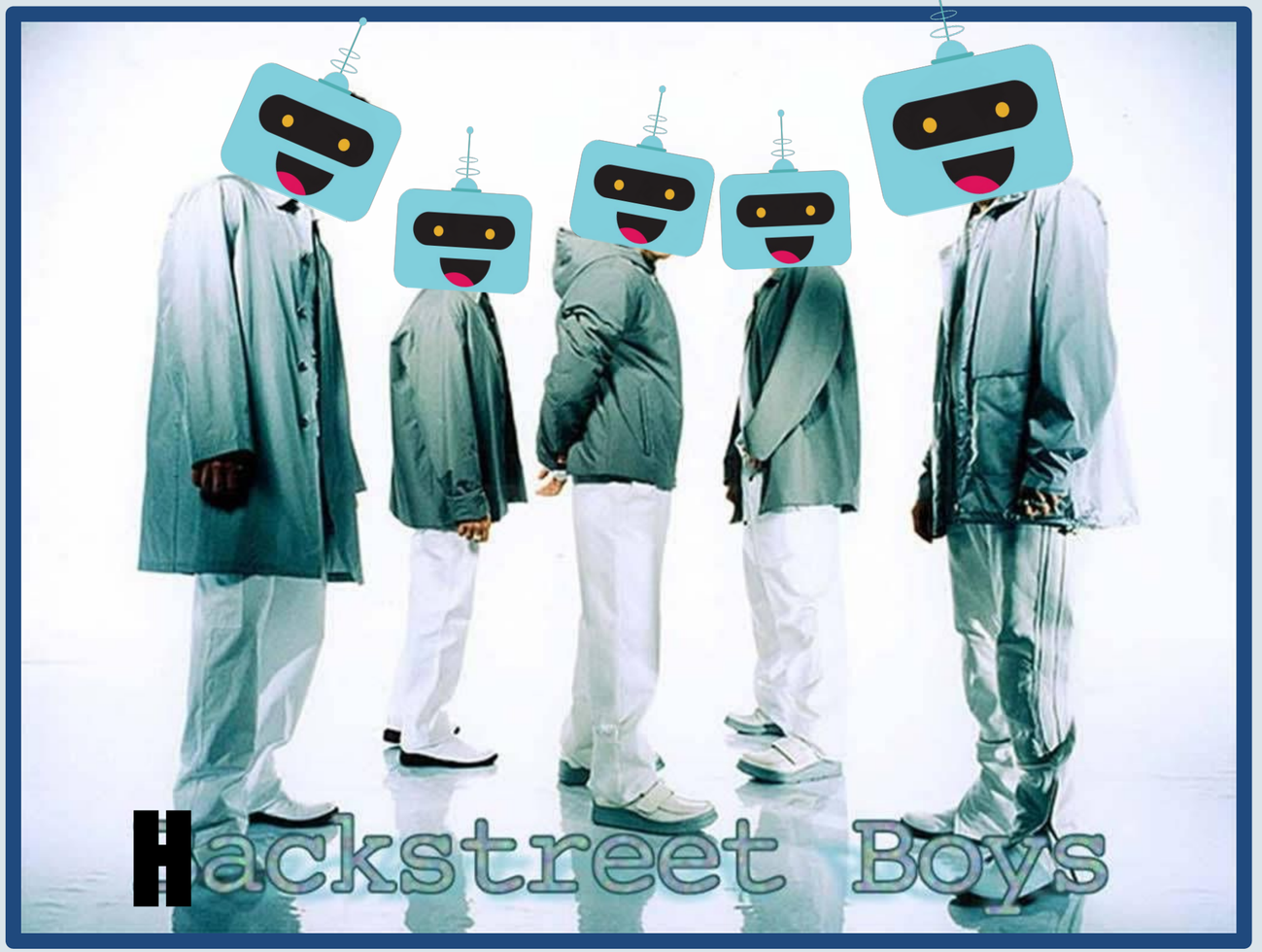
Hackstreet Boyz



[1]

Saba Rahimi
Aaliya Shaikh
Andrew Del Rosso
Amir Vahdat

December 2, 2024

Ford's Issue on Toronto's Bike Lanes

Proposed Bike Lane Removal:
Plans include removing bike lanes on Bloor Street, University Avenue, and Yonge Street [2].

Safety Concerns:
Critics argue this could endanger cyclists and discourage sustainable transportation [2].

[3]

TORONTO

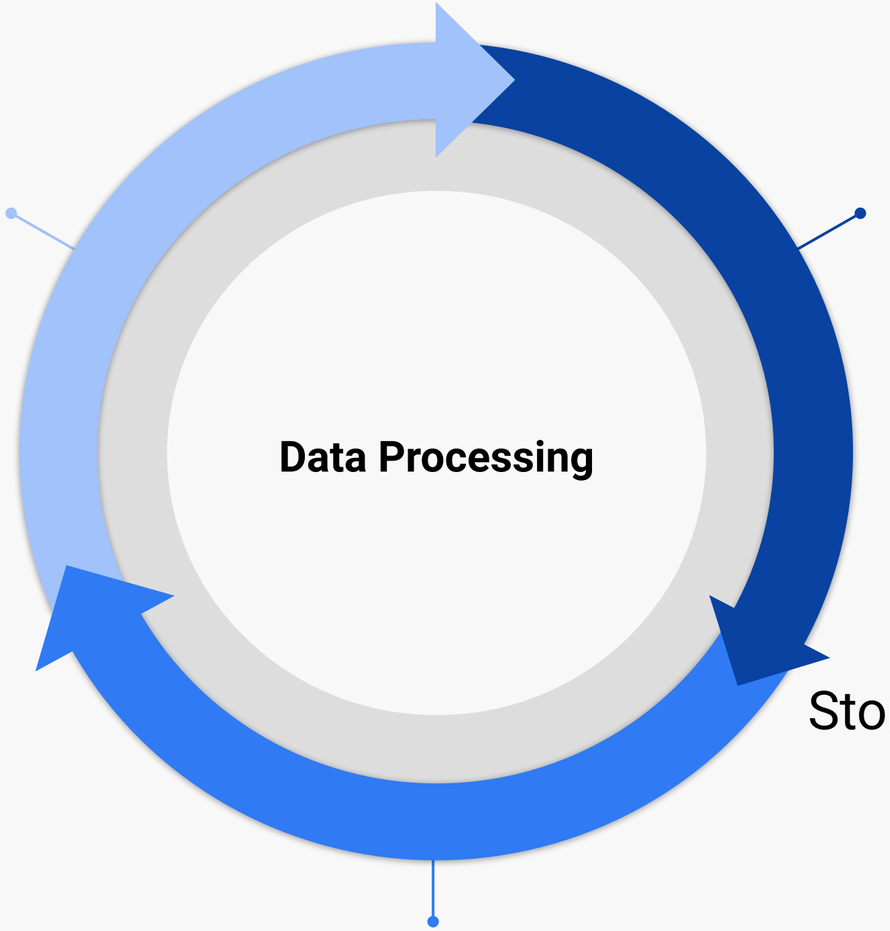
Data Cleaning

Data Extraction

Collecting raw data

Exploratory Data Analysis

Understand the source, behaviour, reliability and relationships within a dataset

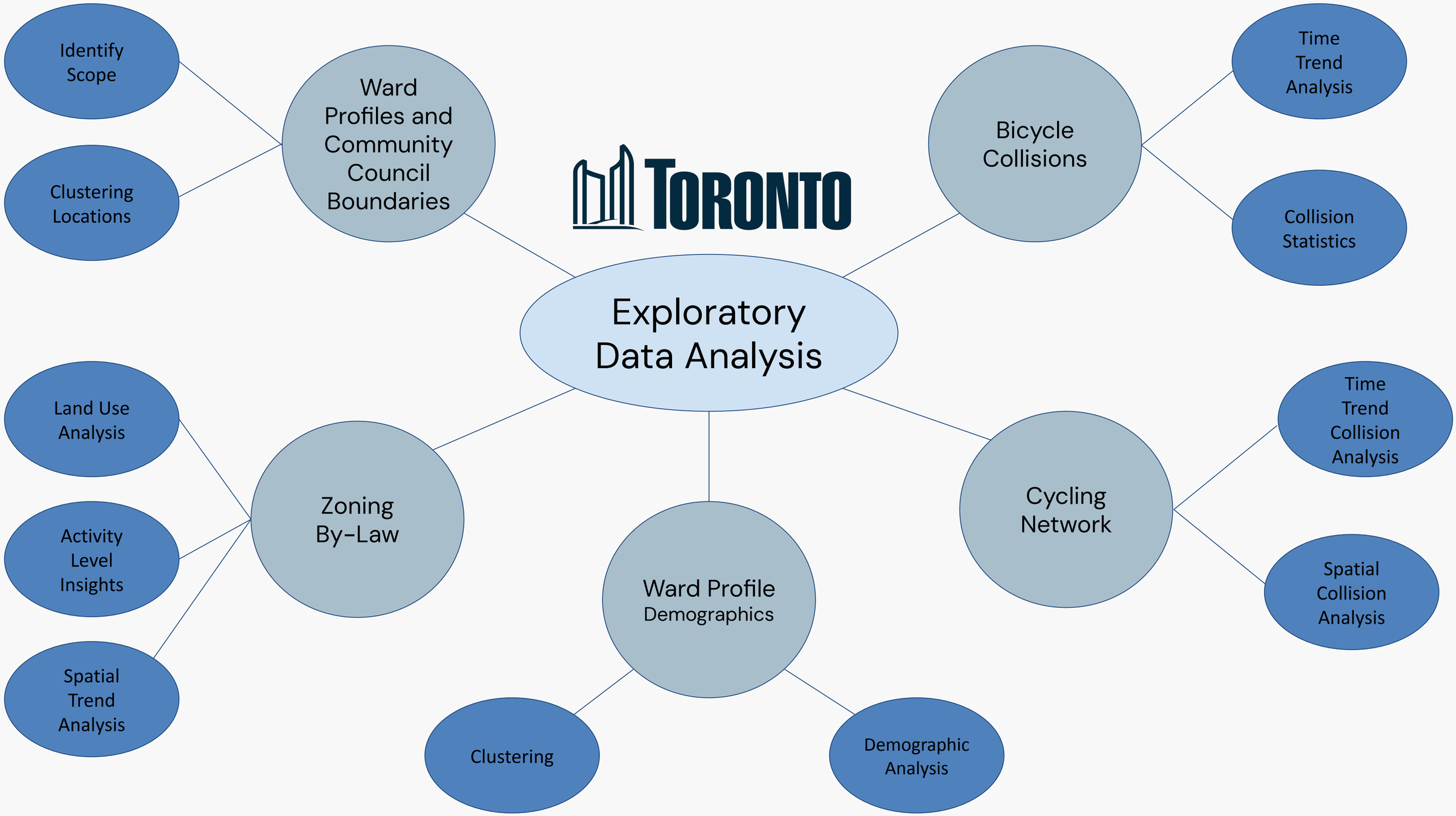


What question is answered?

