Background Report:

Future Travel Demand Modelling

Hamilton

CITY OF HAMILTON
TRANSPORTATION MASTER PLAN
REVIEW AND UPDATE

City of Hamilton
Transportation Master Plan Review and Update
Future Travel Demand Modelling Report

Final Report

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1 INTRODUCTION

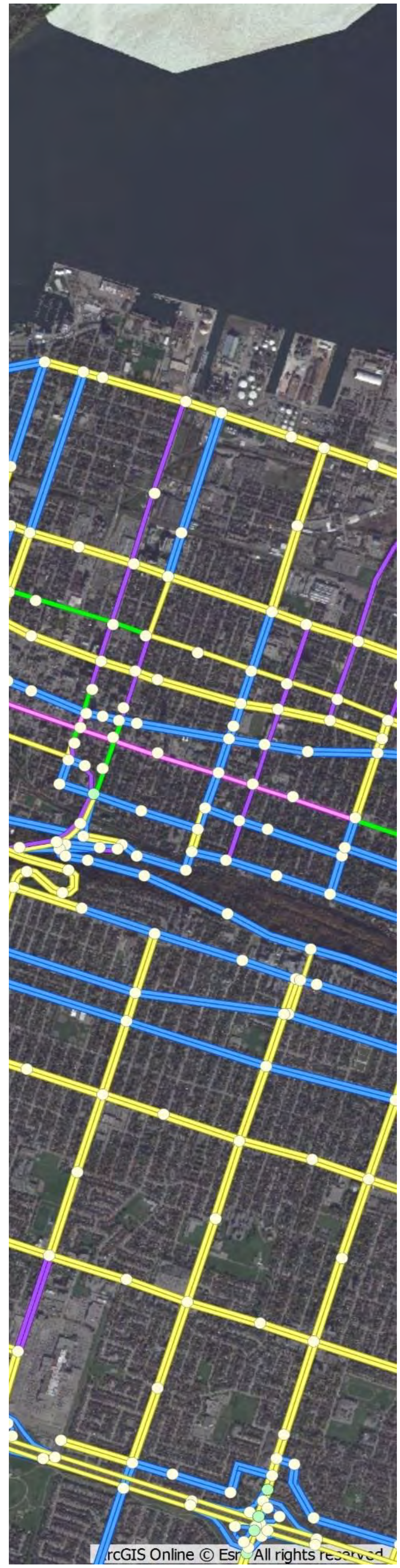
In order to identify existing and future transportation system conditions and assess network needs and opportunities for the City-Wide Transportation Master Plan (CWTMP), travel demand forecasting was undertaken using the travel demand model for the City of Hamilton. The model was utilized to predict the future traffic conditions across the City's transportation system, and thus identify areas where future issues and constraints may be realized (i.e. roads operating at or above their capacity, traffic conditions expected at City boundaries, and natural boundaries such as the escarpment, etc.), as well as evaluate the impacts associated with potential future network improvement scenarios.

The City's travel demand model is a macro-level transportation simulation model, which is capable of:

- Generating trips that use a transportation system;
- Distributing those trips to and from origin-destination traffic zones across the network;
- Dividing the trips by mode of travel (i.e. driver, passenger, transit, etc.); and,
- Assigning the trips to a broad transportation system.

Travel demand models are generally calibrated against observed traffic data crossing a series of imaginary "screenlines", in order to ensure the model adequately simulates captures existing travel. This way, it is assured that the model can be used to accurately predict future conditions, based on growth projections across the Greater Golden Horseshoe (GGH). Macro-level models are generally applied to determine high-level transportation system deficiencies, such as the need for additional capacity over a screenline or within a location. Thus, due to the macro-nature of the model, localized traffic operation issues such as intersection performance, traffic queues, and turning movements are not assessed using demand models.

The City's travel demand model has been calibrated and validated against a 2011 base year. The results of the validation can be found in the "EMME Model Update, Calibration and Validation Report". Accordingly, this report will focus on the future travel demand forecasting for the 2031 future horizon year.

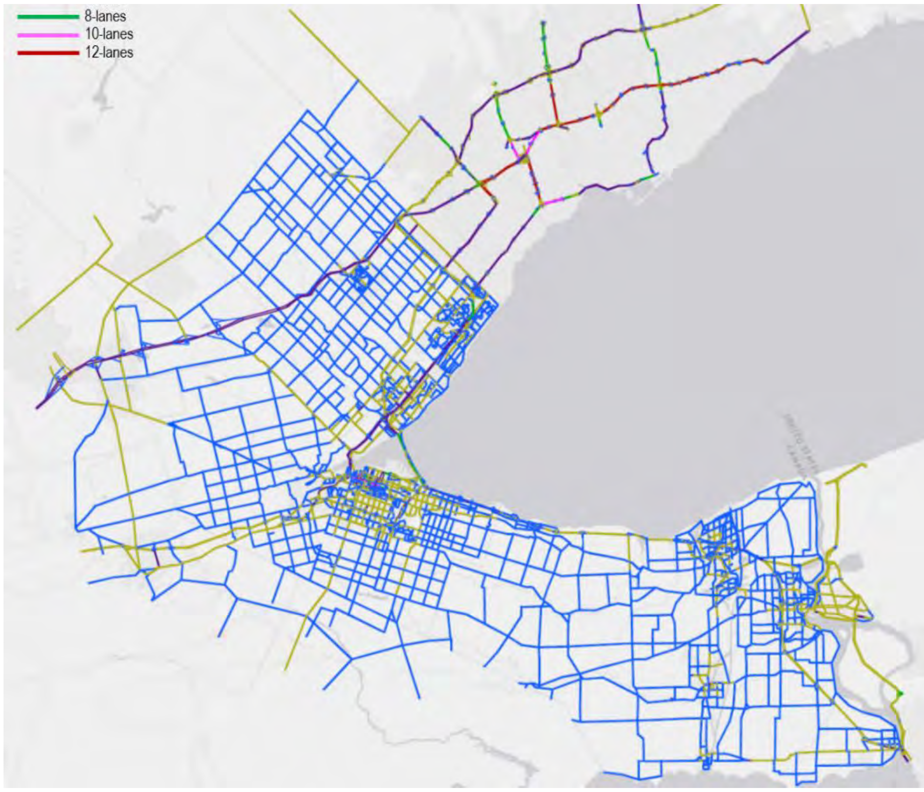


2 CITY-WIDE HAMILTON TRAVEL DEMAND MODEL

The City of Hamilton Travel Demand Model (Hamilton Model) is a macro-level model built using the EMME modelling platform. The model includes a detailed representation of the City's transportation network with information such travel speeds, distances, and capacities coded in. Forecasts are generated by taking population and employment estimates as an input, while also considering the impact of road network travel times, routing decisions, and mode choices.

The model road network covers the City of Hamilton, Halton Region, and Niagara Region in detail, including provincial highways, major arterials, major collector roads and minor collector roads. Outside of Hamilton, Halton, and Niagara, the model includes a sparse network with primarily provincial highways for the City of Toronto and Regions of Peel, York and Durham. Areas outside of the GGH are represented by external zones, which surround the model network at the limits. The local transit network includes Hamilton Street Railway (HSR) routes in the City, GO Transit, along with the Burlington, Oakville, and Milton transit routes. **Figure 2-1** shows the extents of the Hamilton Model road network.

Figure 2-1 – Hamilton Model Network



The Hamilton Model is a full 4-stage transportation model, and thus includes trip generation, trip distribution, modal split, and trip assignment functionality. Trip assignment is undertaken for passenger car, truck, and transit modes. Auto assignment reflects the AM peak hour, while transit is also assigned for AM peak period. Trips are loaded onto the transportation network through traffic zones, which are connected to model nodes via zone connectors strategically located to simulate realistic traffic loading patterns (i.e. zone connectors can represent local roads, commercial property access points, residential neighbourhood entry points, and other points where vehicles can enter the road system). The zone system utilized in the Hamilton model is the GRIDS traffic zone system, which is consistent with the Transportation Tomorrow Survey[1] GTA 2001 zone system.

The Hamilton Model was used as part of the development of the previous Hamilton Transportation Master Plan in 2007, at which time the base year model was calibrated using 2001 Transportation Tomorrow Survey (TTS) data. In 2008, the model was updated to reflect 2006 TTS data / travel patterns. Furthermore, in 2011 the Hamilton Model was utilized for the Preliminary Design and Feasibility Study for Hamilton Rapid Transit, for which the model was updated again to reflect 2011 TTS data. In order to ensure the highest degree of accuracy, the most recent Hamilton Model was reviewed and re-calibrated / validated for this TMP review and update.

2.1 MODEL CALIBRATION / VALIDATION SUMMARY

Prior to proceeding with the assessment of future capacity deficiencies as part of this study, the project team examined the ability of the Hamilton Model to reproduce existing travel patterns at the screenline level of detail. The screenlines previously defined in the "Hamilton EMME/2 Model Update and Calibration Report" (2009) were used for the calibration / validation exercise.

The review found most screenlines and several locations exhibited high simulated-to-observed variance, indicating that the model is not sufficiently calibrated and thus not appropriate for future travel demand forecasting. Thus, a thorough network validation and calibration was undertaken, which included:

- Physical model network refinements, including traffic zone connector adjustments, refinements to link attributes (speed, lane configuration and capacity, volume-delay functions), and network geometry correction.
- Updates to base year transit network characteristics
- Travel Demand Adjustments, based on the GRIDS land use forecasts and localized iterative demand adjustments to better match traffic count data

Once calibrated, the model was validated at the screenline level of detail, assuming a +/- 15% simulated to observed acceptable threshold (in accordance with industry accepted thresholds). The calibrated model was also compared with the modelling exercise completed by the B-Line LRT project and found to be consistent. The model transit assignment was also reviewed for validation against observed passenger volumes.

As illustrated in **Table 2.1** below, while the model generally under simulates traffic volumes, it provides a reasonable correlation between the observed and modelled values. The modelled vehicle volumes across all screenlines were within approximately +/- 15% of the observed volumes, except screenlines 1, 11, 12 and 13 in the northbound / eastbound direction and screenlines 8 and 13 in the southbound / westbound direction. Most modelled screenline flows were within +/- 10% of the observed flow, including all peak direction flows. Additionally, the

[1] The Transportation Tomorrow Survey (TTS) is a comprehensive travel survey conducted in the Greater Toronto and Hamilton Area (GTHA) every 5 years, providing a wealth of transportation data for the Region.

modelled and observed peak period transit ridership volumes entering and exiting the Hamilton Central Business District were also compared. A summary of these volumes is provided in **Table 2.2**, showing reasonable correlation between observed and modelled transit ridership.

Furthermore, the overall goodness-of-fit between link-level observed and simulated auto and transit volumes were checked as an added layer of validation. The comparison of volumes on the auto network showed reasonable correlation, exhibiting an R^2 value of 0.88[2]. Similarly, the comparison of transit volumes to observed transit passenger data also showed acceptable level-of-fit, with an R^2 value of 0.95 (shown in **Figure 2-2** and **Figure 2-3**).

The results of the model validation show that the updated Hamilton Model is generally capable of simulated existing travel patterns, and thus can be used to forecast future transportation conditions. The model calibration / validation process is described in detail in the "EMME Model Update, Calibration and Validation Report".

[2] R^2 is a measure of the level of fit to observed data. A value of 1.0 indicates that the simulated forecasts exactly match the observed data.

Table 2.1 – Summary of Observed and Modelled Auto Volumes (before Demand Adjustment)

Screenline	Vehicle Counts 8:00-9:00		Vehicle simulated AM Peak Hour		Difference		% Difference	
	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB
1 Hamilton - Burlington	5,401	4,194	6,244	4,294	843	100	16%	2%
2 QEW - Burlington	6,475	3,995	6,388	4,347	-87	352	-1%	9%
3 Hamilton - Niagara	3,639	6,062	3,267	6,058	-372	-4	-10%	0%
4 Hamilton - Haldimand	4,359	3,181	4,535	3,485	176	304	4%	10%
5 Hamilton - Brant and Cambridge	960	915	963	883	3	-32	0%	-3%
6 Highway 6 (west side)	3,140	1,844	3,161	1,788	21	-56	1%	-3%
7 Highway 403 (S/E sides)	11,572	10,328	10,966	10,594	-606	266	-5%	3%
8 Escarpment	15,605	7,622	15,976	8,846	371	1,224	2%	16%
9 Red Hill Creek	7,804	11,324	8,664	11,573	860	249	11%	2%
10 Lincoln Alexander / Mud Street	17,249	9,838	16,544	9,006	-705	-832	-4%	-8%
11 Milton West End	533	236	778	249	245	13	46%	6%
12 Highway 5 (south side)	1,633	1,164	2,182	1,278	549	114	34%	10%
13 Wellington St (east side)	2,937	5,607	3,561	3,692	624	-1,915	21%	-34%
Total	**81,307**	**66,310**	**83,229**	**66,093**	**1,922**	**-217**	**2%**	**0%**

Table 2.2 – Summary of Observed and Modelling Transit Volumes

Screenline	Observed Passenger Volume		Modelled Passenger Volume		Difference		% Difference	
	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB	EB / NB	WB / SB
1	749	2631	730	2692	-19	61	-3%	2%
2	992	2334	916	2514	-76	180	-8%	8%
3	512	267	481	323	-31	56	-6%	21%
4	793	1485	791	1435	-2	-50	0%	-3%
5	2894	1436	2802	1296	-92	-140	-3%	-10%
All	**5940**	**8153**	**5721**	**8261**	**-219**	**108**	**-4%**	**1%**

Figure 2-2 – Goodness-of-Fit of Model Validation – Auto Volumes

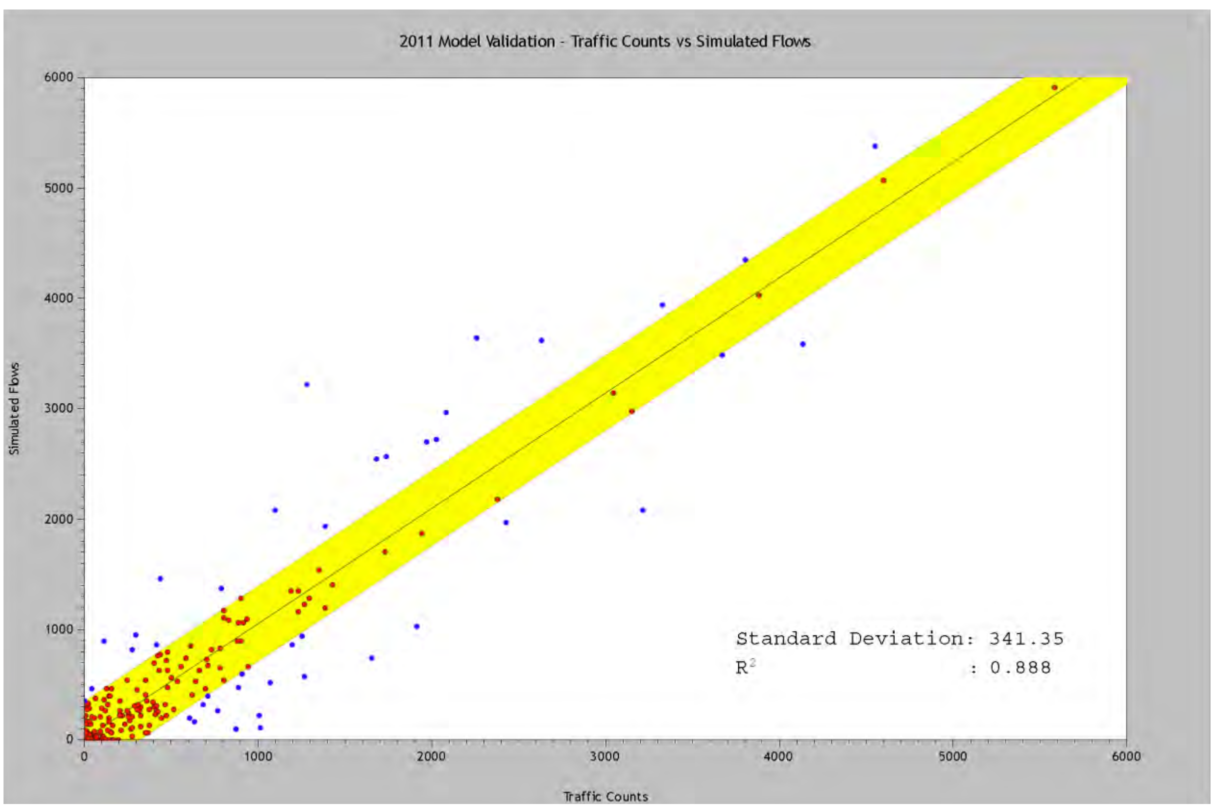
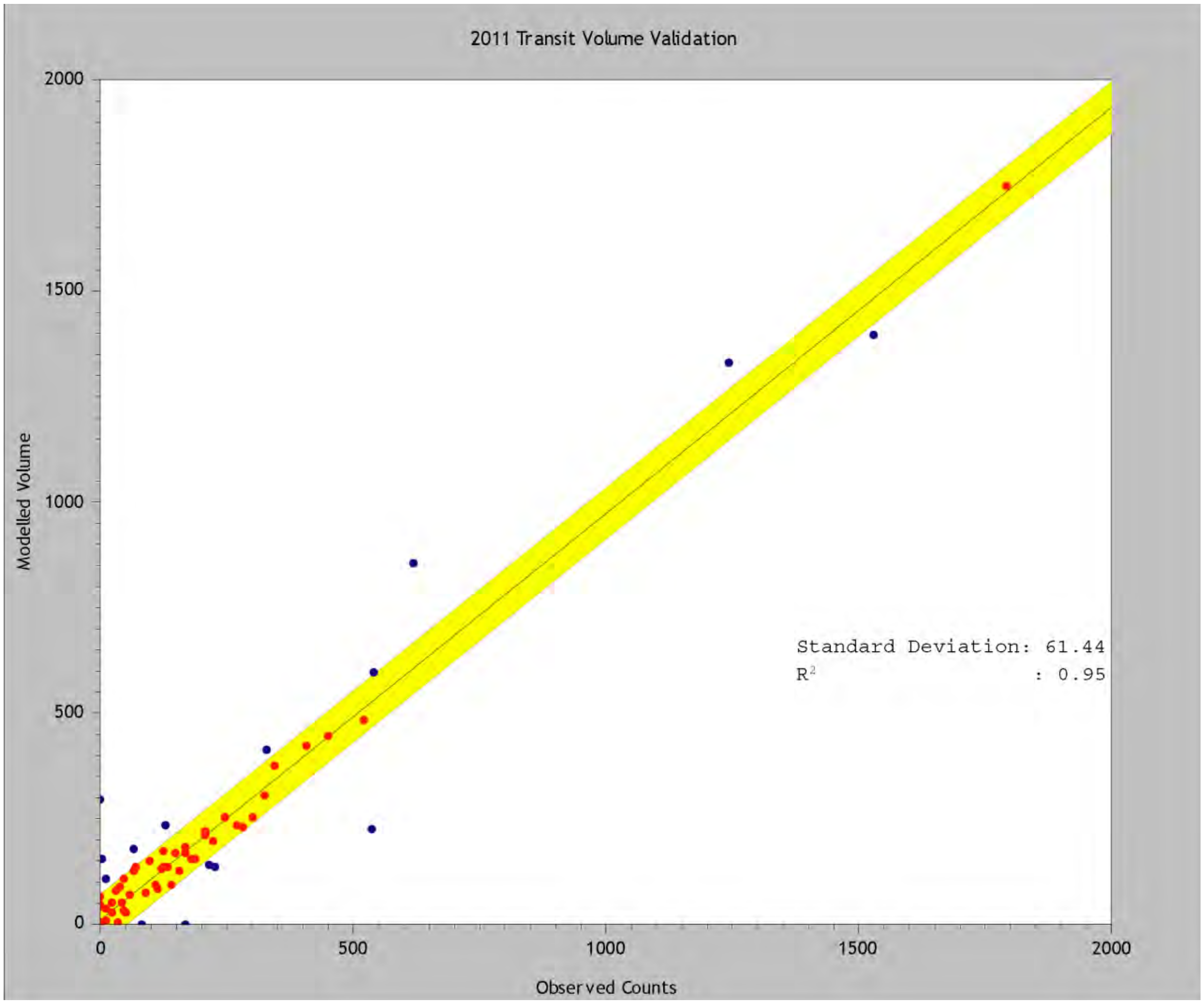


