Review of 2017 to 2021 M-Lab data for the City of Hamilton

March 30, 2022

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Acknowledgements

- This project reviewed and expanded on the work of the Regional and Rural Broadband (R2B2) Project based at the University of Guelph with previous work being graciously shared by the City of Hamilton. For more information, please see https://www.r2b2project.ca/.
- Data used in this project was obtained from the publicly available Measurement Lab (M-Lab) dataset. For more information, please see https://www.measurementlab.net/.
- This project was funded by the City of Hamilton. For more information, please see hamilton.ca/broadband.

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Objectives of this project

- Collect Measurement Lab (M-Lab) data by named communities and forward sortation areas for the City of Hamilton.
- Analyze data for download, upload, and round-trip time (latency) from 2017 to 2021.
- Present summary findings through time series graphs and geospatial visuals.

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Methodology

- This report presents median (50th percentile) statistics for download speeds, upload speeds, and minimum round-trip time from M-Lab's Network Diagnostic Tool (NDT) dataset.
- Median values are used as an average value rather than the mean due to the large variance or dispersion in speed test results. Due to speed test distributions being skewed (see Worden & Hambly, 2022, https://doi.org/10.1016/j.telpol.2021.102247) the mean value tends to be significantly higher than what the majority (i.e., >50%) of users' experience.
- Download and upload speeds are measured in megabits per second (Mbps) and minimum round-trip time, otherwise known as latency or ping, is measured in milliseconds (ms).

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Methodology: Data Collection

- The data used in this project is obtained from M-Lab's publicly available NDT dataset.
- Two datasets are used for this analysis.
- 1) A query of available named communities is used from 01-01-2017 to 02-28-2022.
- 2) A query of Forward Sortation Areas which correspond to the postal codes within the boundaries of the City of Hamilton from 01-01-2017 to 02-28-2022.

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Queried named communities

- Ancaster
- Binbrook
- Carlisle
- Copetown
- Dundas
- Freelton*
- Hamilton
- Hannon
- Jerseyville
- Lynden
- Mount Hope
- Rockton*
- Sheffield*
- Stoney Creek
- Troy
- Waterdown

*These communities were queried but either yielded no results or too few for analysis.

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Summary statistics on communities (2017-2022*)

Named Community	Median Download (Mbps)	Median Upload (Mbps)	Median Round-trip Time (ms)
All Hamilton Communities	**17.03 (N=1,089,573)**	**6.93 (N=1,129,154)**	**21 (N=1,089,573)**
Ancaster	19.14 (N=66,735)	6.73 (N=67,180)	16 (N=66,735)
Binbrook	16.96 (N=11,915)	8.10 (N=13,848)	24 (N=11,915)
Carlisle	22.44 (N=1,279)	8.29 (N=1,414)	11 (N=1,279)
Copetown	42.93 (N=494)	26.98 (N=749)	16 (N=494)
Dundas	22.26 (N=80,482)	7.99 (N=81,008)	16 (N=80,482)
Hamilton - City	16.56 (N=753,865)	6.88 (N=775,537)	23 (N=753,865)
Hannon	11.10 (N=58)	6.83 (N=56)	28 (N=58)
Jerseyville	4.49 (N=495)	3.85 (N=463)	33 (N=495)
Lynden	1.60 (N=60)	1.31 (N=47)	36 (N=60)
Mount Hope	10.13 (N=315)	6.69 (N=223)	16 (N=315)
Stoney Creek	15.83 (N=134,091)	6.01 (N=152,752)	18 (N=134,091)
Troy	5.13 (N=78)	4.02 (N=84)	129 (N=78)
Waterdown	21.43 (N=39,567)	8.02 (N=35,667)	20 (N=39,567)

*Where possible, includes data collected up to February 28th, 2022.

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Summary statistics on communities (2021-2022*)

Named Community	Median Download (Mbps)	Median Upload (Mbps)	Median Round-trip Time (ms)
All Hamilton Communities	**98.53 (N=60,615)**	**8.41 (N=119,691)**	**18 (N=60,615)**
Ancaster	59. 05 (N=1,827)	11.87 (N=1,813)	25 (N=1,827)
Binbrook	133.70 (N=565)	7.96 (N=3,395)	23 (N=565)
Carlisle	16.50 (N=9)	2.66 (N=7)	25 (N=9)
Copetown	8.80 (N=6)	2.50 (N=6)	30 (N=6)
Dundas	93.45 (N=5,919)	10.44 (N=6,018)	19 (N=5,919)
Hamilton - City	92.75 (N=41,417)	8.27 (N=88,744)	18 (N=41,417)
Jerseyville	3.69 (N=66)	1.68 (N=64)	34 (N=66)
Waterdown	218.31 (N=2,849)	20.45 (N=3,270)	12 (N=2,849)

Note: Only named communities with available data for the 2021-2022* period are presented.
*Where possible, includes data collected up to February 28th, 2022.

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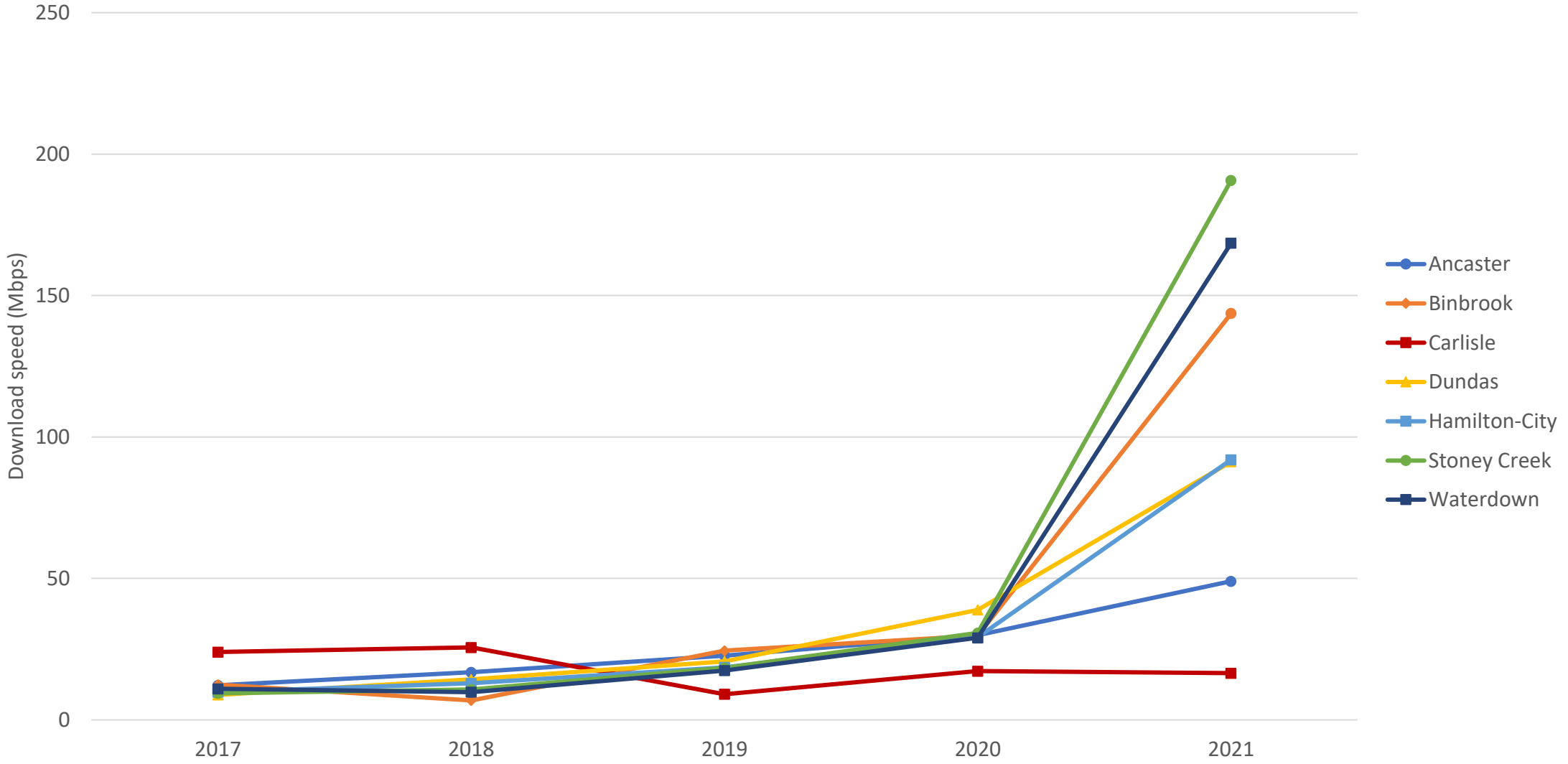
Trends in Median Download Speeds (2017-2021)



Note: Only named communities with sufficient data across all five years are included in the trend graphs.