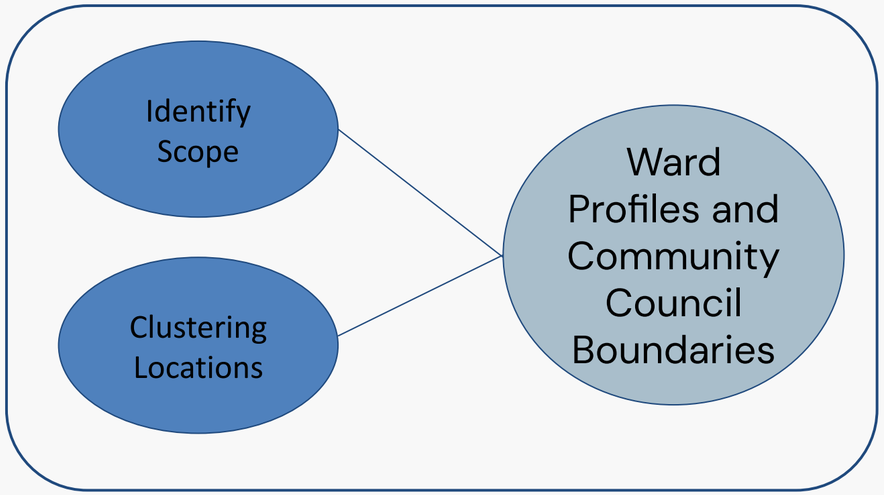
Storytelling

Predictions / Inferences

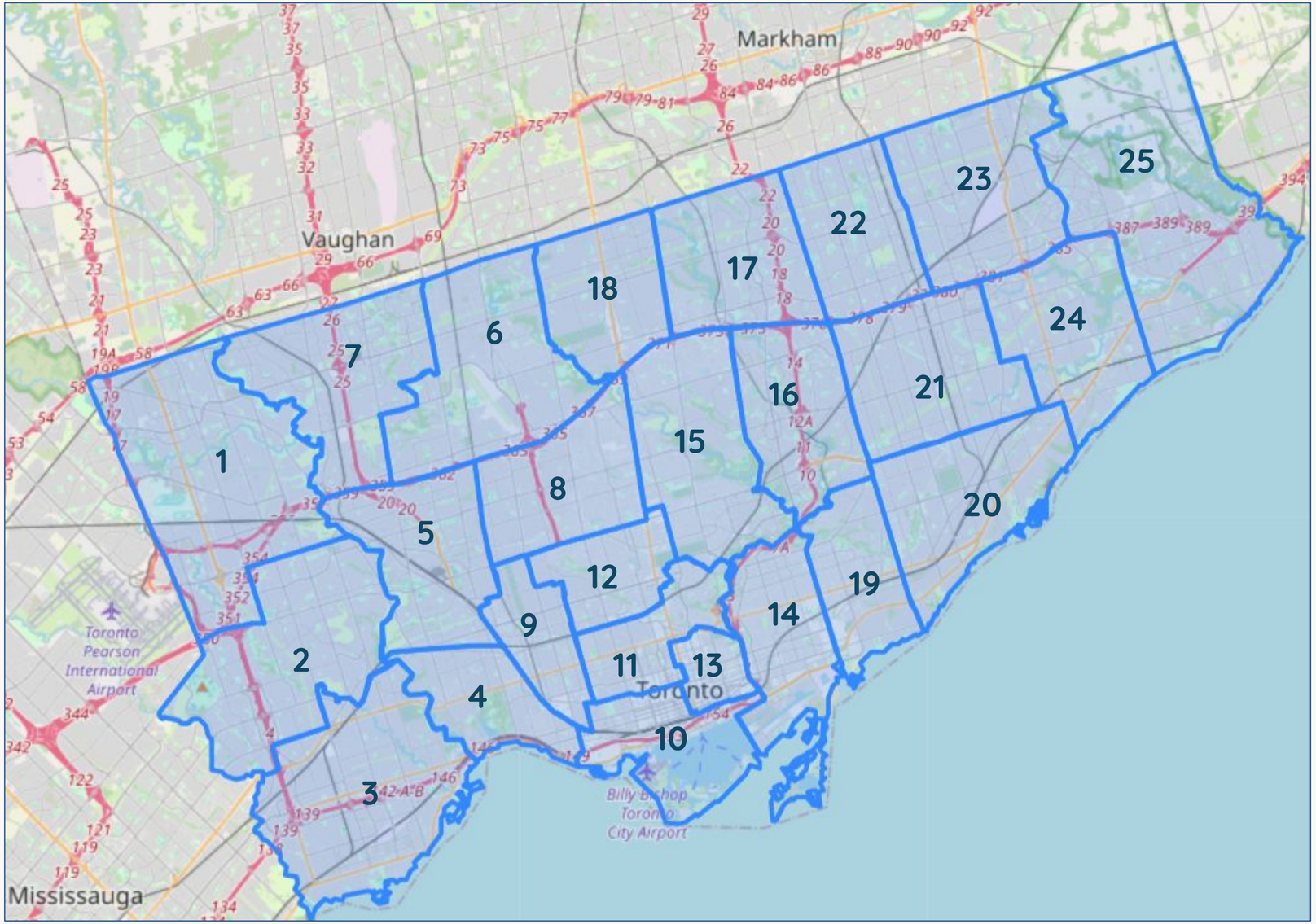
Analyze trends

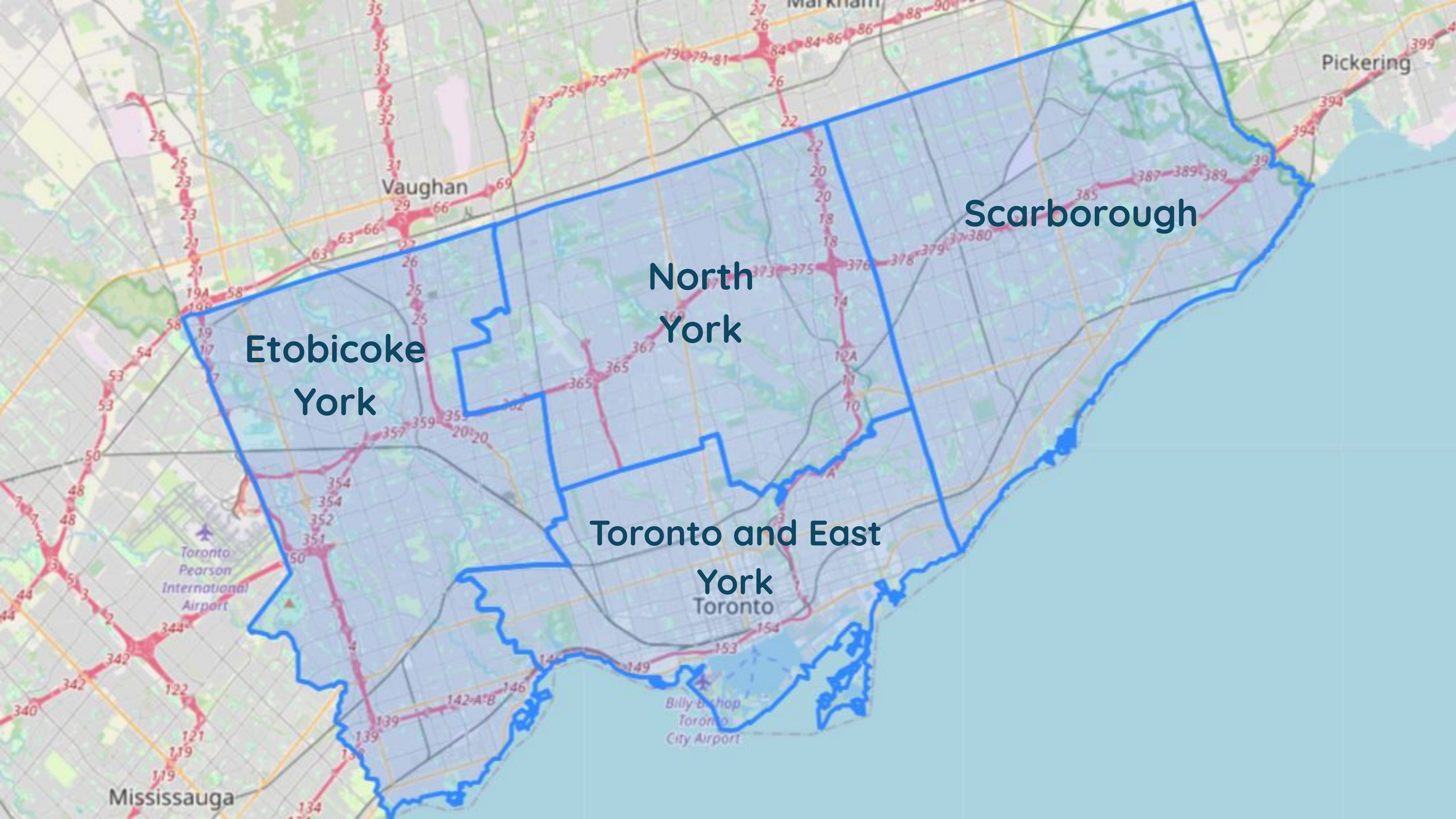

Identify Scope
Clustering Locations
Ward Profiles and Community Council Boundaries
TORONTO
Bicycle Collisions
Time Trend Analysis
Collision Statistics
Exploratory Data Analysis
Land Use Analysis
Activity Level Insights
Spatial Trend Analysis
Zoning By-Law
Ward Profile Demographics
Clustering
Demographic Analysis
Cycling Network
Time Trend Collision Analysis
Spatial Collision Analysis

Ward Profiles and Boundaries

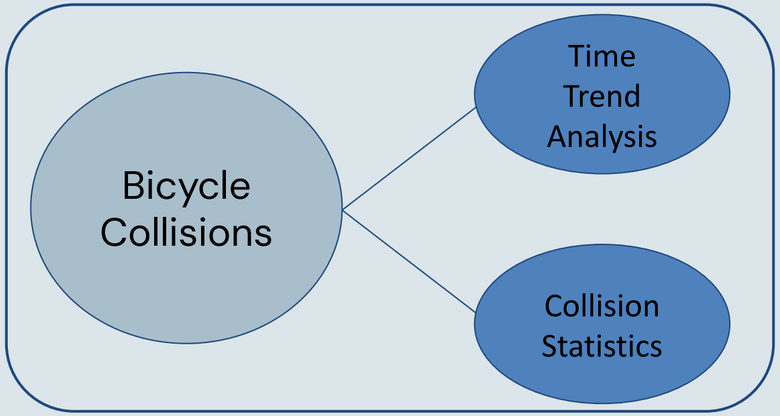


- As of 2018, there are 25 wards aligned with federal and provincial electoral boundaries [4].



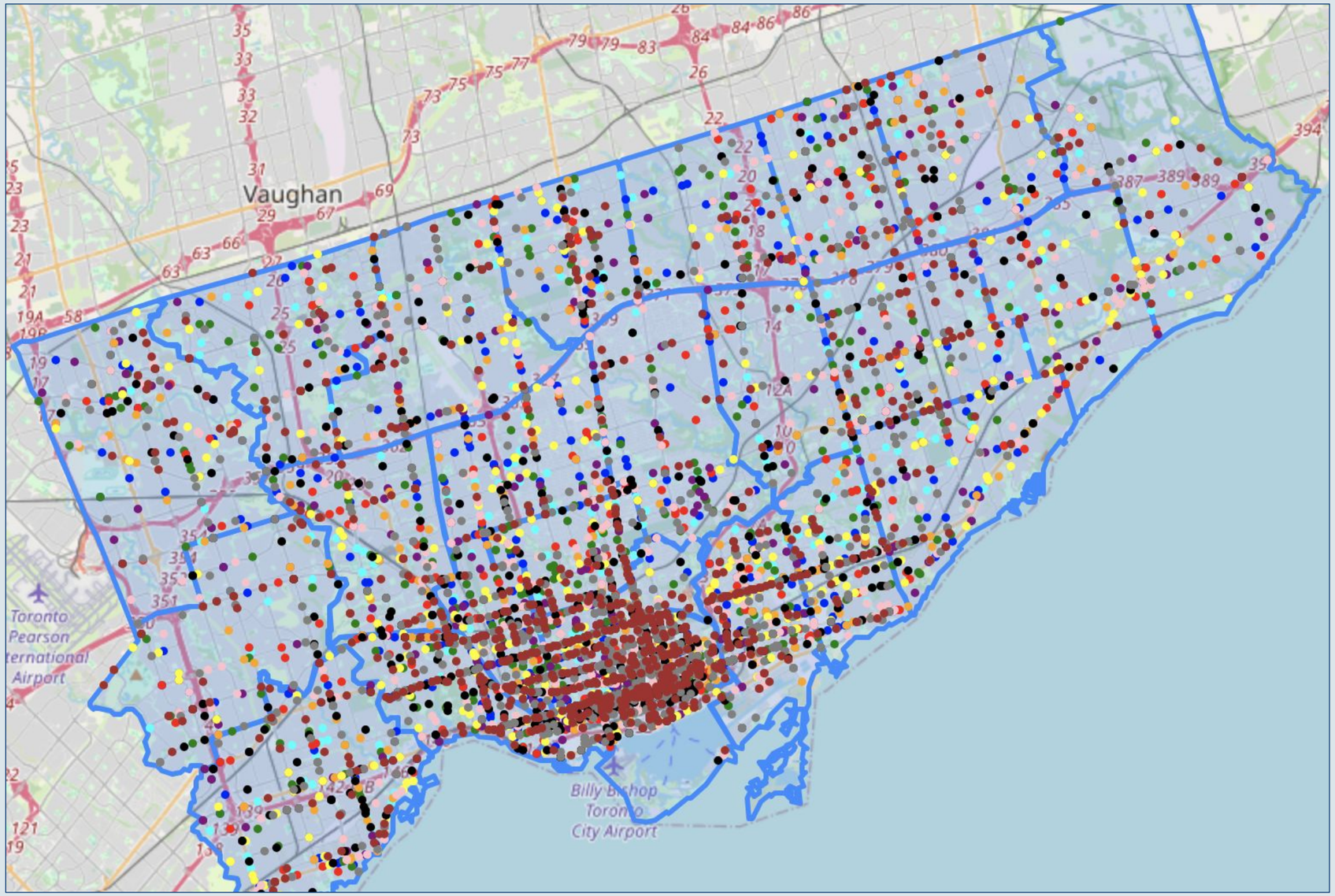

Etobicoke York
North York
Scarborough
Toronto and East York
Vaughan
Markham
Pickering
Toronto
Mississauga
Toronto Pearson International Airport
Billy Bishop Toronto City Airport

Bicycle Collisions across all Wards

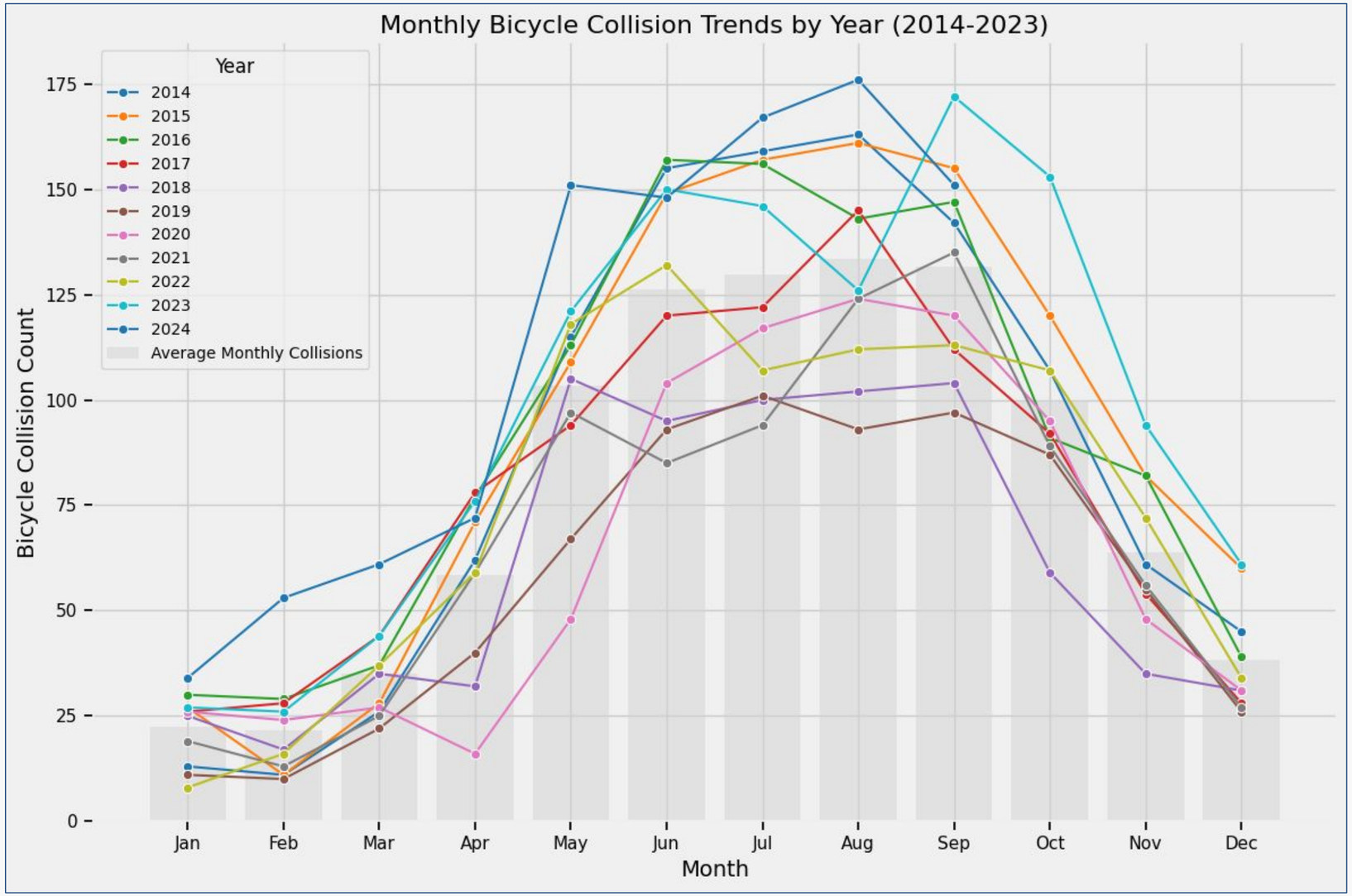


Legend

- Collisions in 2014
- Collisions in 2015
- Collisions in 2016
- Collisions in 2017
- Collisions in 2018
- Collisions in 2019
- Collisions in 2020
- Collisions in 2021
- Collisions in 2022
- Collisions in 2023
- Collisions in 2024



