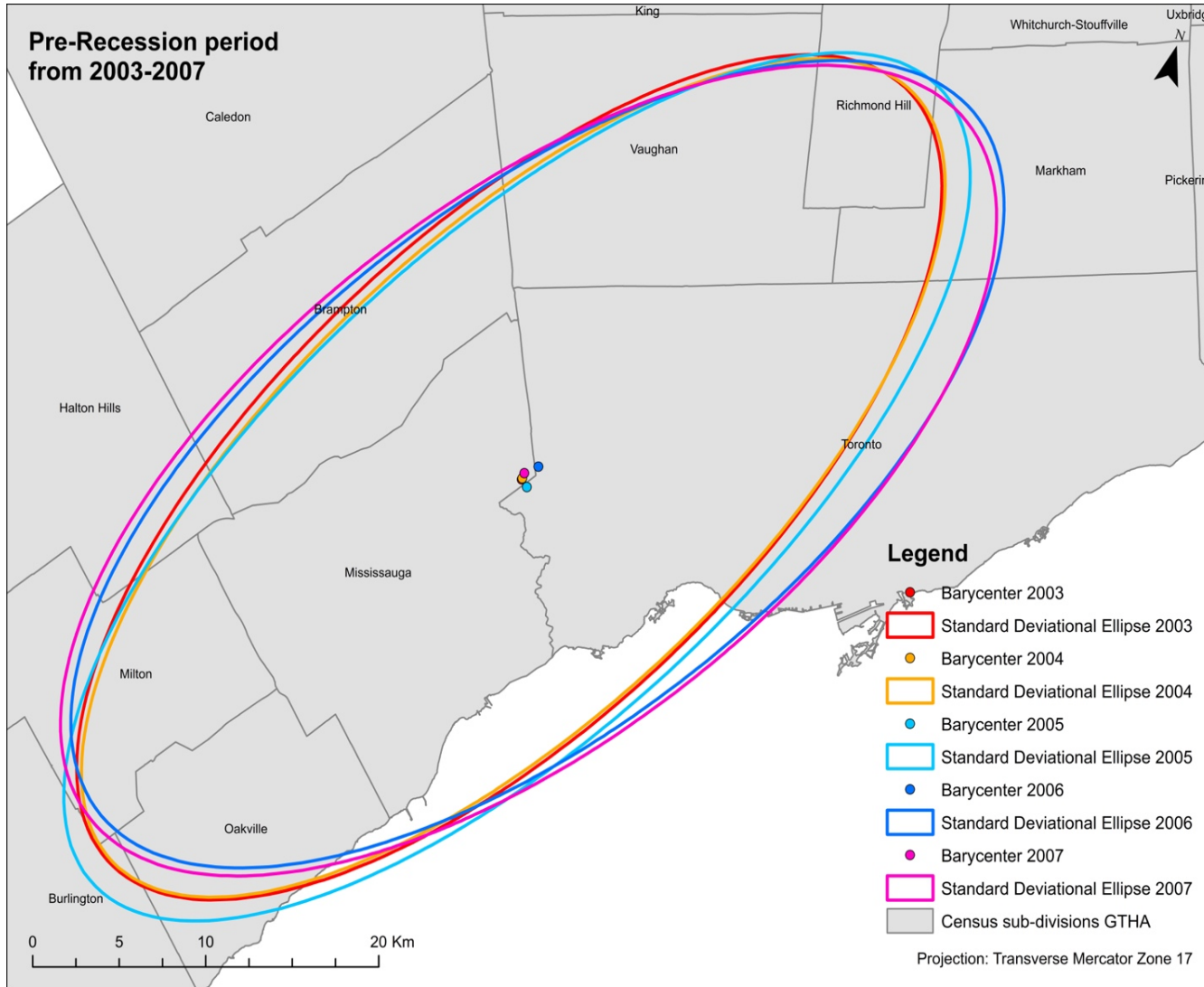
4.3 Results: Centrographic Analysis



Findings:

1. Area of the SDE increased by 10.5%
2. Average distance of the warehousing establishments from their Barycentre increased by 1.3 Km
3. Barycentre moved in the North-West direction

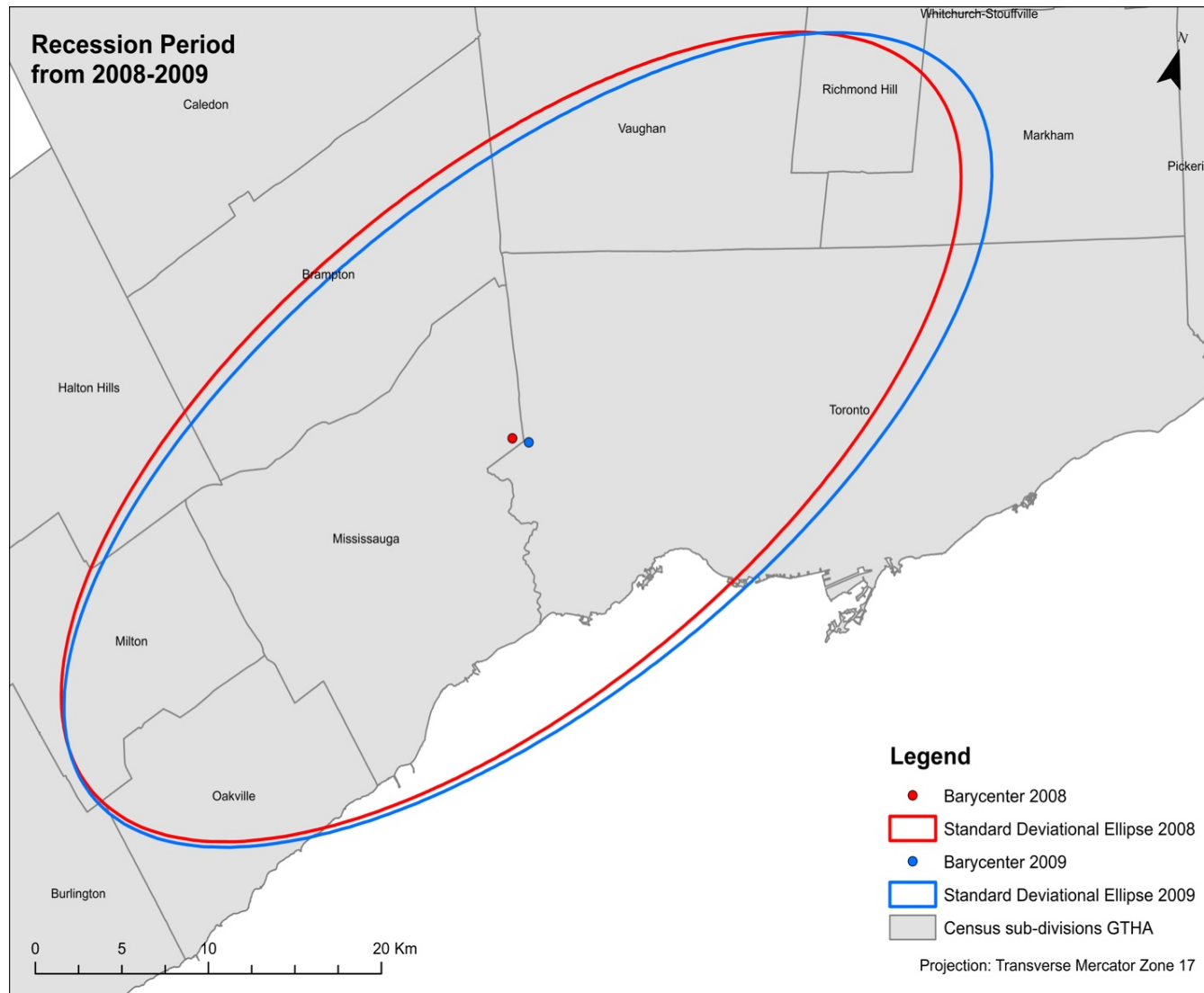
4.3.1 Pre-Recession Period (2003-2007)



Findings:

1. Area of the SDE increased by 11.4%
2. Average distance of warehousing establishments from their Barycentre increased by 0.74 Km

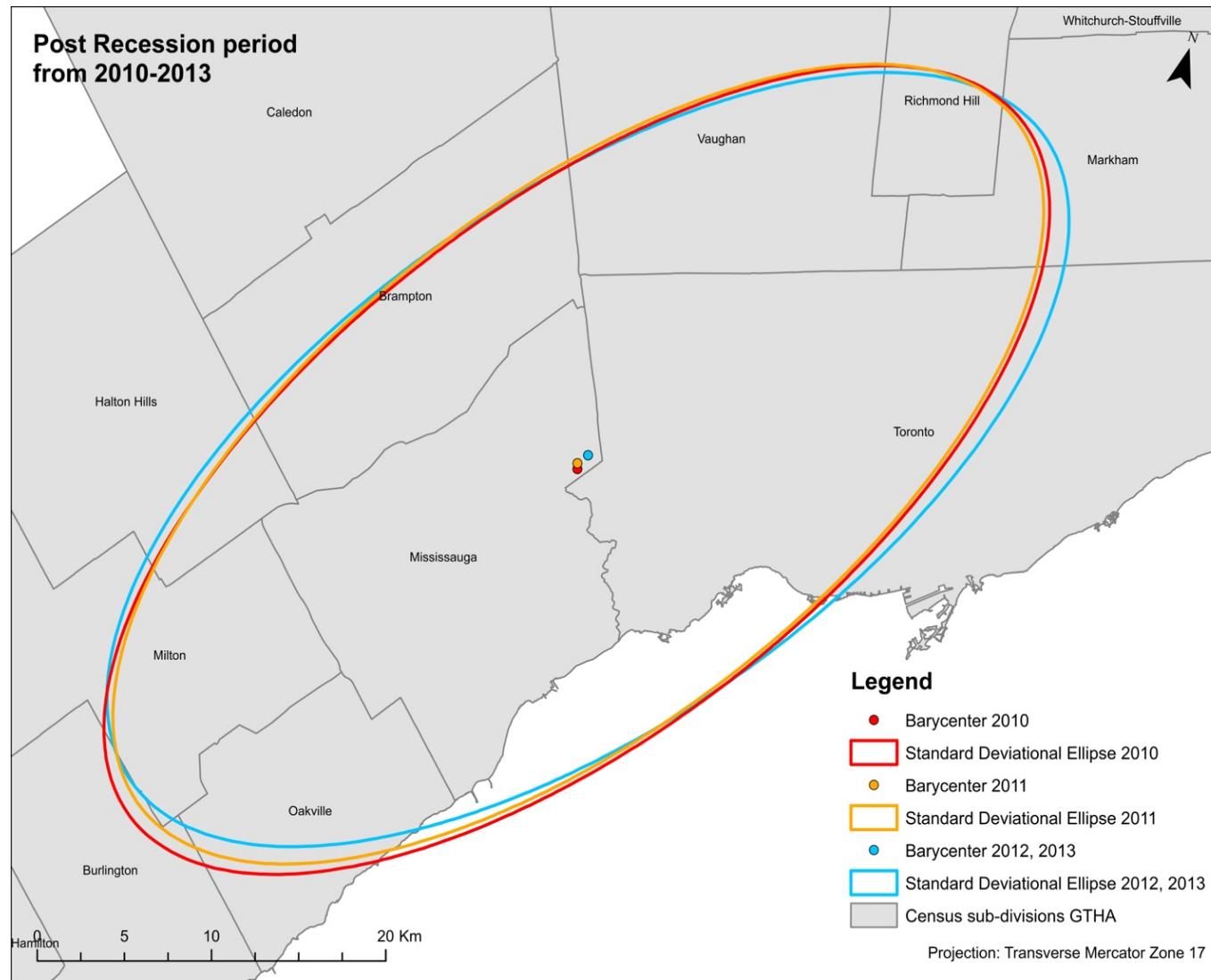
4.3.2 Recession Period (2008-2009)



Findings:

1. Area of the SDE increased slightly by 1.8%
2. Average distance of warehousing establishments from their Barycentre increased slightly by 0.28 Km