Figure 2-3 – Goodness-of-Fit of Model Validation – Transit Volumes



3 FUTURE TRAVEL DEMANDS

With the model calibrated and validated, the future travel demands included in the previous Hamilton Model were reviewed and updated for the CWTMP assessment. The revised 2031 travel demands were then used as the basis of the 2031 base assignment, and needs / opportunities assessment. This section summarizes the 2031 future demands, and adjustments made as part of the TMP review and update.

3.1 LAND USE ASSUMPTIONS

The future travel demand forecasts included in the Hamilton Model were developed based on land use inputs consistent with Growth Related Integrated Development Strategy (GRIDS), the City's long range strategic planning study and capital budget. The land use projections and allocations at the traffic zone level were applied to determine the total peak period trips originating at and destined to the model traffic zones. Generally, for the AM period, population determines the origin trips, and employment determines destination trips. This provides more predictable patterns, as opposed to the varying origin-destination during the PM period and is much more difficult to forecast.

Through this linkage with growth projections, the model is ensured to forecast future traffic based on planning targets. The GRIDS land use projections are summarized in the **Table 3.1** below.

Table 3.1 – City of Hamilton Land Use Data

Area	2011			GRIDS 2021		GRIDS 2031	
	Census 2011 Population (Pop.)	GRIDS Data		Pop.	Jobs	Pop.	Jobs
		Pop.	Jobs				
Flamborough	40,092	40,455	9,950	52,114	12,498	55,426	13,151
Dundas	24,907	25,919	6,886	25,847	7,202	26,270	7,825
Ancaster	36,911	37,164	9,280	42,815	10,328	42,898	11,138
Glanbrook	22,438	21,772	9,155	35,748	11,335	64,405	12,867
Stoney Creek	65,120	66,790	32,051	84,114	36,767	99,302	40,878
Former Hamilton	330,481	338,957	166,574	354,044	189,990	371,447	215,113
Hamilton	**519,949**	**531,057**	**233,896**	**594,682**	**268,120**	**659,748**	**300,972**

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3.2 TRAVEL DEMAND ADJUSTMENTS

To ensure that the calibration adjustments are reflected in the future travel patterns, the 2031 demands were factored based on the demand adjustments applied during calibration (please refer to the ““EMME Model Update, Calibration and Validation Report” for details).

The revised 2031 travel demands were then assigned to the 2031 base network (“do nothing”), and reviewed for overall traffic flows and trip distribution. The assigned auto volumes were also compared to model results developed as part of the Hamilton LRT modelling report (“Hamilton LRT Wider Area Traffic Impacts” report), which focused on the downtown core area. It is understood that localized adjustments were made for the LRT study, and as such the demands from the Hamilton LRT modelling were found to be slightly higher than the Hamilton Model forecasts for the downtown area. To maintain consistency with the LRT study and to adopt the localized adjustments applied as part of that assignment, the 2031 Hamilton model travel demands were also adjusted using an iterative process to better correlate with the LRT model outputs.

With the future 2031 demands adjusted, the model could be utilized to assess potential future improvement scenarios

3.3 TRANSIT ASSUMPTIONS

The future transit demands included in the Hamilton Model assume a growth in transit mode share to 12%. This is reflective of the implementation of new transit initiatives, such as the GO transit expansion, and the planned Hamilton Long Term Rapid Transit System “B.L.A.S.T.” (shown here). A sensitivity test using a 9% transit mode share was undertaken. The results showed increased capital requirements, therefore the importance of reaching the aspirational goal of 12% was maintained.

Transit demands in the Hamilton Model are split into the following transit modes:

- Local Transit
- Local Transit + GO Transit
- GO Rail

Transit demands in the Hamilton Model represent the AM Peak Period.

3.4 TRUCK ASSUMPTIONS

The future truck assignment for the Hamilton Model is assumed to remaining consistent with existing, as described in the ""EMME Model Update, Calibration and Validation Report". Truck assignment is split into long and short haul truck trips, where long haul truck movements are based on the 1995 MTO commercial vehicle survey and 2000 Niagara Bridge crossing survey. This truck matrix is pre-assigned on the road network according to auto equivalents (i.e. number of trucks x 2). The short haul trucks are determined through factoring total vehicle volumes. A factor of 1.03 (three percent) was used for all minor arterials and 1.05 (five percent) for all other road types.

4 2031 BASE MODEL

This section details the Hamilton Model 2031 base network, and future base assignment results which were used to identify future network impacts.

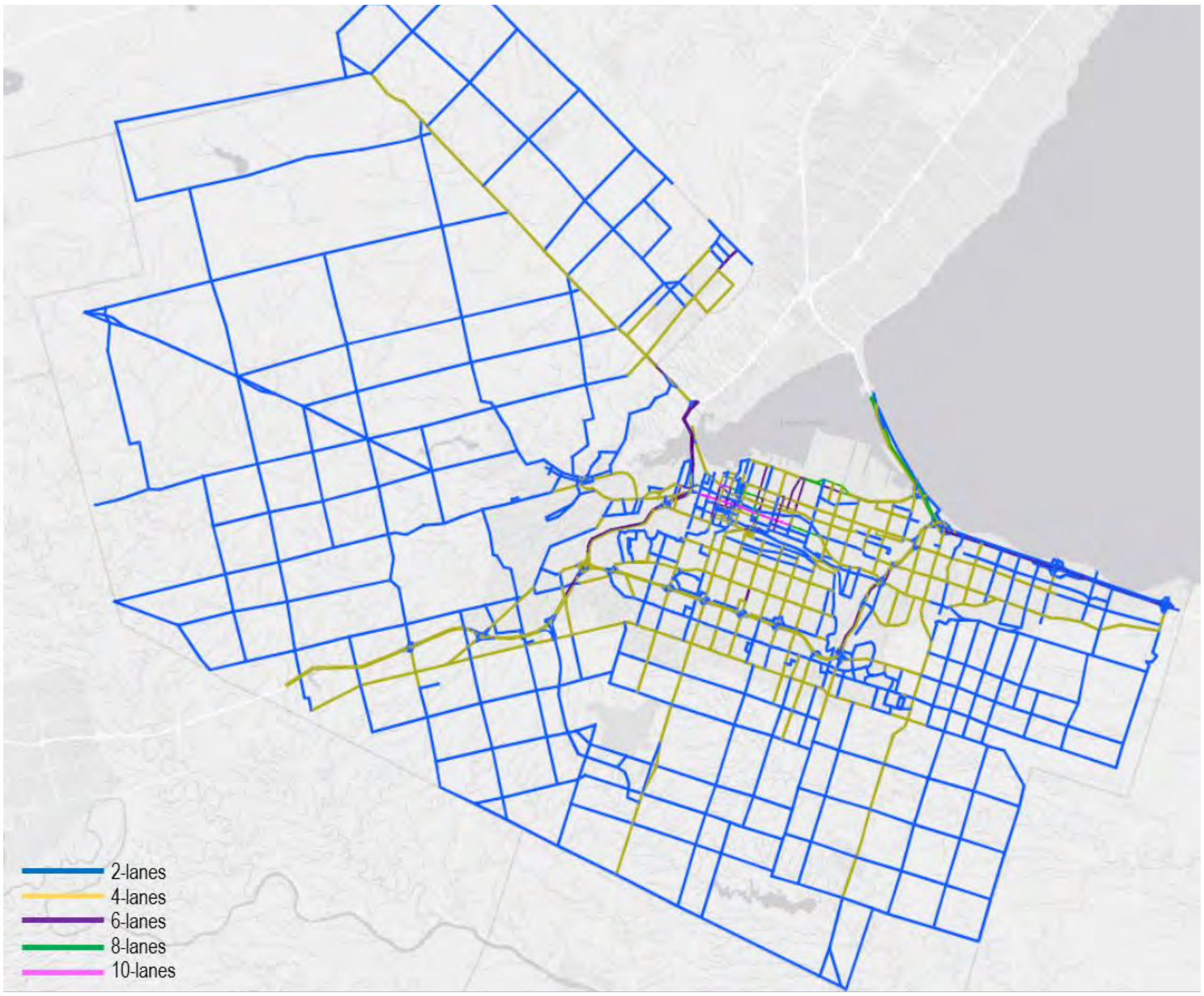
4.1 2031 BASE MODEL NETWORK

The 2031 base "do nothing" network was built on the 2011 base network, and updated to include regional and provincial future approved plans. Within the City of Hamilton, all improvements included in the City's capital program were assumed to be part of the 2031 Base Network, given the official status of these initiatives. The complete list of capital improvements can be found in **Appendix A**.

Additionally, the future transit network was updated to reflect future transit plans, such as the BLAST network (including the King Street LRT B-Line, and express L, A, S, and T express bus lines), and GO rail expansion into Hamilton. It should be noted that to account for the King Street LRT, vehicular lanes along King Street were reduced to 2-lanes (bi-directional), for service and emergency vehicle access.

Truck share and other trip modes are assumed to remain consistent with the base model (please refer to "EMME Model Update, Calibration and Validation Report" for details). The 2031 Base Model is illustrated in **Figure 4-1.**

Figure 4-1 – 2031 Base Network (Hamilton only)



4.2 2041 AM PEAK HOUR BASE ASSIGNMENT RESULTS

The revised and adjusted vehicular and transit travel demands for the 2031 AM Peak Hour / period were assigned to the 2031 Base Road and Transit Networks. The assignment revealed several areas within the City where unstable traffic flow conditions are anticipated, including transportation network impacts and areas where the network is anticipated to exhibit deteriorated levels of service (LOS)[3].The key issues identified are listed below.

[3] Level of Service (LOS) is a qualitative measure sued to related the quality of traffic service on a road segment or intersection, based on performance measures such as speed, capacity, and density. LOS A-C represent stable traffic operations, LOS D represent traffic conditions approach unstable flow, LOS E represents unstable flow near capacity, and LOS F represents at or over capacity conditions (congested)

- Escarpment crossing locations are expected to approach unstable conditions (LOS D-F), including Beckett Drive, James Mountain Road, Jolley Cut, and Sherman Cut.
- The majority of future capacity deficiencies are expected to occur within the Downtown Core, bound by Highway 403, Burlington Street, Red Hill Valley Parkway (RHVP), and the escarpment. Since much of this area is developed, road expansions opportunities may be limited, therefore more investment in shifting the mode share is needed.
- Future planned surface transit routes will experience reduced reliability of travel along several routes due to road network congestion.
- Highways adjacent to the City are expected to operate at or near capacity conditions at certain locations, including:
  - Highway 403 from Highway 6 (Halton Border) to Highway 6 (LOS E-F)
  - Lincoln Alexander Parkway from Upper Wentworth Street to Red Hill Valley Parkway (LOS D-E).
  - Red Hill Valley Parkway for Lincoln Alexander Parkway to King Street (LOS D-F)
  - QEW Skyway (LOSE D-F)
  - QEW from Skyway to Hamilton east border (LOS D-F)

The model results for the 2031 Base Network AM Peak Hour assignment are summarized in **Figure 4-2**, below, displayed by volume-to-capacity ratio (V/C ratio)[4] and the corresponding level of service, as listed below.

- Grey: V/C < 0.75 (LOS A-C) – Stable traffic operations
- Yellow: 0.75 > V/C > 0.90 (LOS D) – Approaching unstable conditions
- Orange: 0.90 > V/C > 1.00 (LOS E) – Unstable flow near capacity
- Red: V/C > 1.00 (LOS F) – At or over capacity conditions

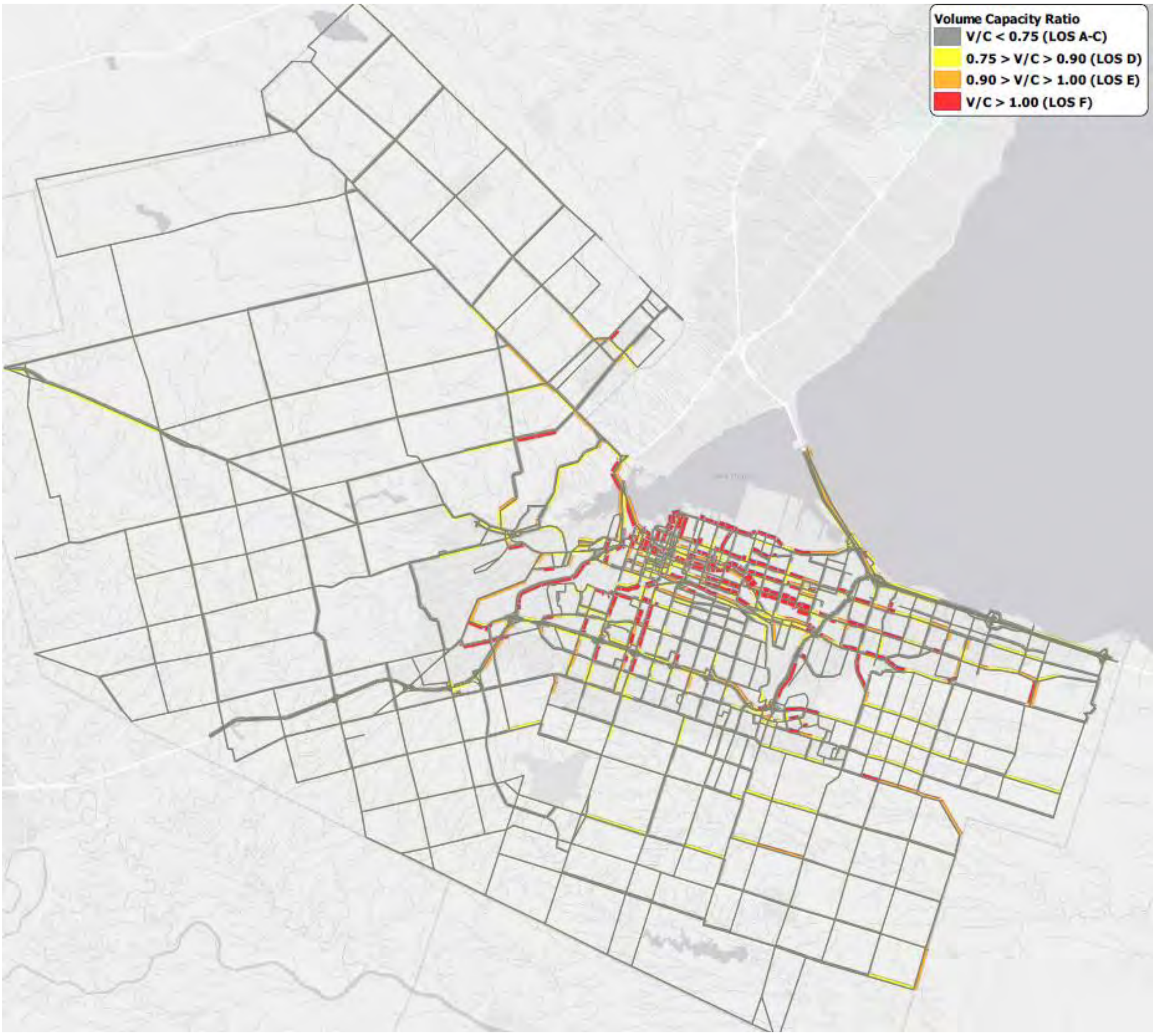
Recognizing the issues identified through the analysis of the 2031 Base AM model results, the following observations can be drawn.