Monthly and Annual Periodicity

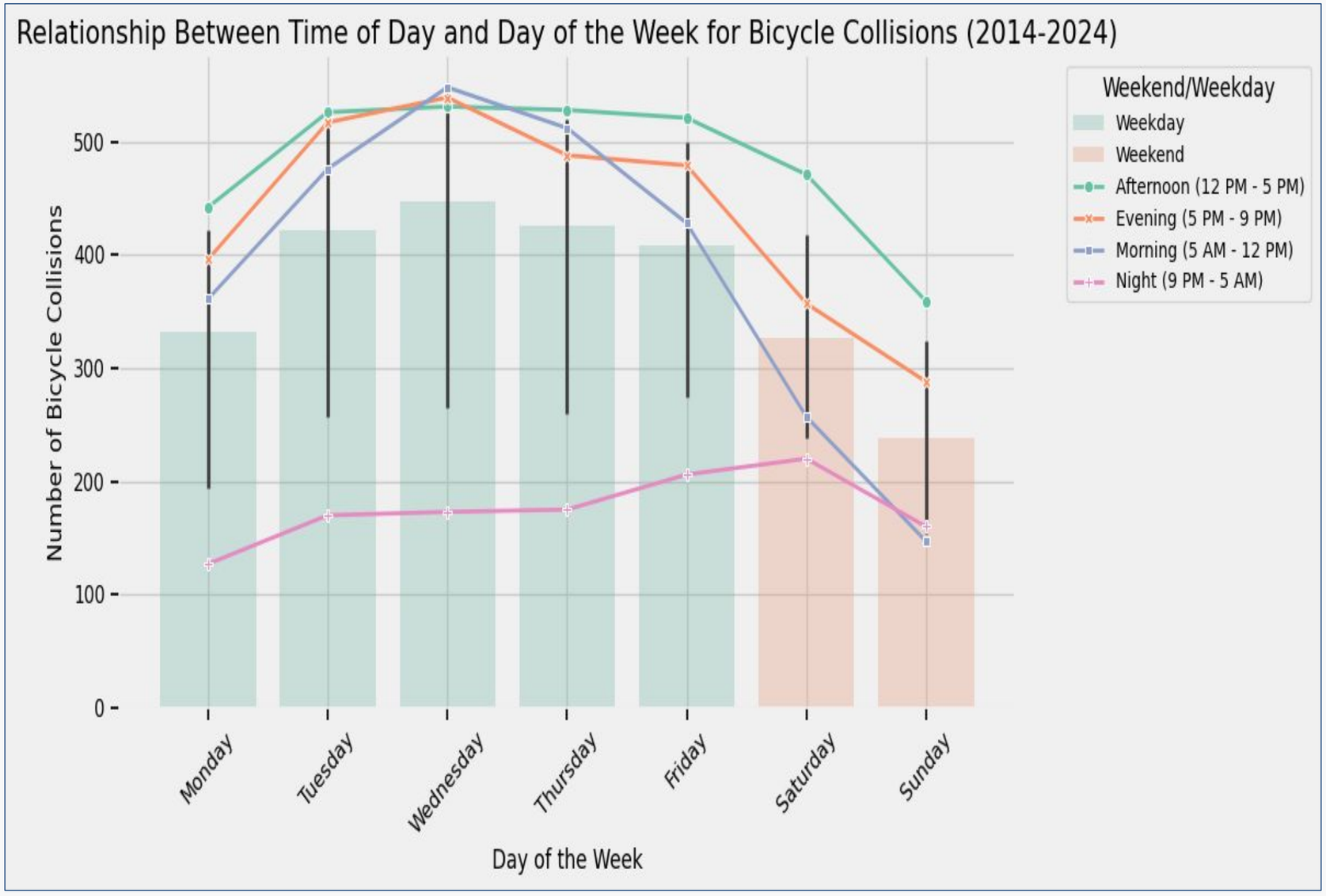


Trends Observed:

- Bicycle collisions peak in warmer months (May to August), particularly in June, and decrease in the fall and winter.

- There is an upward trend in collisions from 2014 to 2024, with notable increases in 2023 and 2024.
    - Due to COVID-19 [5].

Weekly and Daily Trends



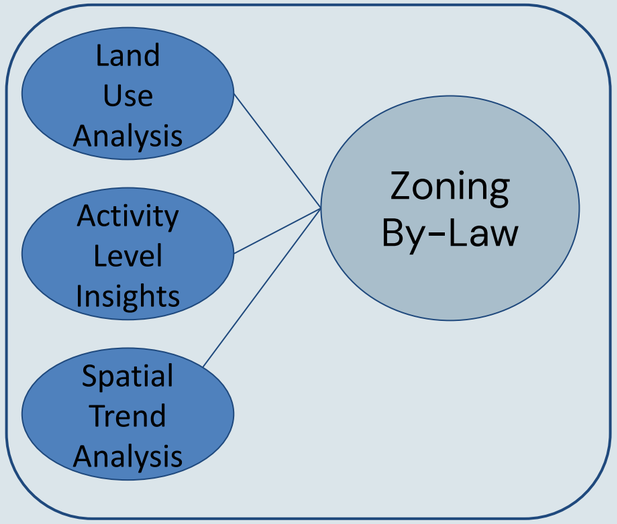
Trends Observed:

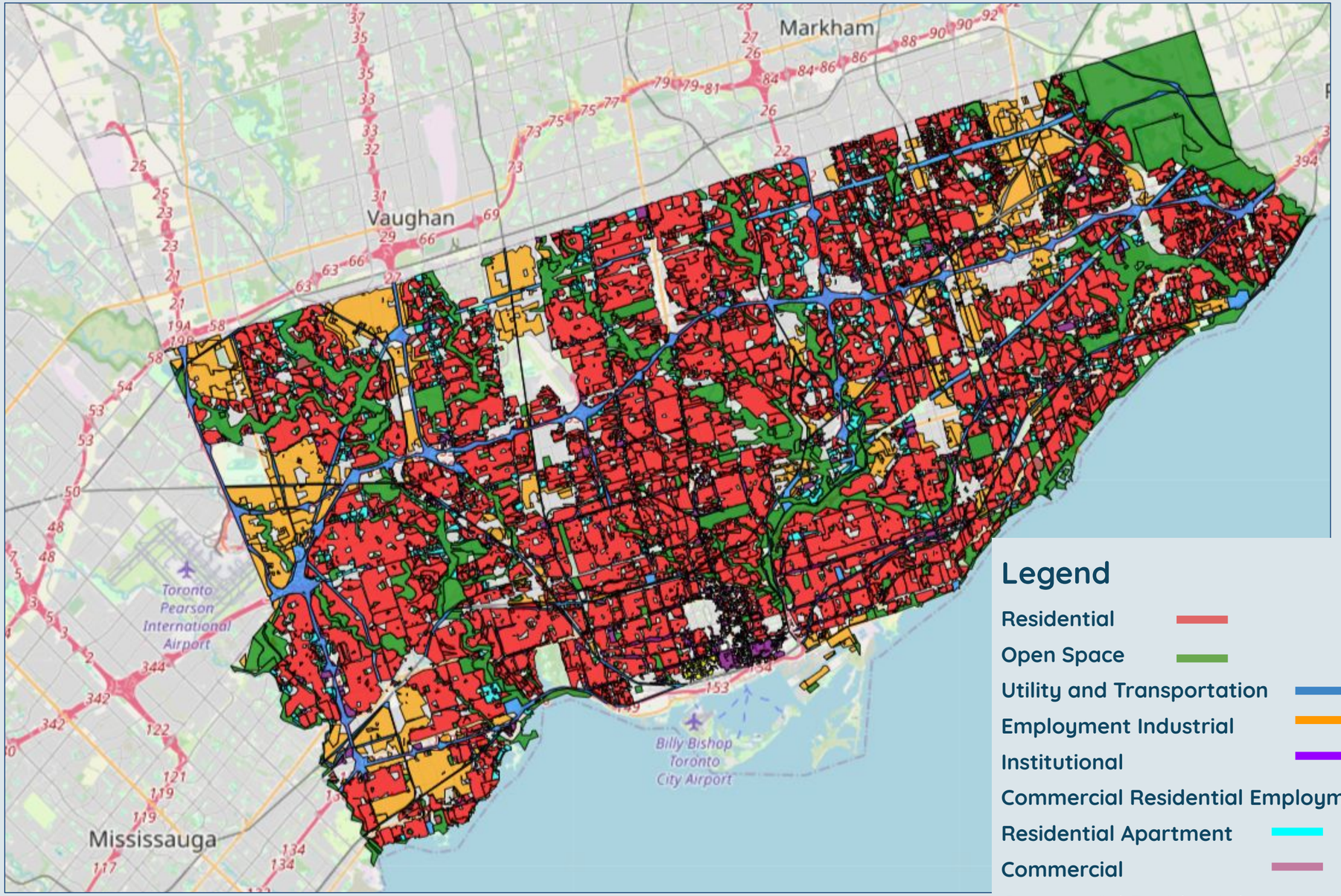
- Bicycle collisions peak on weekdays, particularly in the afternoon (12 PM - 5 PM)
- Collisions drop significantly at night (9 PM - 5 AM), when fewer cyclists are on the roads, and weekends generally see fewer incidents compared to weekdays [6].

Suggest Flashing Beacons on Bicycle Signs

- Research indicates that flashing beacons can reduce speed by up to 20% and increase driver compliance rates by over 80% in active school zones [7].