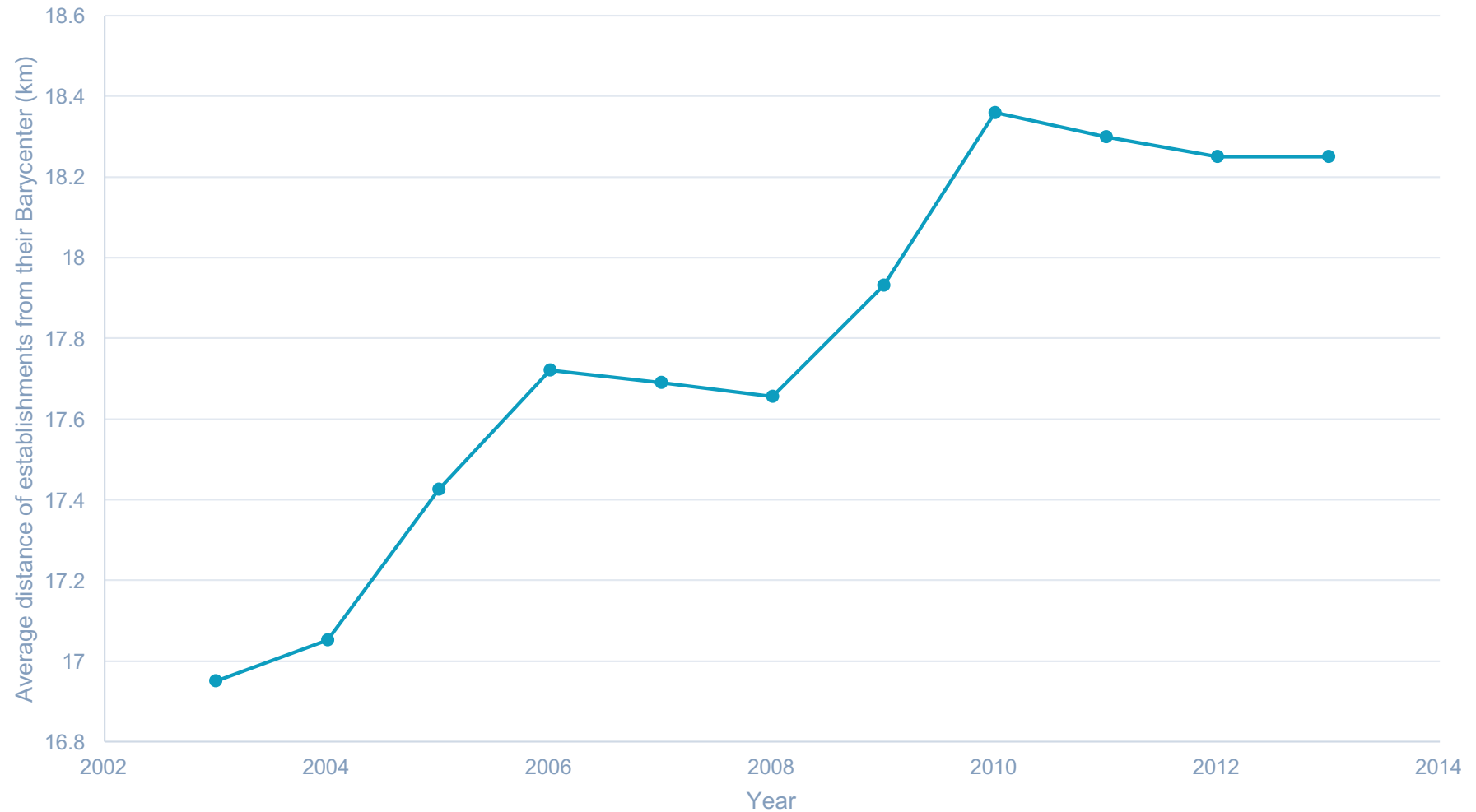
4.3.3 Post-Recession Period (2010-2013)



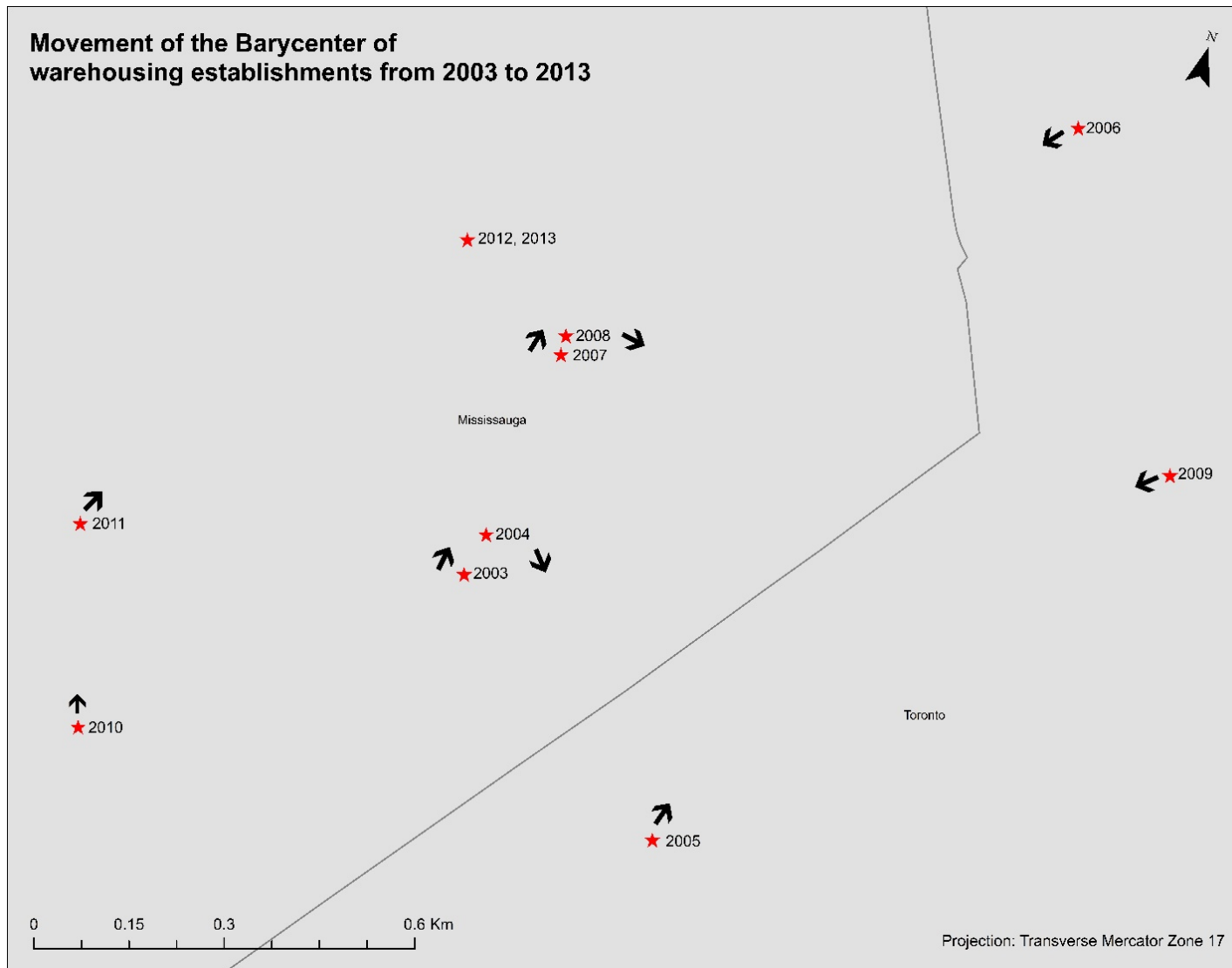
Findings:

1. Area of the SDE approx. remained same (reduction of 0.07%)
2. Average distance of warehousing establishments from their Barycentre decreased slightly by 0.11 Km

4.3.4 Average distance of establishments from their Barycentre



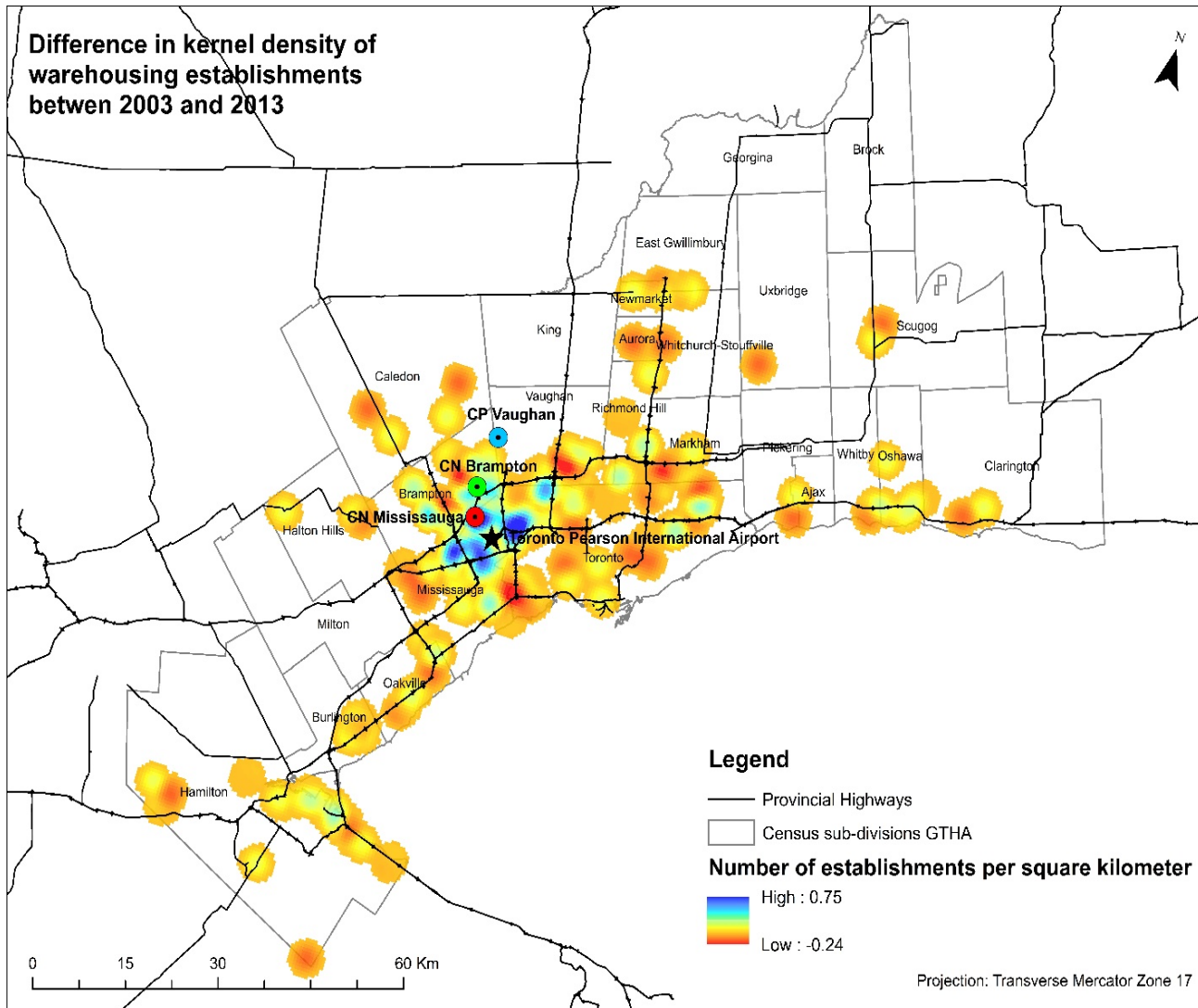
4.3.5 Movement of the Barycentre



Findings:

No clear pattern of movement of Barycentre in one direction

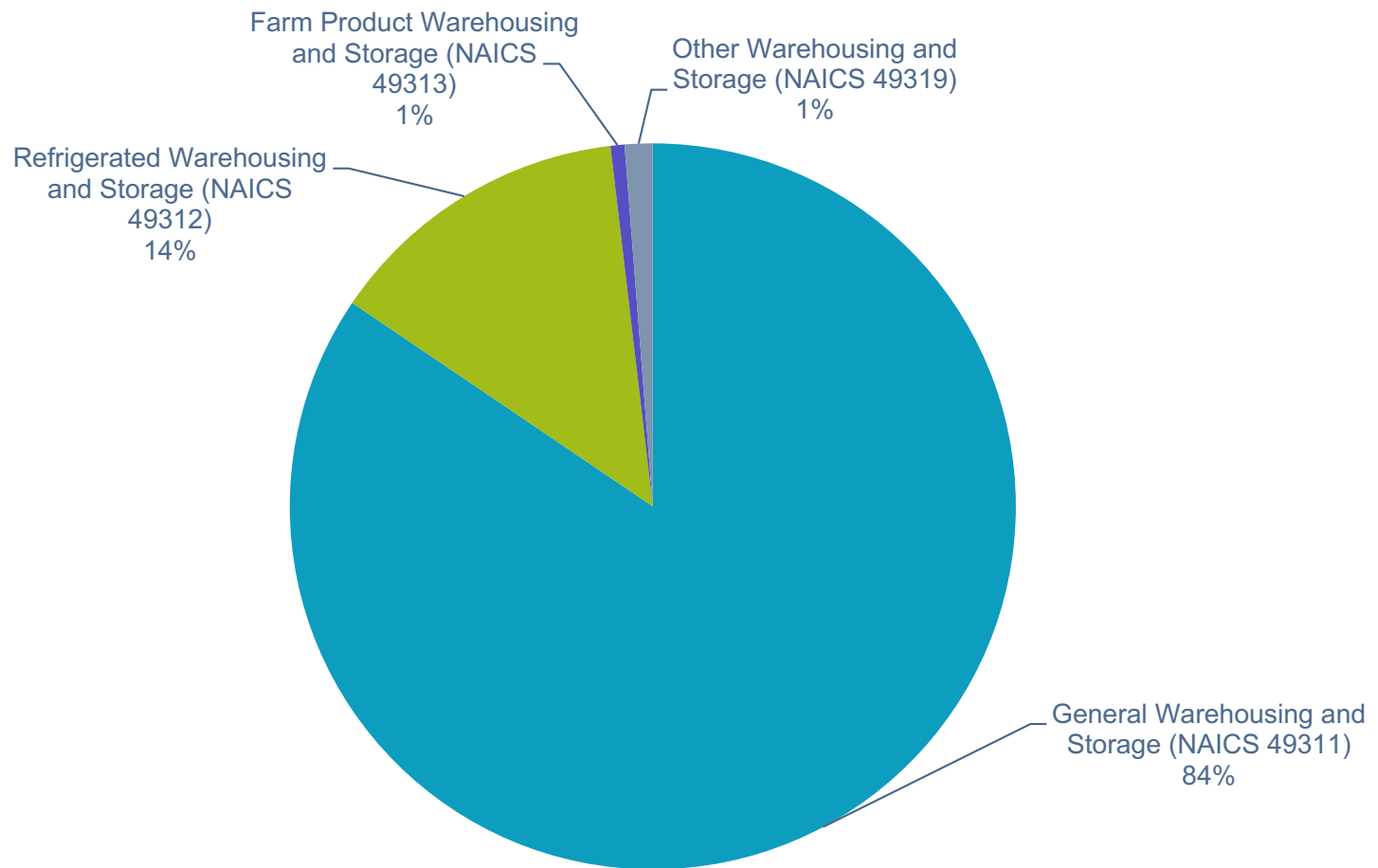
4.4 Results: Kernel Density Estimation



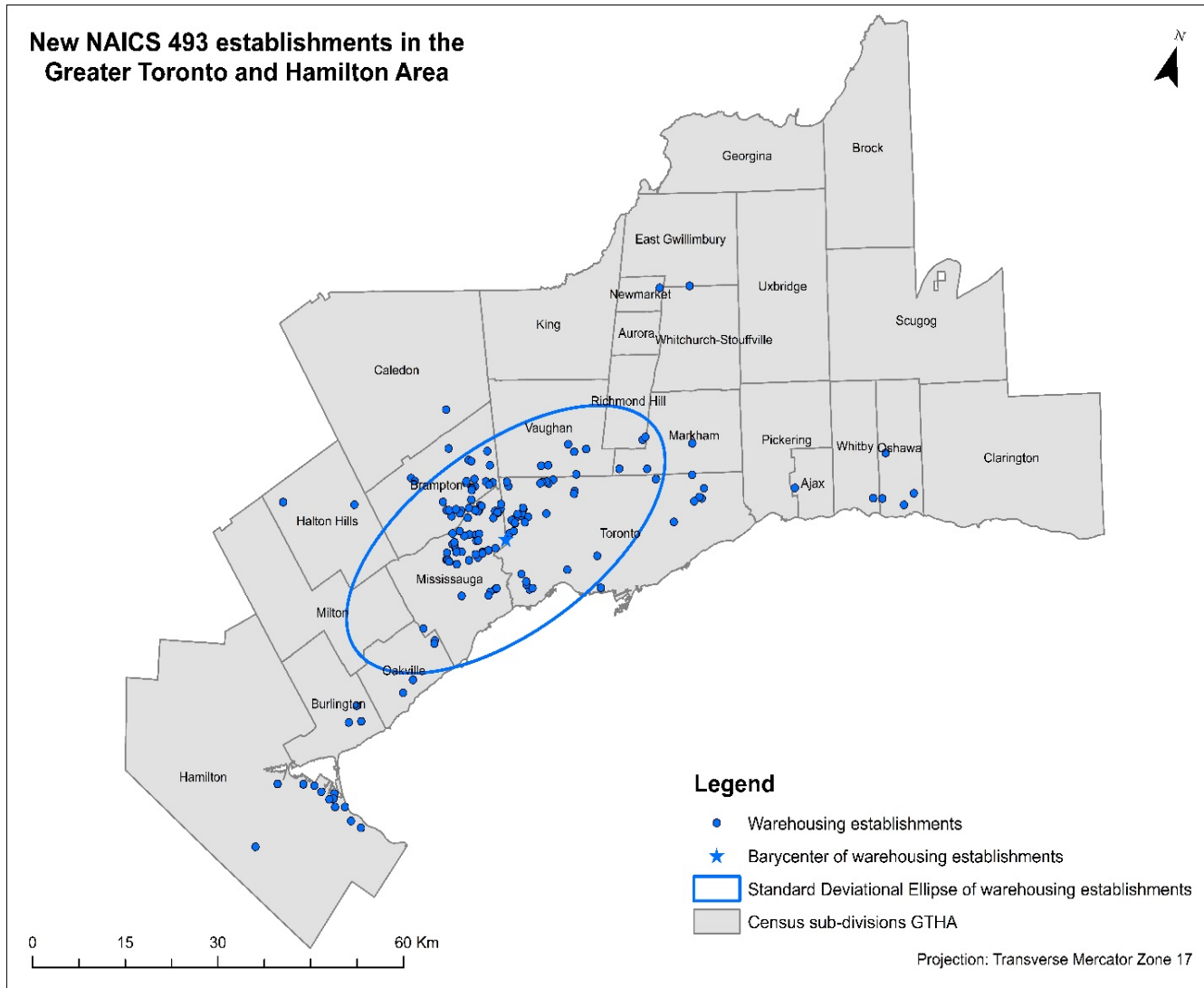
Findings:

1. Growth prominent in the Region of Peel near Pearson airport, CN Mississauga and CN Brampton
2. Growth along junctions of Hwy 401, Hwy 407, Hwy 410 and Hwy 427
3. Decrease along junction of Hwy 427, QEW and Gardiner Expressway due to closure of Obico yard (CN Rail) in 2012
4. Red patches indicate disappearances or relocations (approx. 21% relocations between 2003-2013)

5. New NAICS 493 sub-categories



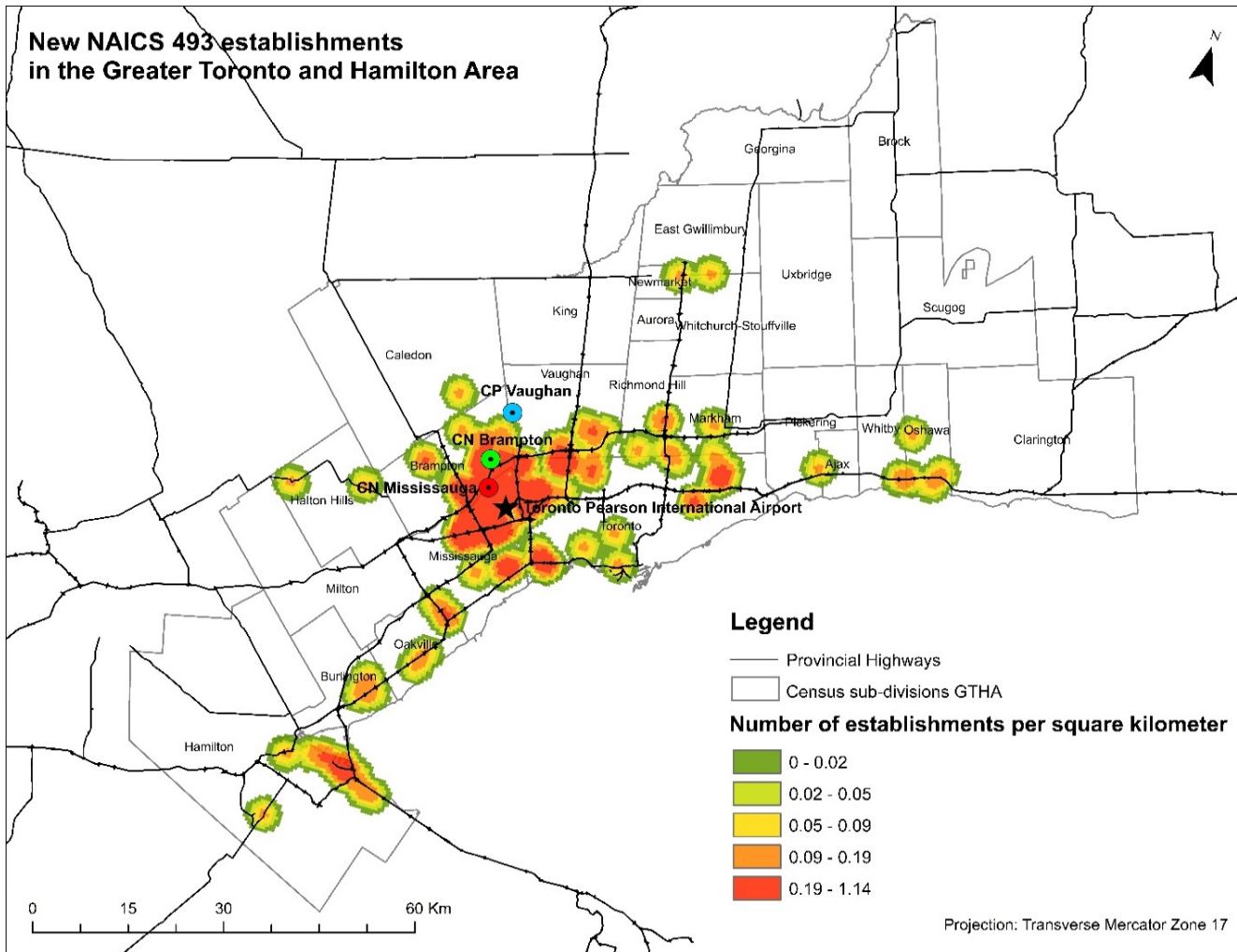
5.1 Spatial Pattern new NAICS 493



Findings:

1. 161 new NAICS 493
2. Barycentre located at the edge of Pearson airport
3. Average distance of warehousing establishments from their Barycentre is 17.7 Km
4. Spreading out in North-East and South-West direction of the GTHA

5.2 Kernel Density of new NAICS 493



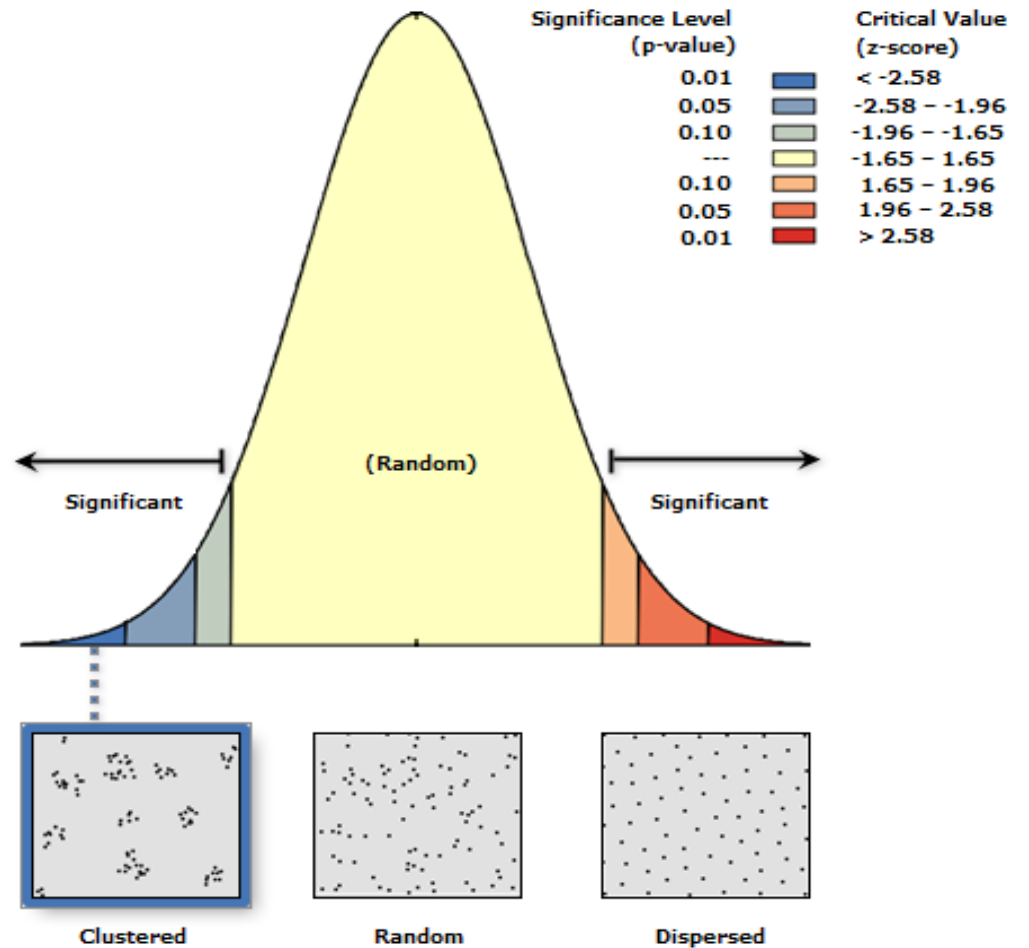
Findings:

1. Maximum density near Pearson Airport, CN Brampton and CN Mississauga, and intersection of major highways

5.3 Test for Existence of Clusters

Nearest Neighbor Ratio Test

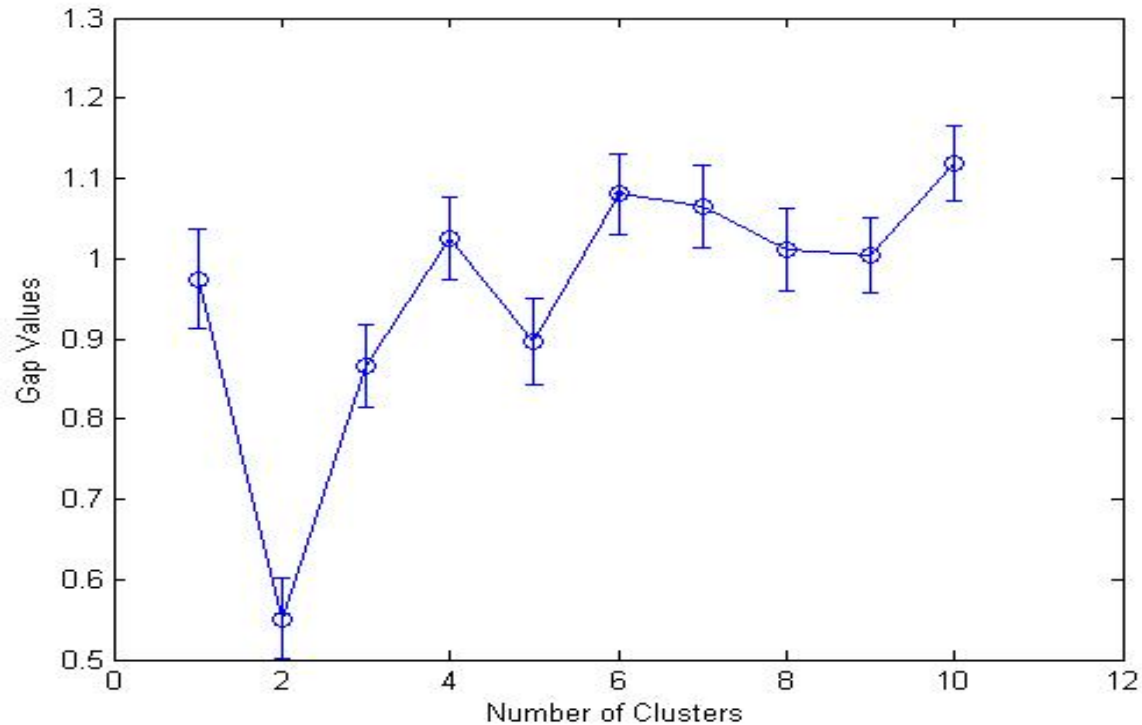
- Null Hypothesis: Warehousing establishments follow Complete Spatial Randomness (CSR)
- Z-score of -13.27



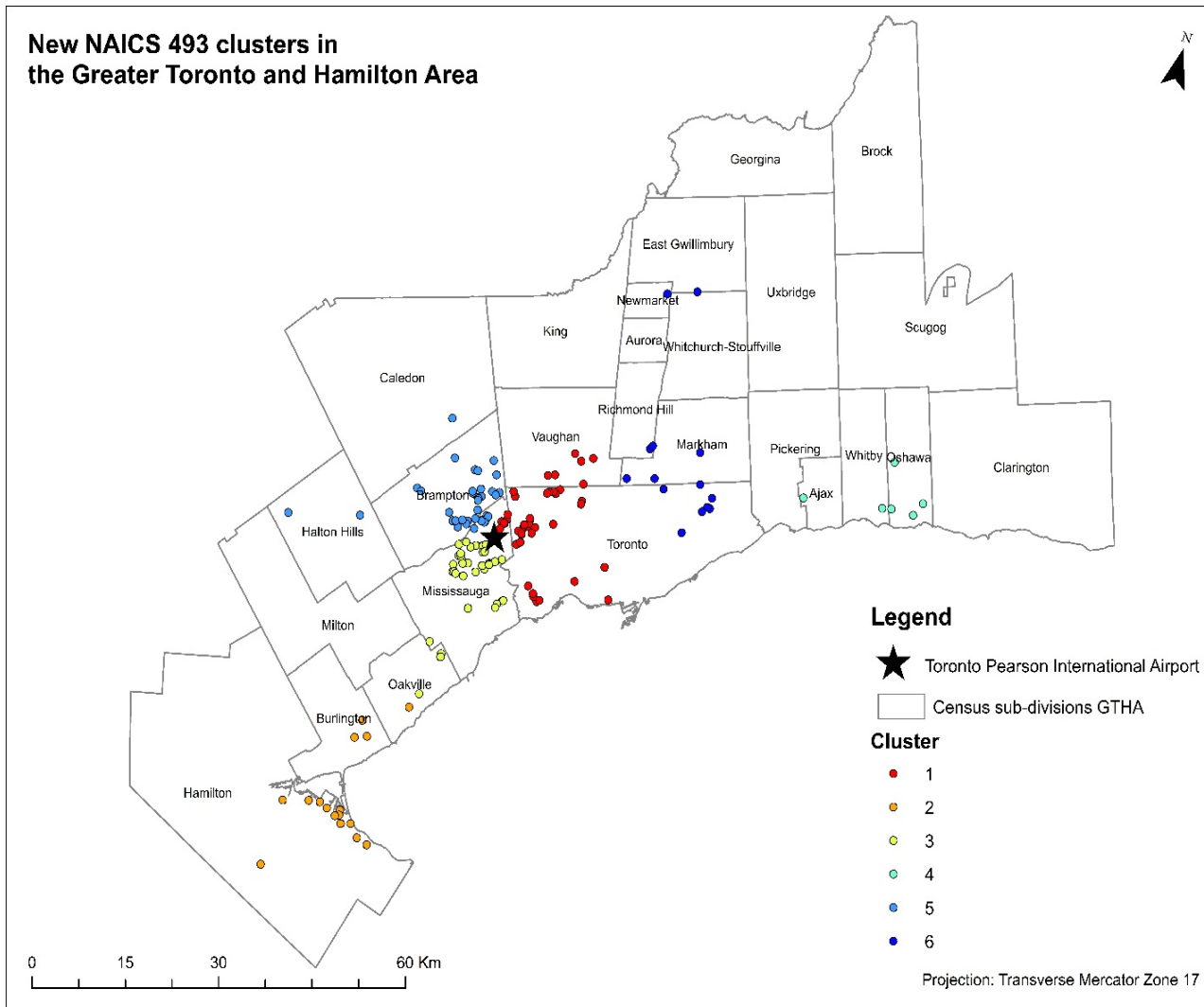
Generated by ArcMap

5.3.1 Cluster Analysis

- Gap Statistic used to find the optimal number of clusters (Tibshirani et al., 2001)
- Optimal number of clusters = 6



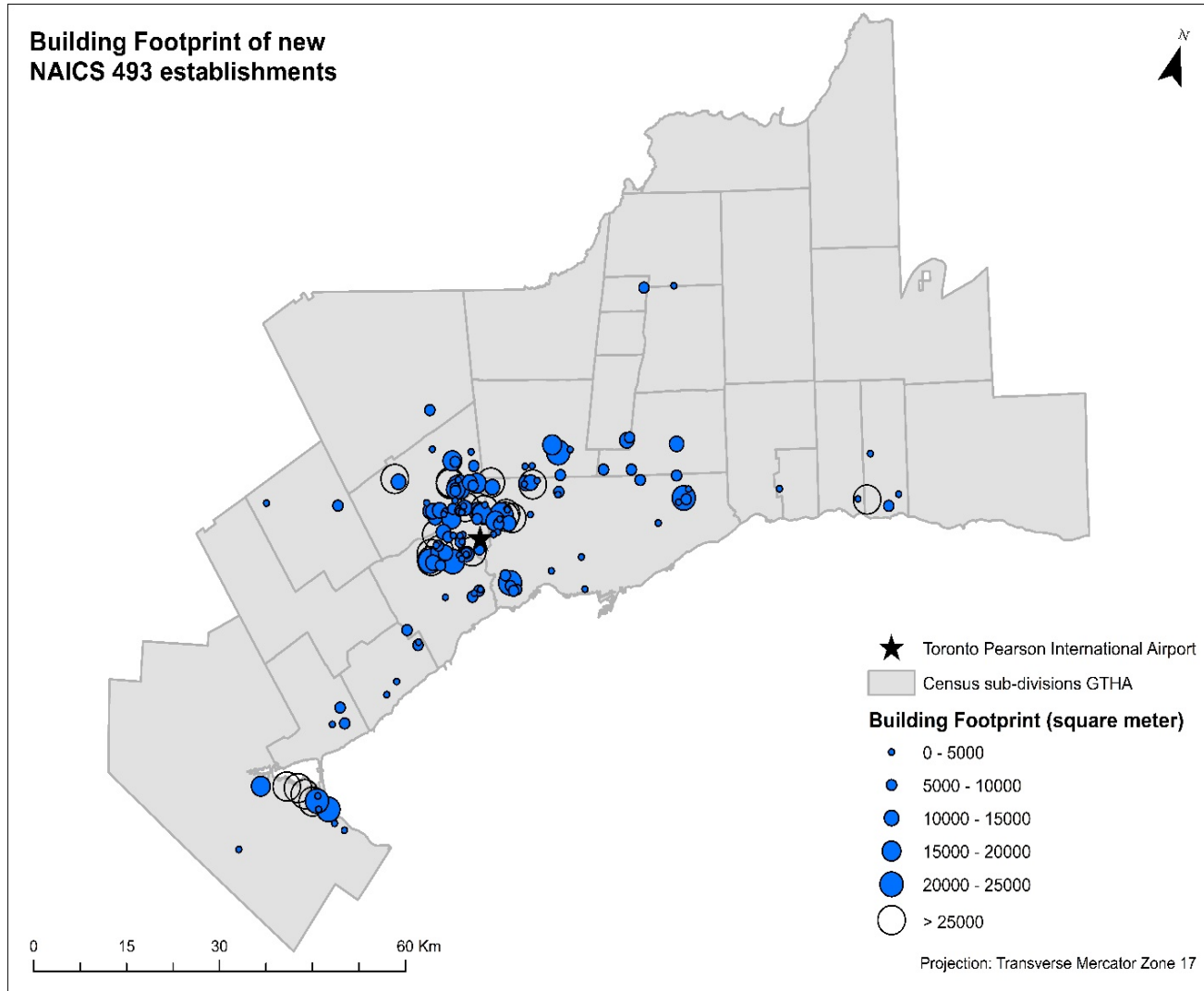
5.3.2 Location of Clusters



Findings:

1. 3 clusters around Pearson airport (red, blue, yellow)
2. 4th cluster extending from Oakville towards City of Hamilton (orange)
3. 5th cluster extending from eastern part of City of Toronto towards Newmarket (dark blue)
4. 6th cluster extending from Ajax towards Oshawa (green)