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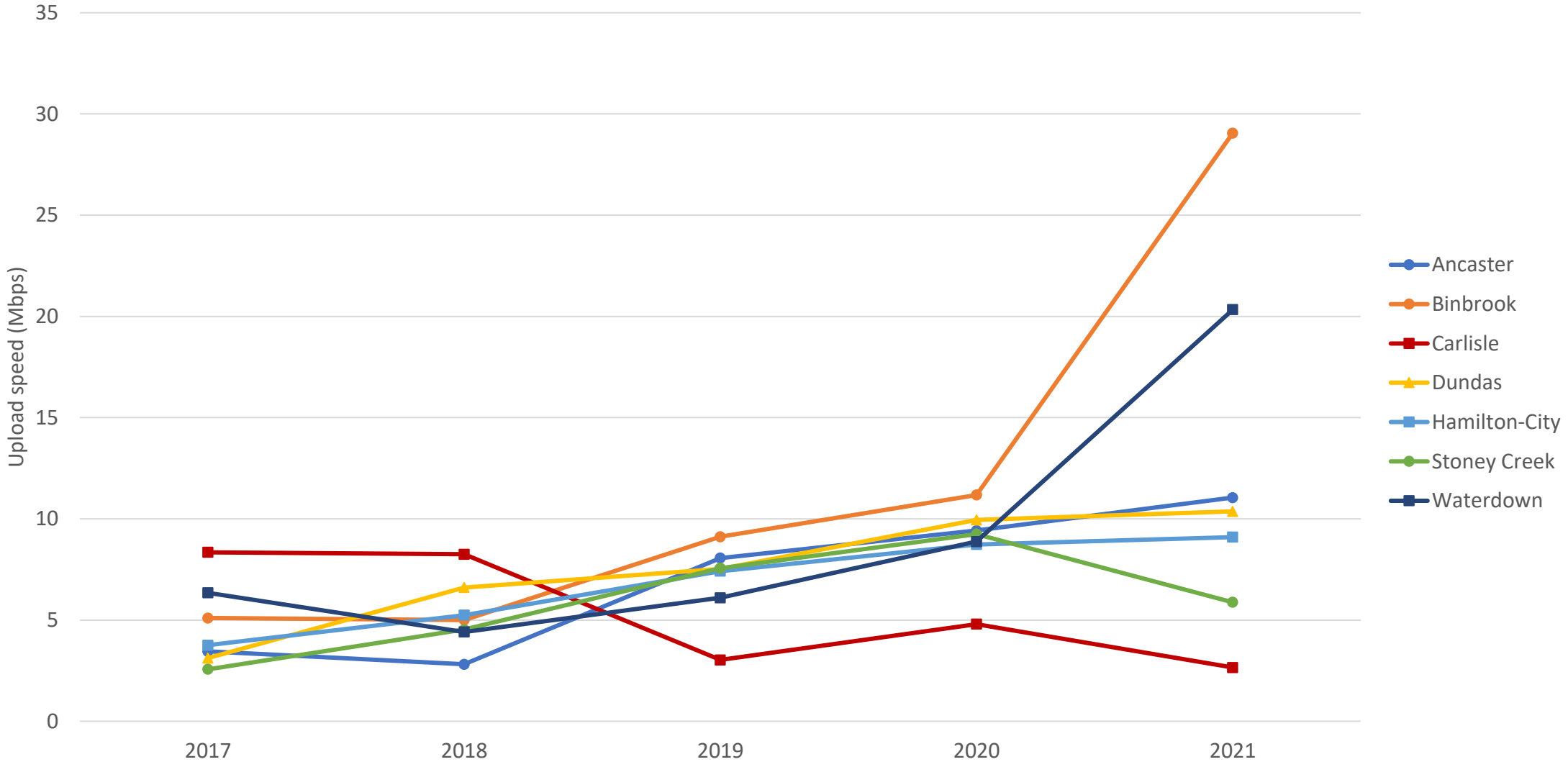
Trends in Median Upload Speeds (2017-2021)



Note: Only named communities with sufficient data across all five years are included in the trend graphs.

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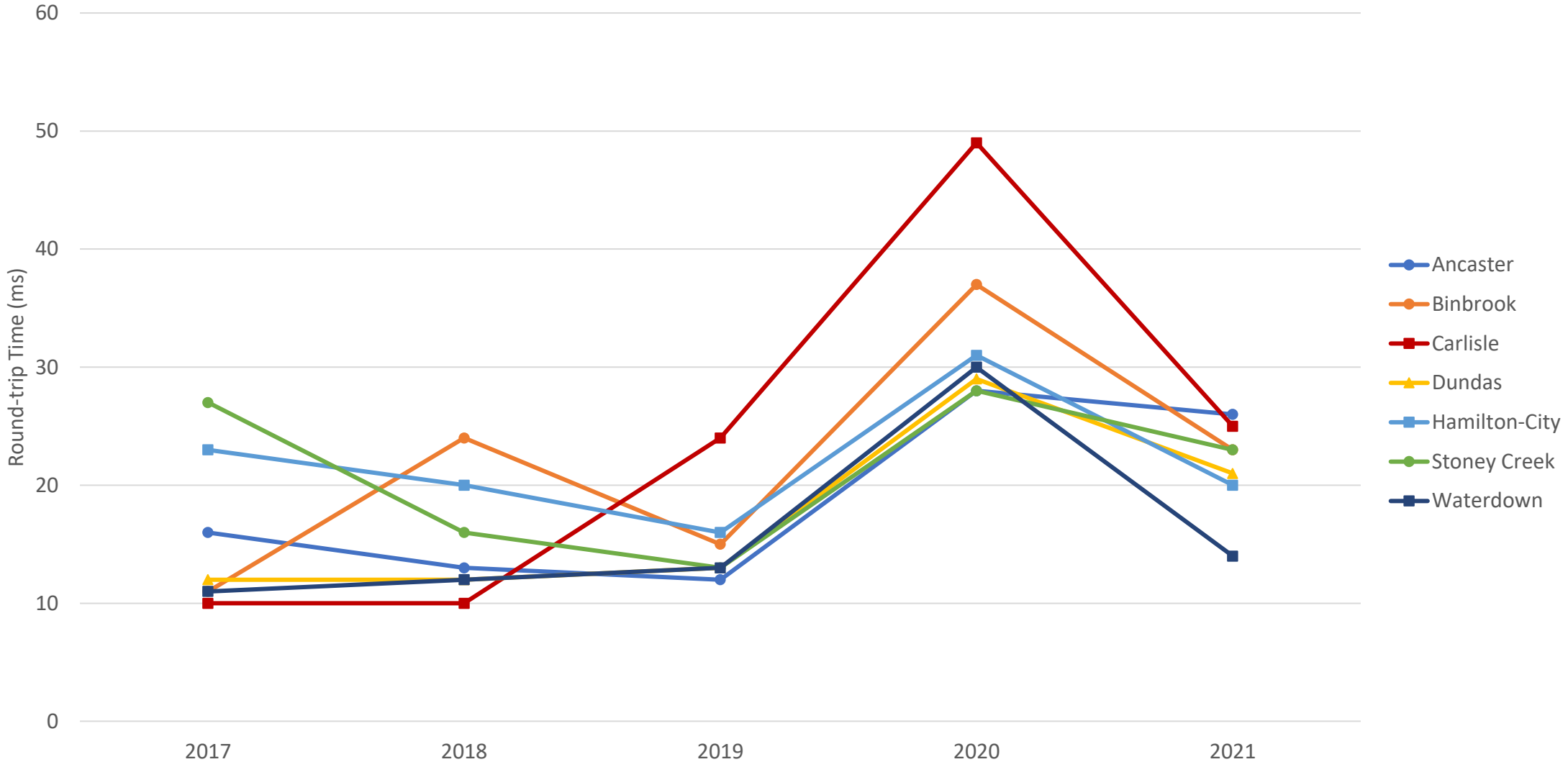
Trends in Median Round-trip Time* (2017-2021)



Note: Only named communities with sufficient data across all five years are included in the trend graphs.
*The round-trip time variable presented is M-Lab's "Minimum RTT" variable which reflects the lowest latency in milliseconds during the speed test.

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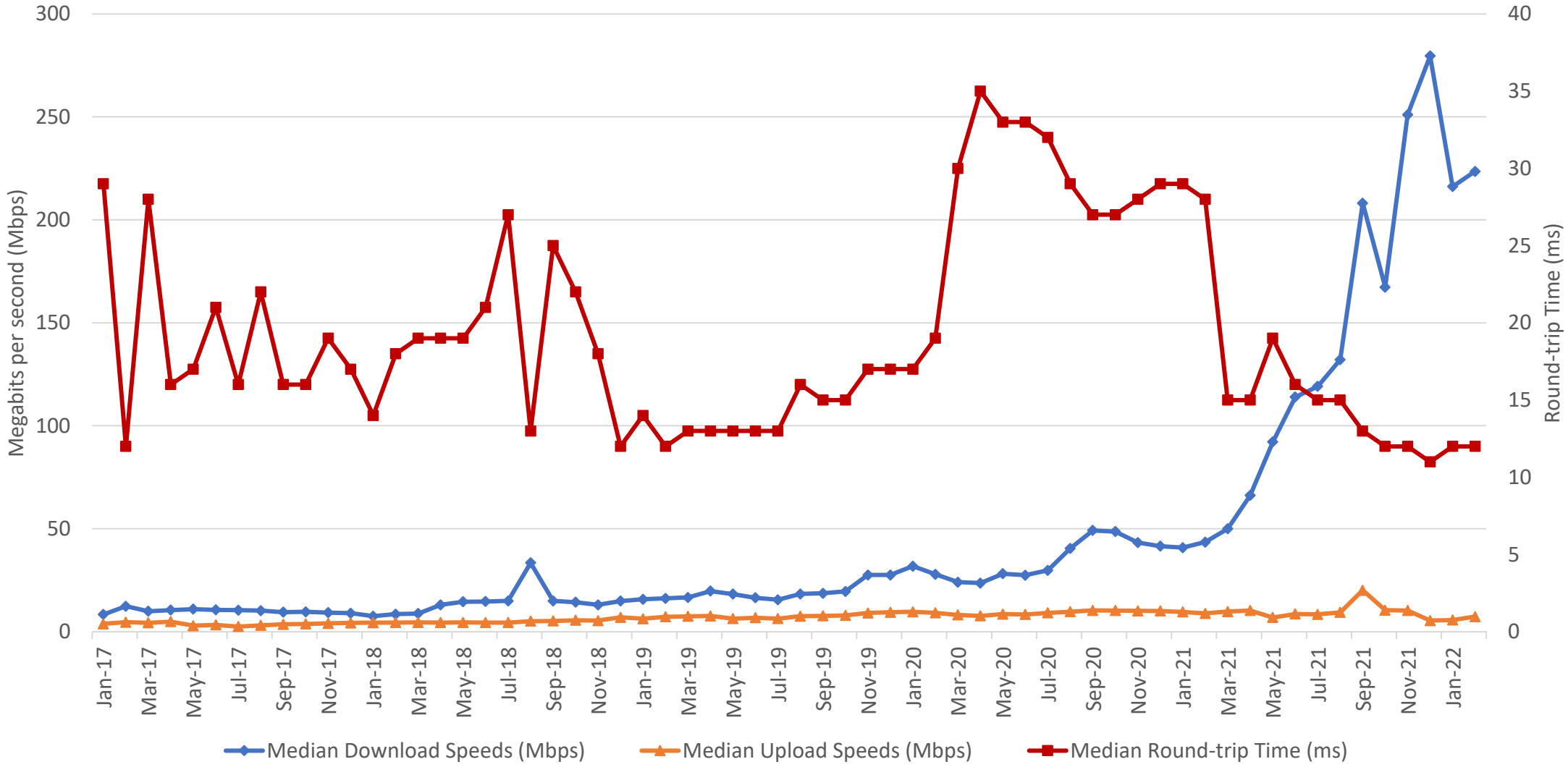
Trends in Monthly Quality of Service (January 2017 to February 2022)



Note: Download and upload speeds are plotted on the left axis while round-trip time is plotted on the right axis.