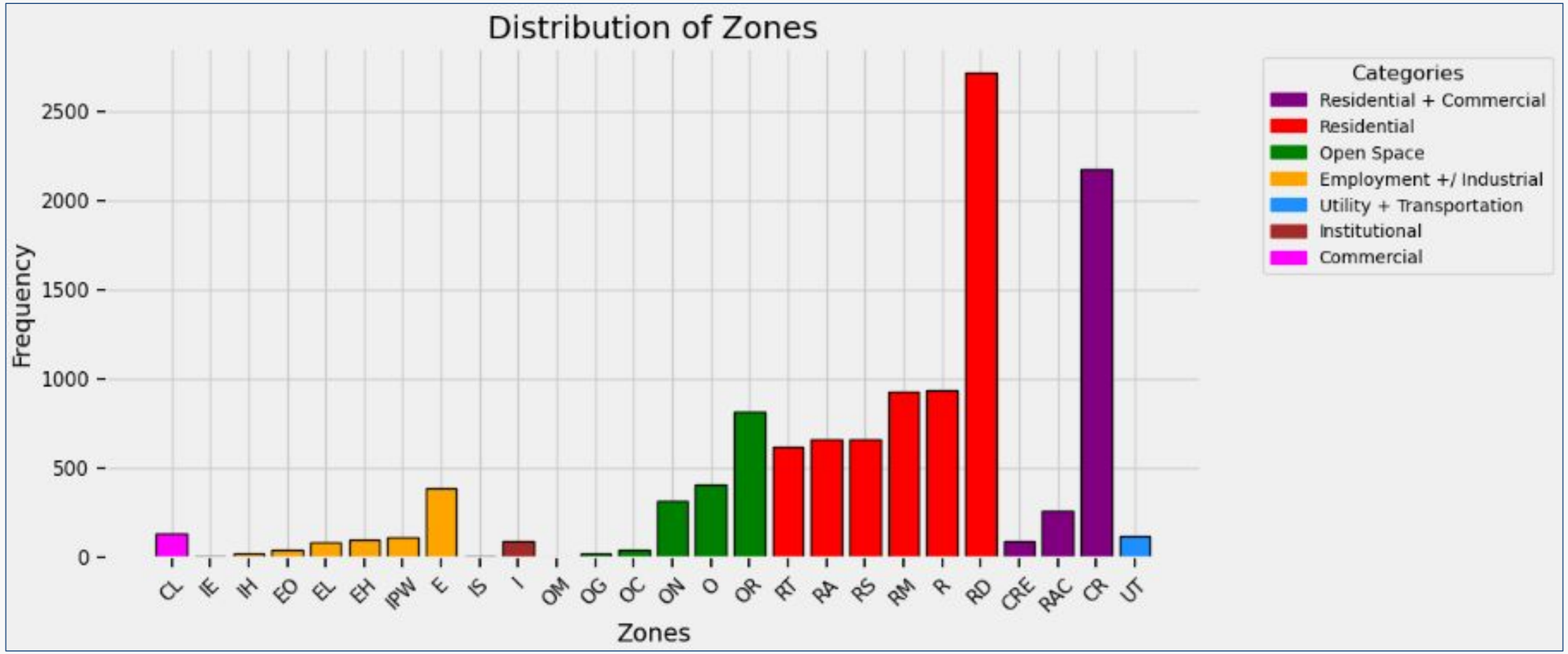
City of Toronto Zoning By-Laws



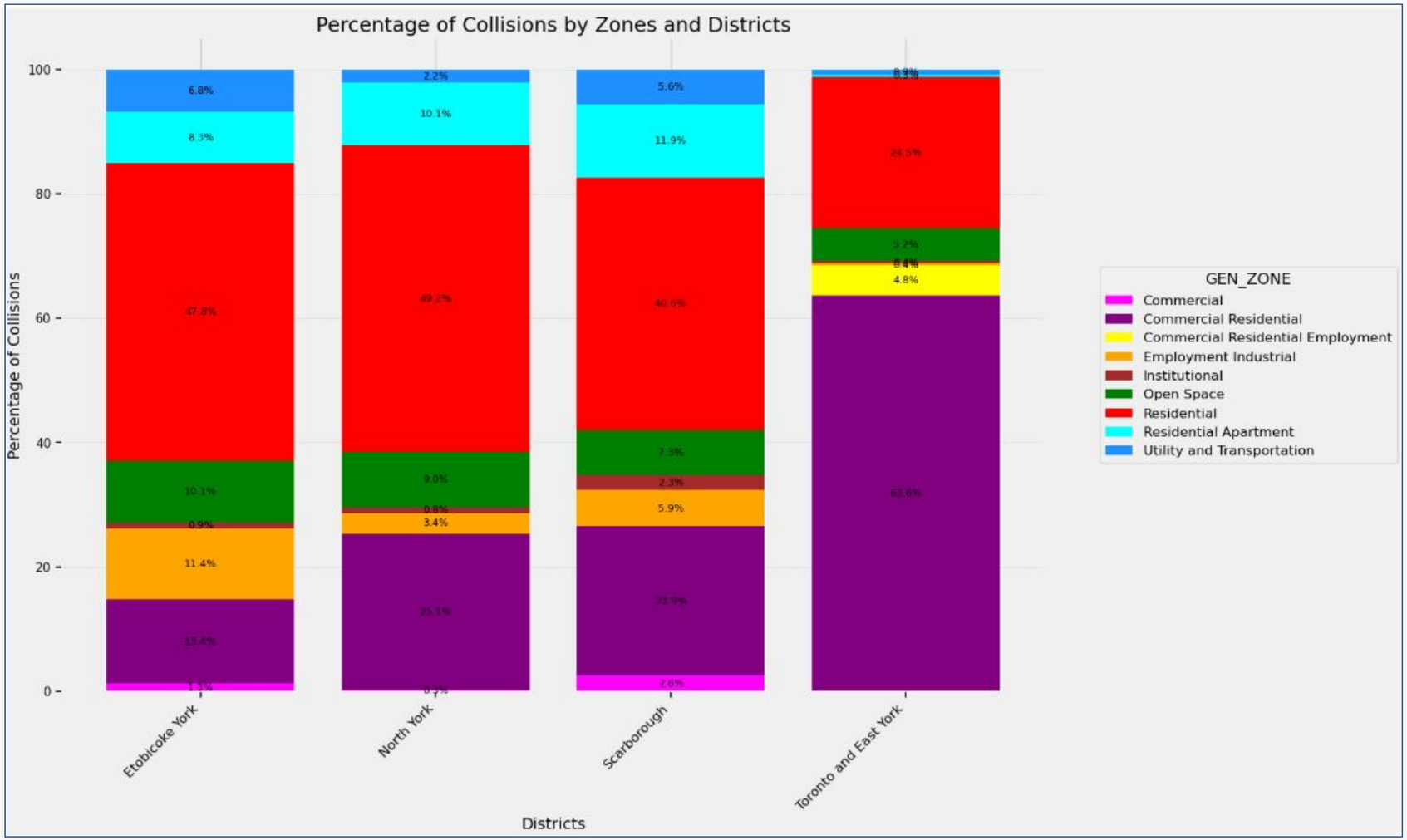


Historical Residential Data

- As per 2021, Residential detached and semi-detached zones covers the most land area in Toronto. The gross area of the RD zone is just under a third (31.5%) of all land in Toronto [8].



Collision Percentages Across Zones and Districts



Trends Observed:

- Residential Zones account for the highest percentage of collisions in the districts, other than Toronto and East York, where Commercial Residential areas account for highest collisions.
- Low level of collisions in commercial, utility and transportation, and institutional zones.

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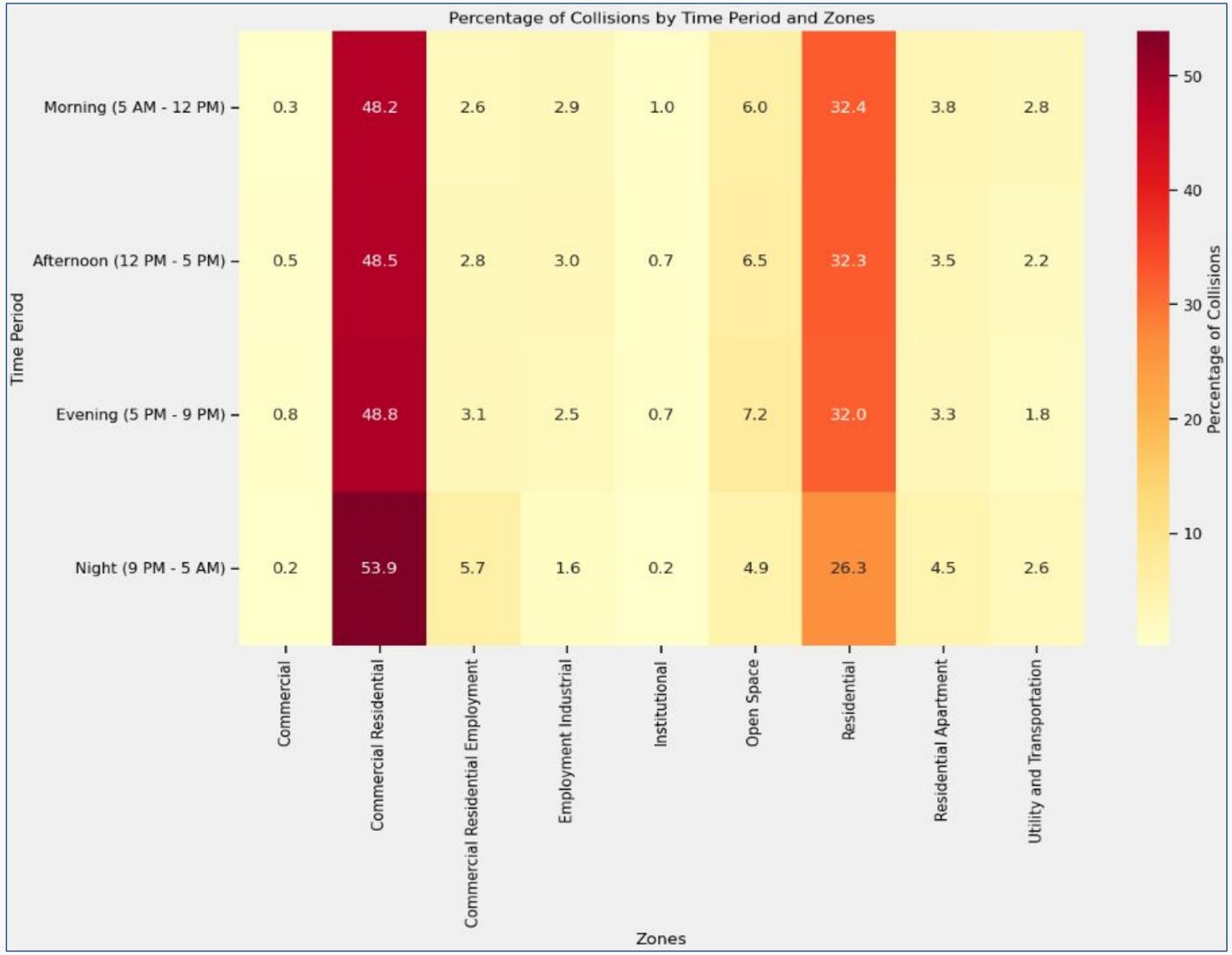
Implementation of Beacons across Zones



Trends Observed:

- Expanding safety measures, such as flashing beacons, to these high-traffic areas could reduce collisions, especially during the afternoon and evening when cyclist activity is highest.

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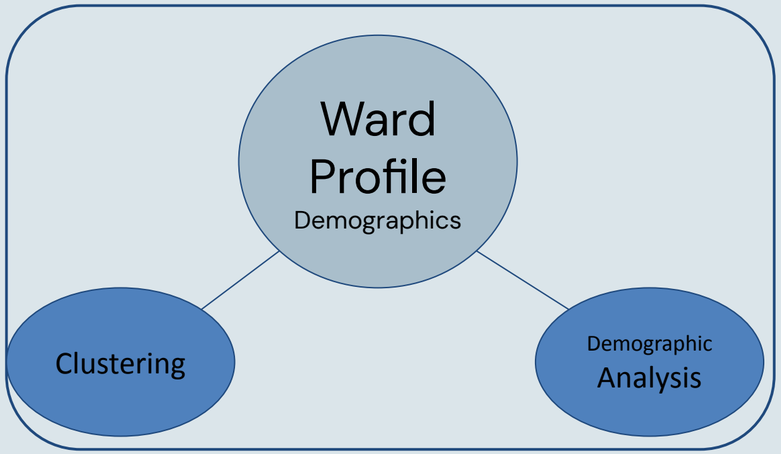
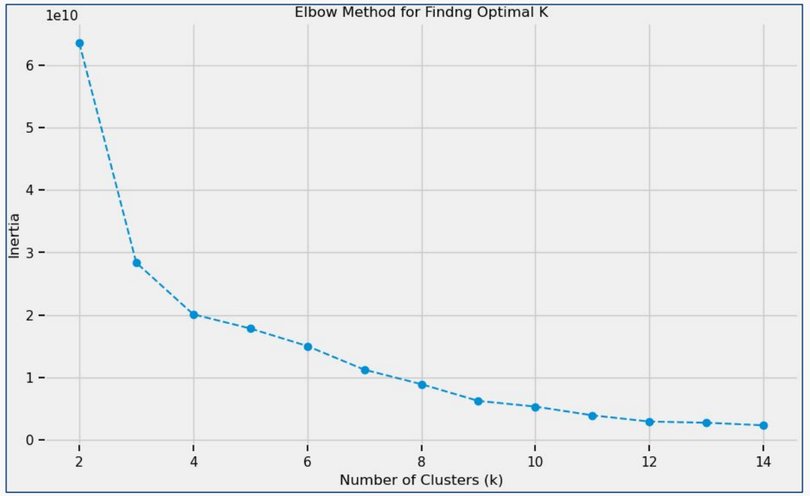
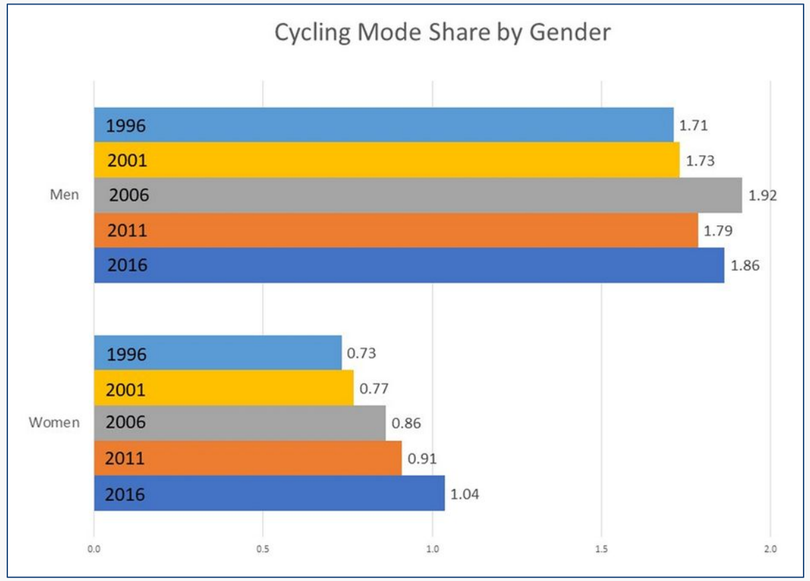
Clustering Process and Reasoning

Clustering:

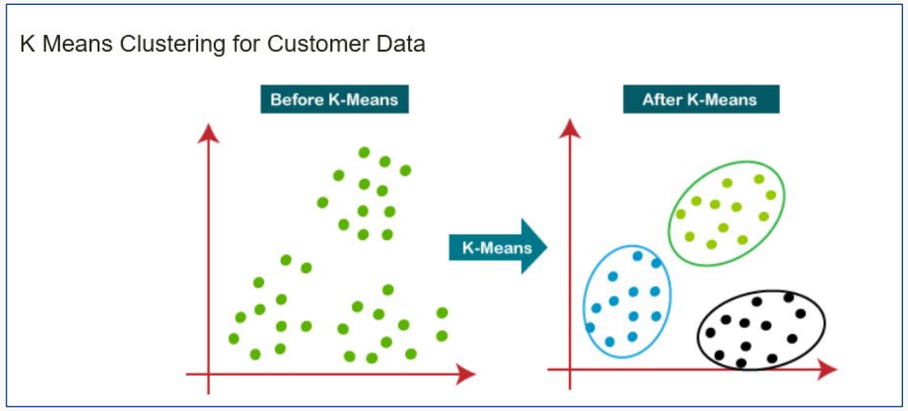
- Looked at features representing larger scale patterns in data backed up by domain knowledge
- Used elbow method to find optimal cluster k number
- Reduced number of dimensions
- Scale data (MinMax Scaling)
- Avoid multicollinearity