- As a natural barrier, crossing the escarpment potentially strains the network at the crossing locations, where some traffic "bottlenecks" are anticipated. However, since not all of the crossings are expected to deteriorate, an assessment of escarpment crossing configuration may provide insight on how best to address the escarpment crossings in the future.
- The constrained nature of the downtown core road network limits the potential for expansion, and thus the importance of transit initiatives to reduce auto-dependency is evident. The future modelling should evaluate the anticipated congestion along planned surface transit routes in order to determine implementation strategy for transit plans, and possible measures to improve transit operations.
- The highway system surrounding and penetrating the City's transportation network is expected to experience decreased performance at certain segments. The majority of these

[4] Volume-to-capacity (V/C) ratio is a metric typically used to measure performance of a road segment or intersection, comparing the traffic volume top available capacity. V/C Ratio of 1 or higher indicates at or over capacity conditions.

issues are anticipated on the provincial highways (Highway 403, QEW), which indicates a need for improvements to MTO facilities. This may strengthen the case for future MTO planning studies. The City's municipal expressways (Lincoln Alexander Parkway and Red Hill Valley Parkway) are anticipated to experience decreased levels of service, but only at certain segments.

Figure 4-2 – 2031 Base Network ("do nothing") AM Peak Hour Model Results



5 FUTURE ALTERNATIVE SCENARIOS

Following the assessment of the 2031 Base Network model results, a series of potential future network alternatives were identified to determine the future impact associated with targeted network changes that address the City's strategic and operational needs. Recognizing that the City road network is constrained by existing built-out conditions in several areas, the alternative scenarios focused on specific issues, improving trip distribution patterns, and supporting alternatives modes of transportation (transit, walking/cycling). Based on this, the alternatives detailed in this section were analyzed.

5.1 EVALUATION CRITERIA

As each scenario focused on different objectives, the criteria used to evaluate the alternative scenarios is not consistent throughout. The following criteria is used in varying combinations to assess the future scenarios.

- **Traffic Diversion:** This metric provides an indication of the magnitude of traffic that diverts from key roads as a result of an alternative scenario network change, and thus informs the impact of network changes.
- **Transportation System Performance:** This metric indicates the performance of road network segments or routes, based on: forecasted traffic volumes and road capacity (volume-to-capacity ratio) and level of service, and identifies future issues / constraints.
- **Traffic Speed (km / hr):** The vehicular speed along road segments provides information on the road operations, simulating the general delay that vehicles may or may not experience.
- **Transit Ridership:** This output provides the forecasting peak period ridership for select transit routes.
- **Travel Demands:** This output indicates if overall travel demands in an area are impacted by an alternative scenario.
- **Estimated CO_2 Emissions / year (metric tons):** This statistic is a calculation of the estimated increase / decrease of emissions associated with a future alternative scenario, relating congestion to air quality / pollutions and environmental sustainability. For this analysis, CO_2 emissions were calculated as per the following formula and assumptions:

$$Estimated\ CO_2 Emissions\ per\ year\ (kg) = \frac{Daily\ Vehicle\ Kilometres\ Travelled}{Average\ Fuel\ Consumption} \times CO_2\ per\ Liter\ gas$$

Where:
Average Fuel Consumption = 9.2 L/100km
CO_2 per Liter gas = 2.3 kg/L
1 kg = 0.001 metric ton

5.2 SCENARIO 1 - ESCARPMENT CROSSINGS

The network performance at escarpment crossings is a key issue for residents, as these routes provide access across the natural barrier to / from the downtown core. The escarpment crossing scenarios developed for this assessment were intended to provide insight on the impacts of certain targeted adjustments to the escarpment crossings, considering travel pattern shifts, road segment operations, and estimated environmental impacts. The escarpment alternatives assessed are described below.

5.2.1 1A: CLAREMONT ACCESS AS 2-LANES UP / 2-LANES DOWN

For Scenario 1A, the purpose was to evaluate the impacts associated with converting Claremont Access to a two (2) lanes up / two (2) lanes down configuration, thereby reducing one southbound travel lane to be converted to walking / cycling. This change from the existing three (3) lanes up / two (2) lanes down configuration would help achieve the City's active transportation goals. Scenario 1A is illustrated in **Figure 5-1**.

Figure 5-1 – Scenario 1A

Key evaluation criteria for this scenario are:

- **Traffic Diversion** from Claremont Access to other escarpment crossing locations, to identify which crossings (if any) would be impacted by the lane SB lane reduction
- **Transportation System Performance** at the escarpment crossing locations, to assess the performance of Claremont Access under this scenario, as well as the impacts on adjacent crossings
- **Traffic Speed** at the escarpment crossings
- **Estimated CO_2 Emissions** to determine any adverse environmental impacts associated with the scenario.

5.2.2 1B: REMOVAL OF DIRECTIONAL CONTROL ON SHERMAN CUT

For Scenario 1B, the demand model was utilized to assess what the impacts would be of converting Sherman Cut from a two (2) lane directionally controlled road to a typical two (2) lane cross section (1-lane northbound, 1-lane southbound). Currently, Sherman Cut operates with directional control during the AM and PM peaks, enabling one-way travel in the peak direction along both lanes, and therefore this scenario was developed to determine the traffic operations without the need for the operational shift and peak crossing restriction. Scenario 1B is illustrated in **Figure 5-2.**

Figure 5-2 – Scenario 1B

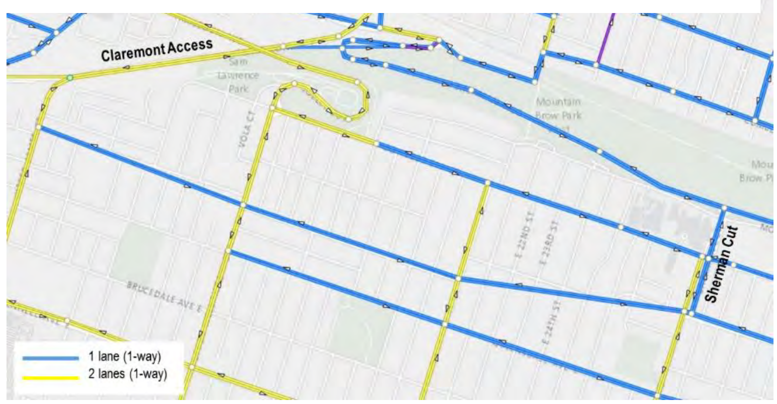
Key evaluation criteria for this scenario are:

- **Traffic Diversion** from Sherman Cut in the AM to other escarpment crossing locations, to identify impacts associated with the SB lane reduction
- **Transportation System Performance** at the escarpment crossing locations, to assess the performance of Sherman Cut as well as adjacent crossings
- **Traffic Speed** at the escarpment crossings
- **Estimated CO_2 Emissions** to determine any adverse environmental impacts associated with the scenario.

5.2.3 1C – COMBINATION OF 1A AND 1B

Scenario 1C assessed the impact of Scenario 1A and 1B combined. Scenario 1C is illustrated in **Figure 5-3.**

Figure 5-3 – Scenario 1C



Key evaluation criteria for this scenario are:

- **Traffic Diversion** from Claremont Access and Sherman Cut in the AM to other escarpment crossing locations, to identify impacts associated with the SB lane reductions
- **Transportation System Performance** at the escarpment crossing locations, to assess the performance of Claremont Access, Sherman Cut as well as adjacent crossings
- **Traffic Speed** at the escarpment crossings

- **Estimated CO_2 Emissions** to determine any adverse environmental impacts associated with the scenario.

5.2.4 MODEL RESULTS

The model results for the 2031 base network and Scenario 1 are provided in **Table 5.1**, and summarized below.

As discussed earlier, the 2031 base traffic forecasts showed that most escarpment crossing locations are expected to operate at Levels of Service (LOS) ranging from D to F. The most impacted crossings (with LOS of F) are Beckett Drive, James Mountain Road, and Jolley Cut. However, Sherman Cut is expected to approach unstable conditions, with an LOS of D.

The modelling results for Scenario 1A showed that the southbound operations are not significantly impacted by the lane reduction, and that Claremont Access continues to operate at an LOS C or better. For Scenario 1B, the results found that with only one (1) lane in each direction, the Sherman Cut would deteriorate to an LOS F in both directions, assuming the base year lane capacities. Additionally, the directional control conversions would shift traffic to James Mountain Road and Claremont Access, where the traffic shifts would result lowered LOS. Scenario 1C assessed the impact of Scenario 1A and 1B combined. As anticipated, the results are fairly similar to Scenario 1B.

Overall, Scenarios 1B and 1C resulted in overall increases in emissions, indicating that the removal of directional control increases escarpment crossing delays.

Volume and V/C Ratio plots from the Hamilton Model for Scenario 1 can be found in A**ppendix B**.

Table 5.1 – 2031 Scenario 1 Model Results Summary

Criteria	Escarpment Crossings Scenarios											
	Base			Scenario 1A			Scenario 1B			Scenario 1C		
	Link	NB	SB	Link	NB	SB	Link	NB	SB	Link	NB	SB
Traffic Diversion (%)	Beckett Dr =	0%	0%	Beckett Dr =	-1%	1%	Beckett Dr =	-1%	-1%	Beckett Dr =	-1%	-1%
	James Mountain Rd =	0%	0%	James Mountain Rd =	36%	0%	James Mountain Rd =	49%	1%	James Mountain Rd =	49%	1%
	Claremont Access =	0%	0%	Claremont Access =	1%	-5%	Claremont Access =	13%	-13%	Claremont Access =	13%	-15%
	Jolley Cut =	0%	0%	Jolley Cut =	-10%	0%	Jolley Cut =	-18%	-8%	Jolley Cut =	-18%	-8%
	Sherman Cut =	0%	0%	Sherman Cut =	-1%	-	Sherman Cut =	-25%	100%	Sherman Cut =	-25%	100%
	Kenilworth Access =	0%	0%	Kenilworth Access =	0%	2%	Kenilworth Access =	11%	-30%	Kenilworth Access =	12%	-28%
Transportation System Performance (V/C ratio and LOS)	Beckett Dr =	1.39	0.78	Beckett Dr =	1.39	0.79	Beckett Dr =	1.38	0.77	Beckett Dr =	1.38	0.77
	James Mountain Rd =	0.72	1.01	James Mountain Rd =	0.98	1.01	James Mountain Rd =	1.07	1.02	James Mountain Rd =	1.07	1.02
	Claremont Access =	0.71	0.39	Claremont Access =	0.71	0.55	Claremont Access =	0.80	0.34	Claremont Access =	0.80	0.49
	Jolley Cut =	1.14	0.37	Jolley Cut =	1.03	0.37	Jolley Cut =	0.94	0.34	Jolley Cut =	0.94	0.34
	Sherman Cut =	0.82	-	Sherman Cut =	0.81	-	Sherman Cut =	1.23	1.07	Sherman Cut =	1.23	1.08
	Kenilworth Access =	0.53	0.34	Kenilworth Access =	0.53	0.34	Kenilworth Access =	0.58	0.24	Kenilworth Access =	0.59	0.24
Traffic Speed (km/hr)	Claremont Access = (s)	54	68	Claremont Access = (s)	53	63	Claremont Access = (s)	47	69	Claremont Access = (s)	47	65
	Sherman Cut = (s)	33	-	Sherman Cut = (s)	34	-	Sherman Cut = (s)	14	20	Sherman Cut = (s)	14	20
Estimated CO_2 Emissions / year (metric tons)	Beckett Dr =	244	136	Beckett Dr =	243	138	Beckett Dr =	241	134	Beckett Dr =	241	135
	James Mountain Rd =	57	80	James Mountain Rd =	77	80	James Mountain Rd =	85	80	James Mountain Rd =	85	81
	Claremont Access =	263	215	Claremont Access =	265	204	Claremont Access =	297	187	Claremont Access =	297	182
	Jolley Cut =	100	32	Jolley Cut =	90	33	Jolley Cut =	82	30	Jolley Cut =	82	30
	Sherman Cut =	33	-	Sherman Cut =	33	-	Sherman Cut =	25	22	Sherman Cut =	25	22
	Kenilworth Access =	178	114	Kenilworth Access =	178	116	Kenilworth Access =	198	80	Kenilworth Access =	199	81
Total		875	577		885	571		927	533		928	531

LEDEND

Transportation System Performance

0.00 - 0.75 V/C =	LOS A-C	
0.75 - 0.90 V/C =	LOS D	
0.90 - 1.00 V/C =	LOS E	
> 1.00 V/C =	LOS F	

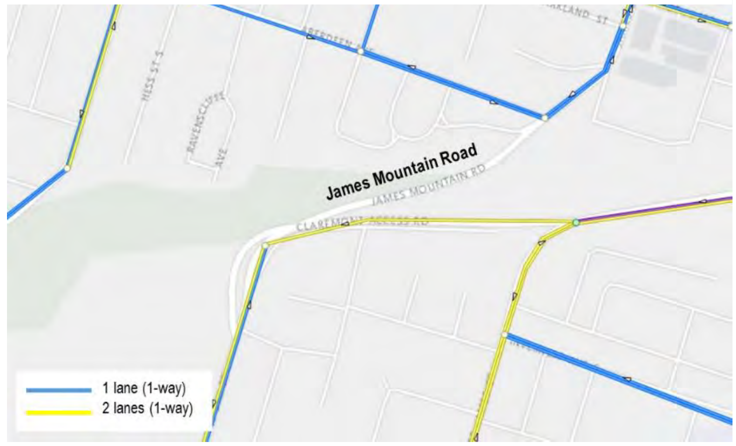
Estimated CO2 Emissions / year (metric tons)

Emissions > Do Nothing	
Emissions < Do Nothing	

5.3 SCENARIO 2 – TRANSIT NEEDS AND OPPORTUNITIES

The congestion anticipated in the downtown core combined with the lack of expansion opportunities in physically constrained built-out areas supports the need for increased mode shift to transit. Considering this, the base network includes future transit initiatives and assumes a 12% transit mode share for 2031.However, surface transit routes may continue to face delays due to operating on locations with capacity constraints and experiencing delays ("pinch points") routes.

Figure 5-4 – Scenario 2



The purpose of the Scenario 2 modelling assessment was to determine the traffic impacts associated with the closure of James Mountain Road to vehicular access (as shown in **Figure 5-4**), in which case the roadway would be utilized by transit and walking / cycling modes. Additionally, this model assessment was also intended to assess the transportation system performance along transit route corridors, in order to determine which routes would experience traffic congestion in the AM peak hour, and which routes are anticipated to generate high ridership demands. By understanding the future road network conditions along transit routes, corridors which would benefit most from transit service increase and subsequent mode share increases can be identified to aid in the prioritization of future transit initiatives.

Key evaluation criteria for this scenario are:

- **Traffic Diversion** from James Mountain Road to adjacent escarpment crossings, to identify impacts associated with the closure.
- **Transportation System Performance** at the escarpment crossing locations adjacent to James Mountain Road, to assess the performance of Claremont Access, Sherman Cut as well as adjacent crossings. Additionally, the transportation system performance along the BLAST planned routes was also evaluated to determine the average and worst-case traffic operations along the route road links.
- **Transit Ridership** for BLAST network, to show the forecasted rapid transit usage
- **Estimated CO_2 Emissions** to determine any adverse environmental impacts associated with the scenario.

5.3.1 MODEL RESULTS

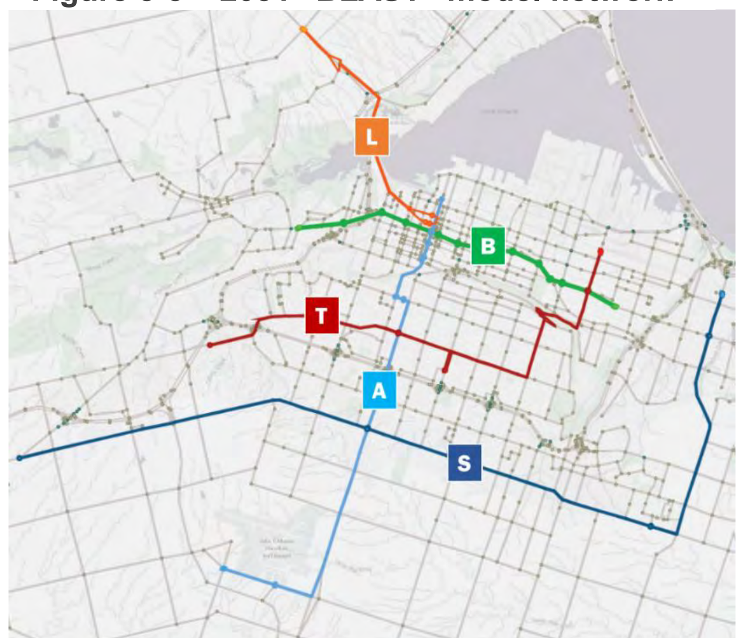
The model results for the base network and Scenario 2 are provided in **Table 5.2**, and are summarized below.