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Queried forward sortation areas

- L0P
- L0R
- L3M
- L7P
- L7S
- L7T
- L8B
- L8E
- L8G
- L8H
- L8J
- L8K
- L8L
- L8M
- L8N
- L8P
- L8R
- L8S
- L8T
- L8V
- L8W
- L9A
- L9B
- L9C
- L9G
- L9H
- L9K
- N0A
- N0B
- N0E
- N1R
- N3L
- N3R
- N3T
- N3W

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Download Speeds from 2017 to 2021 by Forward Sortation Areas

- In the next five slides, maps are presented for download speeds at the Forward Sortation Area level with Ward Boundaries for reference.
- The N values represent the total number of observations in the dataset over all queried forward sortation areas. Therefore, the N values represent a higher number of observations than those specifically belonging within the City of Hamilton.

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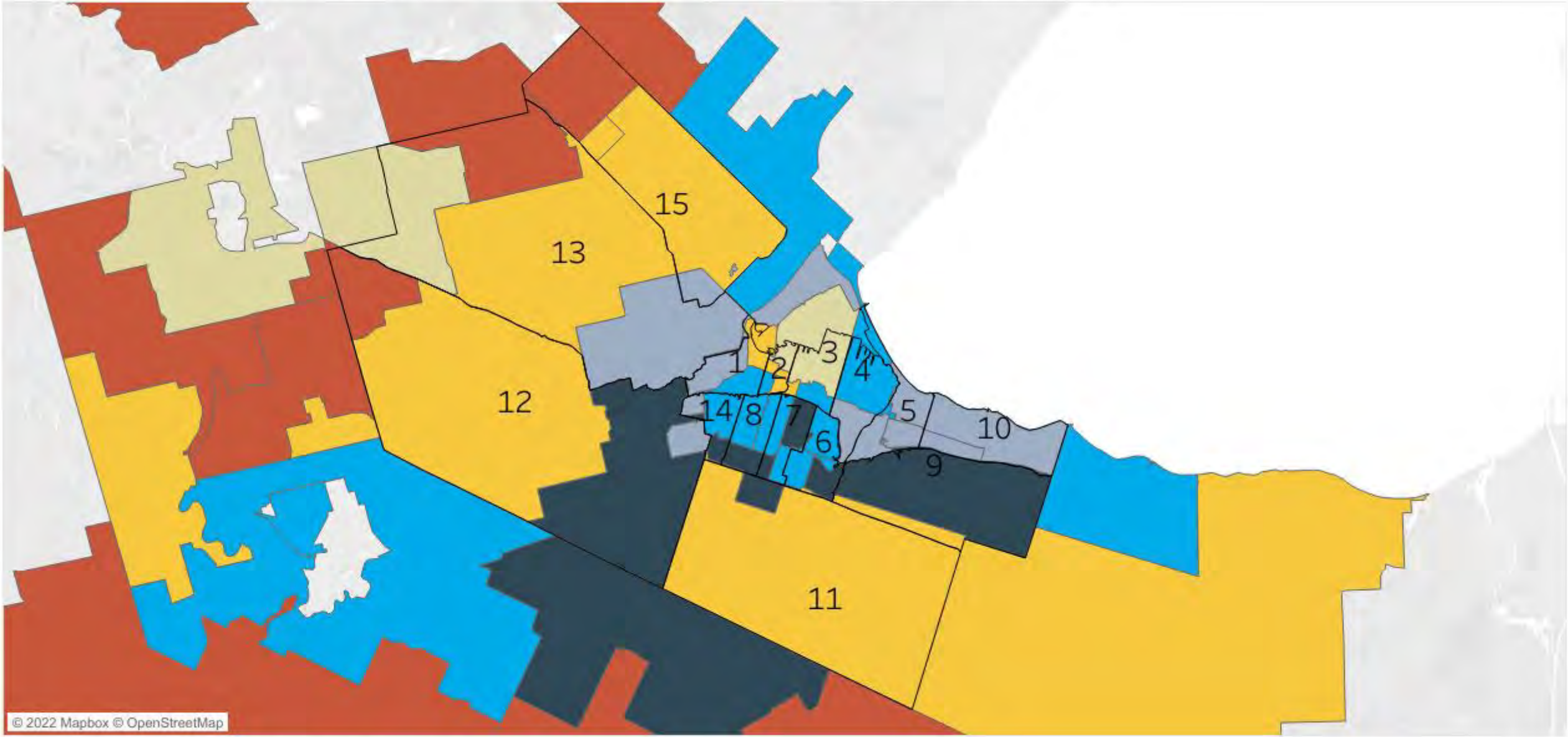
Median Download Speeds by Forward Sortation Area with Ward Boundaries, 2021 (N=827,464)



Median Download Speeds (Source: M-Lab Network Diagnostic Tool)

10 to 20 Mbps | 20 to 30 Mbps | 30 to 40 Mbps | 40 to 50 Mbps | 50 to 60 Mbps | 60 to 70 Mbps

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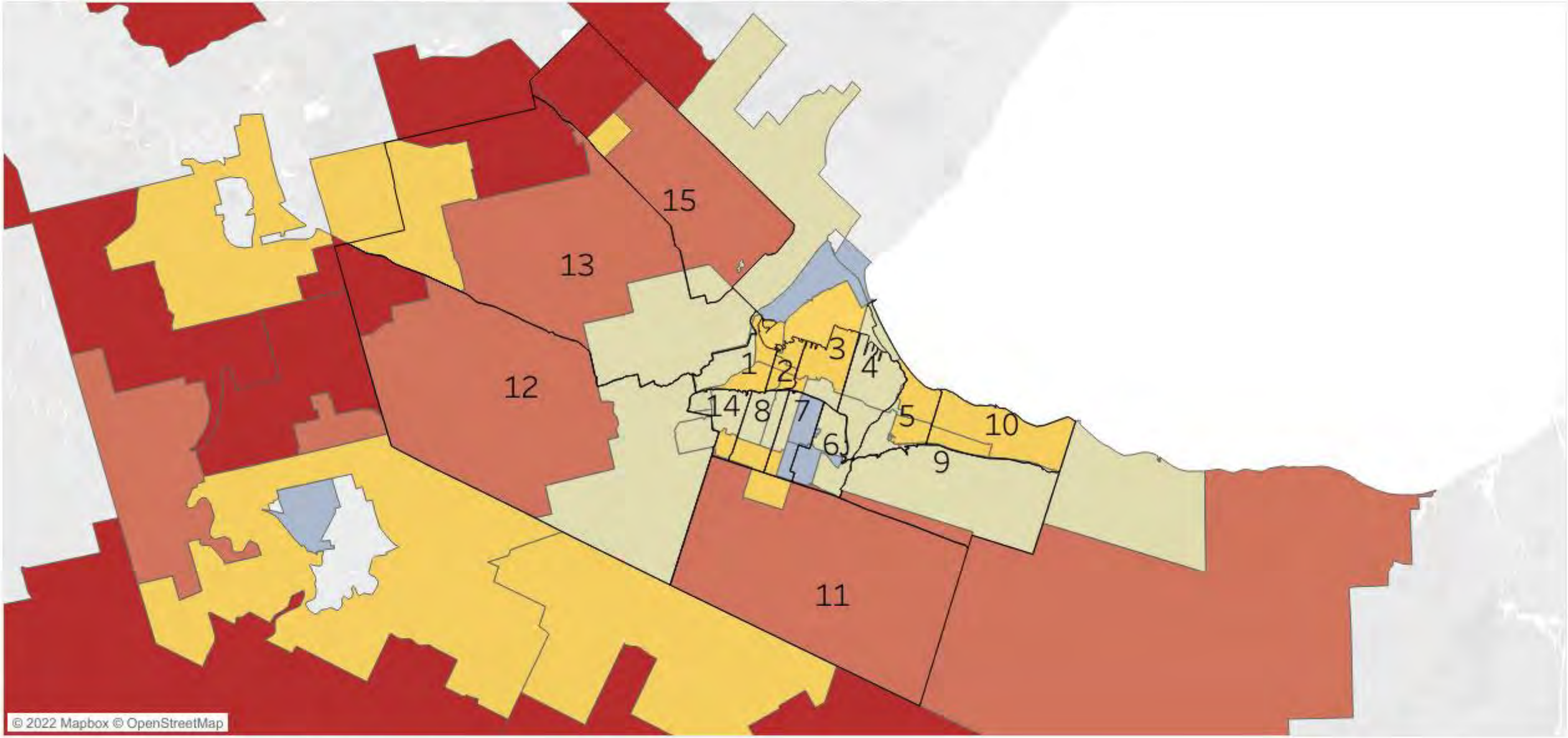
Median Download Speeds by Forward Sortation Area with Ward Boundaries, 2020 (N=793,525)



Median Download Speeds (Source: M-Lab Network Diagnostic Tool)

Less than 10 Mbps | 10 to 20 Mbps | 20 to 30 Mbps | 30 to 40 Mbps | 40 to 50 Mbps