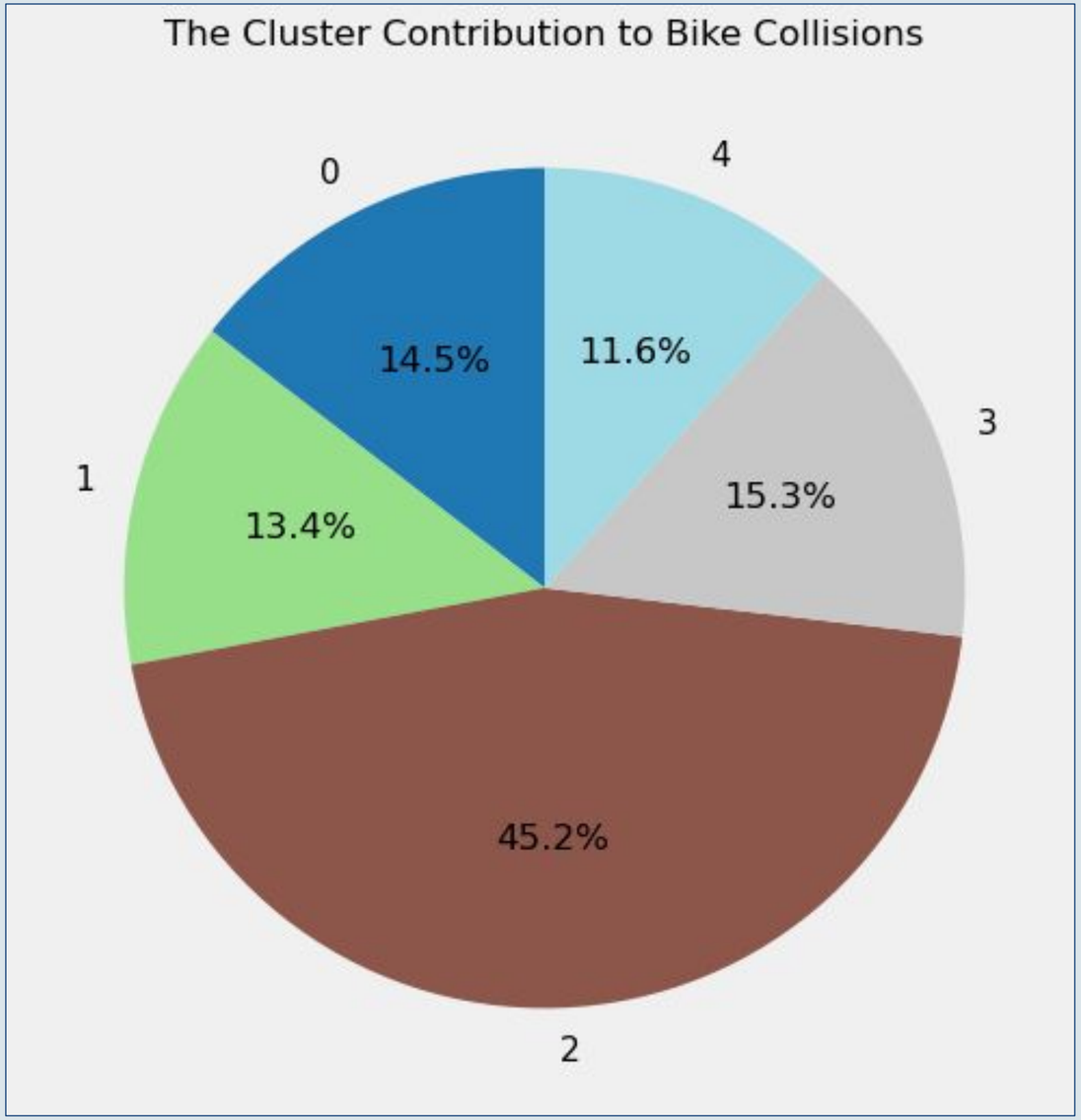


[10]



[11]

Patterns in the Clusters



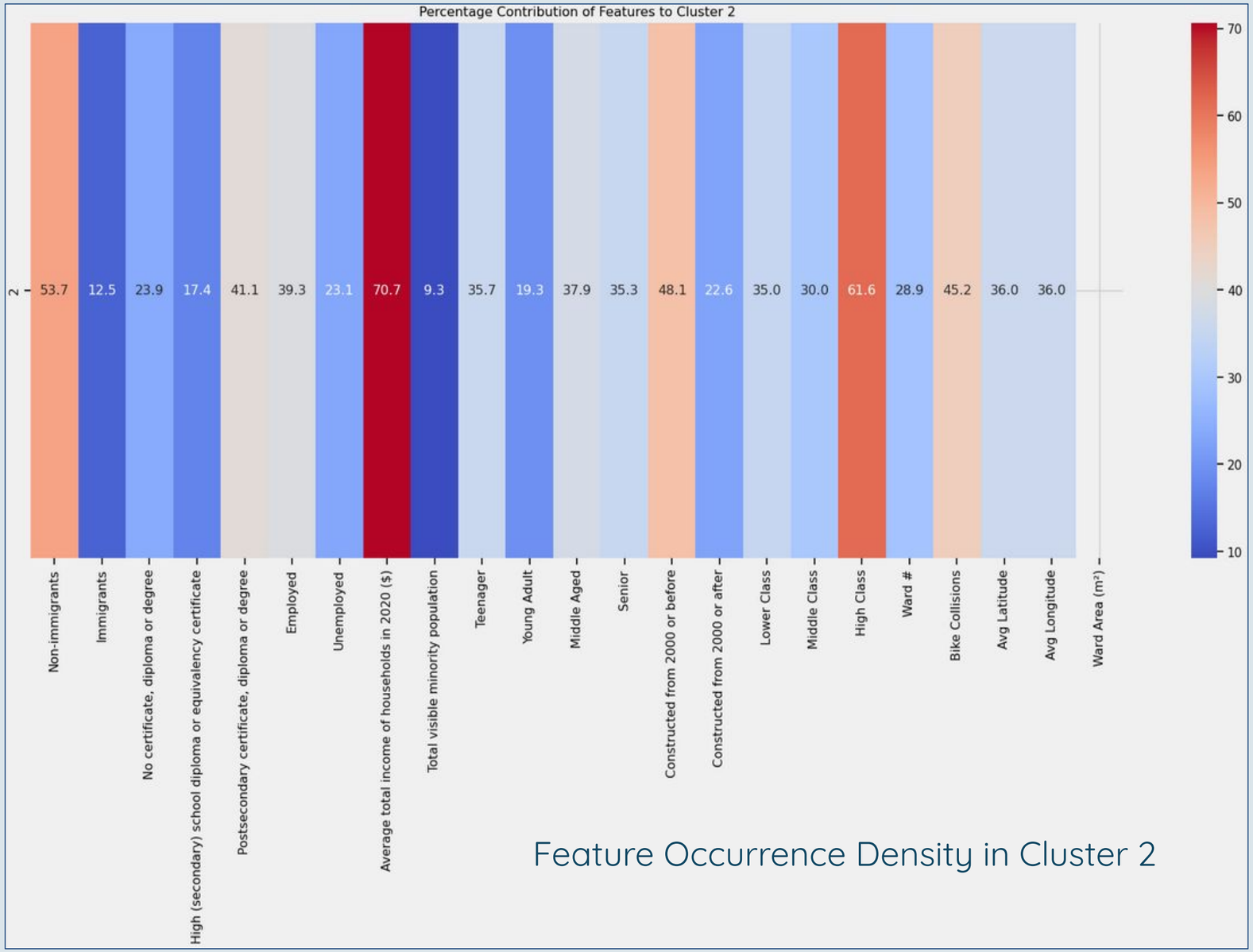
- List of features:
  - Immigration Status
  - Employment Status
  - Level of education (None, high school, postsecondary)
  - Total Household Income
  - Age
  - Class
  - Household construction dates
  - Visible Minority Population
  - Accounted for ward area
- Largest cluster contribution to bike collision being cluster 2
- Why?

Clustered Data Composition

General Correlation of Features

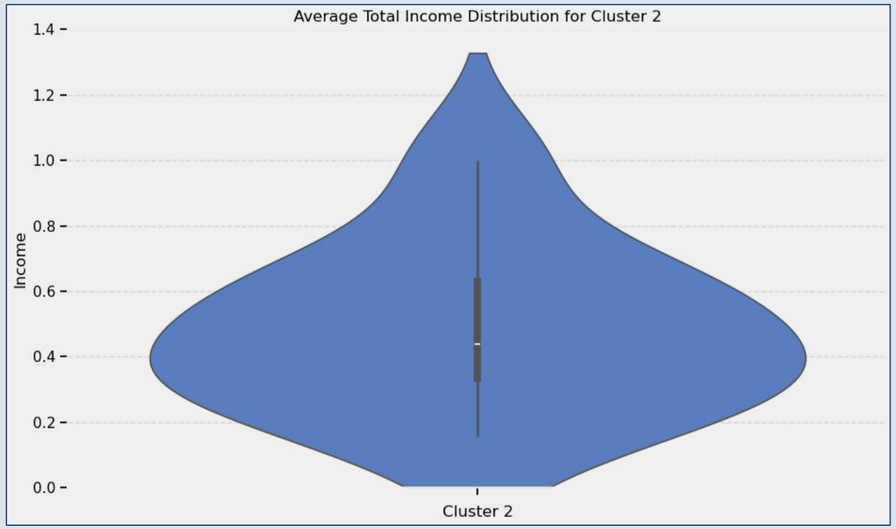
Bike Collisions	1.000000
Young Adult	0.742811
Lower Class	0.739840
.Constructed from 2000 or after	0.720792
Middle Aged	0.714497
Employed	0.709883
Middle Class	0.661535
Postsecondary certificate, diploma or degree	0.640018
Non-immigrants	0.472898
High Class	0.472303
Unemployed	0.408546
Average total income of households in 2020 ($)	0.126725
Constructed from 2000 or before	0.026761
Avg Longitude	-0.079335
Ward #	-0.199082
Total visible minority population	-0.296402
No certificate, diploma or degree	-0.407907
Immigrants	-0.408229
High (secondary) school diploma or equivalency certificate	-0.507721
Avg Latitude	-0.621712
Senior	-0.662883
Teenager	-0.817657
Ward Area (m²)	NaN
Name: Bike Collisions, dtype: float64	

Correlation of features in regards to bicycle collisions shown above (a heatmap would prove to be too cluttered)

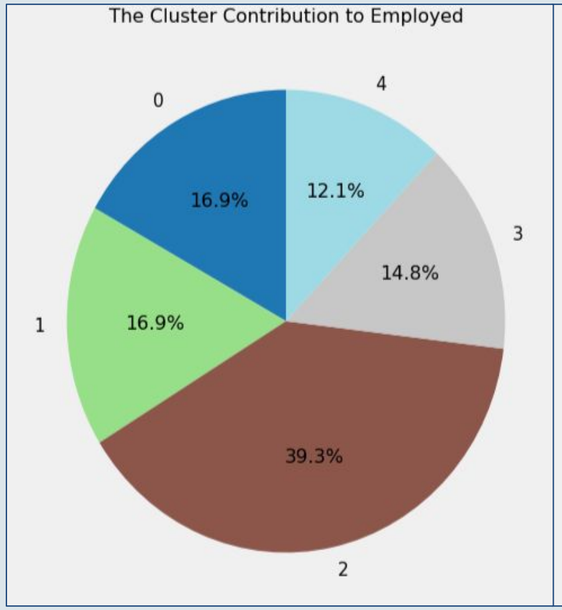


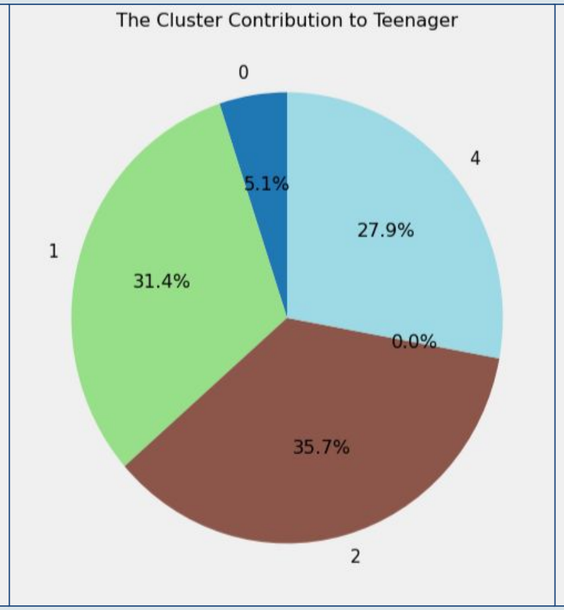
Feature Occurrence Density in Cluster 2

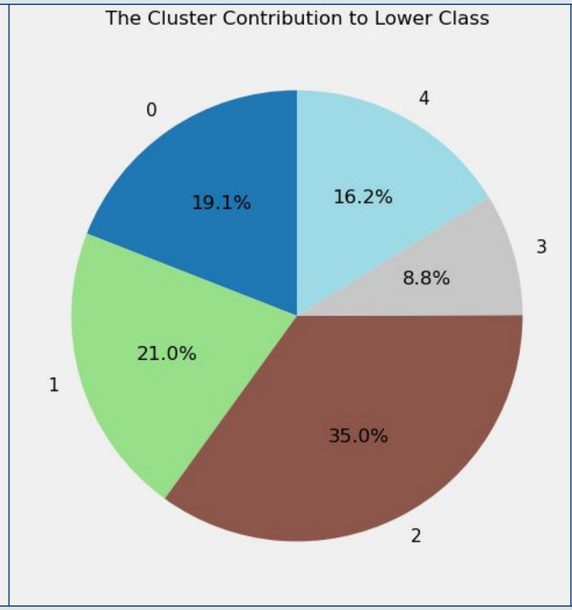
Clustered Data Trends

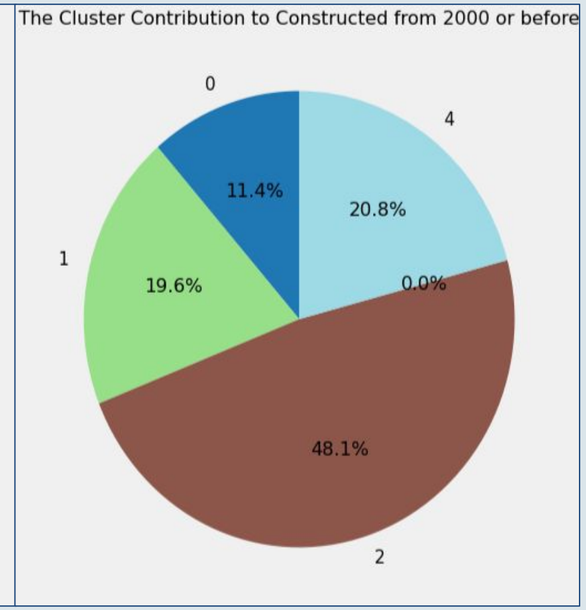


- Total household income lower than the average (data is normalized)
- More employment in Cluster 2
- More teenagers in cluster 2
- Older neighborhoods in cluster 2
- Higher portion of lower class residents