Under the 2031 Base AM network conditions, the model results revealed that the escarpment crossings of Beckett Drive and James Mountain Road are both forecasted to operate at an LOS of D-F, while Claremont Access is expected to operate at an LOS of D in the northbound direction. The closure of James Mountain Road for vehicular travel showed that the majority of trips using James Mountain Road would shift primarily to Beckett Drive, further deteriorating conditions along that corridor.

With regards to transit ridership, the passenger volumes remain consistent between the 2031 Base and Scenario 2, since both scenarios assume the same future transit network. As can be expected, the transit line with the highest ridership is the B-Line LRT (eastbound and westbound). The A-line is also forecasted to accommodate high passenger volumes.

Considering the future transit initiatives (i.e. BLAST network), there are several surface routes which may experience reduced transportation system performance, and thus would benefit from increased service, priority measures, and transit mode shift.

Figure 5-5 – 2031 "BLAST" model network



- The B-Line route will travel along King Street, with the road converted to LRT transit and one (1) vehicular travel lane in each direction to accommodate service vehicle access and emergency response vehicles. Due to this reduced capacity, King Street is forecasted to operate at an LOS of F throughout the LRT corridor, and it is anticipated that the majority of through trips will re-route to appropriate parallel roads.
- The L-line route will travel on Highway 6, Plains Road, York Boulevard, and Cannon Street. On average, the roads along the route are expected to operate at an LOS of D, however congestion / bottlenecks (LOS E-F) are anticipated along York Boulevard from Highway 403 to Queen Street, Bay Street to James Street, and along Cannon Street from Queen Street to James Street.
- The A-line route is planned to travel along from the John C. Murno Hamilton International Airport (Hamilton Airport) along Upper James Street, Fennel Street, James Mountain Road, and James Street, with an average LOS D over the entire line. However, the A-line buses will travel along mostly congested corridors from Stone Church Road to / from the Barton Street loop point, ranging from LOS D-F. Key bottlenecks are anticipated to occur at the Lincoln Alexander Parkway interchange, the escarpment crossing, and Cannon Street to Barton Street.

- Conversely, the S-line is forecasted to travel along mostly free flowing corridors (LOS A-C), with the exception of a few congested areas (LOS D-F). The route is planned to travel along Rymal Road, Upper Centennial Parkway, and Centennial Parkway, and is anticipated to experience deteriorated levels of service along Centennial Parkway between Green Mountain Road and King Street (LOS F) and Rymal Road between Upper Mount Albion Road and 2nd Road (LOS D).
- Similarly, the T-line, which will traverse Golf Links Road, Mohawk Road, Upper Ottawa Street, Kenilworth Access and Kenilworth Avenue, is excepted to travel along mostly free flowing corridors in the AM peak (LOS A-C). The few segments of congestion along this route will experience are Mohawk Road at the Lincoln Alexander Parkway interchange, Mohawk Road between Garth Street and Upper James Street, and Kenilworth Access crossing the escarpment.

Thus, in general, according to the model results the A-line and L-line will be impacted most by future forecasted traffic conditions.

Volume and V/C Ratio plots from the Hamilton Model for Scenario 2 can be found in **Appendix B**.

Table 5.2 – 2031 Scenario 2 Model Results Summary

Criteria	Transit Needs and Opportunities					
	Base			Scenario 2		
	Link	NB	SB	Link	NB	SB
Traffic Diversion (%)	Beckett Dr =	0%	0%	Beckett Dr =	16%	51%
	James Mountain Rd =	0%	0%	James Mountain Rd =	-100%	-100%
	Claremont Access =	0%	0%	Claremont Access =	0%	26%
Transportation System Performance (V/C ratio at crossing)	Beckett Dr =	1.38	0.78	Beckett Dr =	1.60	1.18
	James Mountain Rd =	1.08	1.01	James Mountain Rd =	0.00	0.00
	Claremont Access =	0.78	0.38	Claremont Access =	0.78	0.48
	Line(s)	Avg	Max	Line(s)	Avg	Max
Transportation System Performance along Transit Routes (V/C ratio and LOS)	B Line =	1.17	2.20	B Line =	1.16	2.21
	L Line =	0.57	1.45	L Line =	0.44	1.37
	A Line =	0.79	1.26	A Line =	0.79	1.27
	S Line =	0.51	1.03	S Line =	0.52	1.04
	T Line =	0.56	1.09	T Line =	0.56	1.07
	Other Bus Routes =	0.61	1.55	Other Bus Routes =	0.61	1.53
Transit Ridership (passenger volume)	B Line =	1,983	2,777	B Line =	1,983	2,777
	L Line =	84	147	L Line =	84	147
	A Line =	232	650	A Line =	232	650
	S Line =	33	71	S Line =	33	71
	T Line =	7	27	T Line =	7	27
	Other Bus Routes =	92	1,020	Other Bus Routes =	92	1,020
	Line(s)	Overall		Line(s)	Overall	
Estimated CO_2 Emissions / year (metric tons)	B Line =	5,623		B Line =	5,626	
	L Line =	5,770		L Line =	4,980	
	A Line =	5,913		A Line =	5,904	
	S Line =	13,781		S Line =	13,845	
	T Line =	6,916		T Line =	6,887	
	N/S Bus Routes =	0		N/S Bus Routes =	0	
	E/W Bus Routes =	68,442		E/W Bus Routes =	69,115	
Total		106,445			106,358	

LEDEND

Transportation System Performance

0.00 - 0.75 V/C =	LOS A-C	(grey)
0.75 - 0.90 V/C =	LOS D	(yellow)
0.90 - 1.00 V/C =	LOS E	(orange)
> 1.00 V/C =	LOS F	(red)

Estimated CO2 Emissions / year (metric tons)

Emissions > Do Nothing	(grey)
Emissions < Do Nothing	(yellow)

5.4 SCENARIO 3 –STREET CONVERSIONS (ONE-WAY TO TWO-WAY)

As per the TMP review and update and the City's Strategic Plan, the City of Hamilton is considering the conversion of one-way streets in the downtown core to two-way operations. The future travel demand model can be utilized to determine the impacts of such conversions on the overall travel patterns, inbound / outbound demands, transportation system performance, and emissions per year. For corridors where the total number of one-way lanes is uneven, it is assumed that a centre turn lane would be implemented and the travel lane capacities would increase accordingly (i.e. a three-lane one-way street would be converted to a two-lane two-way street with a center turn lane). The following one-way to two-way street conversions were assessed as part of this alternative.

- Main Street
- Hunter Street
- Cannon Street
- Sherman Avenue
- Birch Street
- Sanford Avenue
- Hess Street
- Queen Street

The Main Street corridor two-way conversion would result in the most significant impacts to the adjacent road network, as it is a major continuous arterial connection throughout the downtown core. The Main Street conversion would also result in controversial and socio-economic impacts, and thus the need / benefits for this future conversion must adequately be demonstrated by the modelling exercise. Recognizing this, Scenario 3 was assessed in three configurations, where all conversions noted above are assumed in place in addition to three Main Street configurations.

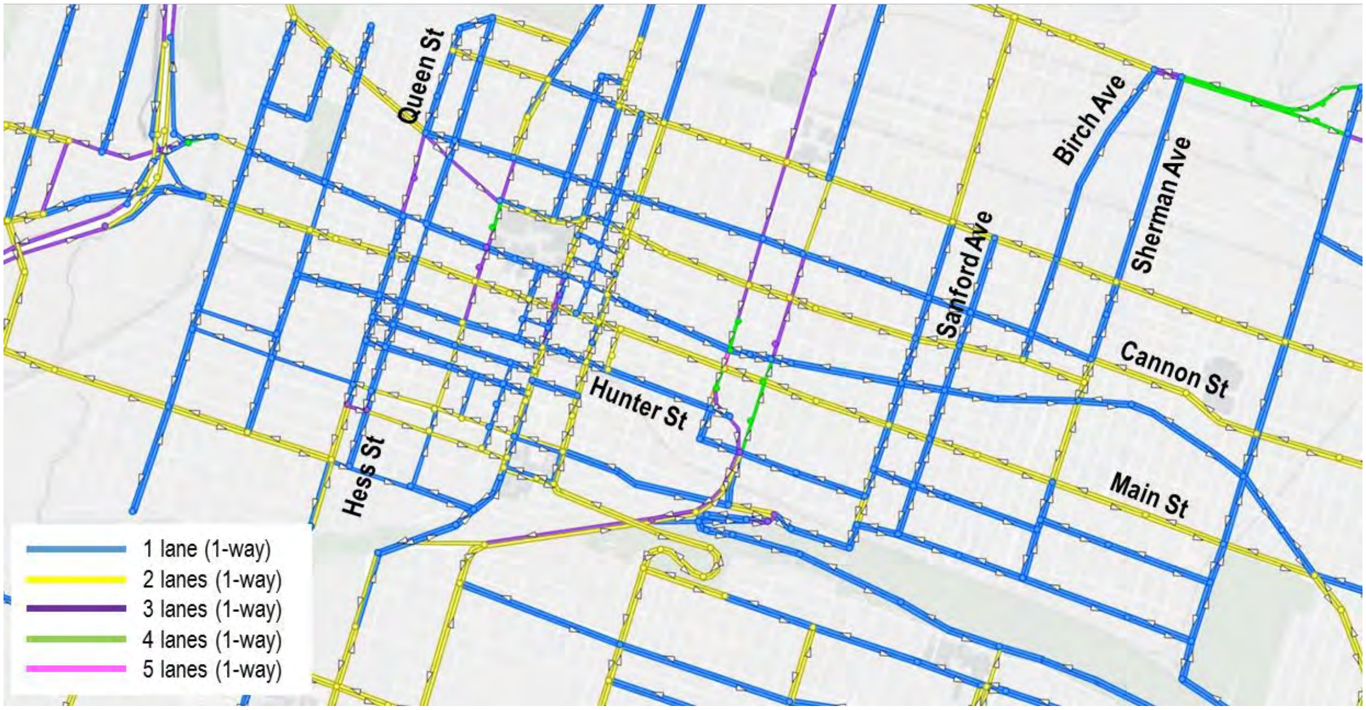
Key evaluation criteria for this scenario are:

- **Travel Demands** inbound / outbound from the downtown core area, to identify if the two-way conversions divert demands from the area.
- **Transportation System Performance** on average over the converted roads, to determine the overall impacts of the two-way conversion on operations.
- **Estimated CO_2 Emissions** to determine any adverse environmental impacts associated with the scenario.

5.4.1 3A – MAIN STREET CONVERSION FROM PARADISE ROAD TO THE DELTA

Scenario 3A includes all one-way to two-way conversions listed in Section 5.4. Main Street was converted to two-way from Paradise Road to the Delta (the entire one-way street corridor). Scenario 3A is shown in **Figure 5-6** below.

Figure 5-6 – Scenario 3A

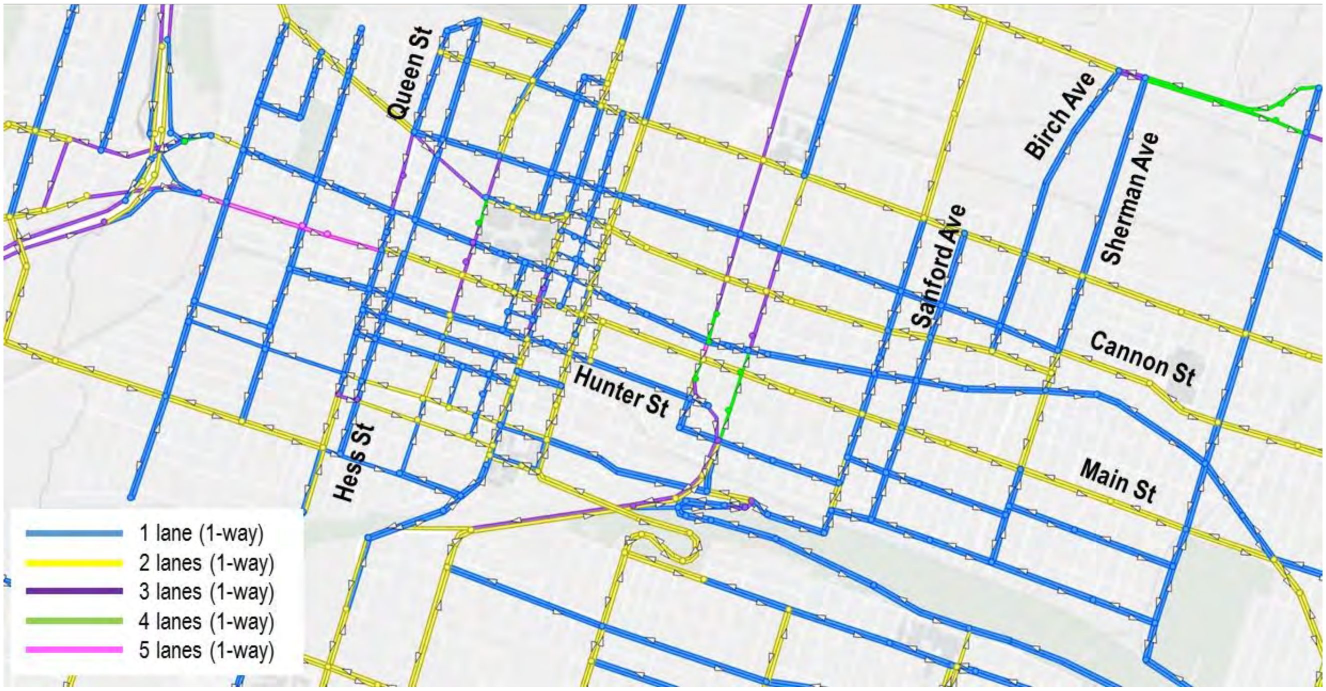


5.4.2 3B – MAIN STREET CONVERSION FROM QUEEN STREET TO THE DELTA

Scenario 3B includes all one-way to two-way conversions listed in Section 5.4 with the exception of Main Street. Main Street was converted to two-way only from Queen Street to the Delta. Scenario 3B is shown in

Figure 5-7 below.

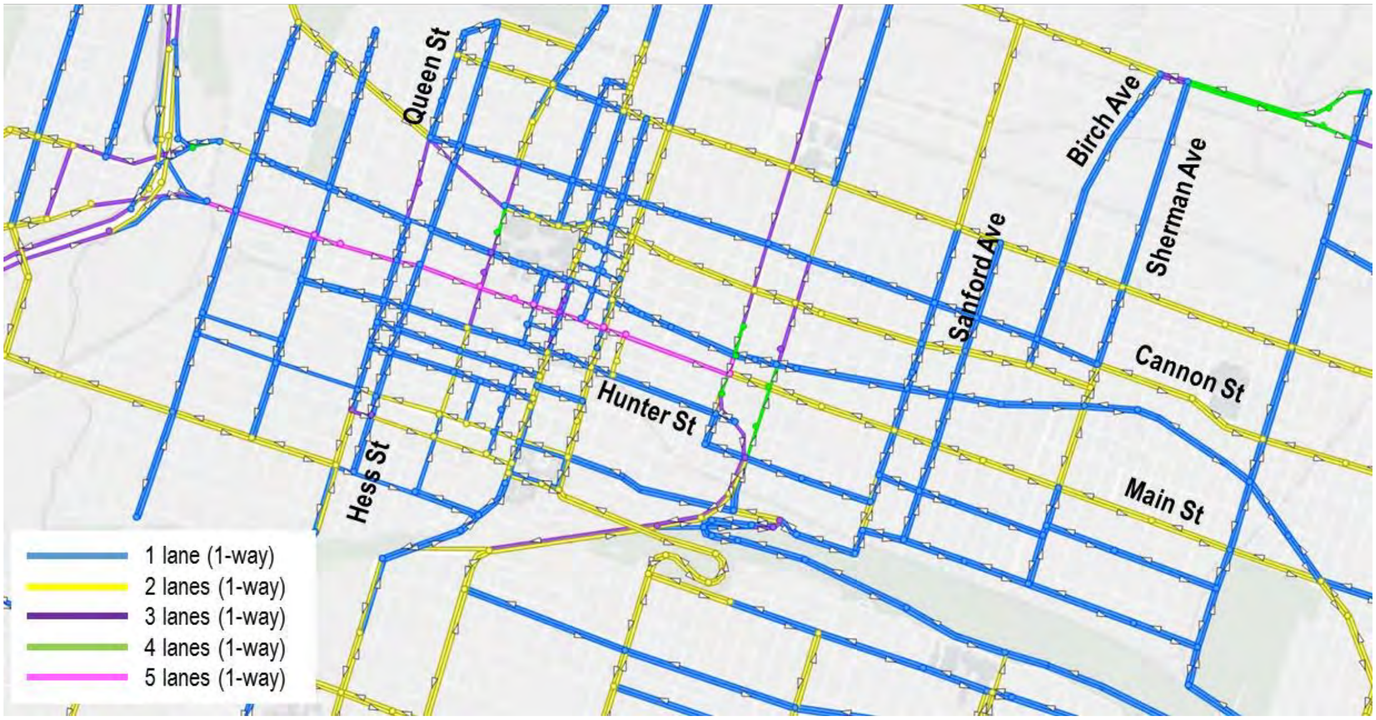
Figure 5-7 – Scenario 3B



5.4.3 3C – MAIN STREET CONVERSION FROM WELLINGTON STREET TO THE DELTA

Scenario 3C includes all one-way to two-way conversions listed in Section 5.4 with the exception of Main Street. Main Street was converted to two-way from Wellington Street to the Delta. Scenario 3C is shown in **Figure 5-8** below.

