Assignment 2: Geocoding Addresses Report

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Methods

The building permit dataset and address points dataset were downloaded as a CSV and shapefile respectively from the City of Kitchener GeoHub open data catalogue. The address points served as the reference data for geocoding, as each record represents a known civic address with spatial coordinates across the City of Kitchener.

Using the *Create Locator tool* in ArcGIS Pro, a Point Address locator was built using the address points as reference data. The Point Address field was selected as it matches individual civic address points rather than street centrelines, providing higher spatial accuracy. The following fields were mapped: AddressNum (house number), FullStreet (street name), and UnitNumber (unit identifier).

The *Geocode Addresses tool* was then run against the full permits dataset using the foldername field as the address input, producing the following results:

Table 1. Geocoding match results for building permits dataset.

Status	Count	Percentage
Matched	72,472	96.29%
Unmatched	2,791	3.71%
Tied	4	<0.01%

All 4 tied matches were resolved manually using the *Rematch tool*, where each tied record was reviewed and the correct candidate was selected. Then, a definition query on the permits dataset was applied to isolate New Construction permits within the study period:

work_type = 'New Construction' AND issue_year >= 1999 AND issue_year <= 2022

This reduced the dataset to 25,870 records. The issue_year field was configured as the time field using a YYYY format, enabling temporal filtering within ArcGIS Pro. The Time Slider was configured with a 1 year step interval spanning January 1, 1999 to December 31, 2022. A 1-year interval was selected to match the annual granularity of the permit data, as building permits are issued throughout the year and grouping by year produces meaningful, readable changes at each animation step.

Finally, an animated visualization was created using the *Animation tools* in ArcGIS Pro. Time Slider Steps were imported to automatically generate one keyframe per year, producing a 24 frames cumulative animation showing new construction permits accumulating across the city over time. A cumulative approach was chosen over a single-year display, as it more effectively

communicates the total growth footprint of the city over time rather than isolated annual snapshots. The animation was exported as an MP4 video. A bar chart of total new construction permits per year was also generated directly from the attribute table to visualize temporal trends. A map layout was produced in ArcGIS Pro displaying all New Construction permits with full cartographic surround including title, legend, scale bar, north arrow, and inset maps. The full processing workflow is summarized in Figure 1.

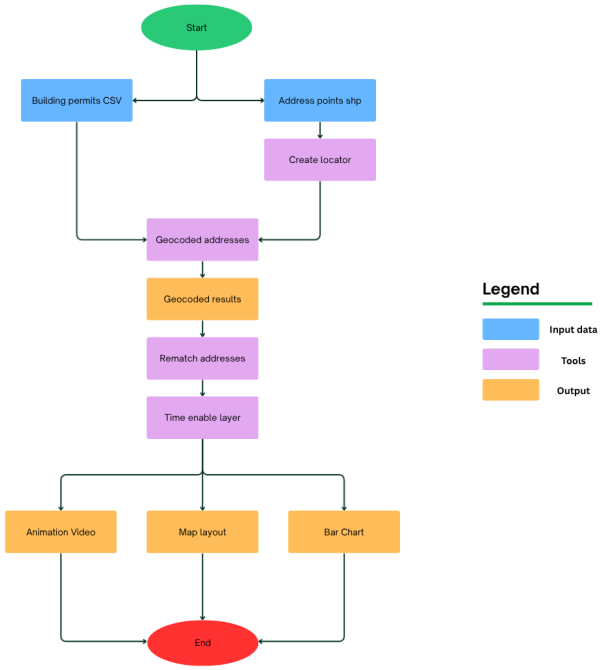

Figure 1. Methods workflow for geocoding City of Kitchener building permits and visualizing new construction activity (1999–2022).

Results and Discussion

The geocoding process achieved a match rate of 96.29% across 75,267 permits, indicating a high-quality locator built from a well-maintained municipal address dataset. The 3.71% unmatched rate is particularly meaningful when examined in the context of new construction. Building permits for new construction are issued before a building physically exists, meaning the associated civic address may not yet have been registered in the City of Kitchener address points layer at the time of its creation. The most recently issued new construction permits are precisely the records least likely to find a match in the reference layer, since both records do not simultaneously exist in both databases. This is a structural limitation inherent to geocoding forward-looking permit data rather than an error in methodology. Renovation and alteration permits, by contrast, reference existing addresses and would be expected to produce higher match rates.