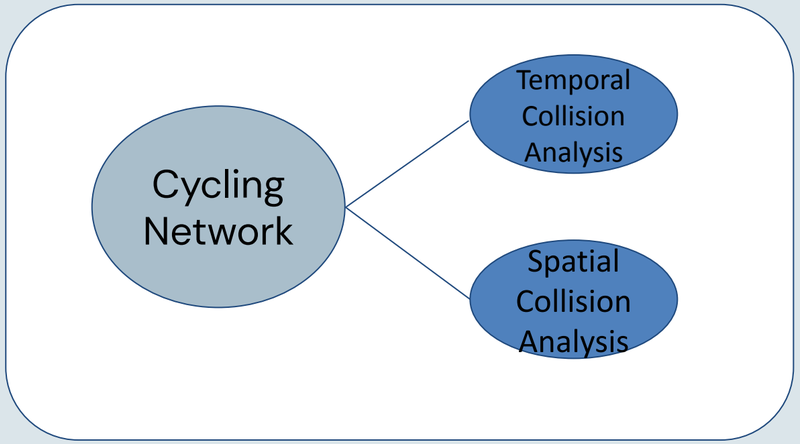








Bike Lane Infrastructure in Toronto



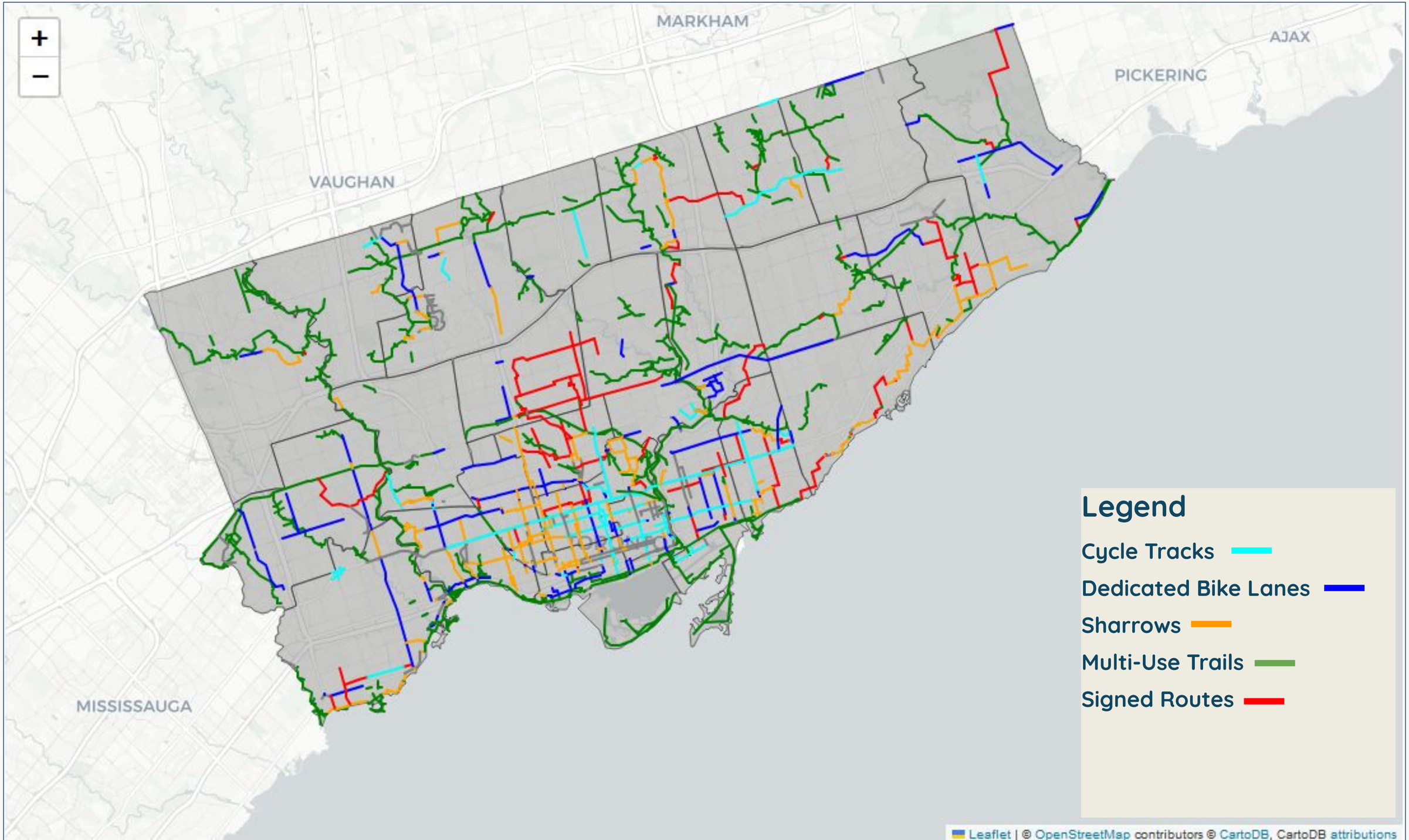
Cycle Tracks [12]

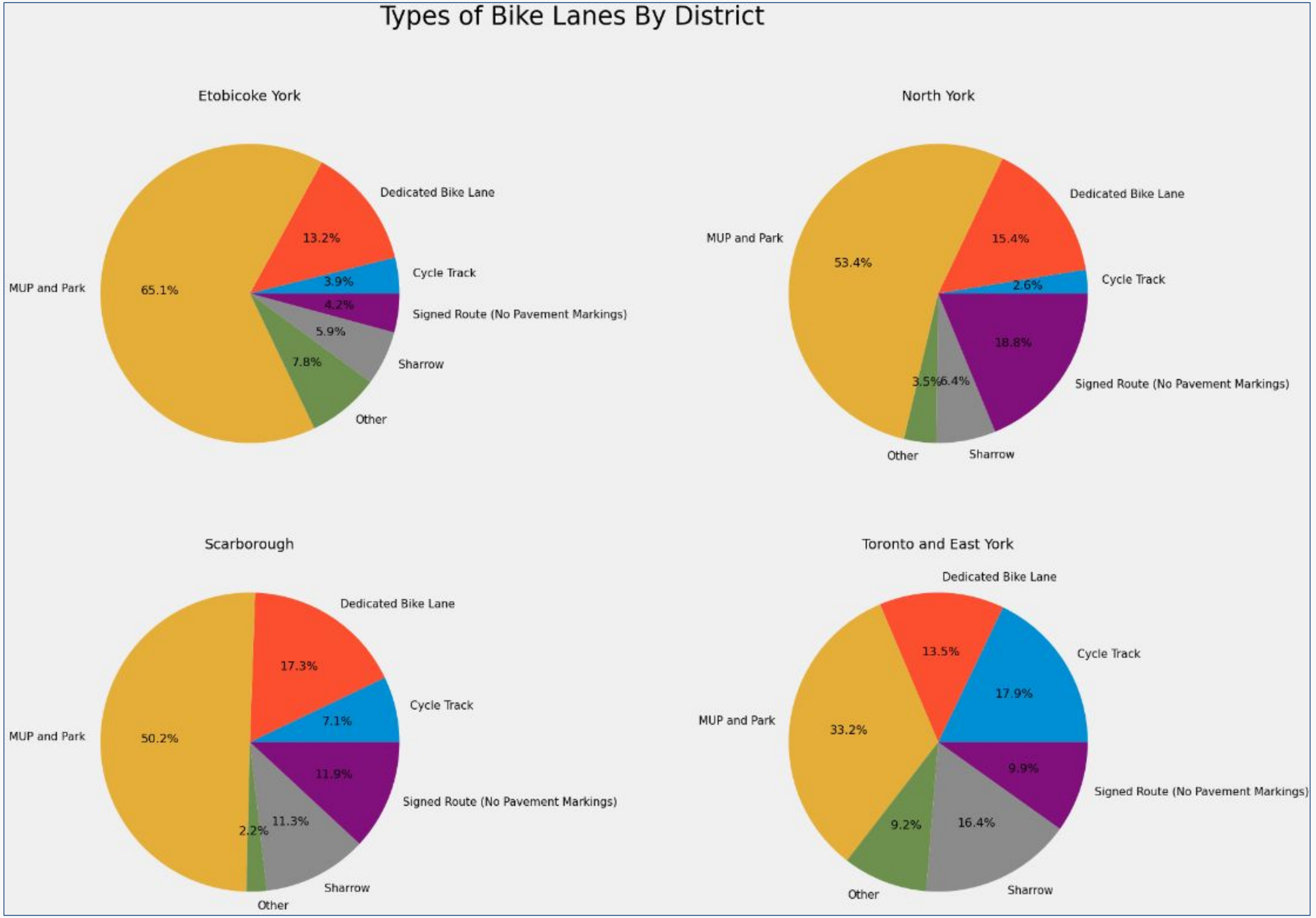
Bicycle Lanes [12]

Sharrow [12]

Multi-Use Trails [12]

Signed Shared Roadways [12], [13]

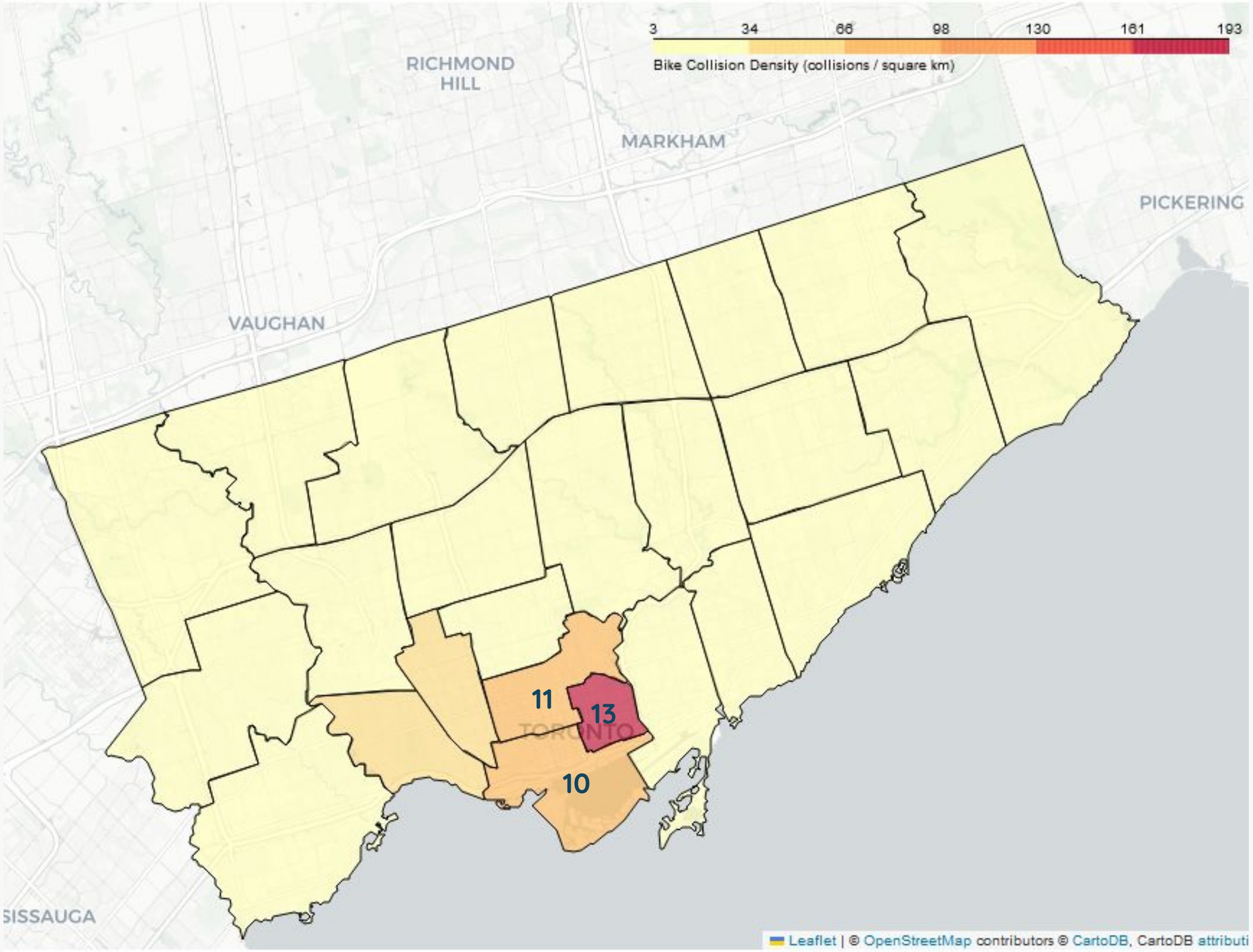

MARKHAM
AJAX
PICKERING
VAUGHAN
MISSISSAUGA
Legend
Cycle Tracks
Dedicated Bike Lanes
Sharrows
Multi-Use Trails
Signed Routes
Leaflet | © OpenStreetMap contributors © CartoDB, CartoDB attributions


Types of Bike Lanes By District
Etobicoke York
Dedicated Bike Lane
13.2%
Cycle Track
3.9%
MUP and Park
65.1%
4.2%
Signed Route (No Pavement Markings)
5.9%
Sharrow
7.8%
Other
North York
Dedicated Bike Lane
15.4%
MUP and Park
53.4%
Cycle Track
2.6%
18.8%
Signed Route (No Pavement Markings)
3.5%
6.4%
Other
Sharrow
Scarborough
Dedicated Bike Lane
17.3%
Cycle Track
7.1%
MUP and Park
50.2%
11.9%
Signed Route (No Pavement Markings)
2.2%
11.3%
Sharrow
Other
Toronto and East York
Dedicated Bike Lane
13.5%
Cycle Track
17.9%
MUP and Park
33.2%
9.9%
Signed Route (No Pavement Markings)
9.2%
16.4%
Other
Sharrow