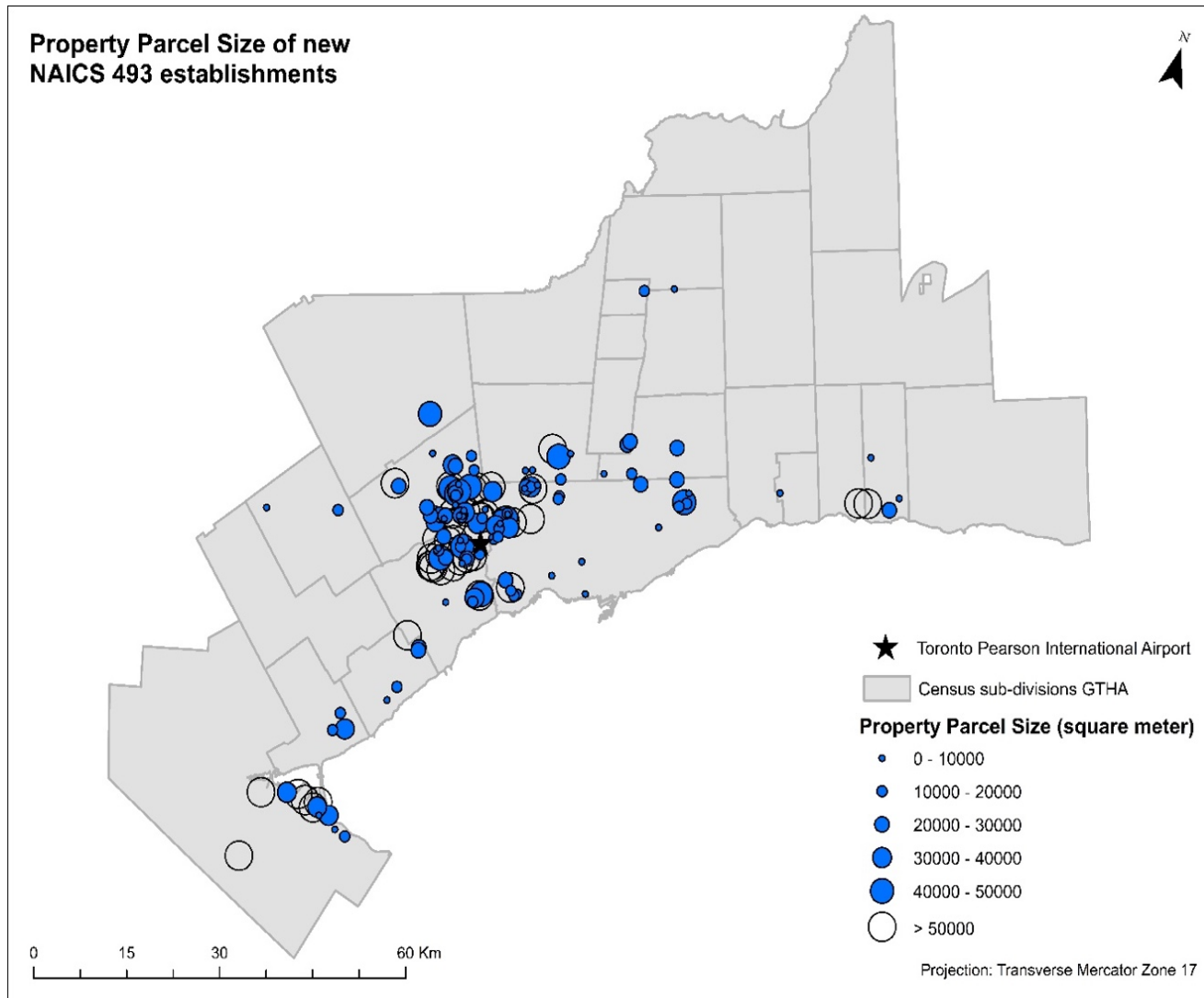
5.4 Building Footprint



Findings:

1. Average Building Footprint is 12,000 m²
2. Establishments greater than 25,000 m² located in the vicinity of Pearson Airport and City of Hamilton

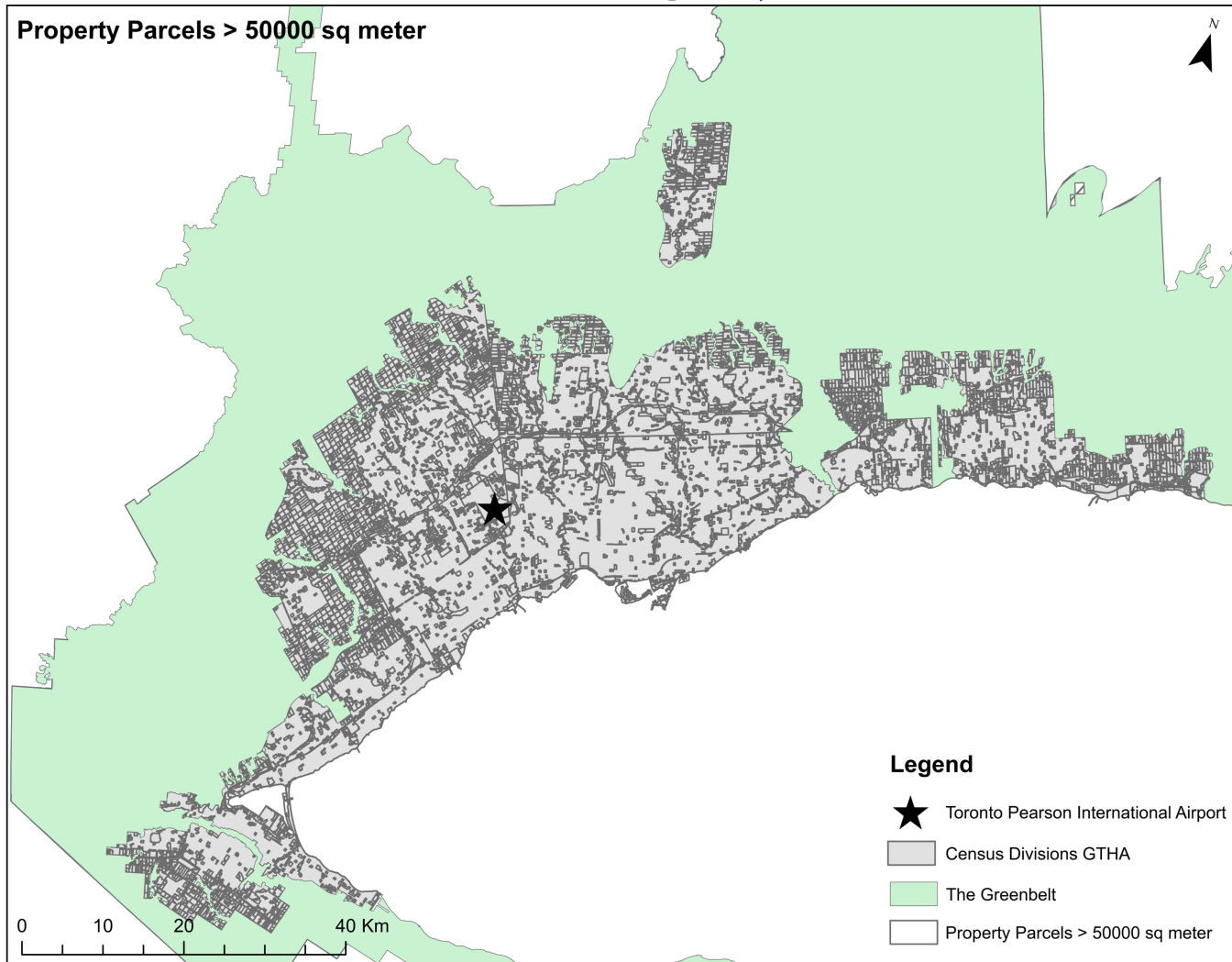
5.5 Property Parcel Size



Findings:

1. Average parcel size is 40,000 m²
2. Establishments greater than 50,000 m² located in the vicinity of Pearson Airport and City of Hamilton

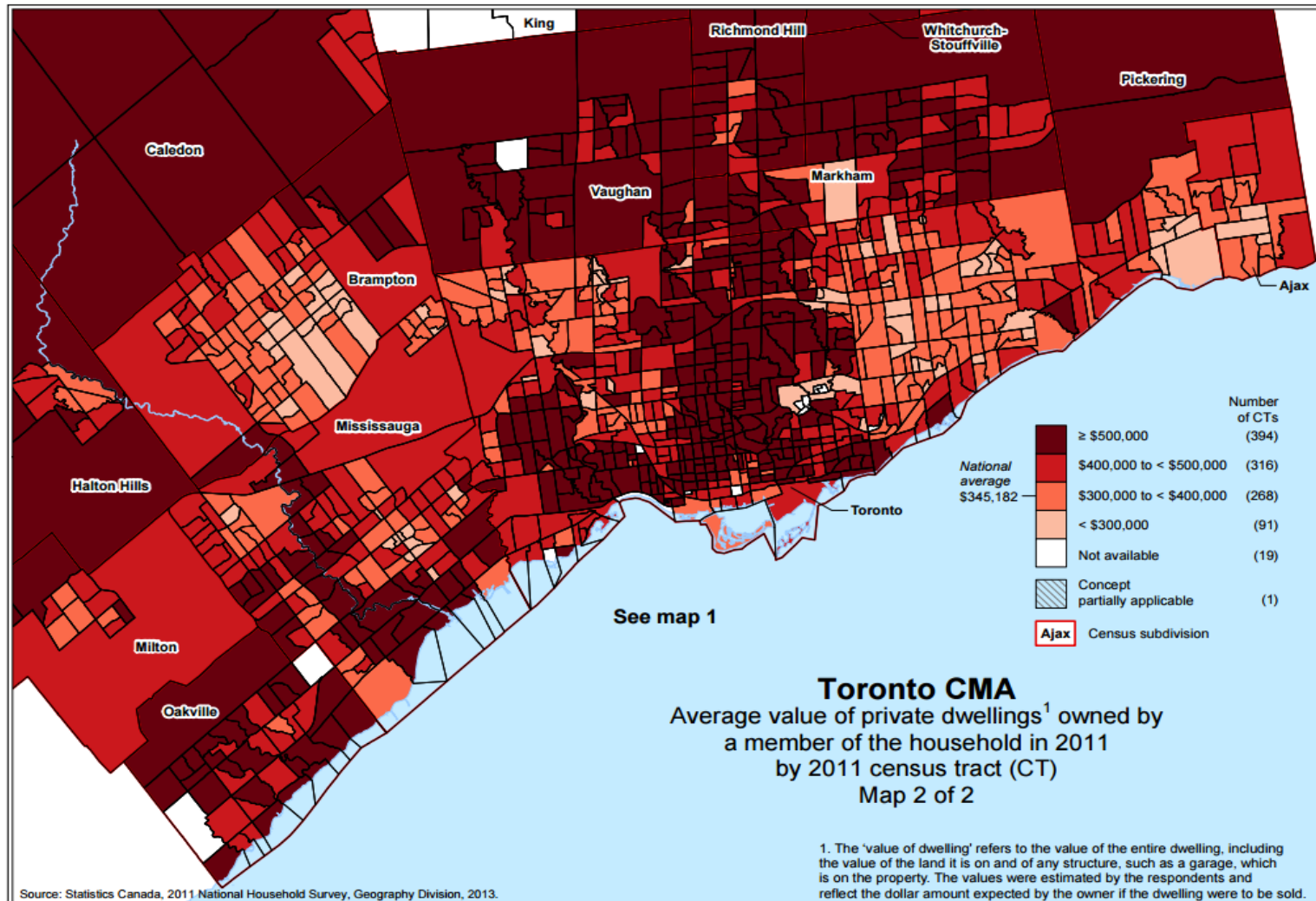
5.5.1 Teranet's Property Parcel Distribution (> 50,000 m²)



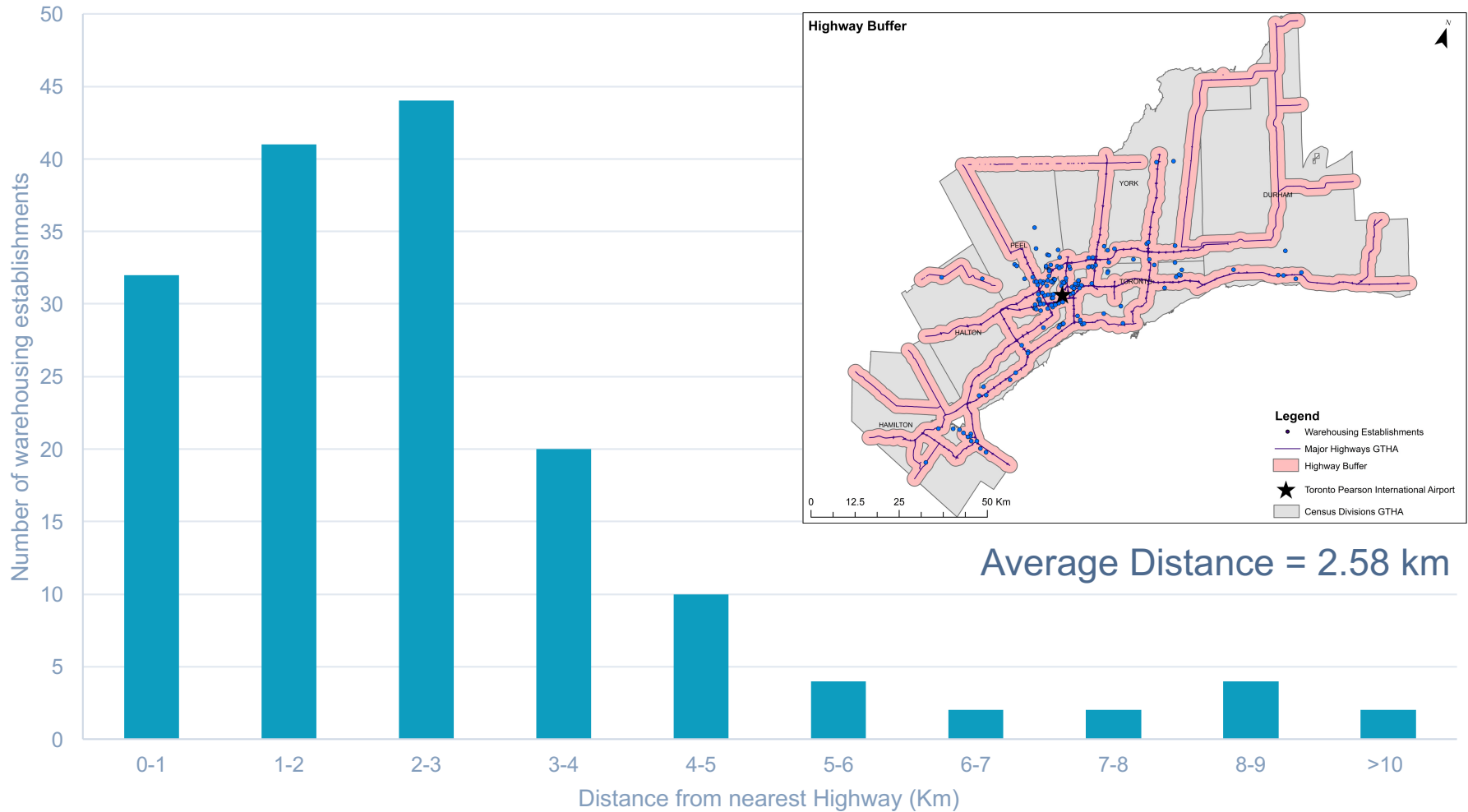
Findings:

Parcels > 50,000 m² located in the vicinity of Pearson Airport, Regions of Peel, York, Durham and City of Hamilton

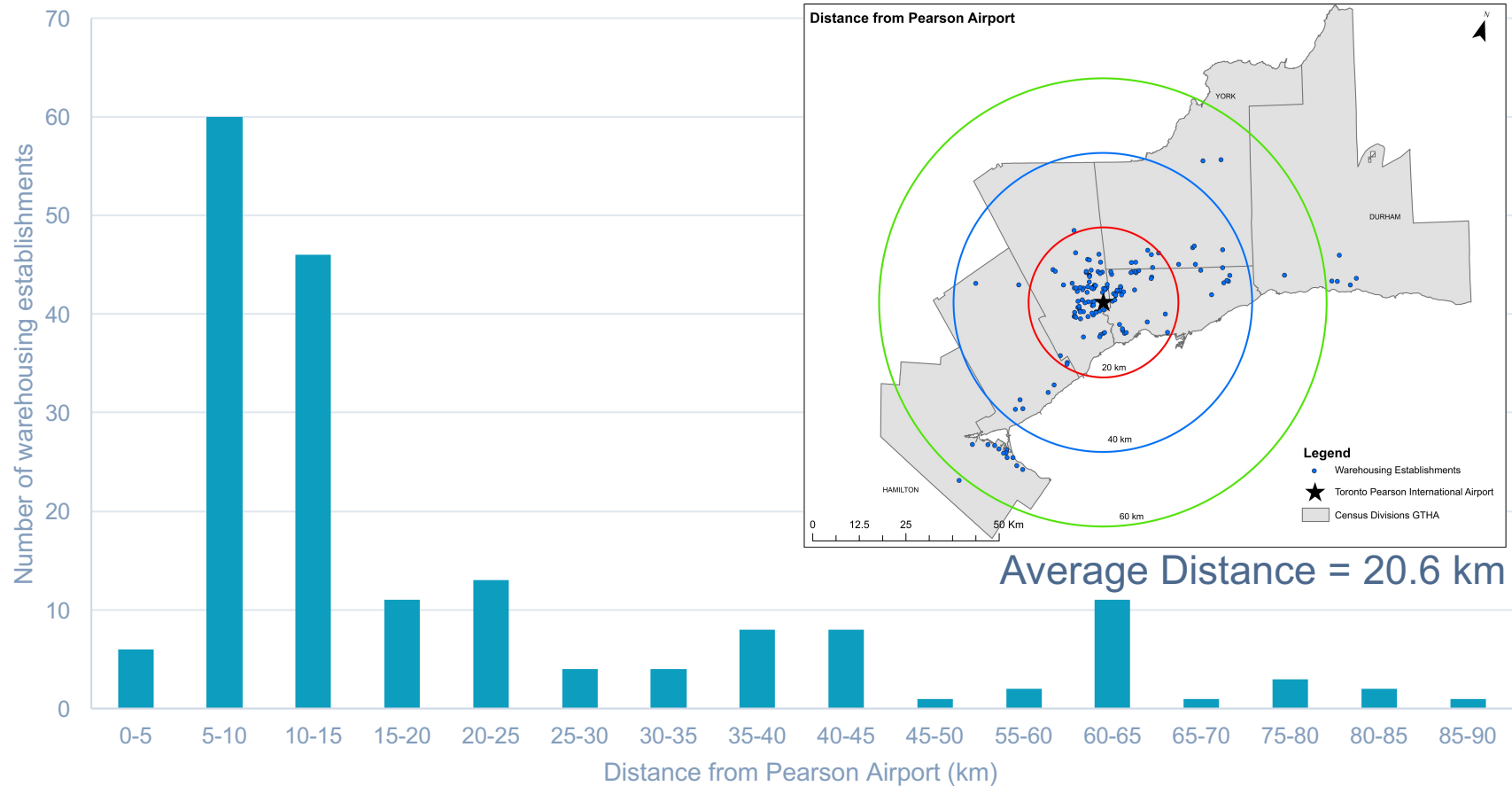
5.5.2 Average Value of Private Dwellings (Source: Statistics Canada, 2011)



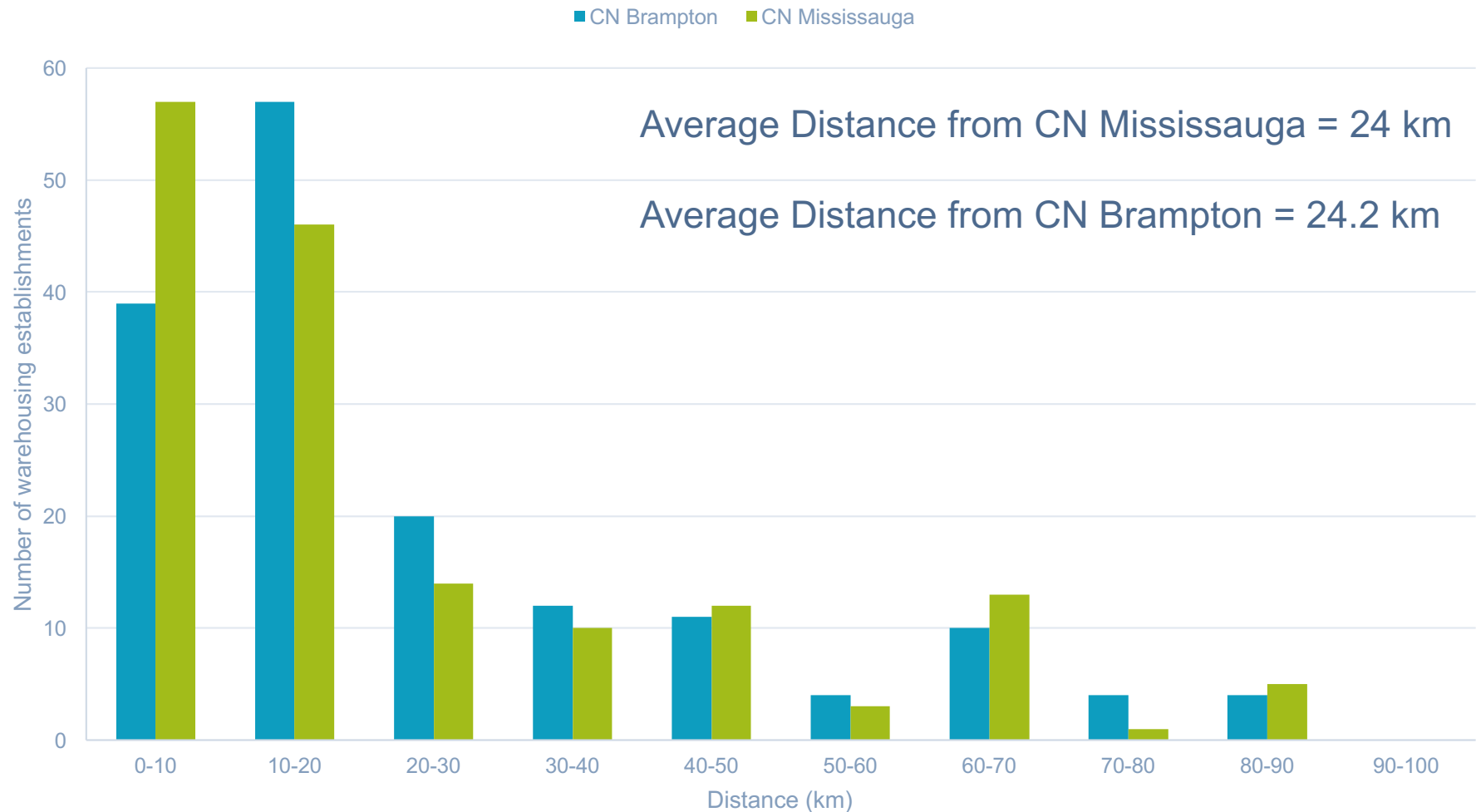
5.6 Distance from nearest Highway



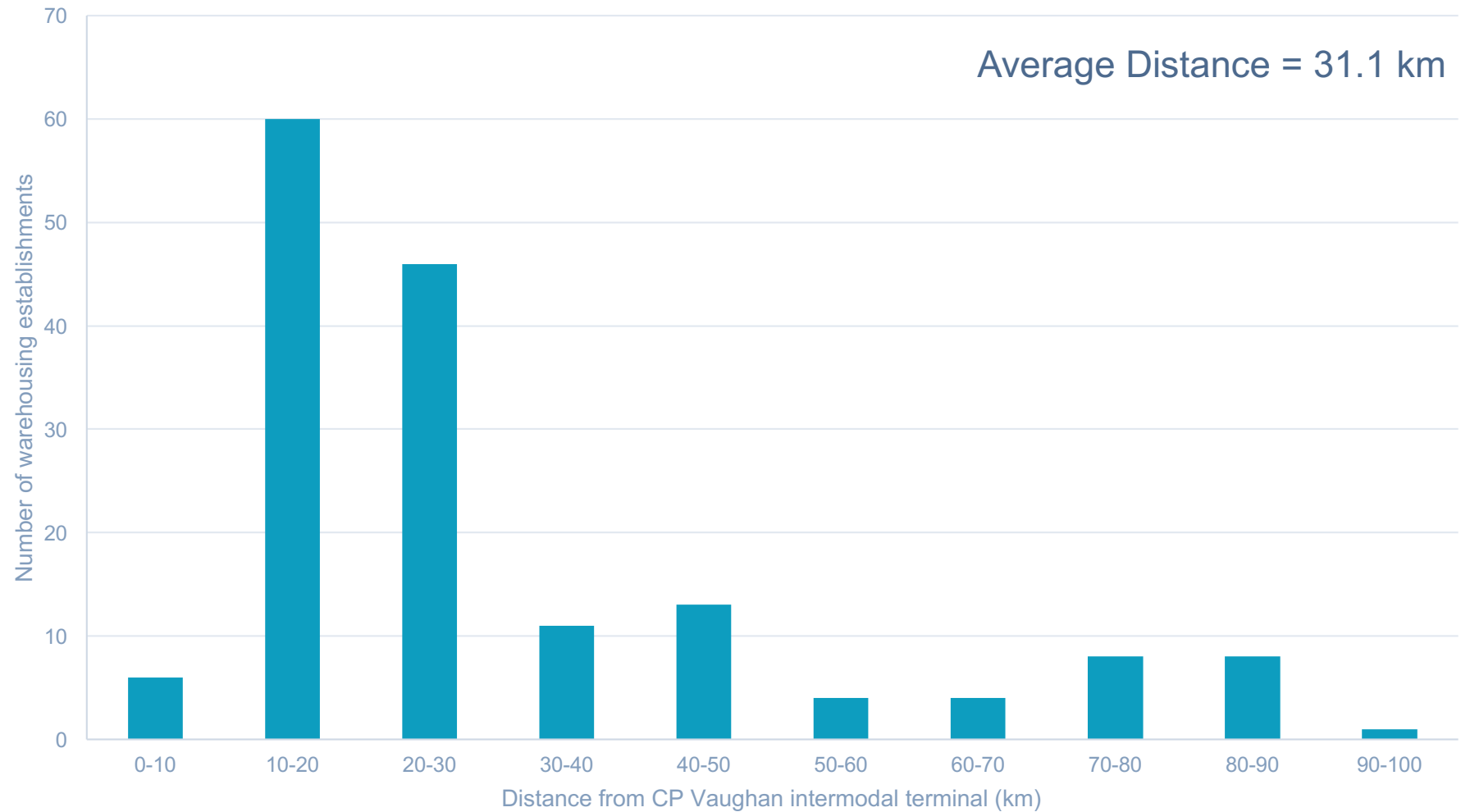
5.7 Distance from Toronto Pearson International Airport