Figure 5-8 – Scenario 3C



5.4.4 MODEL RESULTS

The model results for the base network and Scenario 3 are provided in **Table 5.3**, and are summarized below.

Overall, the inbound and outbound demands for all three (3) scenarios were found to be generally consistent with the 2031 base year demands, indicating that while the traffic redistributed to account for the two-way conversions, the overall demands are not shifting out of the downtown core. Thus, the conversion to two-way streets will not impact the propensity to travel along downtown roads. Additionally, the corridors of Sherman Avenue, Sanford Avenue, and Queen Street are expected to operate at an acceptable LOS C or better.

The scenario 3A, 3B, and 3C results all found that the two-way street conversions negatively impacted the transportation performance along Main Street, decreasing the LOS from C to D. Additionally, two-way conversion under Scenario 3A and 3C showed a decrease in LOS for Hess Street, from C to D. The Hunter Street and Cannon Street LOS also decreased under the two-way conversion scenarios, from LOS D to and LOS E-F. Due to this reduction in performance, these corridors are likely not ideal for two-way conversion consideration. Birch Avenue was shown to operate better under the two-way conversion scheme, reducing from an LOS E to LOS of C or better.

Overall, the two-way conversion scenarios would result in reduced emissions. Volume and V/C Ratio plots from the Hamilton Model for Scenario 3 can be found in **Appendix B**.

Table 5.3 – 2031 Scenario 3 Model Results Summary

Criteria	One-way to Two-way Street Conversions											
	Base			Scenario 3A			Scenario 3B			Scenario 3C		
	Link	NB/EB	SB/WB	Link	NB/EB	SB/WB	Link	NB/EB	SB/WB	Link	NB/EB	SB/WB
Travel Demands over screenlines compared to base (vph)	West of Dundurn St	6,938	4,783	West of Dundurn St	6,093	4,762	West of Dundurn St	6,615	4,617	West of Dundurn St	6,836	4,472
	East of Parkdale Ave	3,791	4,767	East of Parkdale Ave	3,613	5,043	East of Parkdale Ave	3,704	5,014	East of Parkdale Ave	3,724	4,931
	North of Escarpment	7,667	4,676	North of Escarpment	7,583	4,571	North of Escarpment	7,400	4,704	North of Escarpment	7,437	4,837
	North of Barton St	7,652	5,205	North of Barton St	7,427	5,244	North of Barton St	7,521	5,149	North of Barton St	7,666	5,159
Summary	**Total**	**26,048**	**19,431**	**% difference**	**-5%**	**1%**	**% difference**	**-3%**	**0%**	**% difference**	**-1%**	**0%**
Transportation System Performance (V/C ratio & LOS)	Main Street =	0.73	0.00	Main Street =	0.86	0.89	Main Street =	0.80	0.81	Main Street =	0.73	0.88
	Hunter St =	0.00	0.78	Hunter St =	1.07	0.88	Hunter St =	1.10	0.98	Hunter St =	0.82	1.10
	Cannon St =	0.00	0.89	Cannon St =	0.83	0.99	Cannon St =	0.84	1.00	Cannon St =	0.82	1.05
	Sherman Ave =	0.55	0.00	Sherman Ave =	0.55	0.57	Sherman Ave =	0.55	0.57	Sherman Ave =	0.56	0.55
	Birch Ave =	0.00	0.90	Birch Ave =	0.55	0.63	Birch Ave =	0.55	0.62	Birch Ave =	0.56	0.61
	Sanford Ave =	0.34	0.00	Sanford Ave =	0.32	0.19	Sanford Ave =	0.32	0.19	Sanford Ave =	0.34	0.21
	Hess St =	0.60	0.00	Hess St =	0.79	0.46	Hess St =	0.67	0.52	Hess St =	0.77	0.50
	Queen St =	0.00	0.44	Queen St =	0.50	0.61	Queen St =	0.39	0.63	Queen St =	0.42	0.61
	Link	2-dir		Link	2-dir		Link	2-dir		Link	2-dir	
Estimated CO_2 Emissions / year (metric tons)	Main Street =	4,101		Main Street =	4,174		Main Street =	4,029		Main Street =	4,083	
	Hunter St =	333		Hunter St =	435		Hunter St =	465		Hunter St =	446	
	Cannon St =	1,352		Cannon St =	906		Cannon St =	917		Cannon St =	935	
	Sherman Ave =	300		Sherman Ave =	296		Sherman Ave =	298		Sherman Ave =	297	
	Birch Ave =	608		Birch Ave =	284		Birch Ave =	281		Birch Ave =	279	
	Sanford Ave =	157		Sanford Ave =	121		Sanford Ave =	120		Sanford Ave =	129	
	Hess St =	100		Hess St =	207		Hess St =	203		Hess St =	209	
	Queen St =	364		Queen St =	371		Queen St =	346		Queen St =	345	
Total		7315			**6794**			**6659**			**6723**	

LEDEND

Transportation System Performance

0.00 - 0.75 V/C =	LOS A-C	(grey)
0.75 - 0.90 V/C =	LOS D	(yellow)
0.90 - 1.00 V/C =	LOS E	(orange)
> 1.00 V/C =	LOS F	(red)

Estimated CO2 Emissions / year (metric tons)

Emissions > Do Nothing	(grey)
Emissions < Do Nothing	(yellow)

6 CONCLUSIONS AND OBSERVATIONS

Based on the model results summarized above, the following conclusions / observations can be drawn:

- The future base 2031 model assignment shows that transportation system performance issues are anticipated at the escarpment crossings and in the downtown core.
- A 2-lanes up / 2-lanes down configuration for Claremont Access would operate at acceptable LOS, and thus the proposed lane reduction can be converted to an active transportation corridor.
- The removal of directional control at Sherman Cut during the AM Peak Hour would result in increased delays at the crossing, in addition to traffic shifts to other escarpment crossings. Therefore, it recommended that the current operations be maintained.
- Restricting James Mountain Road to transit and active modes would burden adjacent escarpment crossings. However, the improved transit connection across the escarpment would potentially have positive impacts on transit reliability and possible mode shift behavior and present an opportunity to provide transit priority.
- While the King Street LRT and the associated reduction in travel lanes along King Street cause decreased LOS on King Street, the route is intended for emergency and service traffic access, and can be controlled with operational adjustments / restrictions. Traffic previously using King Street should shift to adjacent roads, or to the LRT line. This has been further optimized as part of the LRT project.
- Transit priority measures may assist with improved schedule reliability to mitigate the bottlenecks that are anticipated along future transit routes including:
  - B-Line Route - the entire King Street LRT corridor
  - L-Line Route - York Boulevard corridors from Highway 403 to Queen Street and Bay Street to James Street, Cannon Street corridor from Queen Street to James Street
  - A-Line Route – Lincoln Alexander Parkway interchange, Escarpment crossing, and James Street from Cannon Street to Barton Street
  - S-Line Route - Centennial Parkway corridor between Green Mountain Road and King Street and Rymal Road between Upper Mount Albion Road and 2nd Road.
  - T-Line Route - Mohawk Road at the Lincoln Alexander Parkway interchange, Mohawk Road corridor between Garth Street and Upper James Street, and Kenilworth Access crossing the escarpment.
- One-way to two-way street conversions are anticipated to reduce LOS performance on some streets, particularly on Main Street, Hunter Street and Cannon Street.

Appendix A

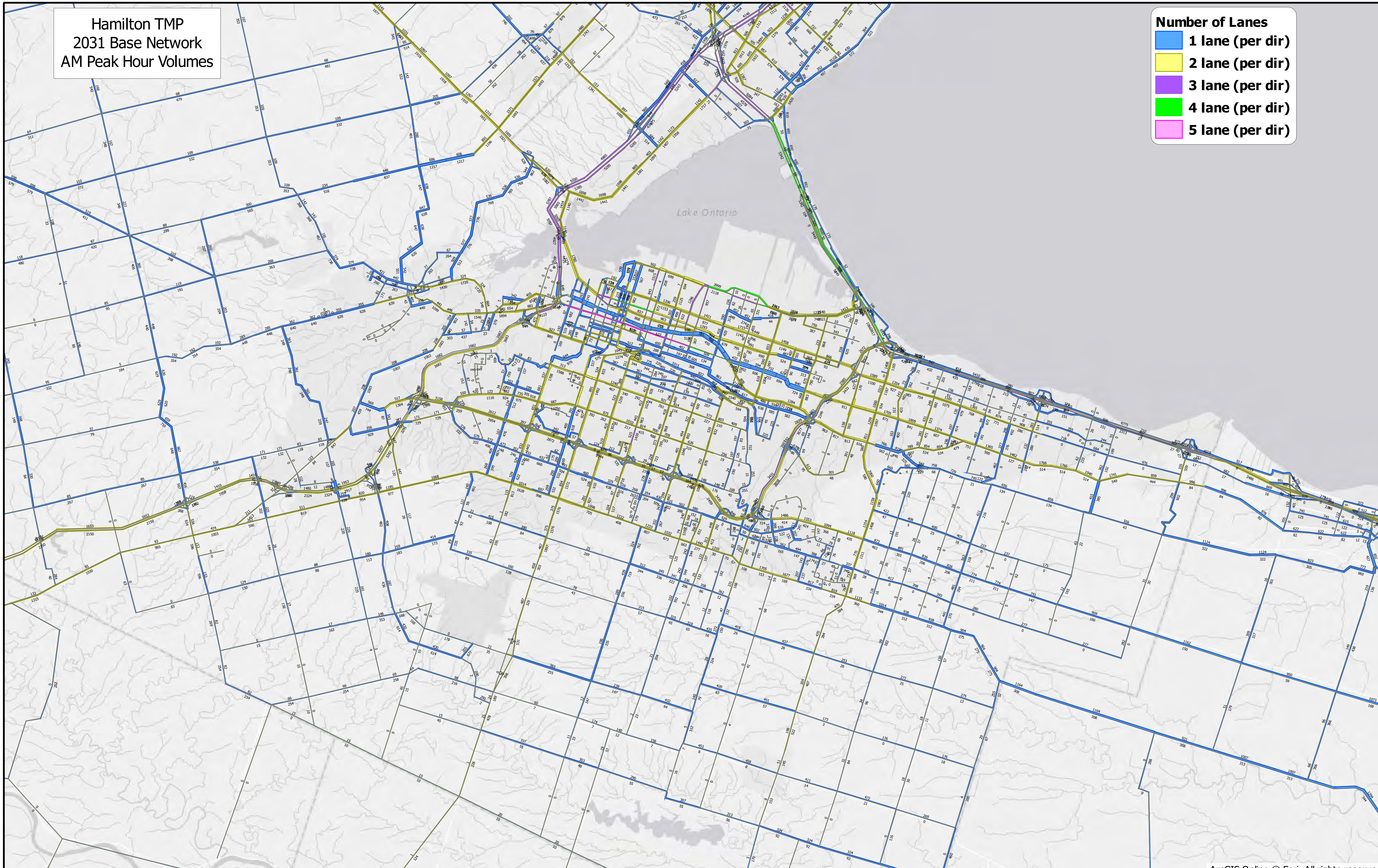
Capital Improvements

Road Name	From	To	Description of Works	Anticipated Timing	Status (As in Figure 3 in	Existing Lanes	Proposed (as per SDG report)			
							Lanes	Speed	Capacity	VDF
Airport Access Facility	Red Hill Valley Parkway	Hwy 6	New Road	2007-2011	Pending					
Ancaster Development (Trinity @ Wilson)										
New E/W Road (Ancaster)	Tradewind Drive / Cormorant Road	Trinity Road	New Road	2007-2011	In Progress		2	50	500	21
New Mid-block Collector (Ancaster)	Cormorant Road	Tradewind Drive	New Road	2007-2011	In Progress		2	50	500	21
Arvin Avenue	McNeilly Road	just east of Lewis Road	New Road	2007-2011	In Progress					
Arvin Avenue	Jones Road	existing end	New Road	2007-2011	In Progress		2	50	500	21
Arvin Avenue	existing end	extend to McNeilly Road	New Road	2007-2011	In Progress		2	50	500	21
Barton Street	Fruitland	Glover Road	Two-way Left-turn Lane	Beyond 2021	Pending				1000	
Barton Street	Glover Road	Fifty Road	Two-way Left-turn Lane	Beyond 2021	Pending				1000	
Baseline Road	Winona Road	North Service Road	Two-way Left-turn Lane	2007-2011	**Completed**					
Binbrook Road	Fletchers Road	3 km west of Hwy 56	Road Widening	2012-2021	In Progress	2	3	60	1000	33
Binbrook Road	E and W of Hwy 56		Intersection Improvements	2012-2021	In Progress					
Bold St	Queen Street	James Street	Two-way conversion from one-way	2007-2011	Pending					
Centre Road/Hamilton Street										
Centre Road	Northlawn Avenue	Parkside Drive	Two-way Left-turn Lane		Pending				1100	
Hamilton Street	Parkside Drive	John Street	Two-way Left-turn Lane		Pending				1100	
Community Avenue	Stoney Creek limits	Teal Avenue	Conversion to urban cross-section	2012-2021	Pending					
Dartnall Road	Rymal Road	Dickenson Road	New Road	2007-2011	In Progress	2	4	50	700	24
Dartnall Road	Stone Church Road	Rymal Road	Road Widening and Two-way Left-turn Lane	2007-2011	In Progress	2	4	50	700	24
Dickenson Road E.	west of Nebo Road	west of Glover Road	Conversion to urban cross-section	2012-2021	Pending					
Dickenson Road E.	east of Hwy 6	west of Nebo Road	Addition of Left turn lanes	2012-2021	Pending					
Dickenson Road W.	west of Hwy 6	Glancaster Road	Conversion to urban cross-section	2012-2021	Pending					
Duke St	Queen Street	James Street	Two-way conversion from one-way	2007-2011	Pending					
Falcon Road	Fifty Road	West limits	Conversion to urban cross-section	2007-2011	Completed					
Fifty Road	QEW	Hwy 8	Road Widening	Beyond 2021	Pending	2	4	60	900	36
Fletcher Road	Rymal Road	Binbrook Road	Addition of Left turn lanes	2012-2021	In Progress		3	60	1000	33
Fruitland Road	Arvin Avenue	Barton Street	Road Widening	Beyond 2021	Pending	2 +TWLTL	4	60	500	31
Garden Avenue	Teal Avenue	Pinelands Avenue	Conversion to urban cross-section	2007-2011	Pending					
Garner Road										
Garner Road	50m east of Miller Drive	50m west of Southcote Road	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	Hwy 2	50m west of Shaver Road	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m west of Fiddlers Green Road	50m east of Fiddlers Green Road	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m east of Fiddlers Green Road	50m west of Miller Drive	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m east of Southcote Road	50m west of Kitty Murray La	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m east of Kitty Murray La	50m west of Glancaster Road	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m east of Glancaster Road	Old Hamilton boundary	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m west of Miller Drive	50m east of Miller Drive	Road Widening	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m west of Kitty Murray Lane	50m west of Kitty Murray La	Road Widening	2012-2021	In Progress	2	4	60	900	36
Garner Road	West of Shaver Road	50m east of Shaver Road	Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m west of Southcote Road	50m east of Southcote Road	Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50m west of Glancaster Road	50m east of Glancaster Road	Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garner Road	50 m east of Shaver Road	50m west of Fiddlers Green Road	Road Widening and Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Wilson Street / Hwy 2	Hwy 52	Hwy 53	Two-way Left-turn Lane	2012-2021	In Progress	2	4	60	900	36
Garth Street	Stone Church Road	Rymal Road	Two-way Left-turn Lane	2007-2011	In Progress				800	
Garth Street Extension	Twenty Road	Dickenson Road	New Road	Beyond 2021	Pending		2	50	700	24
Glancaster Road	Hwy 53	Twenty Road	Addition of Left turn lanes	2007-2011	Pending					
Glover Access Road (Stoney Creek)	Glover Road	North Service Road	Conversion to urban cross-section	2007-2011	Completed					
Glover Road (Hamilton)	Rymal Road	Dickenson Road	Conversion to urban cross-section	2007-2011	In Progress					
Golf Links Road	McNiven Road	Kitty Murray La	Two-way Left-turn Lane	2012-2021	Pending				1100	
Governor's Road	Creighton Drive	Bridlewood Drive	Two-way Left-turn Lane	2012-2021	In Progress	2WB+1EB (2011), 1WB+TWLTL+1EB (2014)	4	50	700	24
Governor's Road	Creighton Drive	Osler Drive	Road Widening	2012-2021		2	4	50	700	24
Hamilton Drive	Hwy 403	0.35km south	Intersection Improvements	2007-2011	Pending					
Hwy 20	Ridge Road	300m south of Ridge Road	Intersection Improvements	2012-2021	Pending					
Hwy 20	100m south of Green Mountain	800m south of Gm Mtn	Two-way Left-turn Lane	2012-2021	Pending					
Hwy 20	350m south of Mud Street	830 m south of Mud Street	Two-way Left-turn Lane	2012-2021	Pending					
Hwy 8	Hillcrest Avenue	Park Street	Two-way Left-turn Lane	Beyond 2021	In Progress					
Hwy 8	Bond Street	Dundas Limits	Two-way Left-turn Lane	Beyond 2021	Pending				1100	
Hwy 8	Fruitland Road	Hamilton Boundary	Road Widening	Beyond 2021	In Progress	1WB+TWLTL+1EB (2014) Dewitt to Envoy (Plus Bike Lanes) to Glover Road	4	80	1000	56
Hwy 8	Dewitt Road	Fruitland Road	Road Widening and Two-way Left-turn Lane	Beyond 2021	In Progress	2	4	80	1000	56
Hwy 5 / Hwy 6	East of Hwy 6	West of Hwy 6	Intersection Improvements	2012-2021	In Progress					
Jerseyville Road	Martin Road	Lloyminn Avenue	Two-way Left-turn Lane	2012-2021	Pending				800 and 1100	
Jerseyville Road	Shaver Road	Martin Road	Two-way Left-turn Lane	2012-2021	Pending				800 and 1100	
Jerseyville Road	Wilson Street	Lloyminn Avenue	Two-way Left-turn Lane	2012-2021	Pending				800 and 1100	
Jones Road	Barton Street	South Service Road	Conversion to urban cross-section	2012-2021	Pending					
Kenmore Avenue	Arvin Avenue	Barton Street	Conversion to urban cross-section	2012-2021	Pending					
King St	Queen Street	Wellington Street	Two-way conversion from one-way	2007-2011	Defferd for LRT					
Leaside Avenue	Arvin Avenue	Barton Street	Conversion to urban cross-section	2012-2021	Pending					
Lewis Road	Barton Street	South Service Road	Conversion to urban cross-section	2007-2011	Pending					
MacNab St	Cannon Street	Guise Street	Two-way conversion from one-way	2007-2011	Completed	2	1 NB + 1 SB by 2013	50	400	20
McNeilly Road	Barton Street	South Service Road	Conversion to urban cross-section	2007-2011	Completed					