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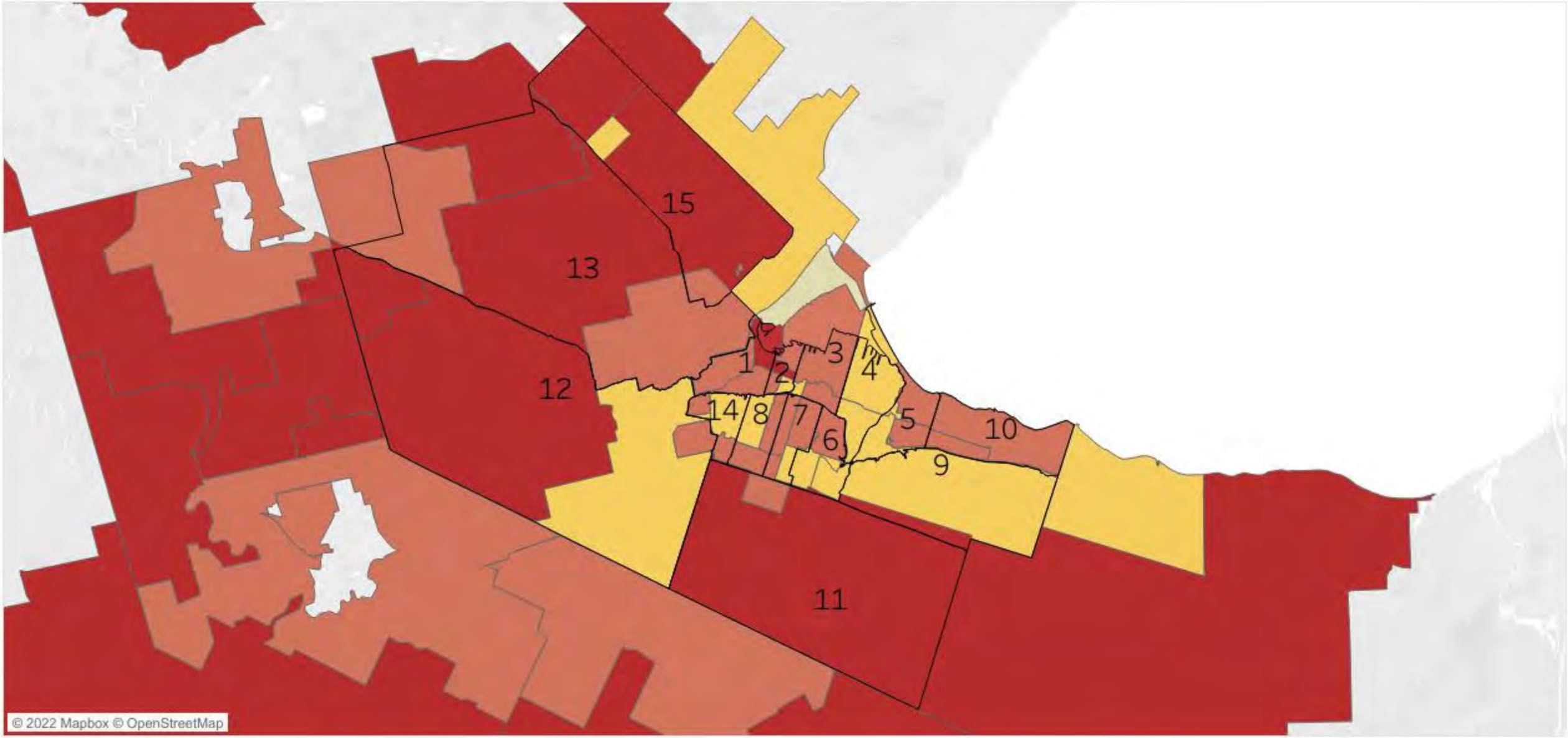
Median Download Speeds by Forward Sortation Area with Ward Boundaries, 2019 (N=502,993)



Median Download Speeds (Source: M-Lab Network Diagnostic Tool)

Less than 10 Mbps | 10 to 20 Mbps | 20 to 30 Mbps | 30 to 40 Mbps

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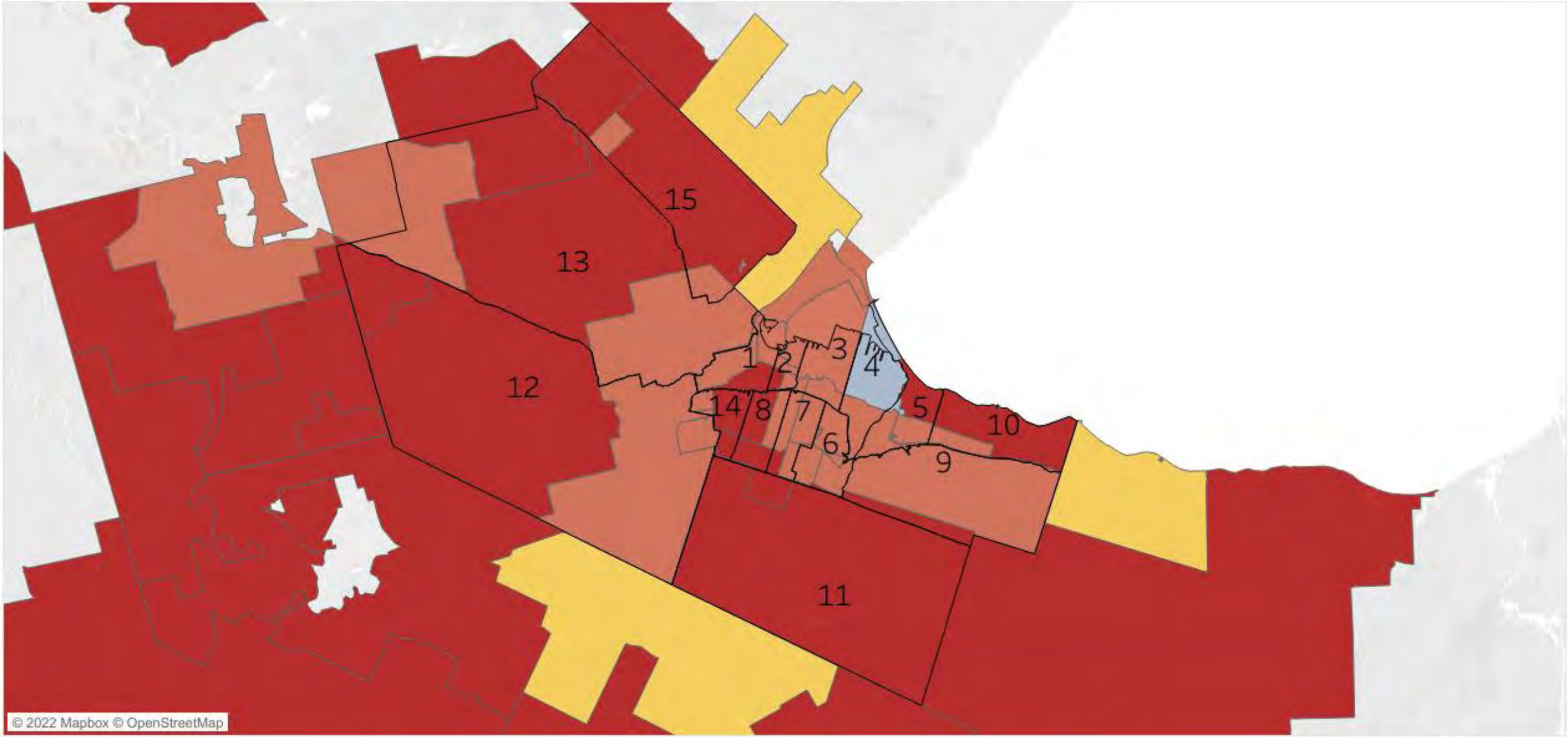
Median Download Speeds by Forward Sortation Area with Ward Boundaries, 2018 (N=395,095)



Median Download Speeds (Source: M-Lab Network Diagnostic Tool)

Less than 10 Mbps | 10 to 20 Mbps | 20 to 30 Mbps | 40 to 50 Mbps

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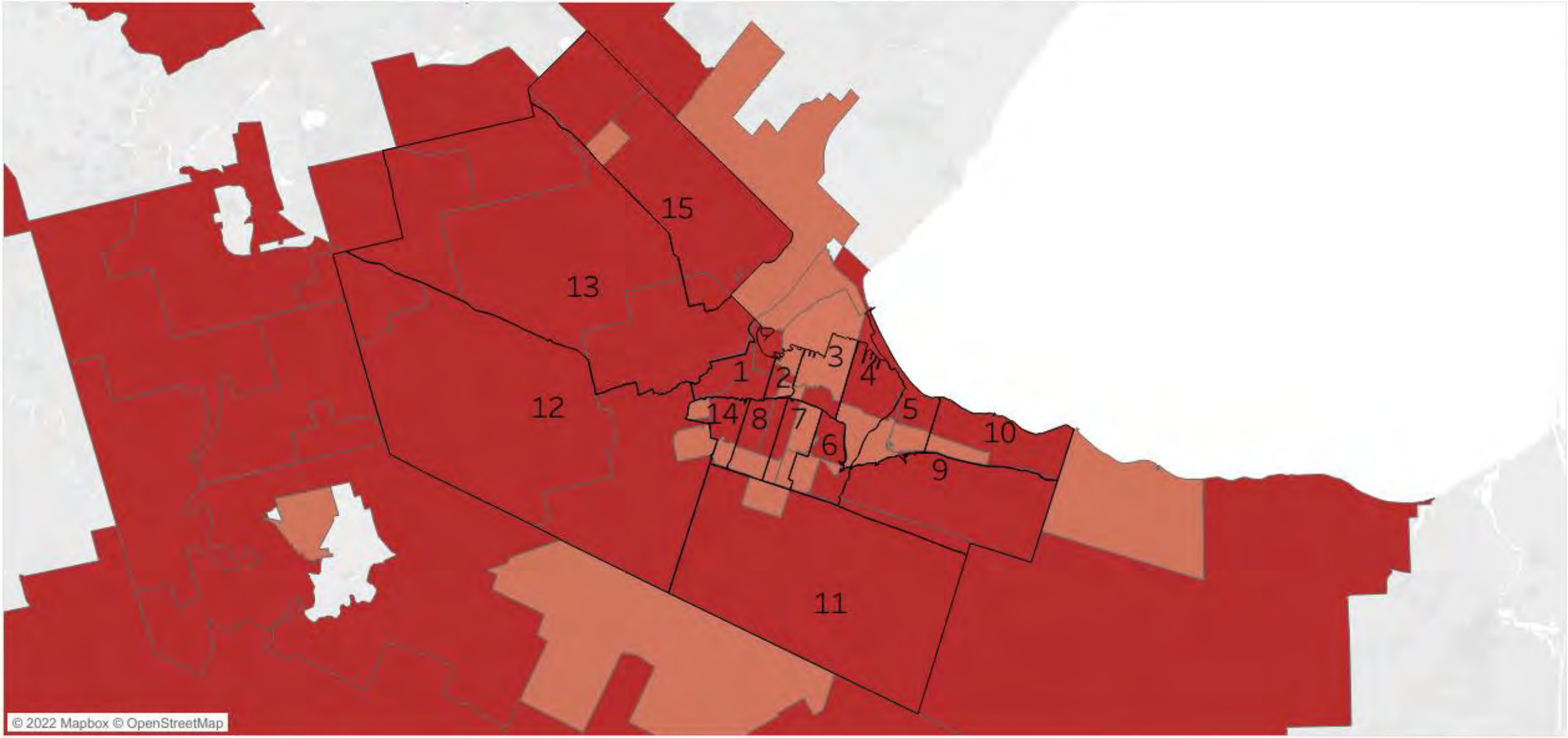
Median Download Speeds by Forward Sortation Area with Ward Boundaries, 2017 (N=250,933)



Median Download Speeds (Source: M-Lab Network Diagnostic Tool)

Less than 10 M.. 10 to 20 Mbps

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Upload Speeds from 2017 to 2021 by Forward Sortation Areas

- In the next five slides, maps are presented for upload speeds at the Forward Sortation Area level with Ward Boundaries for reference.
- The N values represent the total number of observations in the dataset over all queried forward sortation areas. Therefore, the N values represent a higher number of observations than those specifically belonging within the City of Hamilton.