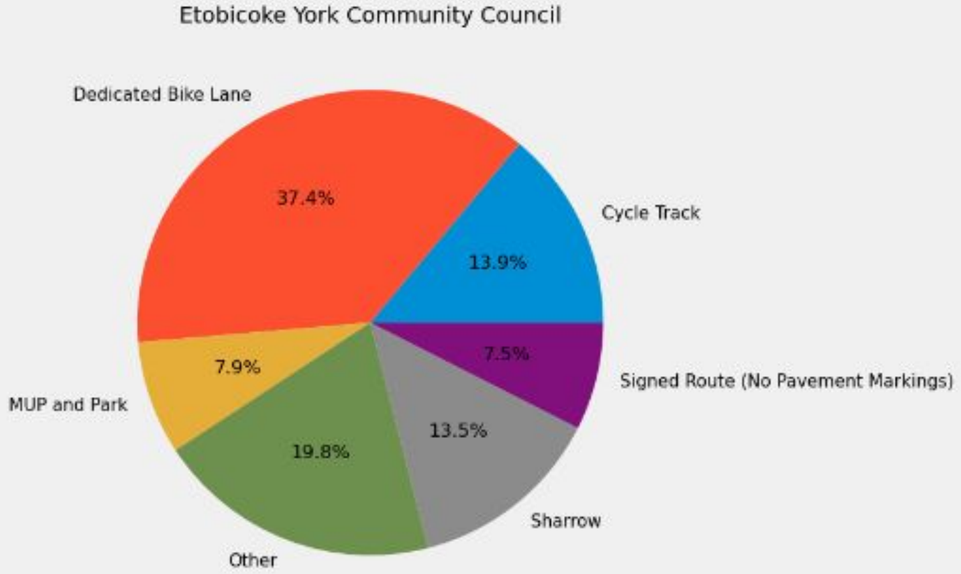
Key Takeaways:

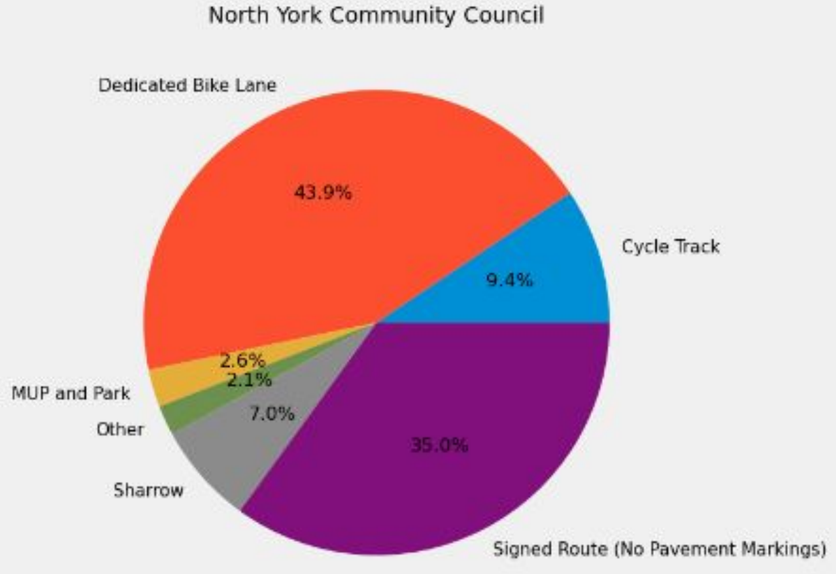
Most collisions occurred in Wards 10, 11, and 13. These Wards are located in the downtown core and include high traffic attractions such as:

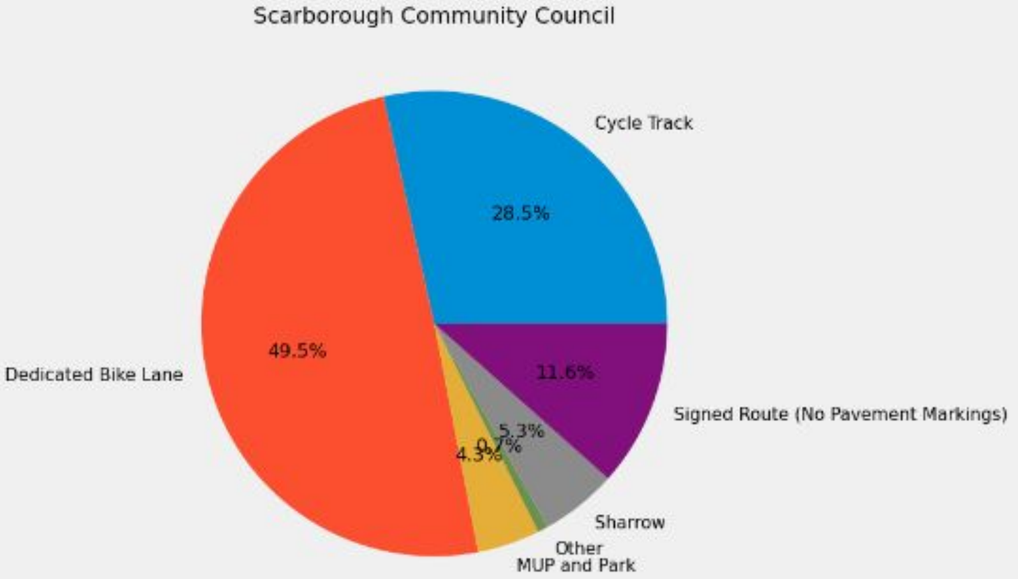
- Universities
- Transit Hubs
- Office Buildings

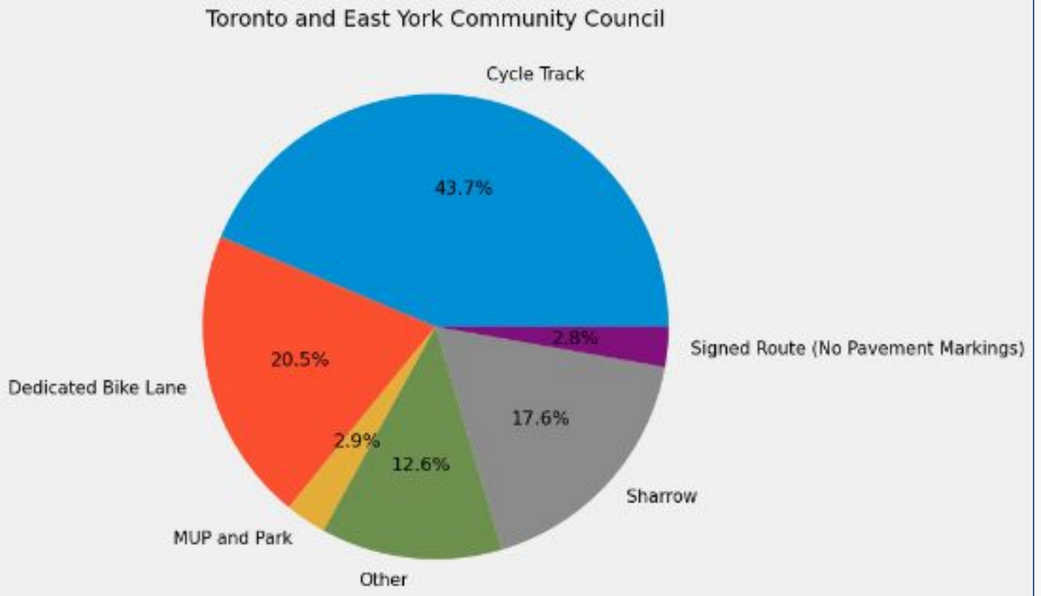


Collisions in Each Type of Bike Lane By District









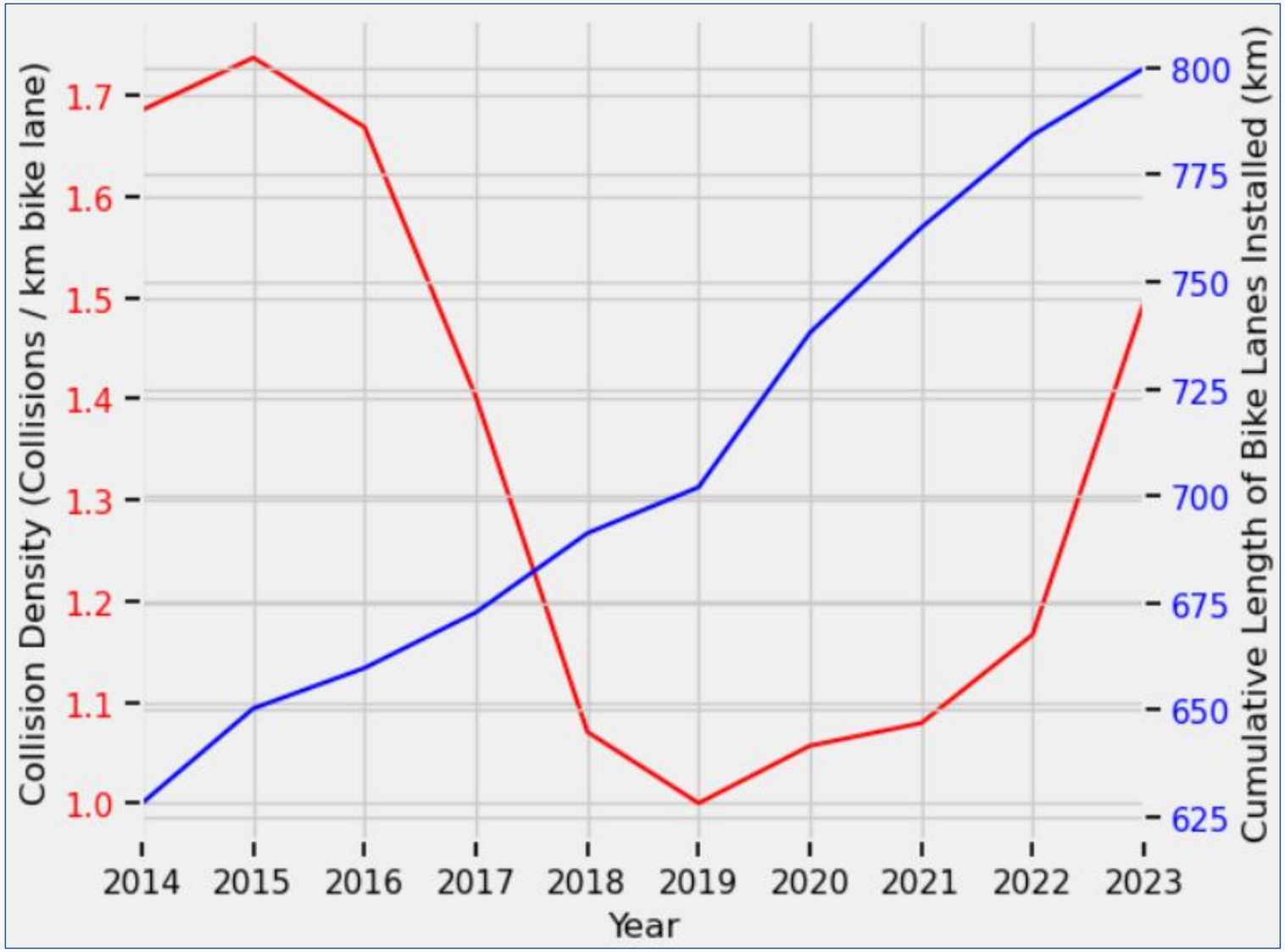
Key Takeaways

Collision Density:

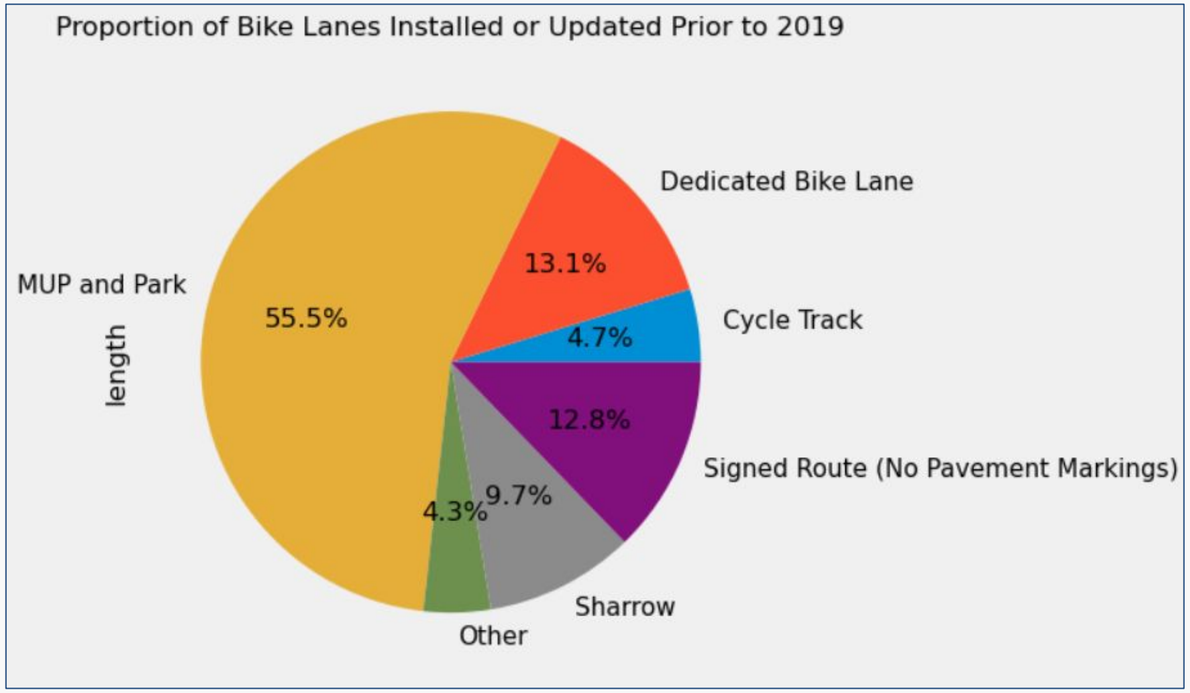
- Decreases from 2015 to 2019
- Increases from 2019 to 2023

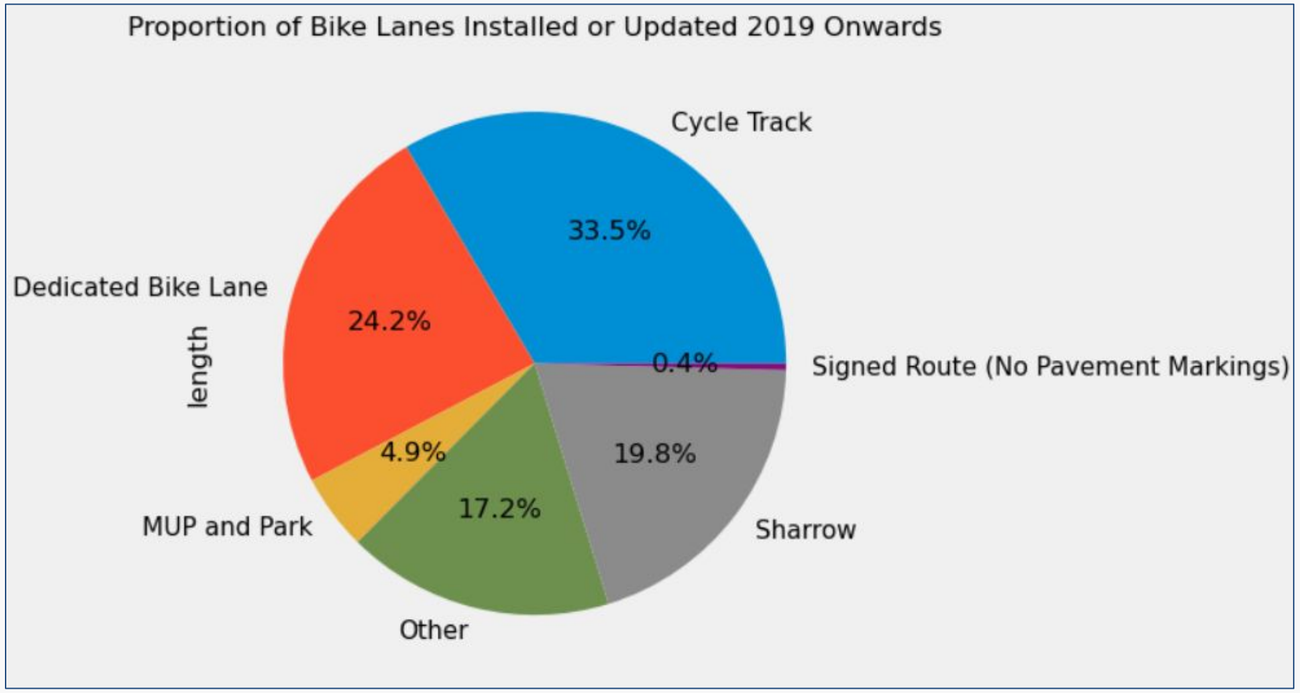
Cumulative Bike Lane Length:

- Increases from 2014-2023



What Changed in 2019?