McNiven Road	Rousseaux Street	Golf Links Road	Road Widening	2007-2011	Pending	2	3 (by 2031)	50	700	24
Millen Road	South Service Road	Hwy 8	Two-way Left-turn Lane	2012-2021	In Progress					
Mohawk Road	McNiven Road	Hwy 403	Road Widening	2007-2011	Pending		2	50	700	24
Nebo Road	Rymal Road	Former Hamilton Limits	Two-way Left-turn Lane	2012-2021	In Progress					
Nebo Road	Former Hamilton Limits	Dickenson Road	Conversion to urban cross-section	2012-2021	In Progress					
North Service Road	Grays Road	Green Road	Road Widening	2007-2011	Pending					
North Service Road	Green Road	East City Limits	Conversion to urban cross-section	2007-2011	Pending					
Oriole Avenue	South Service Road	Winona Road	Conversion to urban cross-section	2007-2011	In Progress					
Parkside Drive	Braeheid Avenue	East part of industrial section	Two-way Left-turn Lane	2012-2021	In Progress	2	4	50	800	35
Parkside Drive	Hwy 6	Braeheid Avenue	Road Widening	2012-2021	In Progress	2	4	50	800	35
Pinelands Avenue	Community Avenue	South Service Road	Conversion to urban cross-section	2007-2011	Pending					
Queen St	Cannon Street	Barton Street	Road Narrowing	2011-2021	Pending	2 NB (2011)	2	50	500	21
Queen St	Barton Street	Cannon Street	Road Narrowing	2014-2022	Pending	2NB + 1SB (2014)	3			
Regional Road 56	Community Core	North Limits	Road Widening and Two-way Left-turn Lane	2012-2021	Pending					
Regional Road 56	Community Core	South Limits	Road Widening and Two-way Left-turn Lane	2012-2021	Pending					
Regional Road 56	South Limits of ROPA 9	Binbrook Road	Road Widening	2012-2021	Pending	2	4	80	1000	56
Regional Road 56	Rymal Road	Street M	Road Widening	2012-2021	Pending	2	4	80	1000	56
Rymal Road	Dartnall Road	Fletcher	Road Widening	2012-2020	Completed	2EB / 2 WB + TWLTL (2015)	4	60	900	36
Rymal Road	Ryckmans Street	Trinity Church Road	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Rymal Road	Trinity Church Road	Hwy 20	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Rymal Road	Garth Street	West 5th	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Rymal Road	Upper Paradise Road	Garth Street	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Rymal Road	former west Hamilton limits	Upper Paradise Road	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Rymal Road	West 5th Street	Upper James Street	Road Widening	2012-2021	Completed	2 / 3	4	60	900	36
Scenic Drive	Old City limits	Lavender Drive South Leg	Two-way Left-turn Lane	2007-2011	Pending					
Seabreeze Crescent	Glover Road	McNeilly Road	Conversion to urban cross-section	2007-2011	In Progress					
Seaman Street	South Service Road	Dewitt Road	Conversion to urban cross-section	2007-2011	Pending					
Shaver Road	Wilson Street	Garner Road	Two-way Left-turn Lane	2012-2021	Pending				550	
Shaver Road	Hwy 403	Wilson Street	Conversion to urban cross-section	2012-2021	Pending				550	
South Service Road	Millen Road	Grays Road	Road Widening	2012-2021	Pending	2	4	60	700	34
Southcote Road	Golf Links Road	Garner Road	Road Widening	2012-2021	Pending		4	60	700	34
Springbrook Road	Meadowlands Blvd	Garner Road	Two-way Left-turn Lane	2012-2021	Pending					
Stone Church Road	Pritchard Road	Winterberry Drive	Two-way Left-turn Lane	2012-2021	Completed					
Stone Church Road	East of Garth Street	West 5th Street	Two-way Left-turn Lane	2007-2011	Completed					
Stone Church Road	Upper Wellington Street	Upper James Street	Two-way Left-turn Lane	2007-2011	Completed					
Sulphur Springs Road	Wilson Street	Mansfield Drive	Conversion to urban cross-section	2012-2021	Completed					
Sunnyhurst Avenue	Barton Street	North end	Conversion to urban cross-section	2012-2021	Pending					
Teal Avenue	Garden Avenue	South Service Road	Conversion to urban cross-section	2012-2021	Pending					
Trinity Church Road	Rymal Road	Golf Club Road	Conversion to urban cross-section	2012-2021	In Progress					
Trinity Church Road	Golf Club Road	Binbrook Road	Addition of Left turn lanes	2012-2021	In Progress					
Trinity Church Road Extension	Rymal Road	Stone Church Road	New Road	2007-2011	In Progress		2	60	700	34
Trinity Road	1 km S of Wilson Street	Hwy 403	Road Widening	Beyond 2021	Pending	2	4	80	1000	
Twenty Road	Glancaster Road	Glover Road	Two-way Left-turn Lane	2012-2021	In Progress					
Twenty Road Extension	Glover Road	Trinity Church Road	New Road	2012-2021	In Progress					
Upper Gage Avenue	Mohawk Road	Thorley Drive/Edwina Pl.	Two-way Left-turn Lane	2007-2011	Pending					
Upper James Street	Rymal Road	Former South Hamilton Limits	Two-way Left-turn Lane	2012-2021	Pending					
Upper Mount Albion Road	Rymal Road	Mud Street	Two-way Left-turn Lane	2012-2021	In Progress					
Upper Mount Albion Road	Rymal Road	Highland Road	Road Closure	2012-2021	In Progress					
Upper Ottawa Street Extension	Former City Hamilton Limits	Twenty Road	New Road	2012-2021	Pending		2	50	700	24
Upper Sherman Avenue	Stone Church Road	Rymal Road	Two-way Left-turn Lane	2012-2021	Pending					
Upper Sherman Avenue	Stone Church Road	Lincoln Alexander Parkway	Two-way Left-turn Lane	2007-2011	Pending					
Upper Wellington Street	Rymal Road	Stone Church Road	Two-way Left-turn Lane	2012-2021	Completed					
Upper Wellington Street	Limeridge Road	Stone Church Road	Road Widening and Two-way Left-turn Lane	2012-2021	Completed					
Waterdown New East-West Link					In Progress					
New East West Link/Hwy 6 (Waterdown)	West of Hwy 6	East of Hwy 6	Intersection Improvements	2012-2021	In Progress					
New East-West Link (north of Parkside)	Hwy 6	Churchill Avenue (at Parkside)	New Road	2012-2021	In Progress					
New East-West Link/Centre St (Waterdown)	North of New East West Link	South of New East West Link	Intersection Improvements	2012-2021	In Progress		2	60	800	
Parkside Drive	Churchill Avenue (at Parkside)	New N-S Link (East of Upcountry Boundary)	Road Widening	2012-2021	In Progress	2	4	60	800	
New North-South Link (E of Upcountry Boundary)	Parkside Drive	Dundas Street	New Road	2012-2021	In Progress		2	50	1000	
Dundas Street/New North-South Link (Waterdown)	West of New N-S Link (Waterdown)	East of New N-S Link (Waterdown)	Intersection Improvements	2012-2021	In Progress					
Dundas Street	New N-S Road (Waterdown South)	Hamilton Boundary	Road Widening	2012-2021	In Progress	4 + TWLTL	6	60	900	
Waterdown Road					In Progress	2	4	60	800	35
Waterdown Road	Mountain Brow Road	Hwy 403	Road Widening	2012-2021	In Progress	2	4	60	800	35
Mountain Brow Road	Waterdown Road	New North-South Road	Road Widening	2012-2021	In Progress					
New North-South Link (Waterdown South)	Mountain Brow Road	Dundas Street	New Road	2012-2021	In Progress					
Weir's Lane	Hwy 8	Escarpment	Conversion to urban cross-section	2007-2011	In Progress					
Wellington St	Hunter Street	Young Street	Road Narrowing	2007-2011	Pending	4	2	50	500	
West 5th Street	Stone Church Road	Rymal Road	Two-way Left-turn Lane	2012-2021	Pending				800	
West 5th Street	Limeridge Road	Stone Church Road	Two-way Left-turn Lane	2012-2021	Pending				800	
Wilson Street	Hamilton Drive	just west of Halson Street	Road Widening	2012-2021	Completed	2	3	50	900	36
York Blvd / Wilson St	Bay Street	Wellington Street	Two-way conversion from one-way	2011-2021	Completed	2 EB + 1 WB (2011)	3 (by 2021)	50	700	
York Blvd / Wilson St	Victoria Street	Bay Street	Two-way conversion from one-way	2011-2022	Completed	3 EB (2011)	3 (by 2021)	50	700	

Appendix B

Model Plots



Hamilton TMP
2031 Base Network
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
Lake Ontario
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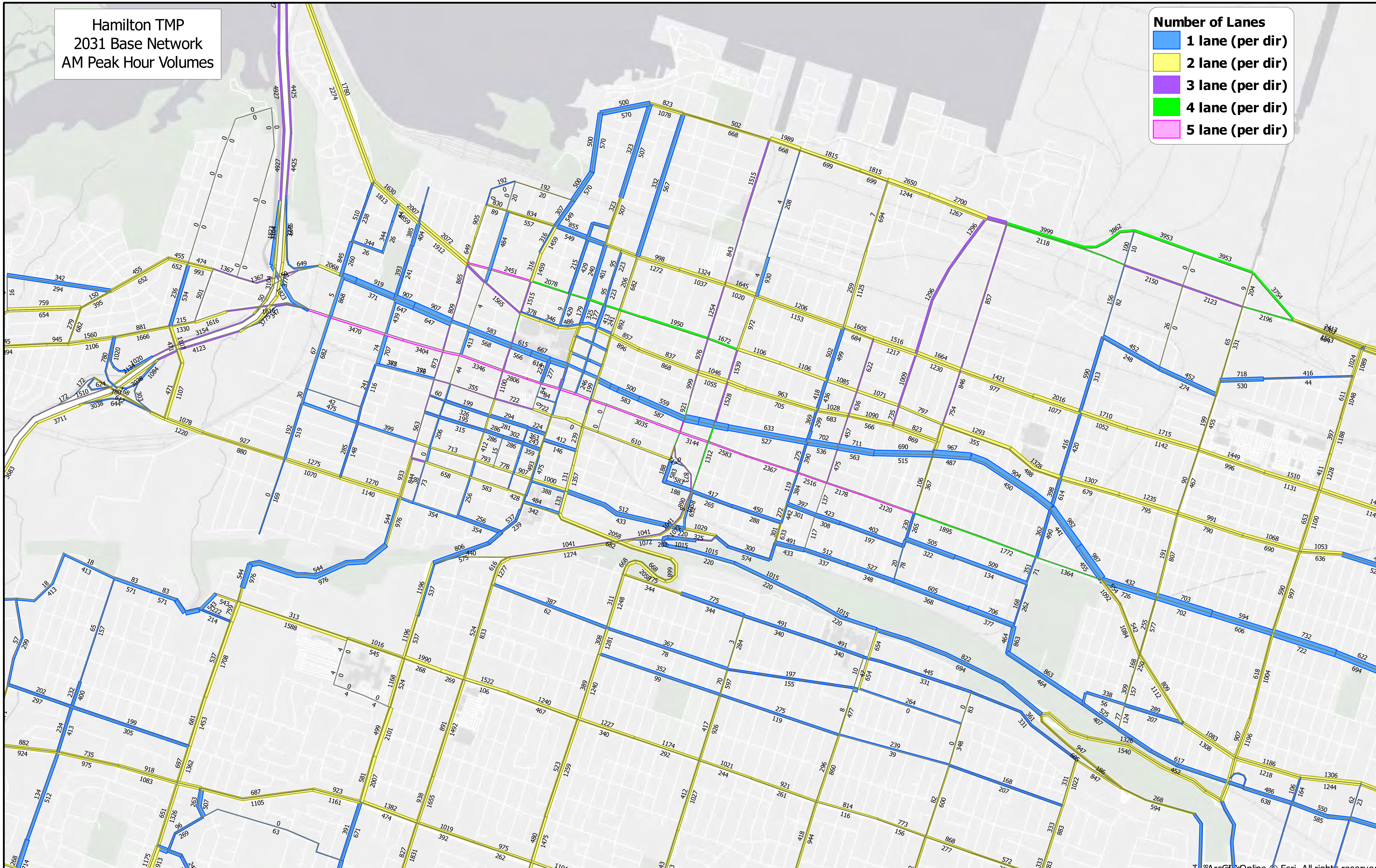
Hamilton TMP
2031 Base Network
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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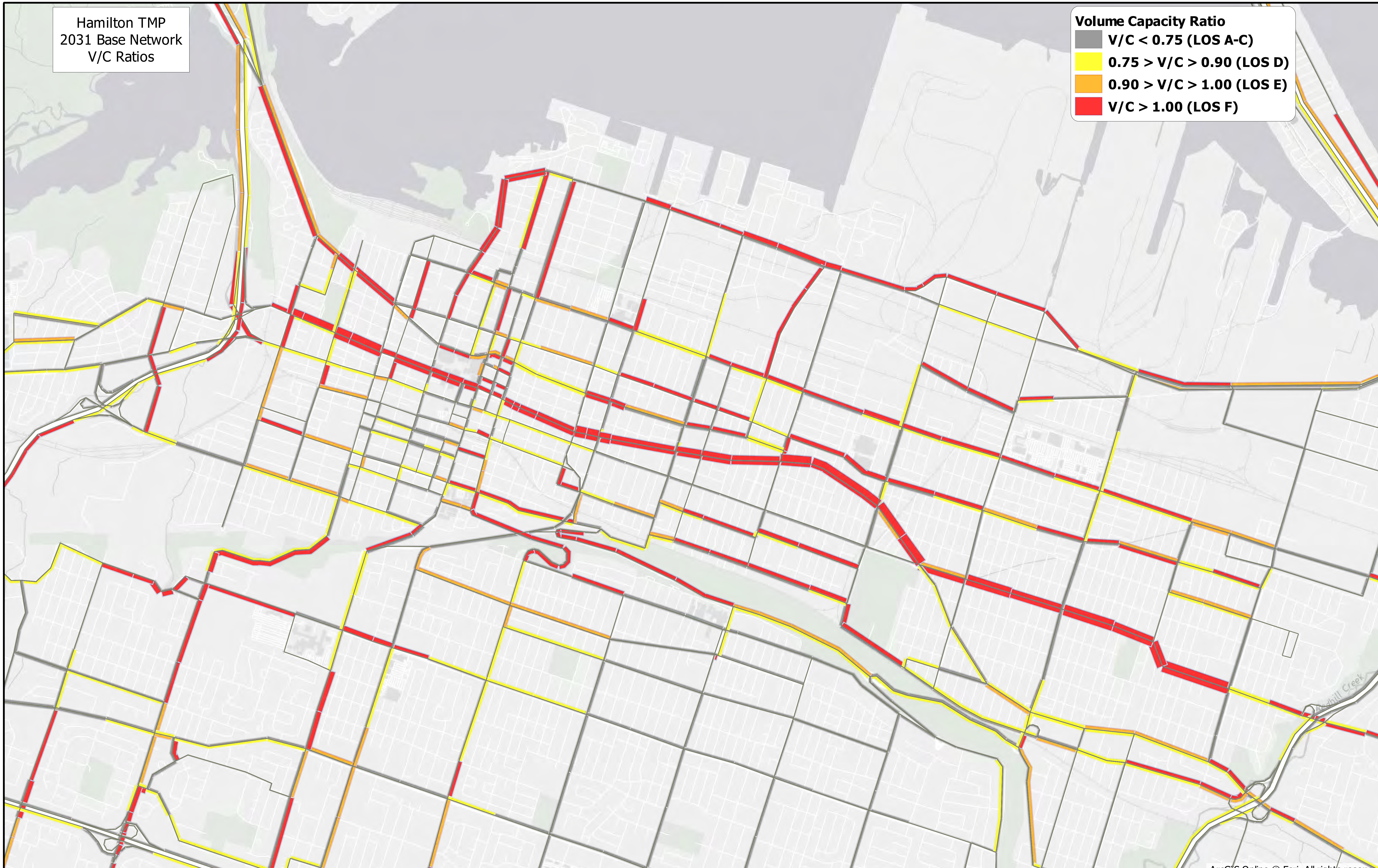