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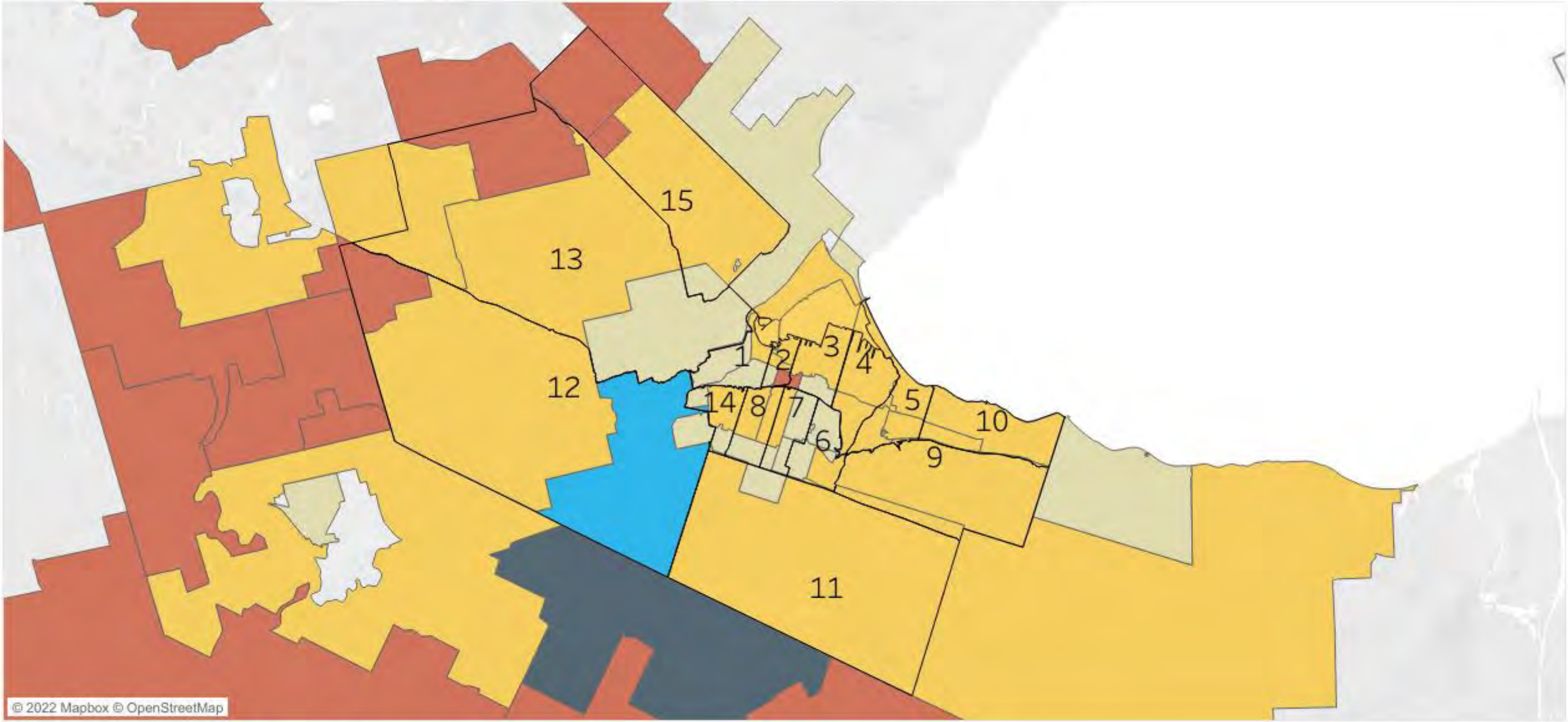
Median Upload Speeds by Forward Sortation Area with Ward Boundaries, 2021 (N=779,560)



Median Upload Speeds (Source: M-Lab Network Diagnostic Tool)

- 1 to 5 Mbps
- 5 to 10 Mbps
- 10 to 15 Mbps
- 20 to 25 Mbps
- 25 to 30 Mbps

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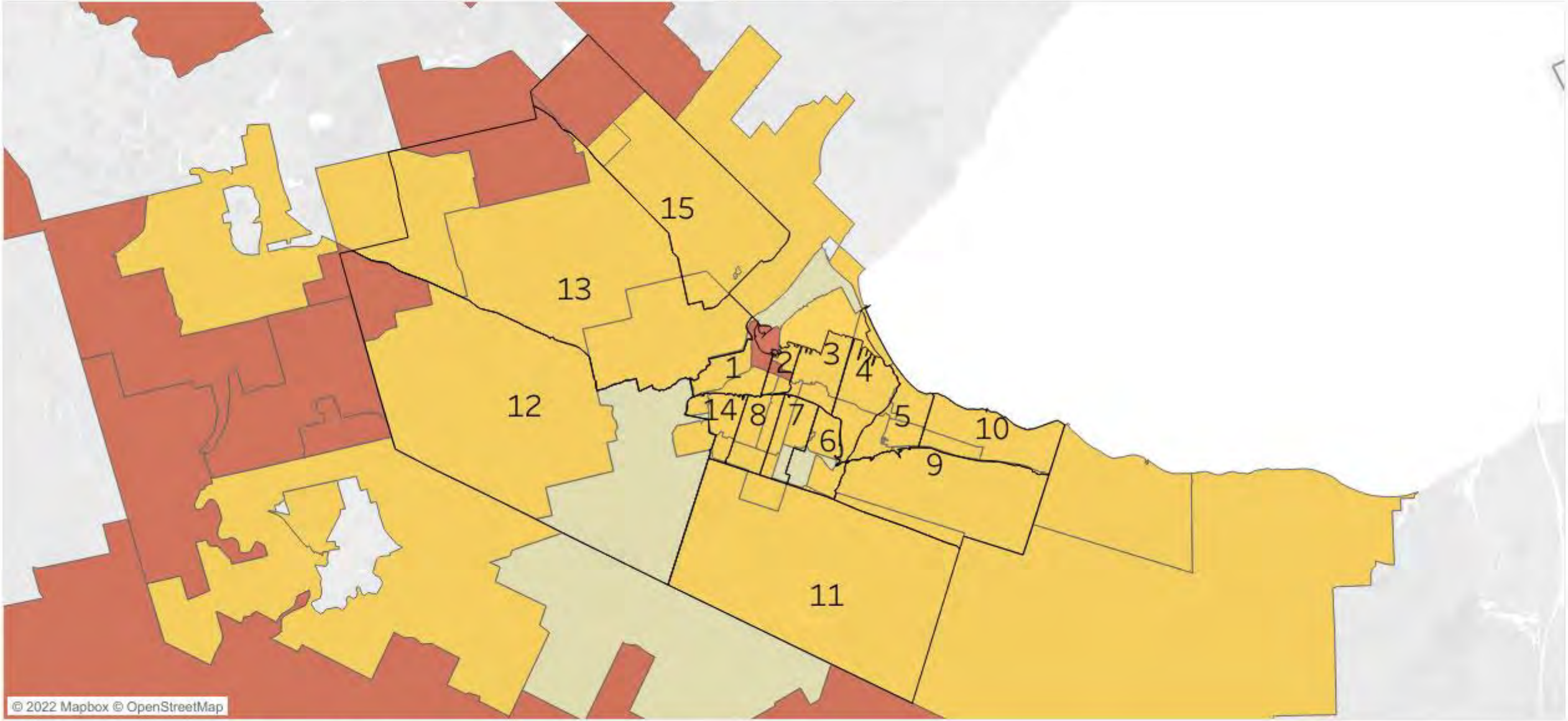
Median Upload Speeds by Forward Sortation Area with Ward Boundaries, 2020 (N=741,079)



Median Upload Speeds (Source: M-Lab Network Diagnostic Tool)