Prior to 2019, the majority of bike lanes installed were multi-use paths (MUPs), after 2019 that changed to cycle tracks. Some relevant examples:

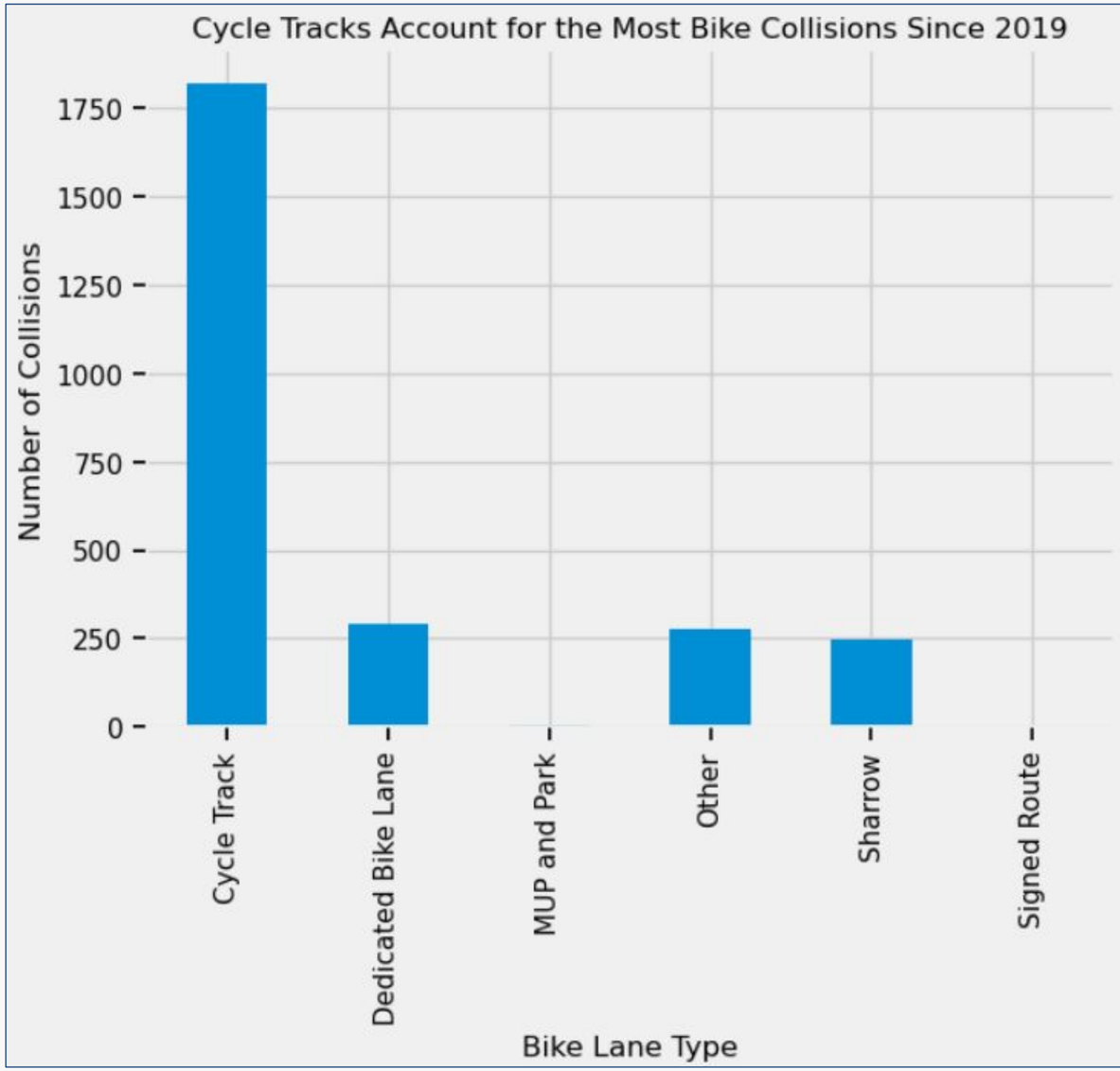
- Cycle tracks installed on Bloor St. W. from Shaw Street to Runnymede Road in 2020-2021 [14]
- Cycle tracks installed on University Ave. from Bloor Street West to King Street West in 2020-2022 [15]
- Cycle tracks installed Yonge St. from Bloor Street and Davisville Avenue in 2021 [16]

Cycle Tracks Seem To Be The Safest...Are They?

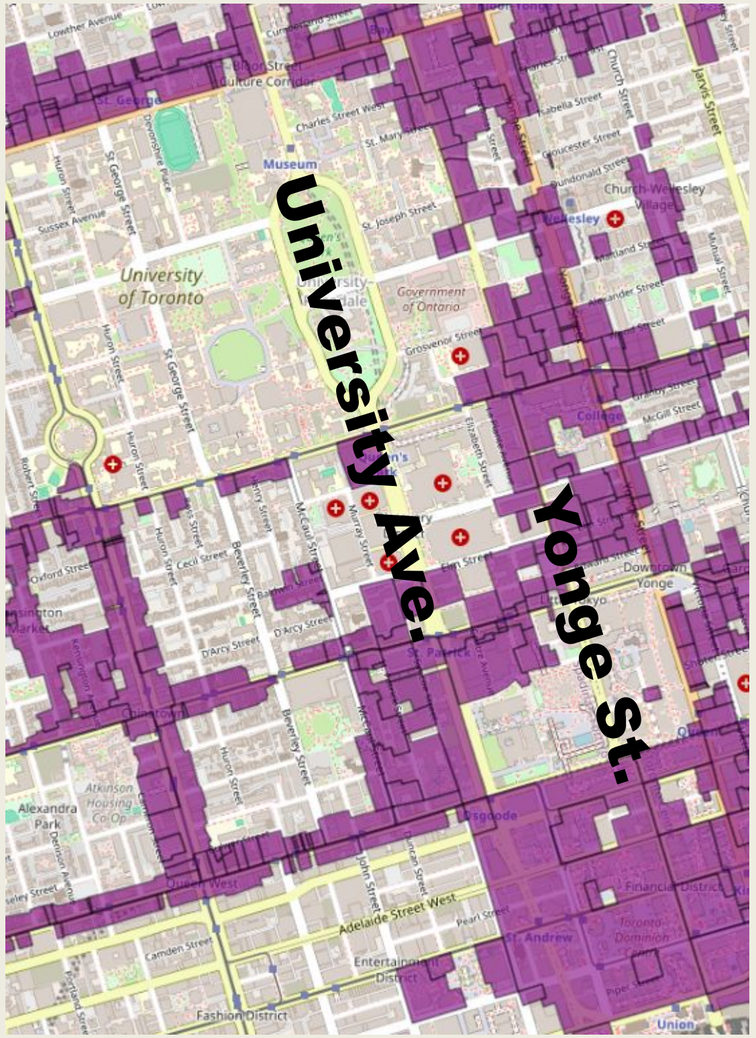
- The vast majority of bike collisions since 2019 occurred in cycle tracks.
- Research found that bike accidents are 2.6 times more likely on bike lanes than roadways [17].
- This is also consistent with another American study from 2019 that found that the number of bike collisions is 117% greater on bike lanes than shared roadways and 400% greater on bike lanes that are separated by some sort of traffic median [17].

What is the Problem?

- Cycle tracks are more dangerous - especially when there exists a large number of intersections - because they tend to hide the cyclists from the drivers [17].
- Makes both drivers and cyclists less sensitive to the dangers of their interactions [17].



Commercial Residential Zones



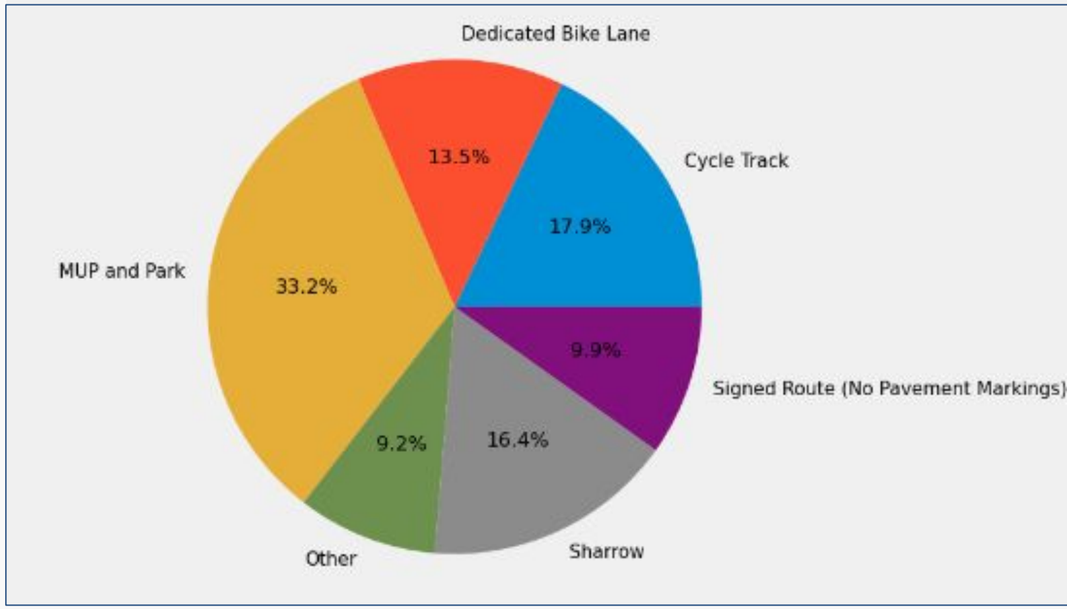
- Bike lanes are essential for promoting safe, sustainable transportation and reducing traffic congestion.
- In 2021, ~139,000 people commuted by bike. [18]
- 400% increase in bike commuters on these streets compared to average [19].

What Can Be Done?

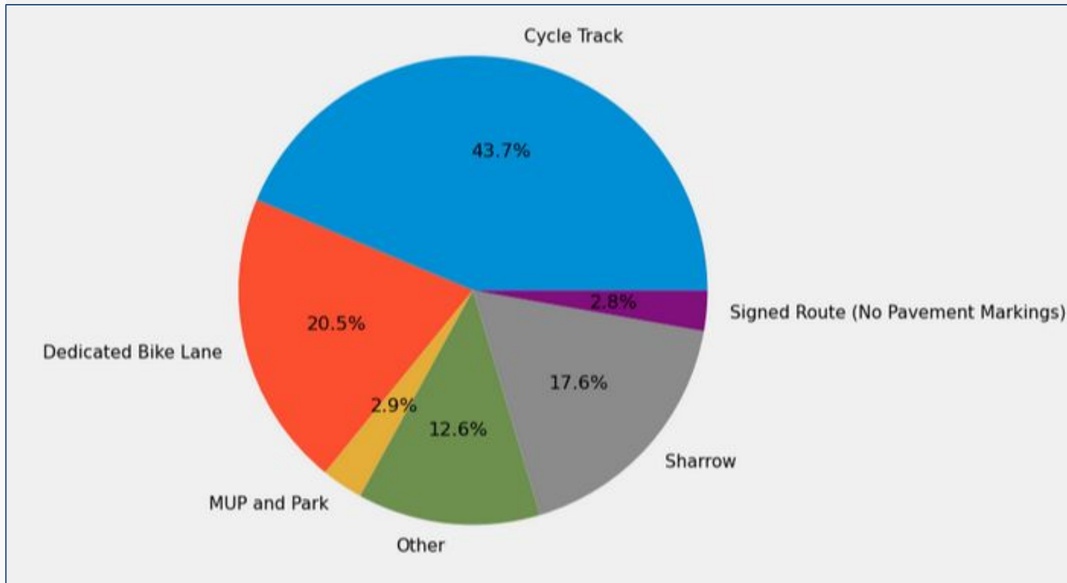
Replace Cycle Tracks with Other Bike Lanes

- More than two times the bike collisions occur in cycle tracks compared to dedicated bike lanes in the Toronto/East York district, but they are almost proportional in distance.
  - Replace cycle paths with dedicated bike lanes and reinstate an extra lane of vehicular traffic.
  - Add flashing beacons to bicycle signs along these routes to flash during rush hour.

Proportion of Bike Lanes in Toronto/East York District



Collisions by Bike Lane in Toronto/East York District



Thank You For Listening!

We are happy to answer any questions you may have.

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