Hamilton TMP
2031 Base Network
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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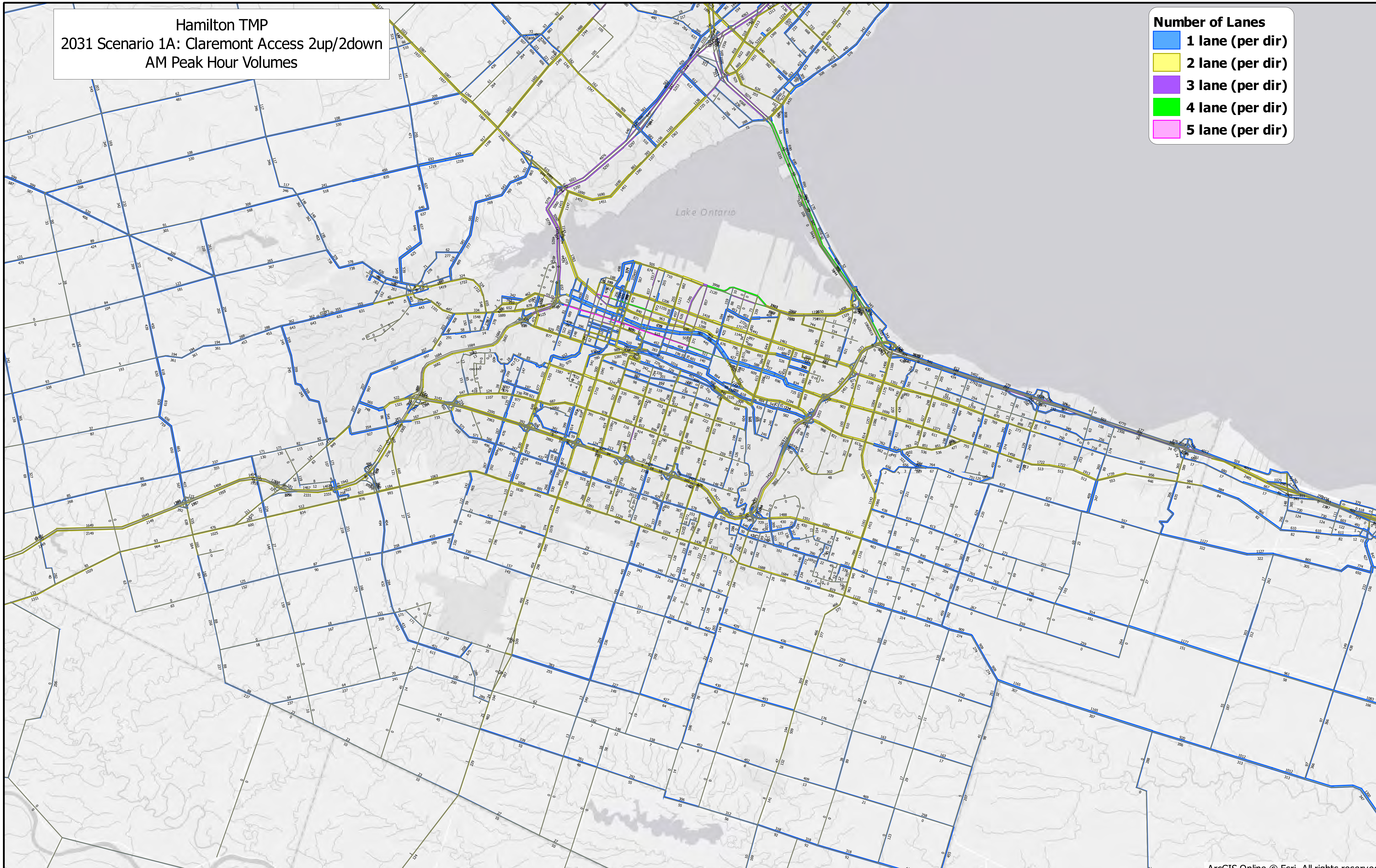
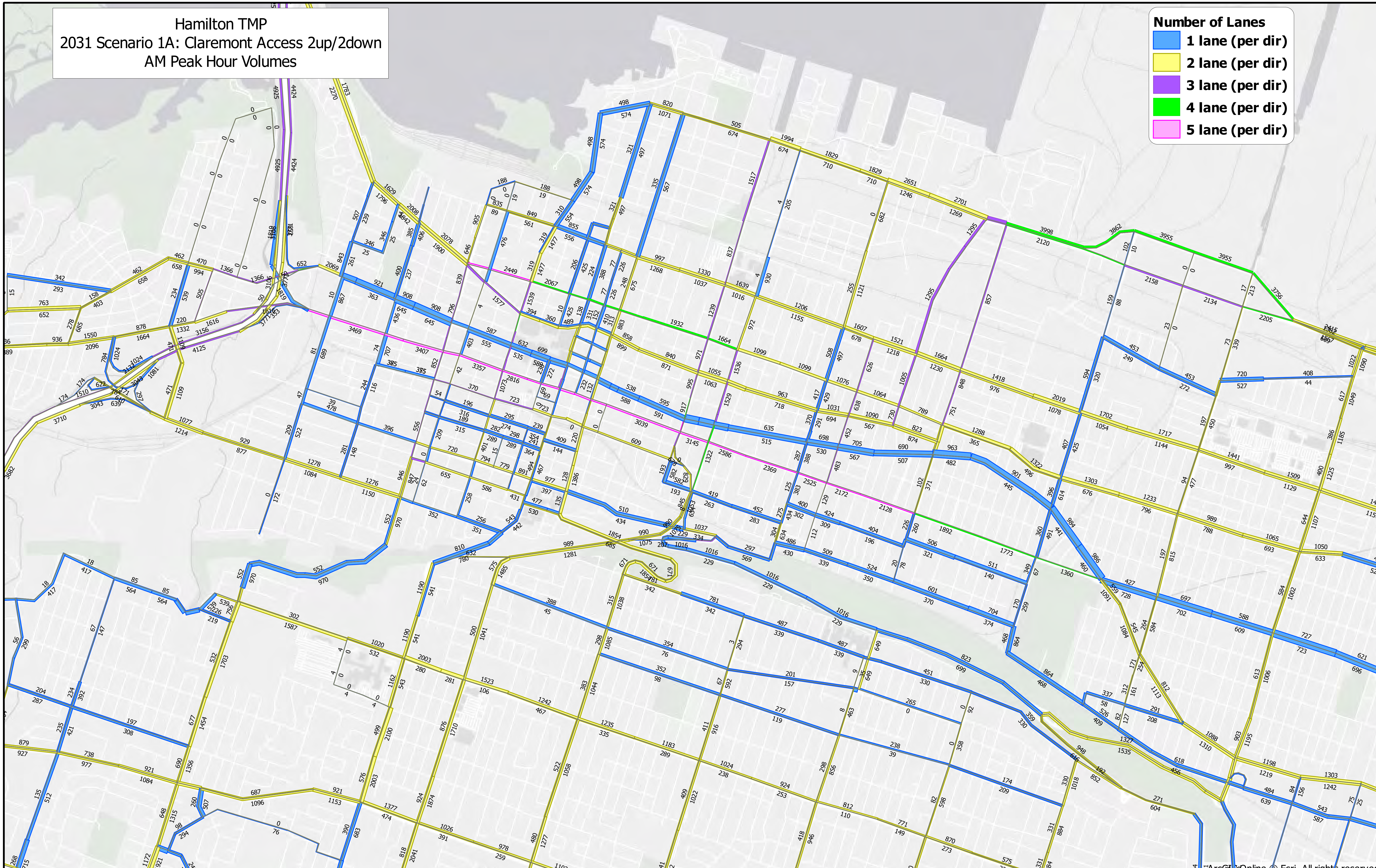

Hamilton TMP
2031 Scenario 1A: Claremont Access 2up/2down
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
Lake Ontario
ArcGIS Online © Esri. All rights reserved.



Hamilton TMP
2031 Scenario 1A: Claremont Access 2up/2down
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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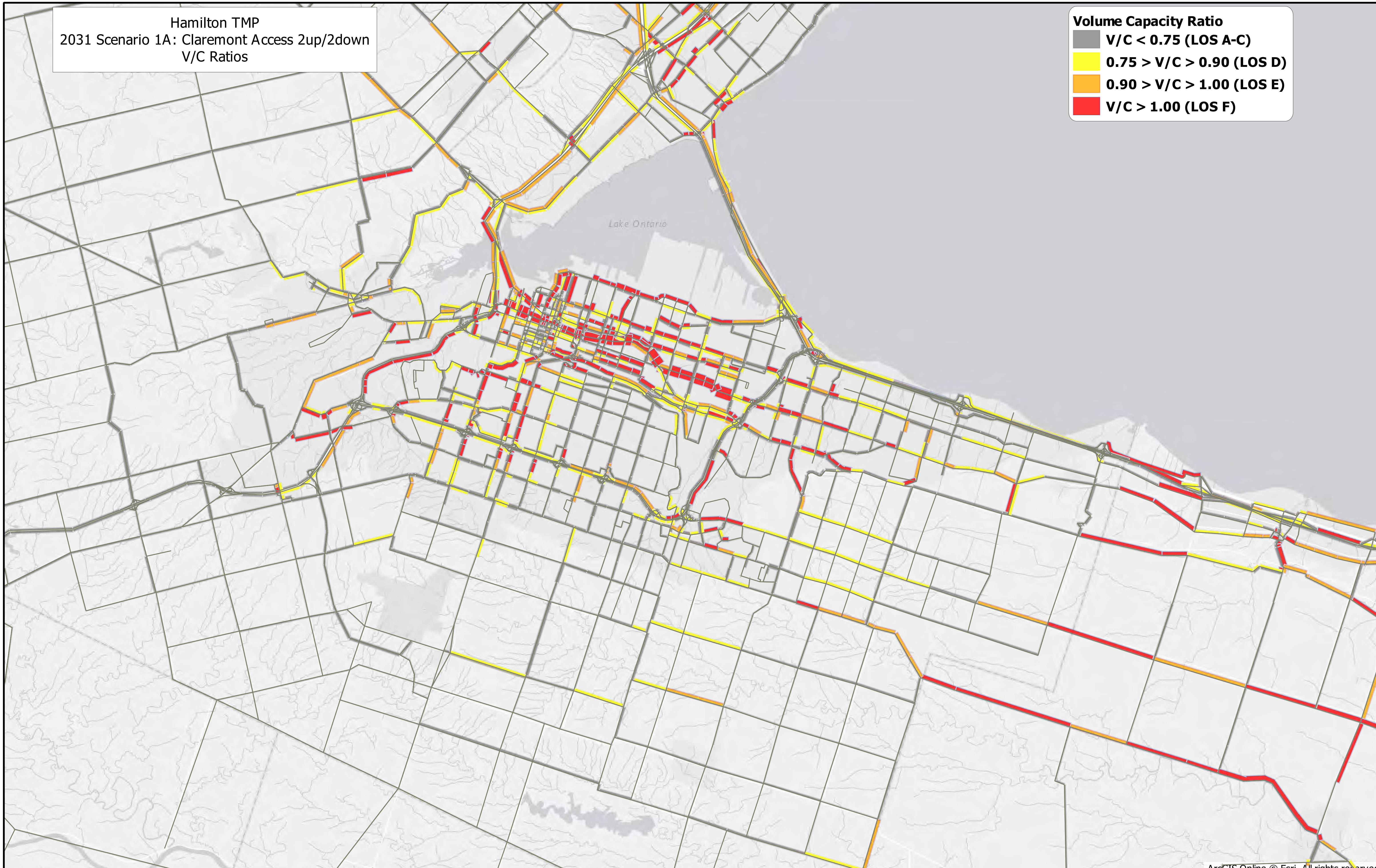
Hamilton TMP
2031 Scenario 1A: Claremont Access 2up/2down
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
Lake Ontario
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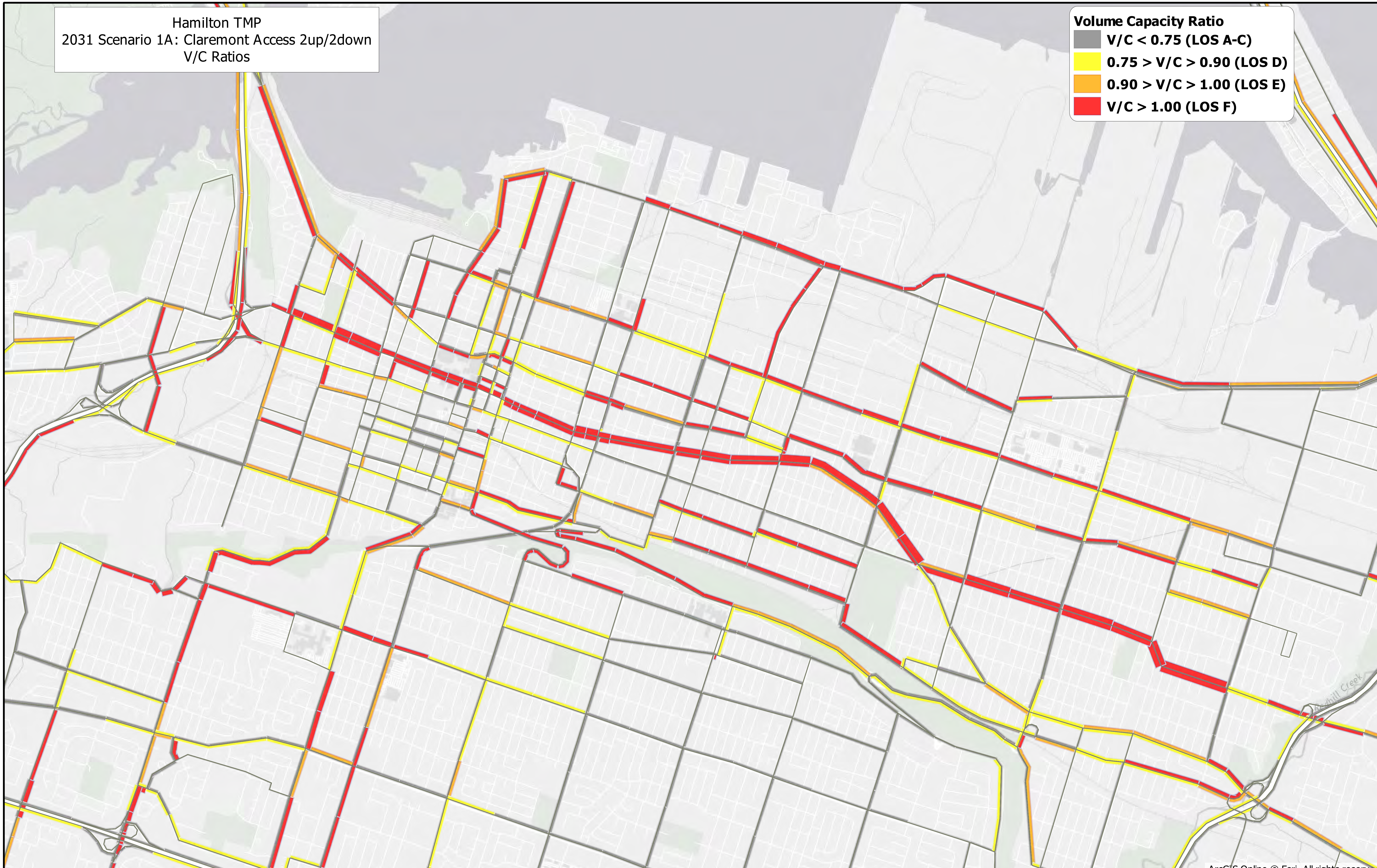