5.8 Distance from CN Brampton and CN Mississauga Intermodal Terminal



5.9 Distance from CP Vaughan Intermodal Terminal



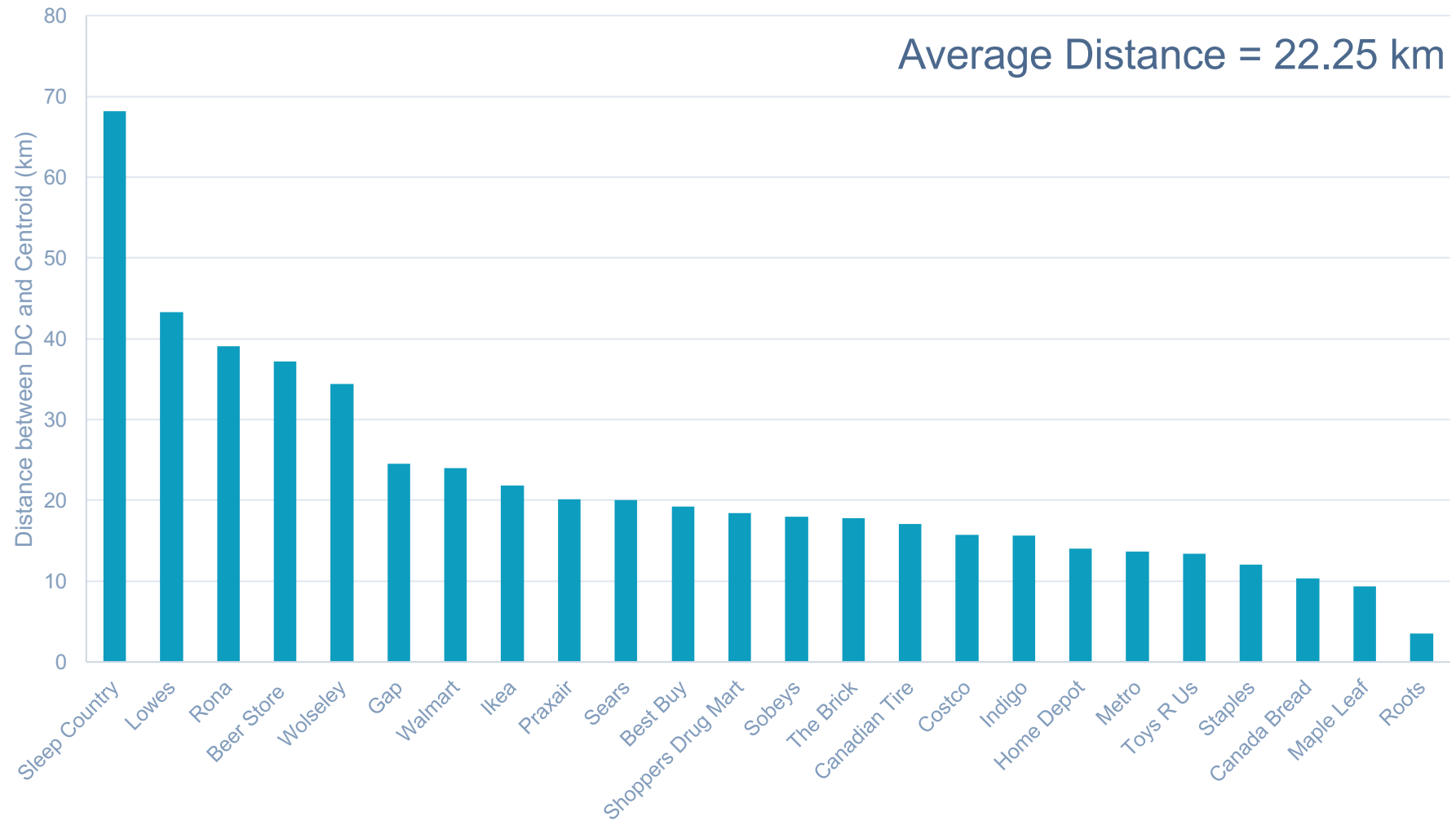
6. Spatial relationships within multi-establishment firms

- DC's categorized under NAICS 541614 Process, Physical Distribution and Consulting Services.
- Relationship between DC's and other retail establishments within same firm.
- Criteria for locating the DC's.

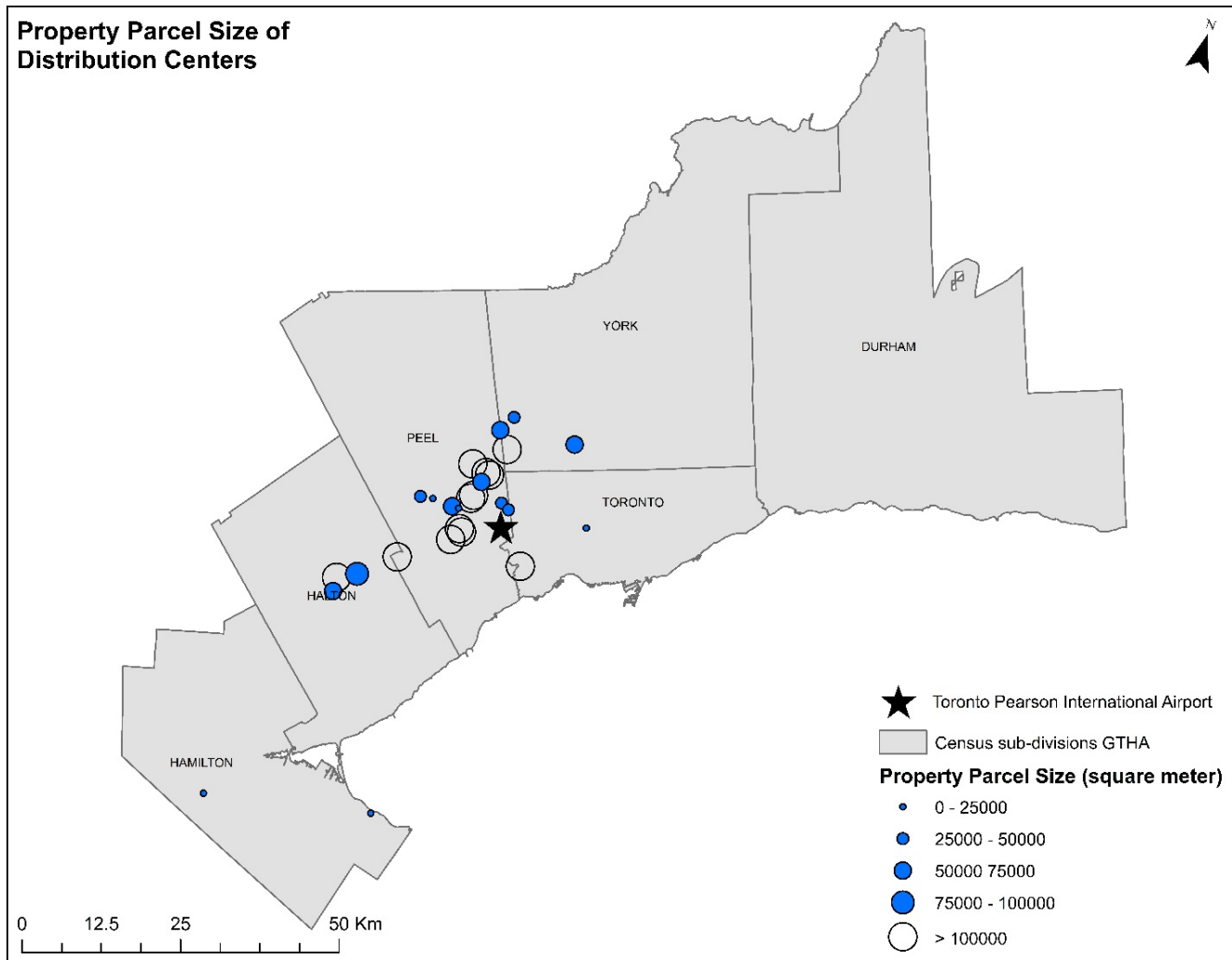
6.1 Multi-establishment Firms

Annual Revenue	Firms
> \$ 10 billion	Walmart, Sobeys, Costco, Metro, Praxair, Shoppers Drug Mart
\$ 5 billion - 10 billion	Canadian Tire, Rona, The Home Depot, Best Buy, Lowe's, Sears
\$ 1 billion - 5 billion	Maple Leaf Foods, Staples, Ikea, Wolseley, Canada Bread
\$ 500 million – 1 billion	Gap, Toys R Us, Beer Store, Sleep Country
< \$ 500 million	Roots, Indigo Books & Music, The Brick