Spatial analysis of the 25,870 New Construction permits reveals concentrated development activity along the suburban areas of Kitchener. As shown in Figure 2, clusters are prominent in suburban neighbourhoods including Huron South, Doon South/Pioneer Park, and Grand River South.

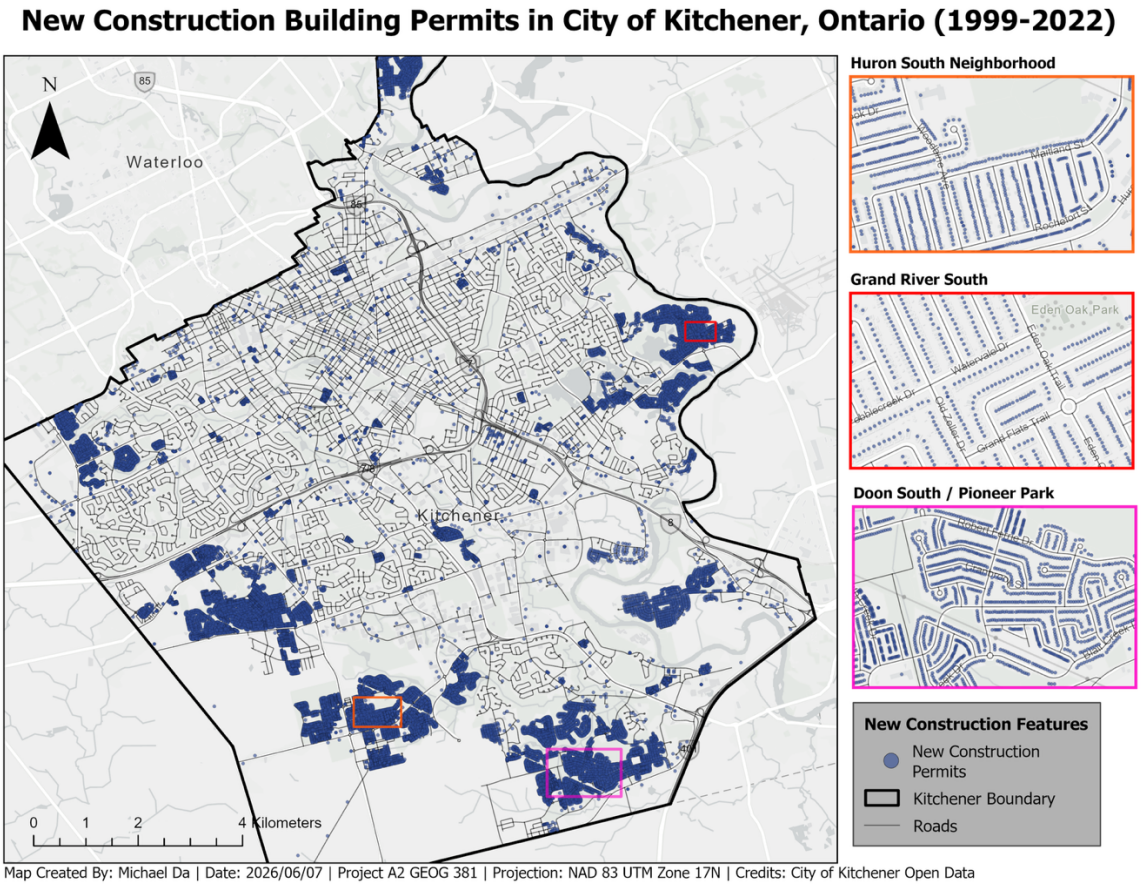

Figure 2. Map of New Construction building permits, City of Kitchener, Ontario (1999–2022).

This pattern reflects the outward expansion of Kitchener's residential footprint through greenfield development, where undeveloped land at the urban edge is converted into residential subdivisions. New construction in these areas is driven by lower land costs, available parcels, and municipal development approvals in suburban growth zones, which are common characteristics of mid-sized Ontario municipalities during this period.