- 1 to 5 Mbps
- 5 to 10 Mbps
- 10 to 15 Mbps

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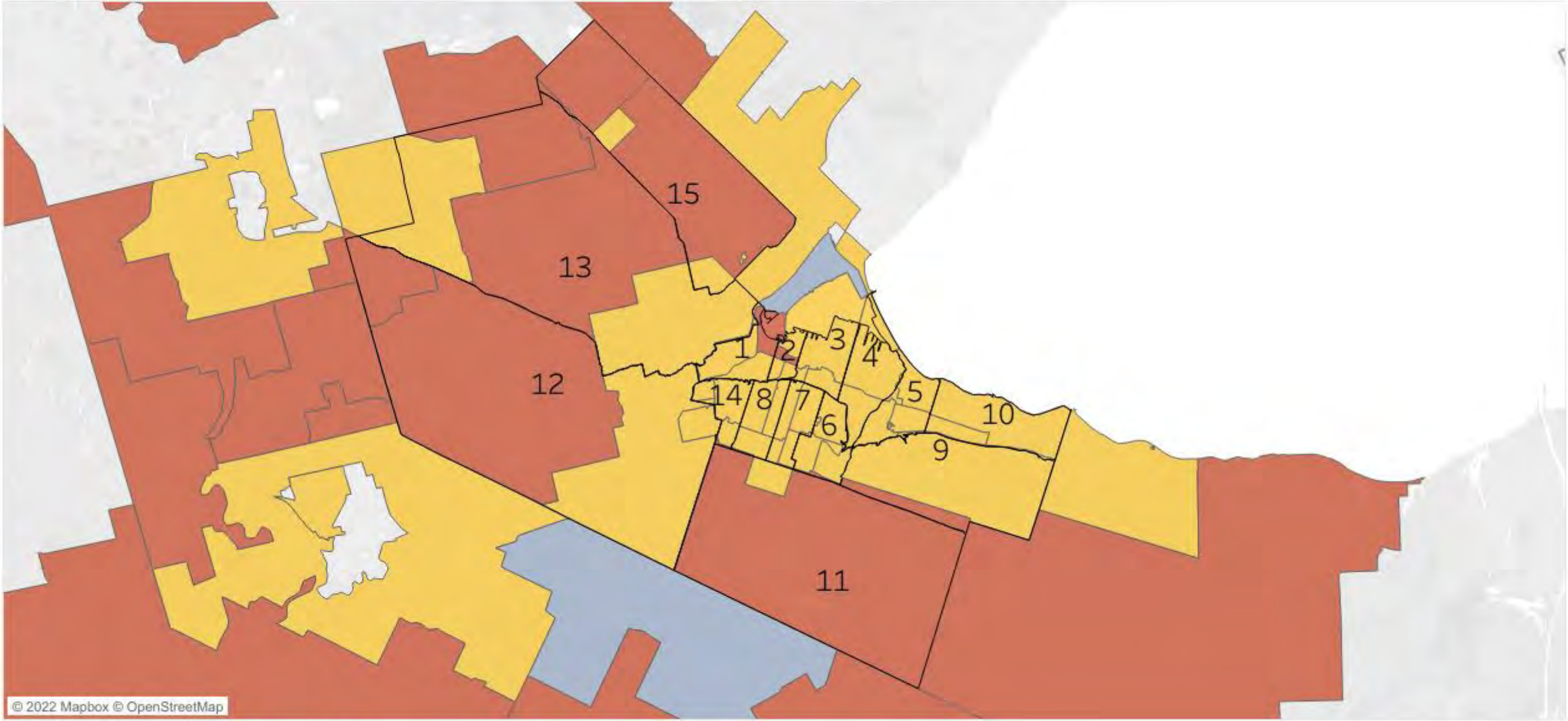
Median Upload Speeds by Forward Sortation Area with Ward Boundaries, 2019 (N=523,601)



Median Upload Speeds (Source: M-Lab Network Diagnostic Tool)

- 1 to 5 Mbps
- 5 to 10 Mbps
- 15 to 20 Mbps

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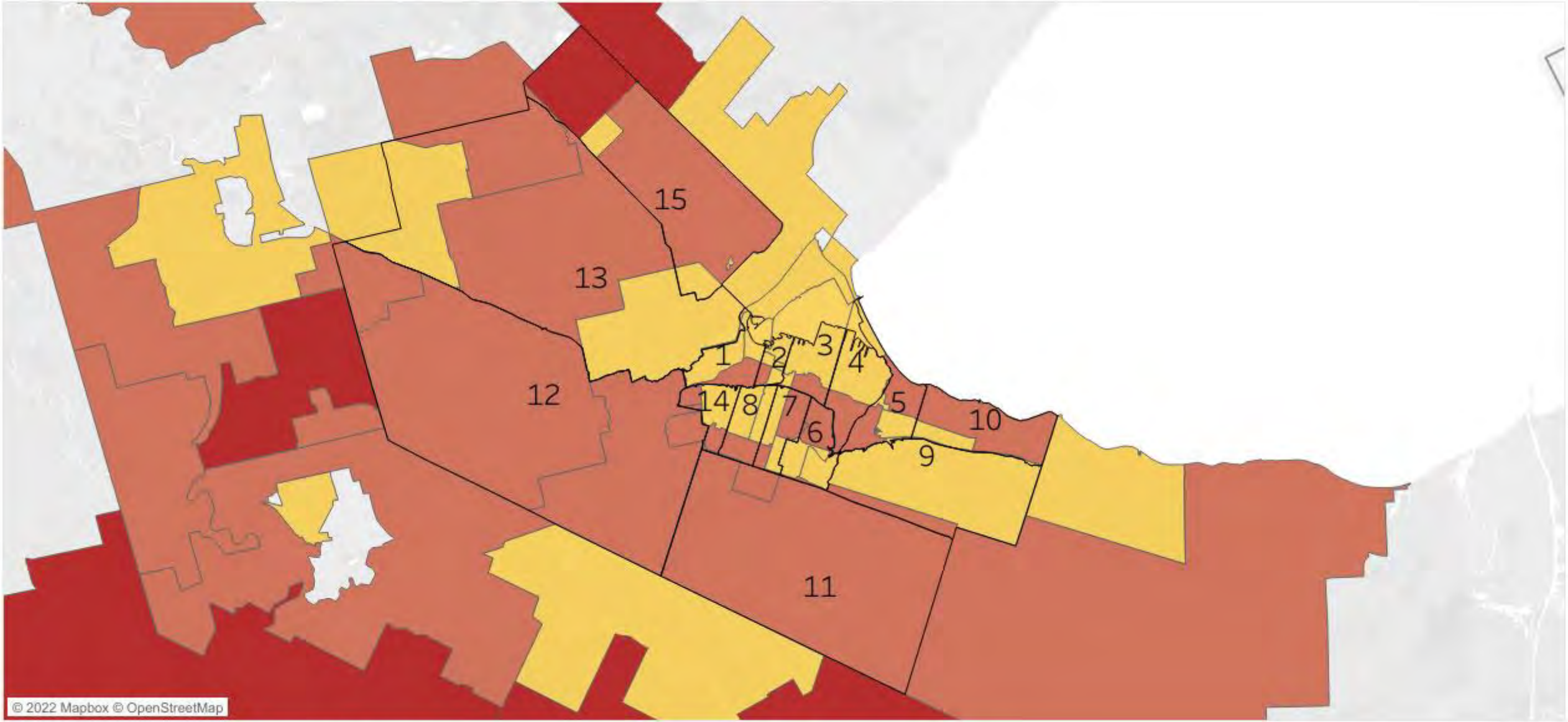
Median Upload Speeds by Forward Sortation Area with Ward Boundaries, 2018 (N=374,828)



Median Upload Speeds (Source: M-Lab Network Diagnostic Tool)

- Less than 1 Mbps
- 1 to 5 Mbps
- 5 to 10 Mbps

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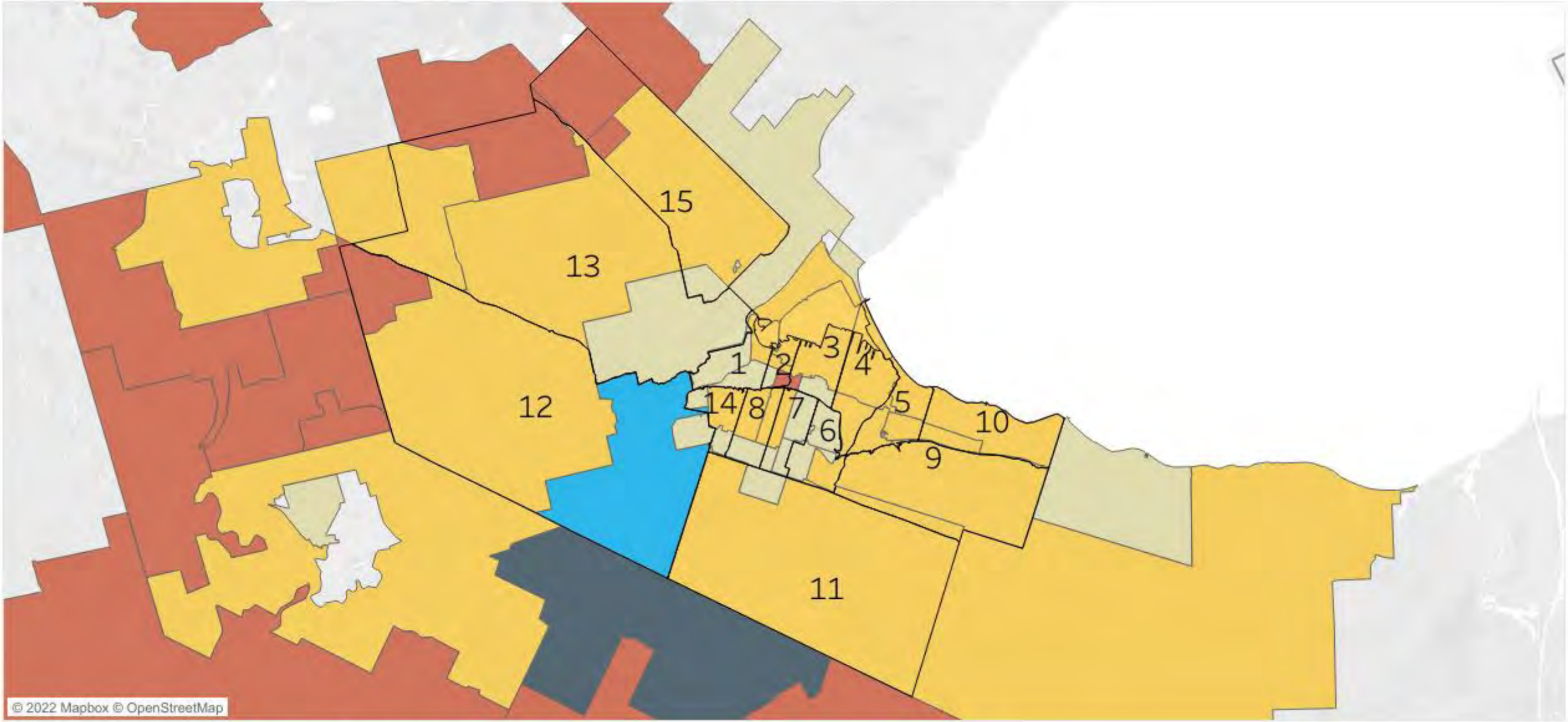
Median Upload Speeds by Forward Sortation Area with Ward Boundaries, 2017 (N=218,514)



Median Upload Speeds (Source: M-Lab Network Diagnostic Tool)

- 1 to 5 Mbps
- 5 to 10 Mbps
- 10 to 15 Mbps
- 20 to 25 Mbps
- 25 to 30 Mbps

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Minimum Round-trip Times from 2017 to 2021 by Forward Sortation Areas

- In the next five slides, maps are presented for minimum round-trip times (latency) at the Forward Sortation Area level with Ward Boundaries for reference.
- The N values represent the total number of observations in the dataset over all queried forward sortation areas. Therefore, the N values represent a higher number of observations than those specifically belonging within the City of Hamilton.