6.2 Distance between distribution centers and centroid of retail establishments



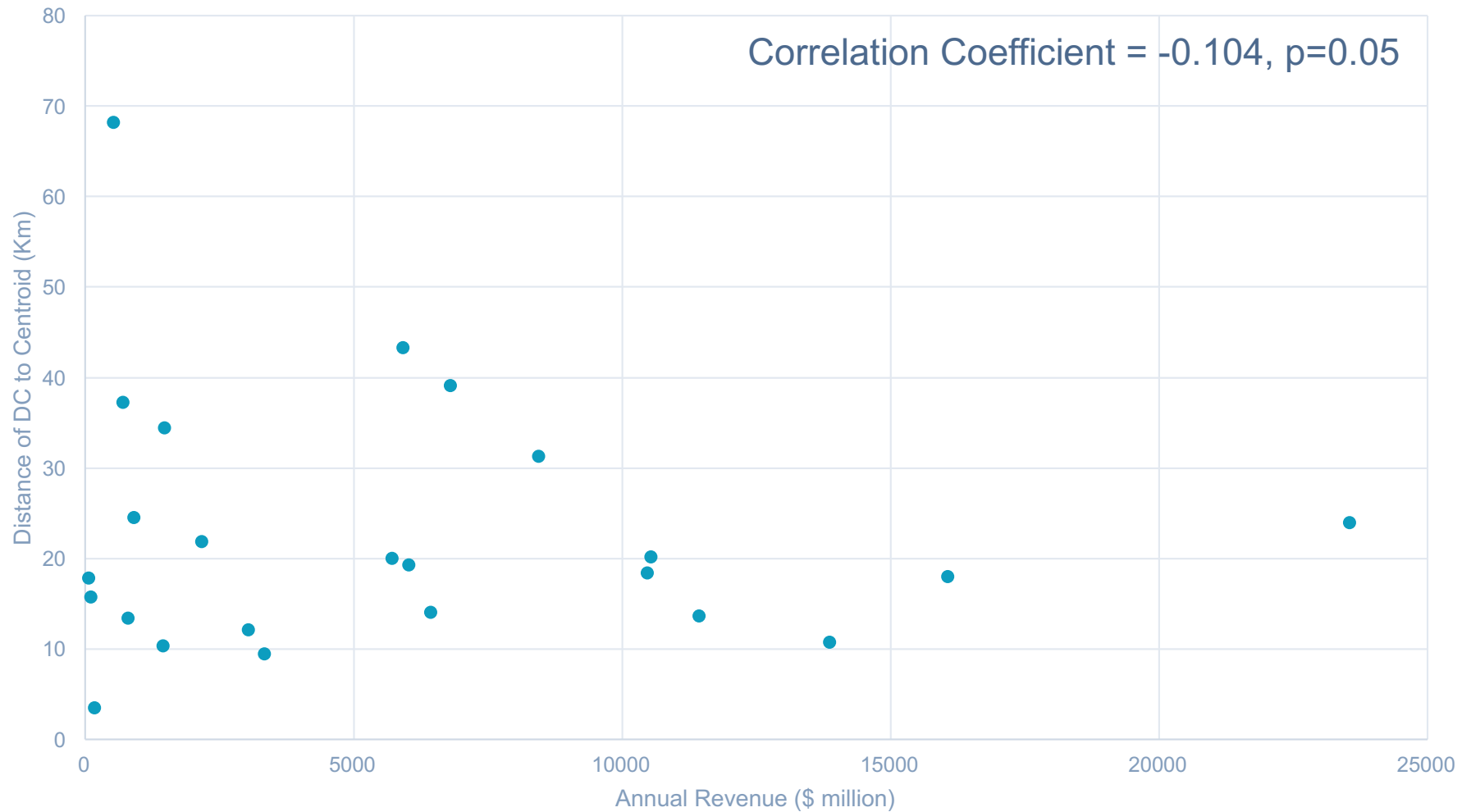
6.3 Property Parcel Size



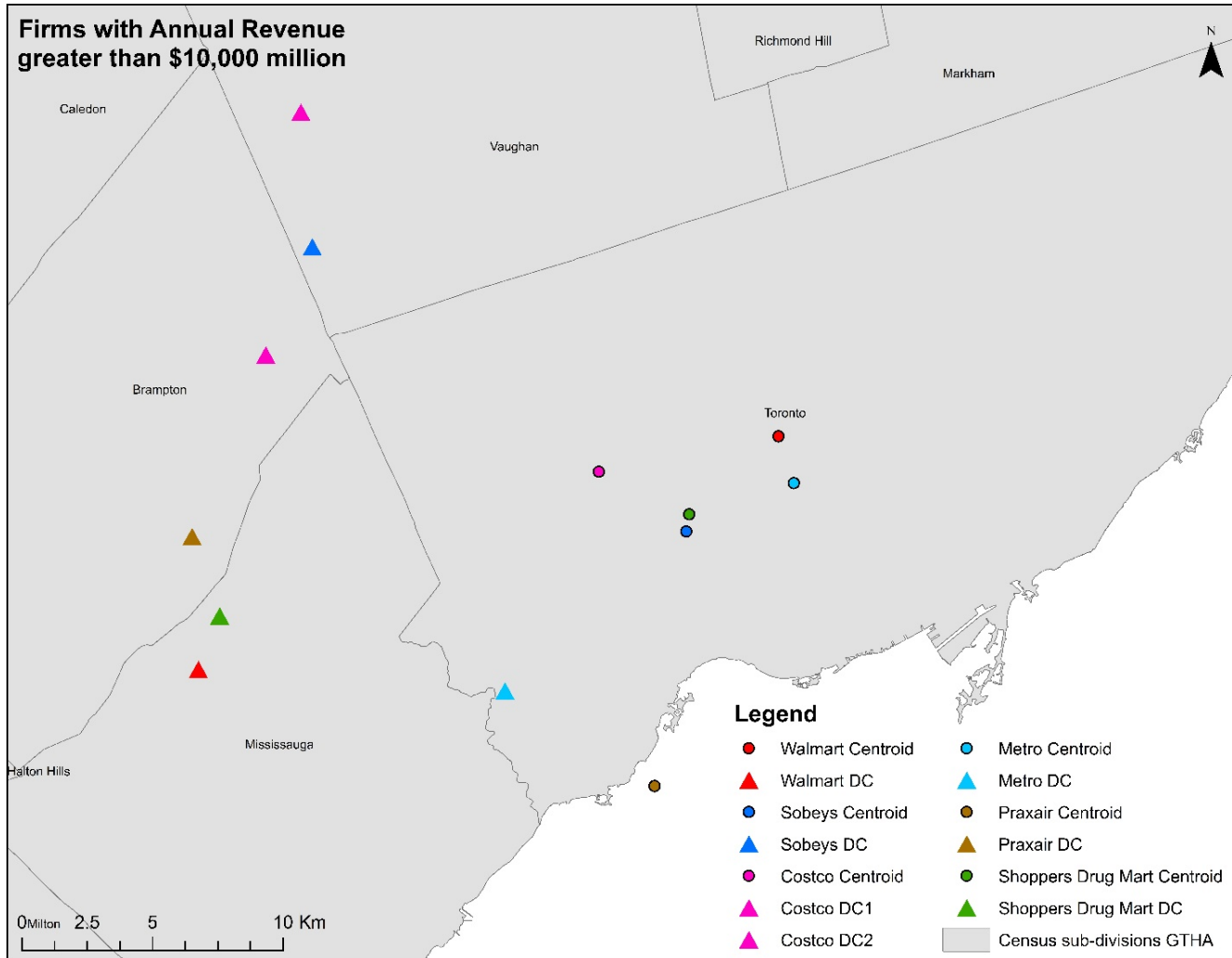
Findings:

1. Average parcel size is 140,000 m²
2. Establishments greater than 100,000 m² located at the periphery of City of Toronto

6.4 Annual Revenue, and Distance between Distribution Center and Centroid of Retail Establishments



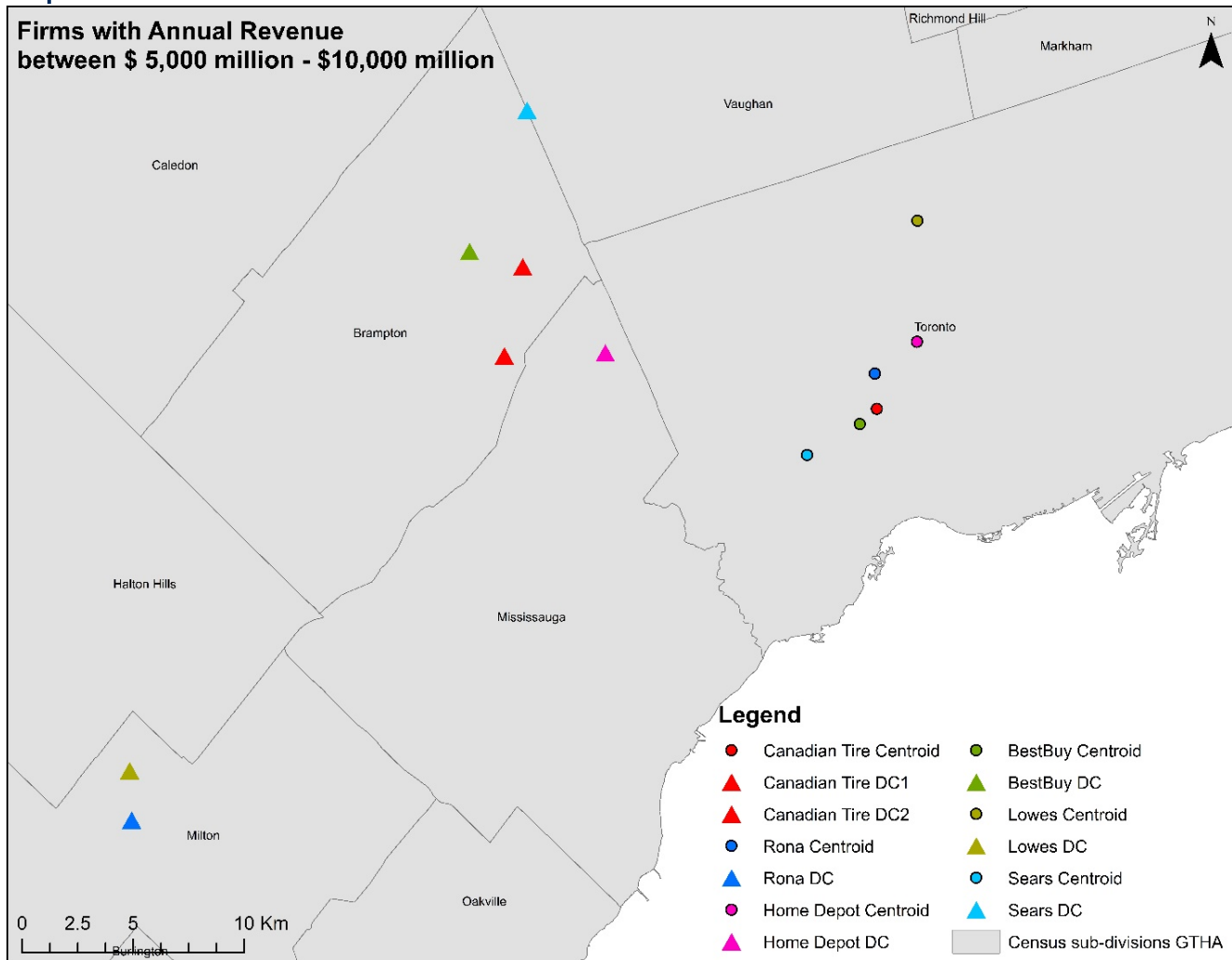
6.5 Annual Revenue > \$10 billion



Findings:

1. Average distance is 17.93 km
2. Costco Canada has 2 Distribution Centers

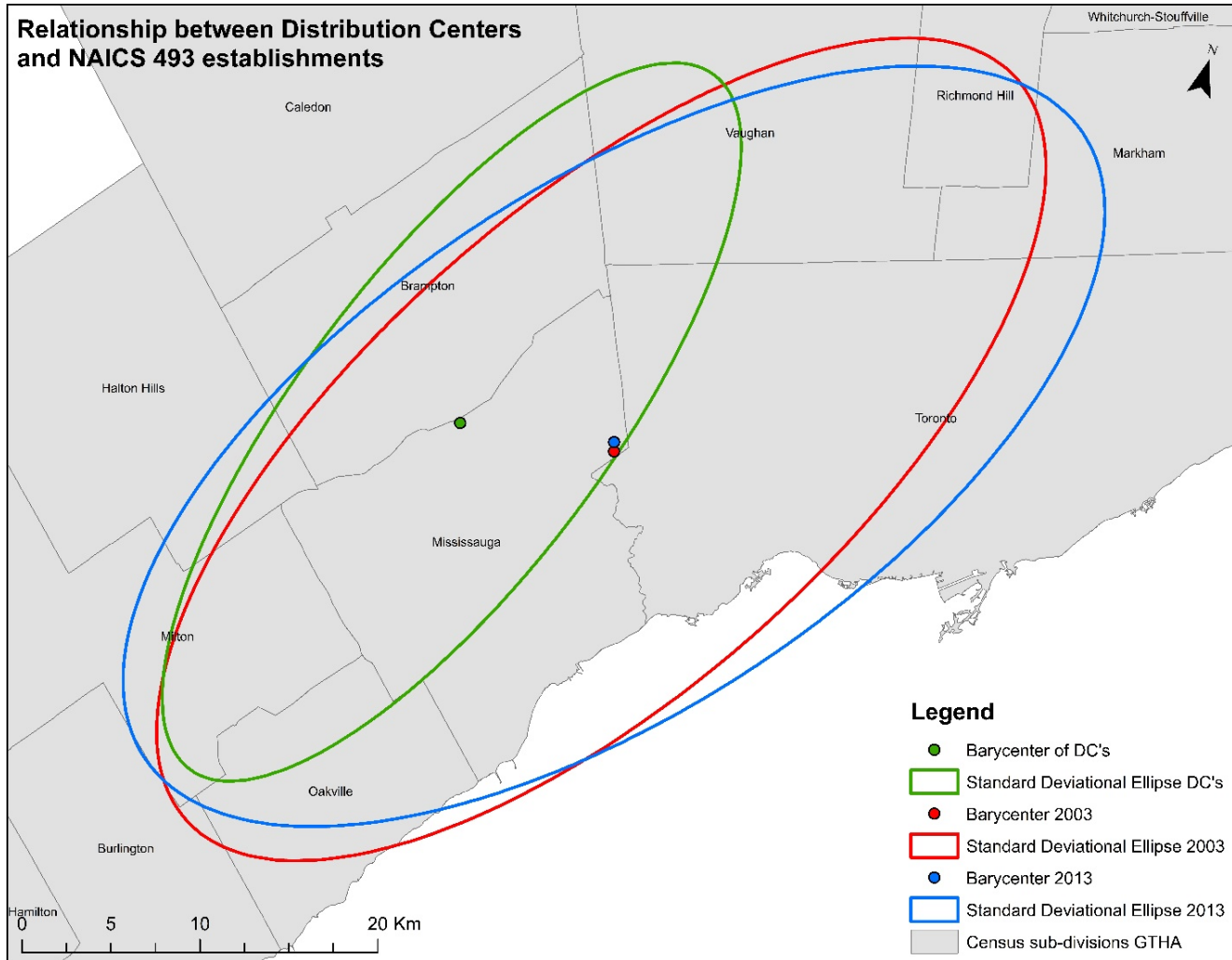
6.5.1 Annual Revenue between \$5 billion – \$10 billion



Findings:

1. Average distance is 24.25 km
2. Canadian Tire has 2 Distribution Centers

6.6 Relationship between Distribution Centers and NAICS 493



Findings:

1. Distance between mean centers decreased by 0.86%
2. Area of intersecting ellipses increased by 3.22%

7. Conclusions

- Largest share of the new warehousing establishments appeared between 2005-2006, and 2009-2010.
- Sub-urbanization trend observed is not obvious in the GTHA.
- Logistics industry in the GTHA is fairly monocentric.
- Large tracts of land used around the Toronto Pearson International airport.
- Trade-off between transportation costs and land prices while location DC.
- Inward movement of NAICS 493 towards major DC's.

8. Future Research

□ **Location Choice Model for Warehouses/Distribution Centers in the GTHA**

- Location Characteristics (land prices, number of NAICS 493, number of Distribution Centers)
- Transportation Access measures (distance from nearest highway, distance to airport and intermodal terminals)
- Firms characteristics (distance of distribution center to centroid of retail establishments, annual revenue, employment size)

□ **Interviews with commercial real-estate brokers**

- Identifying suitable locations for locating warehousing establishments or distribution centers

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Thanks You!!
Questions?

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