The spatial component of this data is critical to understanding growth patterns that tabular permit counts alone cannot reveal. Viewing the permits as geolocated points makes it immediately apparent that construction is not evenly distributed across the city but is concentrated along specific corridors and edges. This has direct implications for municipal planning: infrastructure investment in roads, water, sewage, and transit must follow the direction

of new construction, and clustering near the suburban fringe signals sustained pressure on services not originally designed to support those densities. The animated visualization reinforces this point by showing the cumulative expansion of development year by year, making the direction and pace of urban growth legible in a way a static table of counts could never achieve. The bar chart of total new construction permits per year, shown in Figure 3, reveals equally informative temporal patterns.

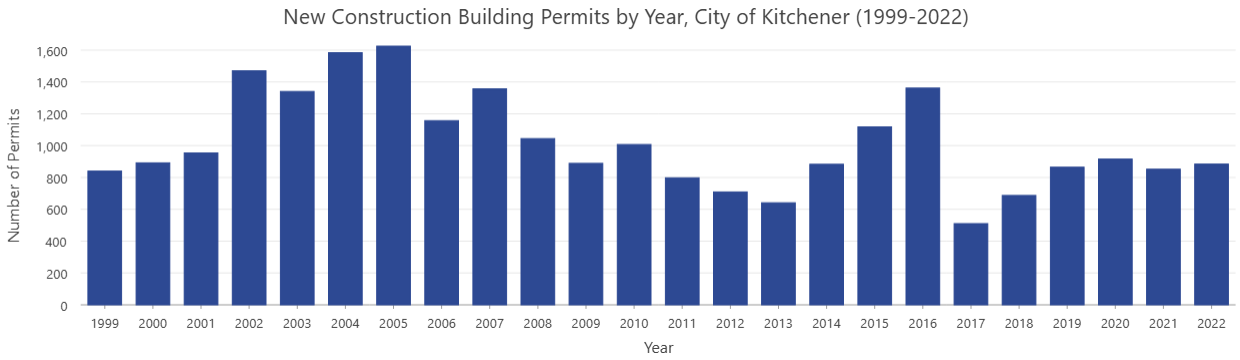

Figure 3. Total new construction building permits issued per year, City of Kitchener (1999–2022).

New construction permit volumes were relatively flat in the late 1990s and very early 2000s, then rose sharply to a peak in the mid-2000s (roughly 2002 to 2007). A sustained decline followed through the late 2000s, reaching a local low around 2012 to 2013. This aligns with the lagged effects of the 2008 global financial crisis, during which tightening credit conditions and economic uncertainty significantly reduced housing demand and stalled development projects across North America. Kitchener's manufacturing sector, which experienced major restructuring during this period including plant closures and employment losses in the automotive supply chain, likely compounded the local impact on new construction activity. The single lowest year in the entire series is 2017, at roughly 460 permits. This was likely caused by Ontario's Fair Housing Plan, introduced in April 2017, which added a 15% Non-Resident Speculation Tax and expanded rent controls, cooling the regional market that year.

A recovery in permit activity is visible from approximately 2014 onward, with a more pronounced increase around 2015 and 2016. This upturn corresponds to a period of historically low interest rates in Canada that stimulated housing demand, alongside the announcement and early construction phases of the ION Light Rail Transit system in Waterloo Region. The ION corridor spurred intensification interest along the transit route, contributing to renewed development in downtown Kitchener and renewed suburban growth as the regional population continued to expand.

Conclusion

Geocoding the City of Kitchener building permits dataset and mapping new construction activity from 1999 to 2022 demonstrates the value of converting tabular address data into a spatial format for urban analysis. The 96.29% match rate confirms the reliability of the municipal address points layer as a geocoding reference, while the 3.71% unmatched rate reflects a fundamental limitation when geocoding forward-looking construction permits against a reference layer that may not yet contain newly issued addresses. Spatially, the clustering of new construction in the suburban periphery captures Kitchener's outward growth trajectory, while the animated visualization makes this expansion tangible year by year. The temporal trends in the bar chart connect permit activity directly to real-world economic and policy events, from the 2008 recession to the post-2014 recovery, demonstrating that building permit data is not only a legal administrative record but a meaningful spatial and temporal indicator of urban growth and economic conditions.

References

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