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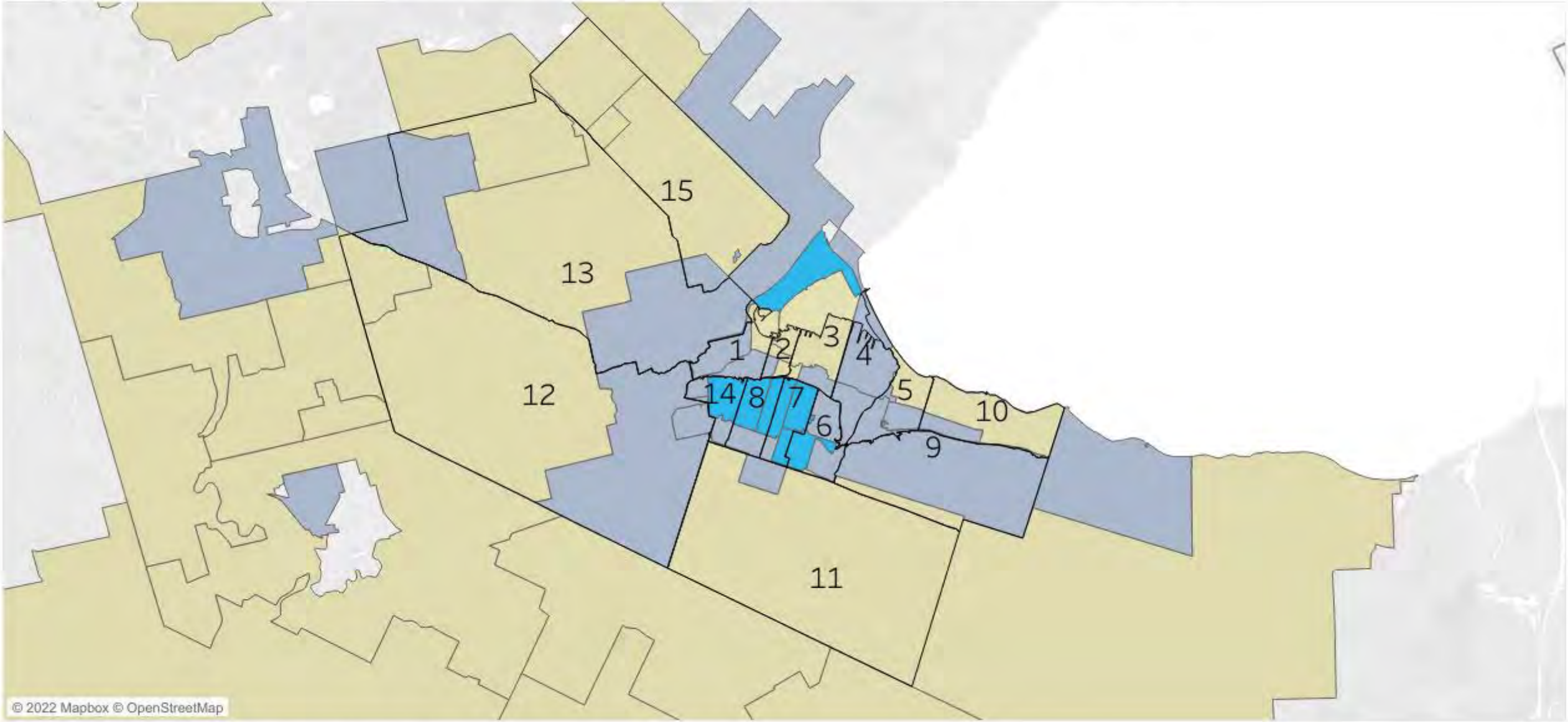
Median Round-trip Time Speeds by Forward Sortation Area with Ward Boundaries, 2021 (N=827,464)



Median Round-trip Time (Source: M-Lab Network Diagnostic Tool)

- 15 to 20 ms
- 20 to 25 ms
- 25 to 30 ms

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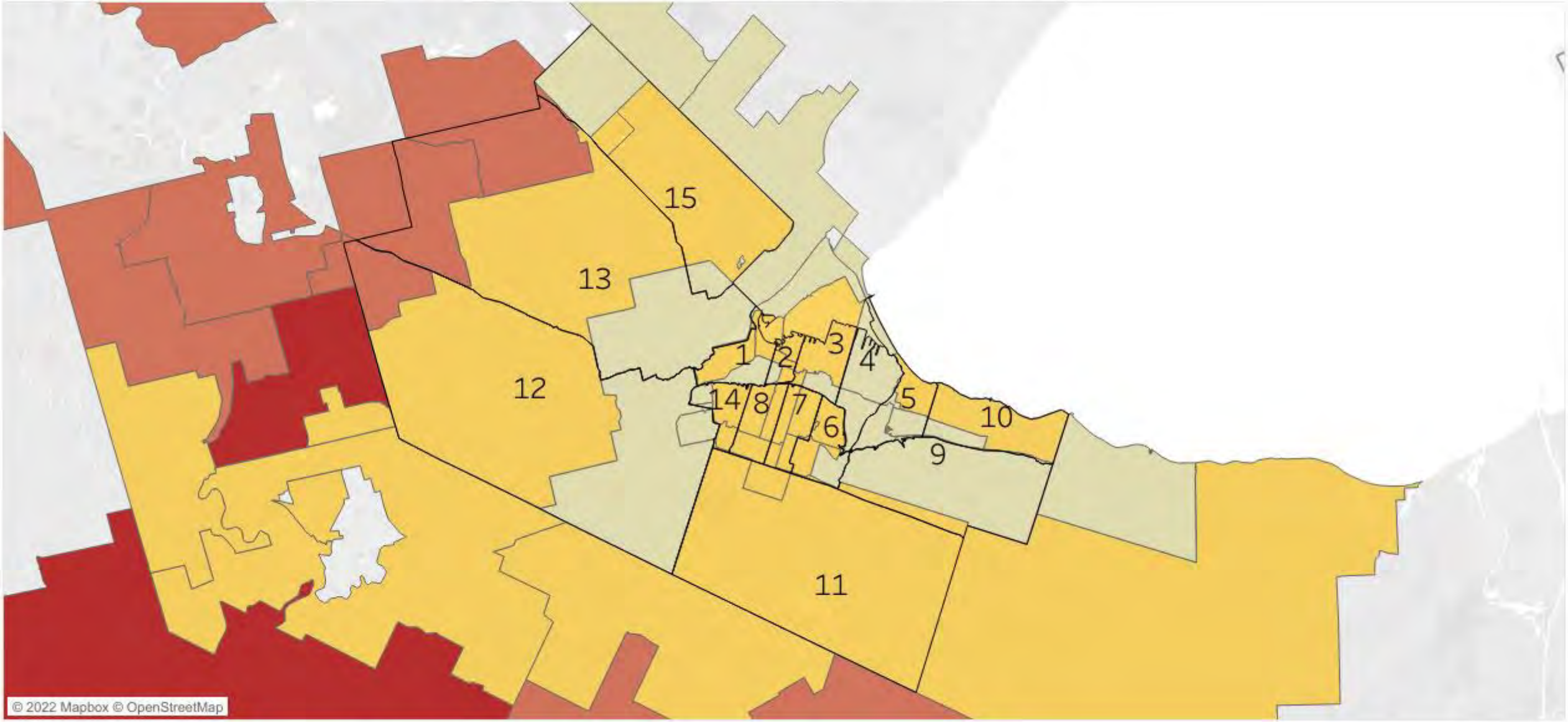
Median Round-trip Time by Forward Sortation Area with Ward Boundaries, 2020 (N=793,525)



Median Round-trip Time (Source: M-Lab Network Diagnostic Tool)

- 25 to 30 ms
- 30 to 35 ms
- 35 to 40 ms
- More than 40 ms

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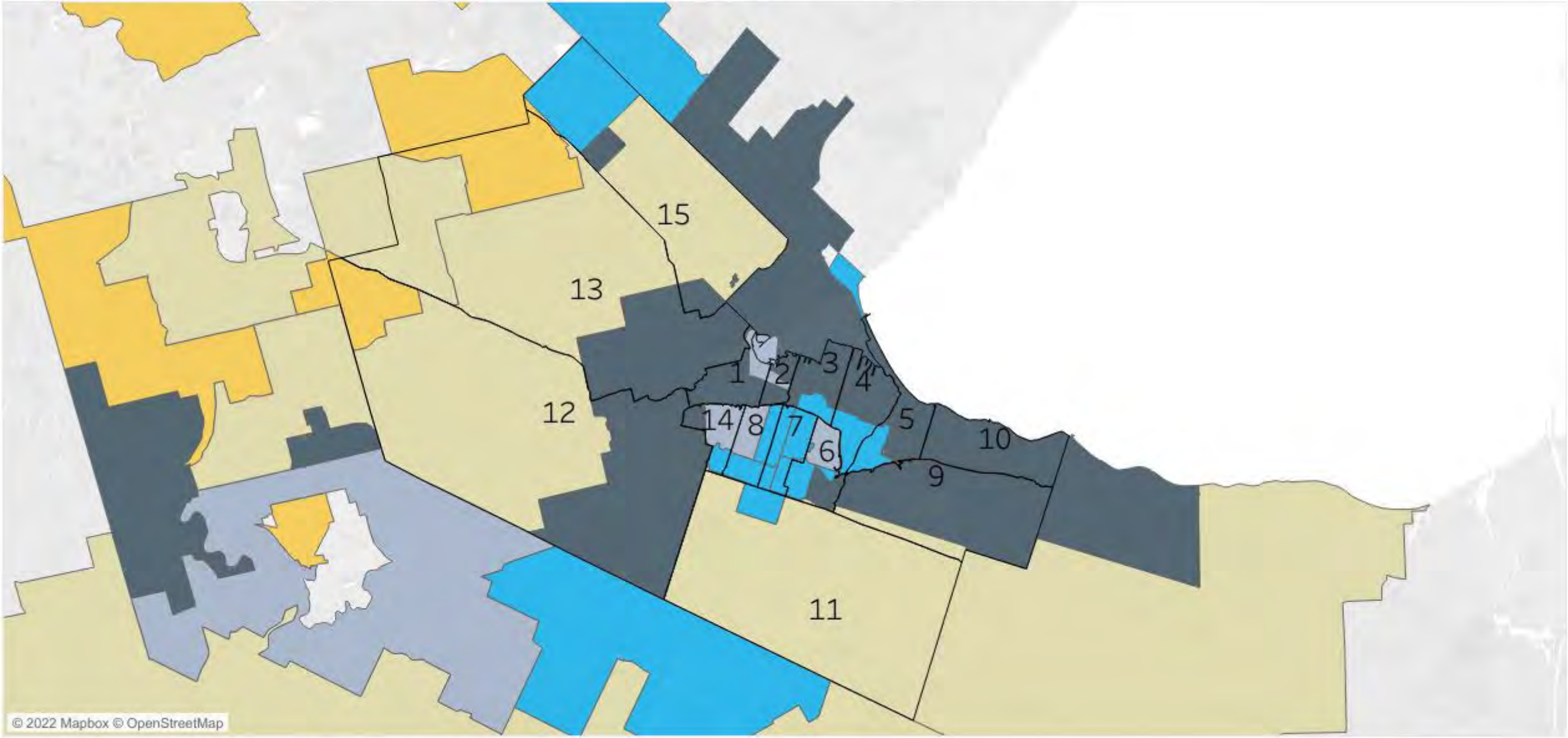
Median Round-trip Time by Forward Sortation Area with Ward Boundaries, 2019 (N=502,993)



Median Round-trip Time (Source: M-Lab Network Diagnostic Tool)

10 to 15 ms | 15 to 20 ms | 20 to 25 ms | 25 to 30 ms | 30 to 35 ms

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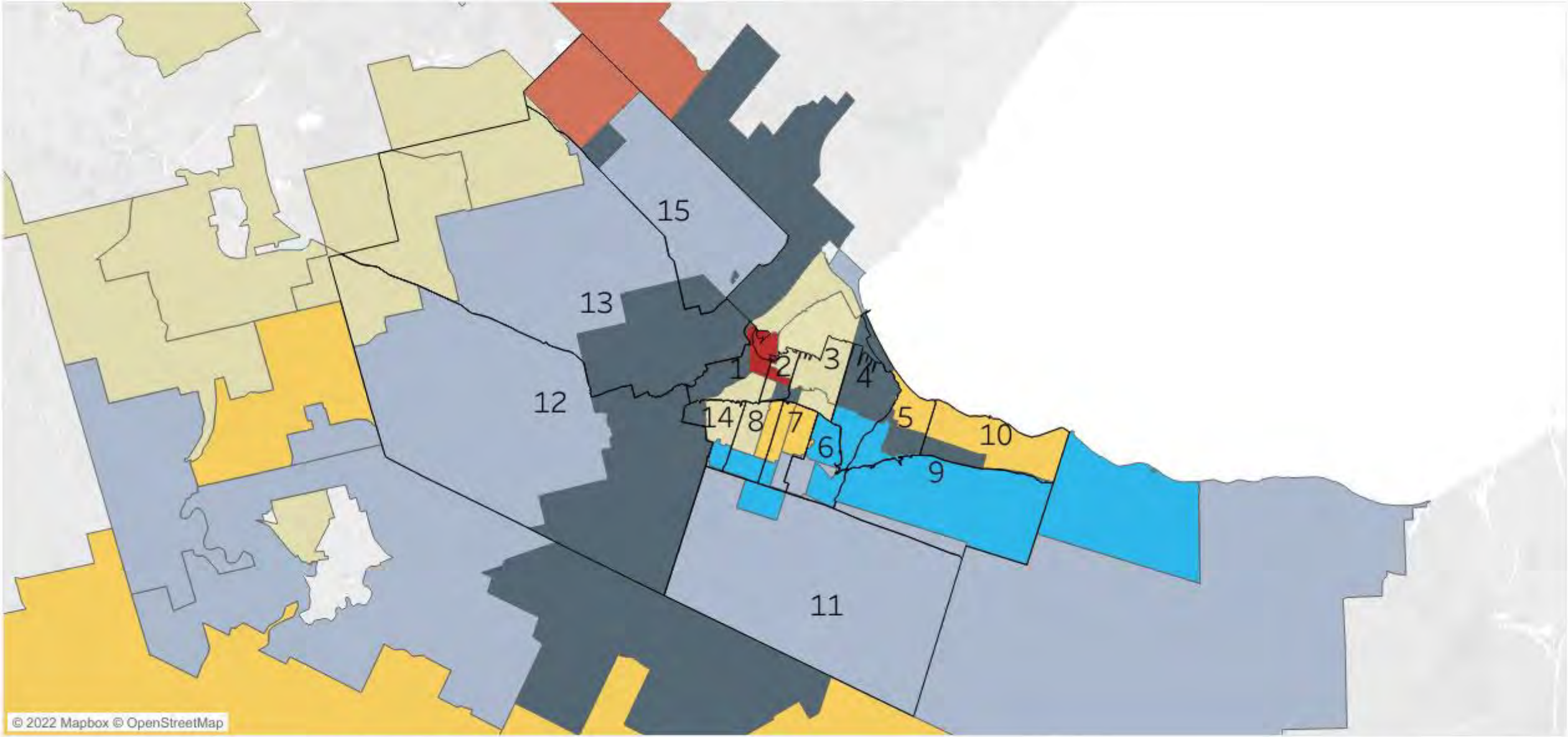
Median Round-trip Time by Forward Sortation Area with Ward Boundaries, 2018 (N=395,095)

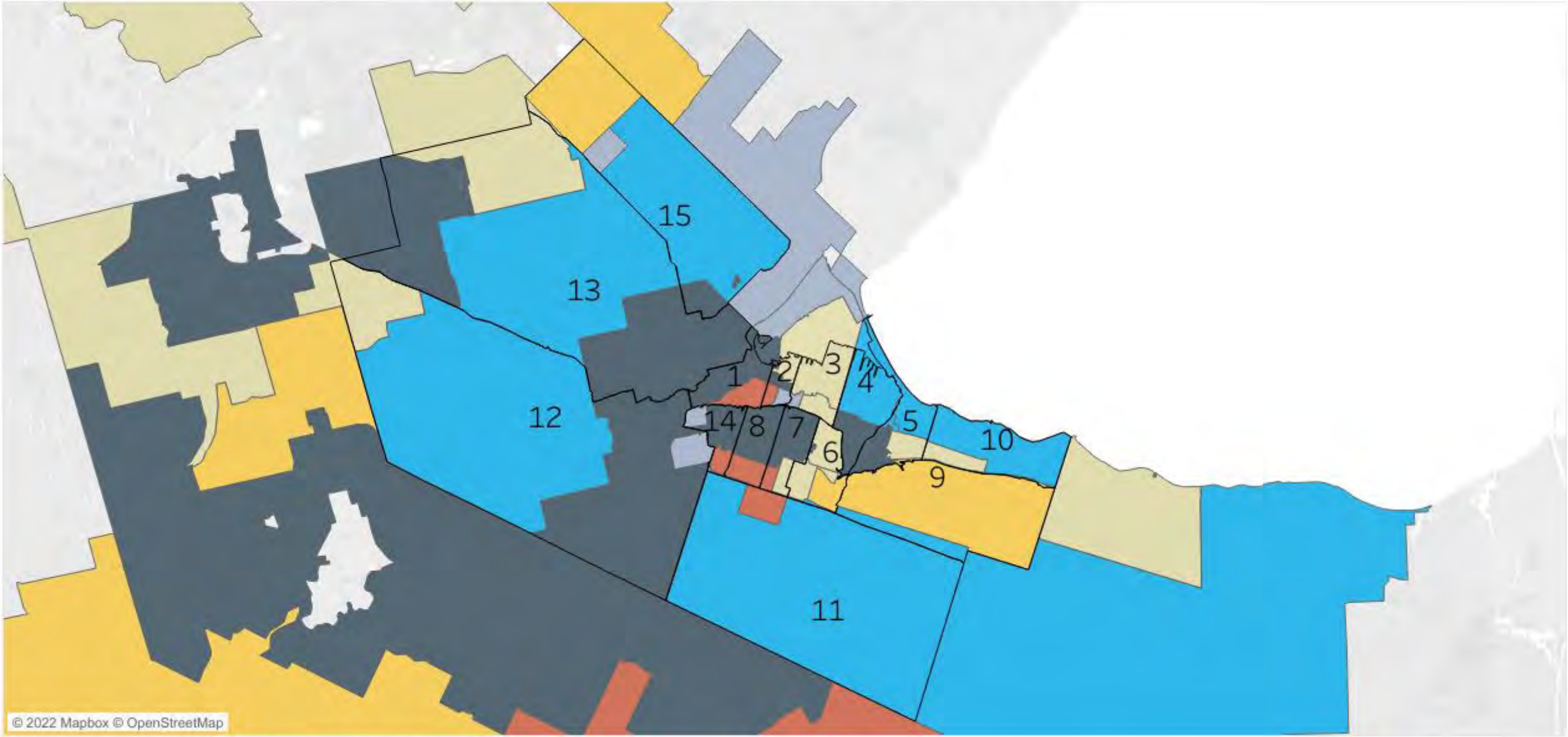


Median Round-trip Time (Source: M-Lab Network Diagnostic Tool)

10 to 15 ms | 15 to 20 ms | 20 to 25 ms | 25 to 30 ms | 30 to 35 ms | 35 to 40 ms | More than 40 ms

FRONTIER INSIGHTS

Median Round-trip Time by Forward Sortation Area with Ward Boundaries, 2017 (N=250,933)



Median Round-trip Time (Source: M-Lab Network Diagnostic Tool)

10 to 15 ms | 15 to 20 ms | 20 to 25 ms | 25 to 30 ms | 30 to 35 ms | 35 to 40 ms

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Summary

- Approximately 1.1 million speed test results are available for the City of Hamilton area from January 2017 to February 2022.
- Time series analysis suggests that download speeds gradually increased up until March of 2021 when they increased significantly.
- Upload speeds have also increased but at a modest rate.
- Latency, as measured by minimum round-trip time, has experienced more variability and no clear trend is apparent.

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Summary continued

- M-Lab data does not exist at a fine enough resolution for detailed urban/rural divide analysis. However, we are able to conclude that in general, urban areas have seen more rapid improvements in quality of service over the 2017-2021 period than rural areas.
- Mapping of results also suggests that rural areas within the City of Hamilton may have slightly better quality of service than neighbouring rural areas outside of the City of Hamilton boundaries.

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