Hamilton TMP
2031 Scenario 1A: Claremont Access 2up/2down
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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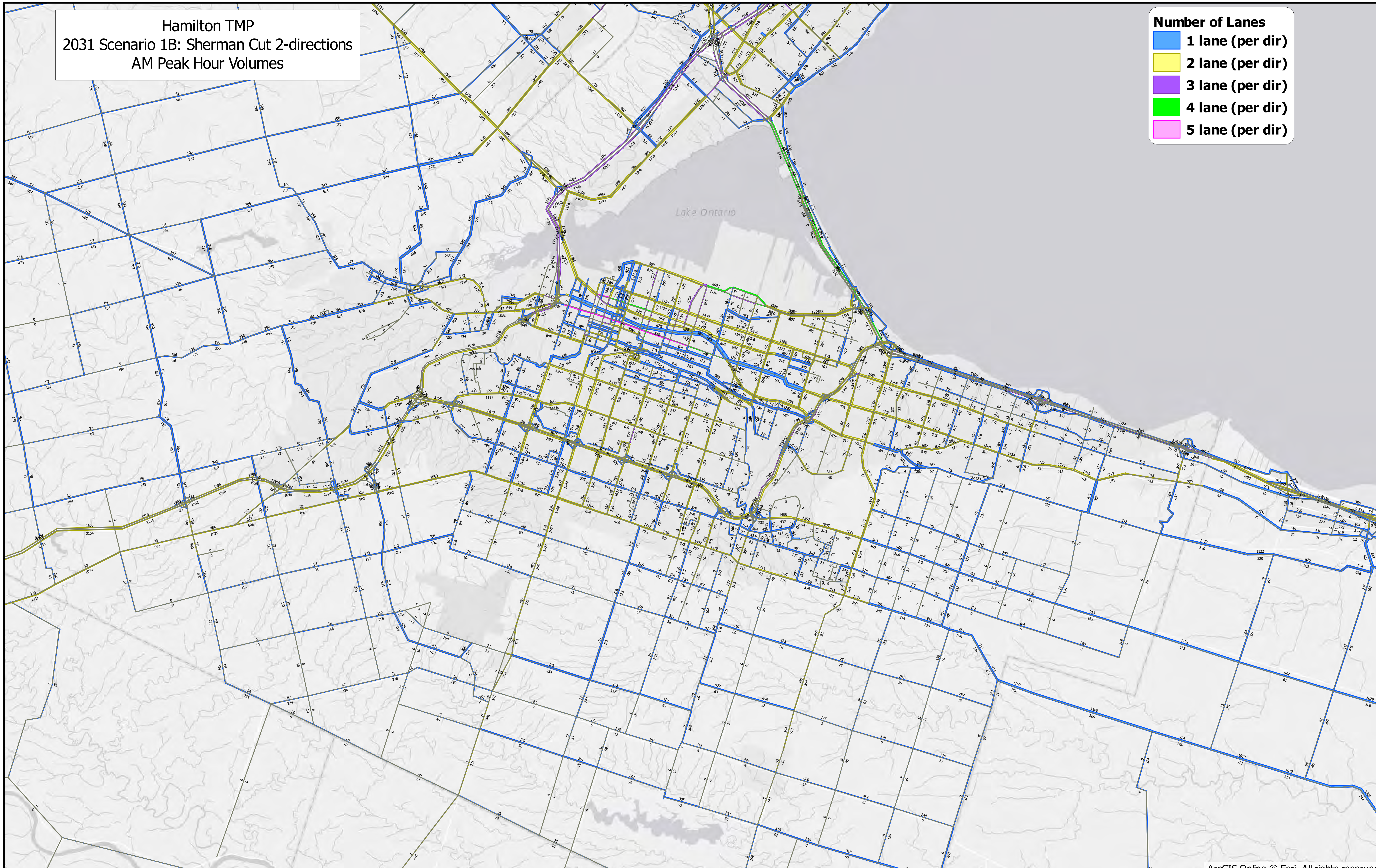
Hamilton TMP
2031 Scenario 1B: Sherman Cut 2-directions
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
Lake Ontario
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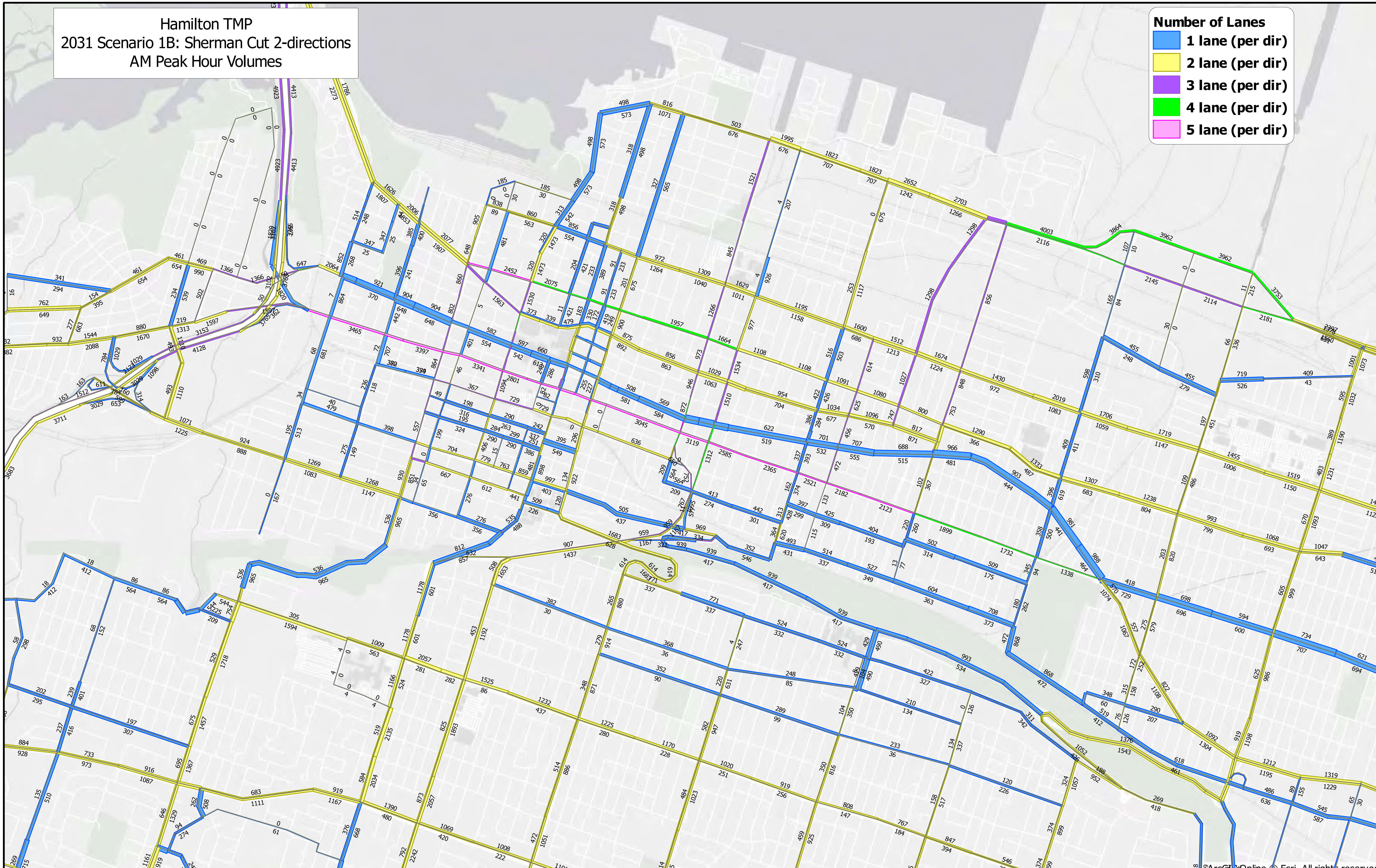
Hamilton TMP
2031 Scenario 1B: Sherman Cut 2-directions
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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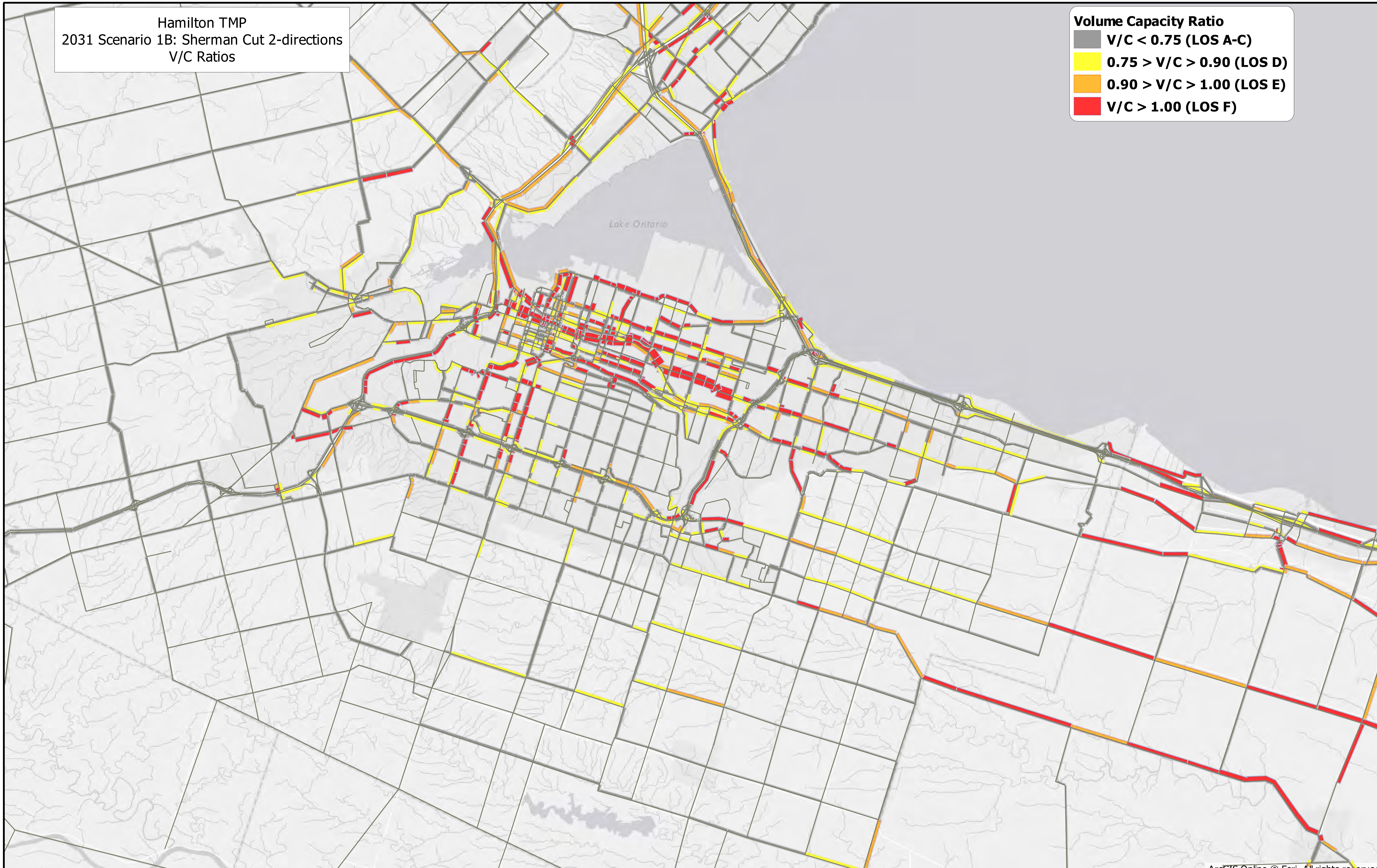
Hamilton TMP
2031 Scenario 1B: Sherman Cut 2-directions
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
Lake Ontario
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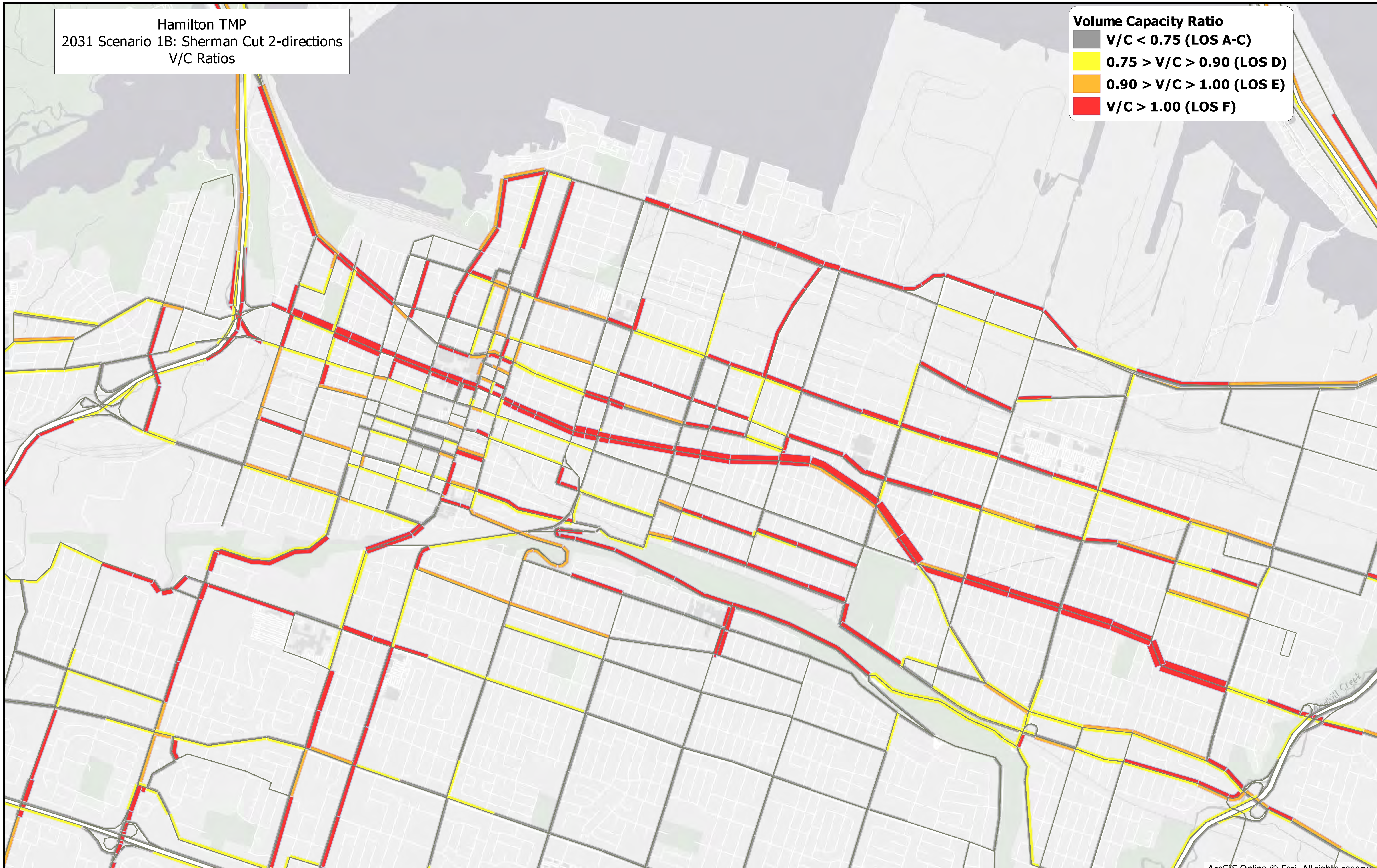

Hamilton TMP
2031 Scenario 1B: Sherman Cut 2-directions
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
Redhill Creek
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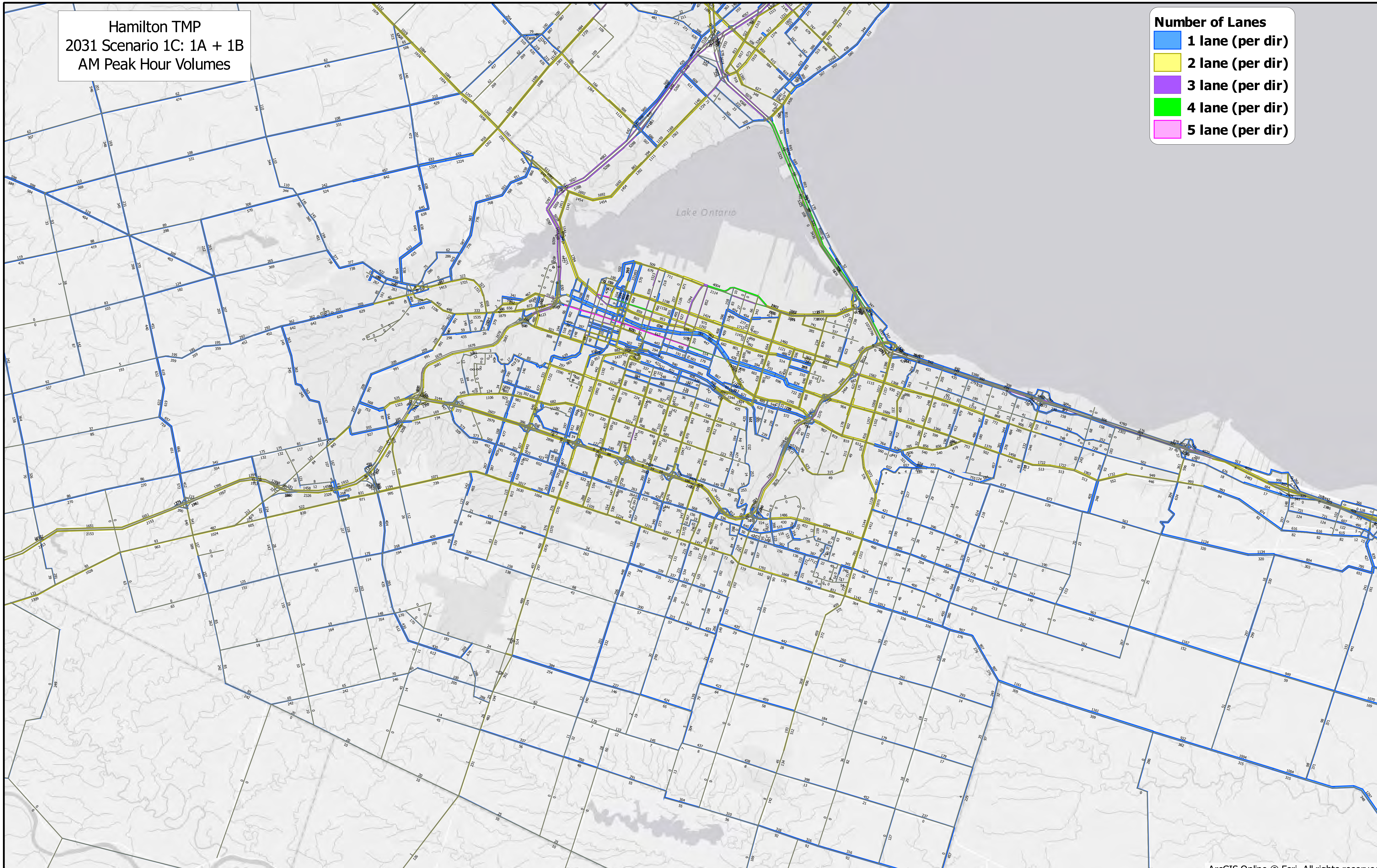
Hamilton TMP
2031 Scenario 1C: 1A + 1B
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
Lake Ontario
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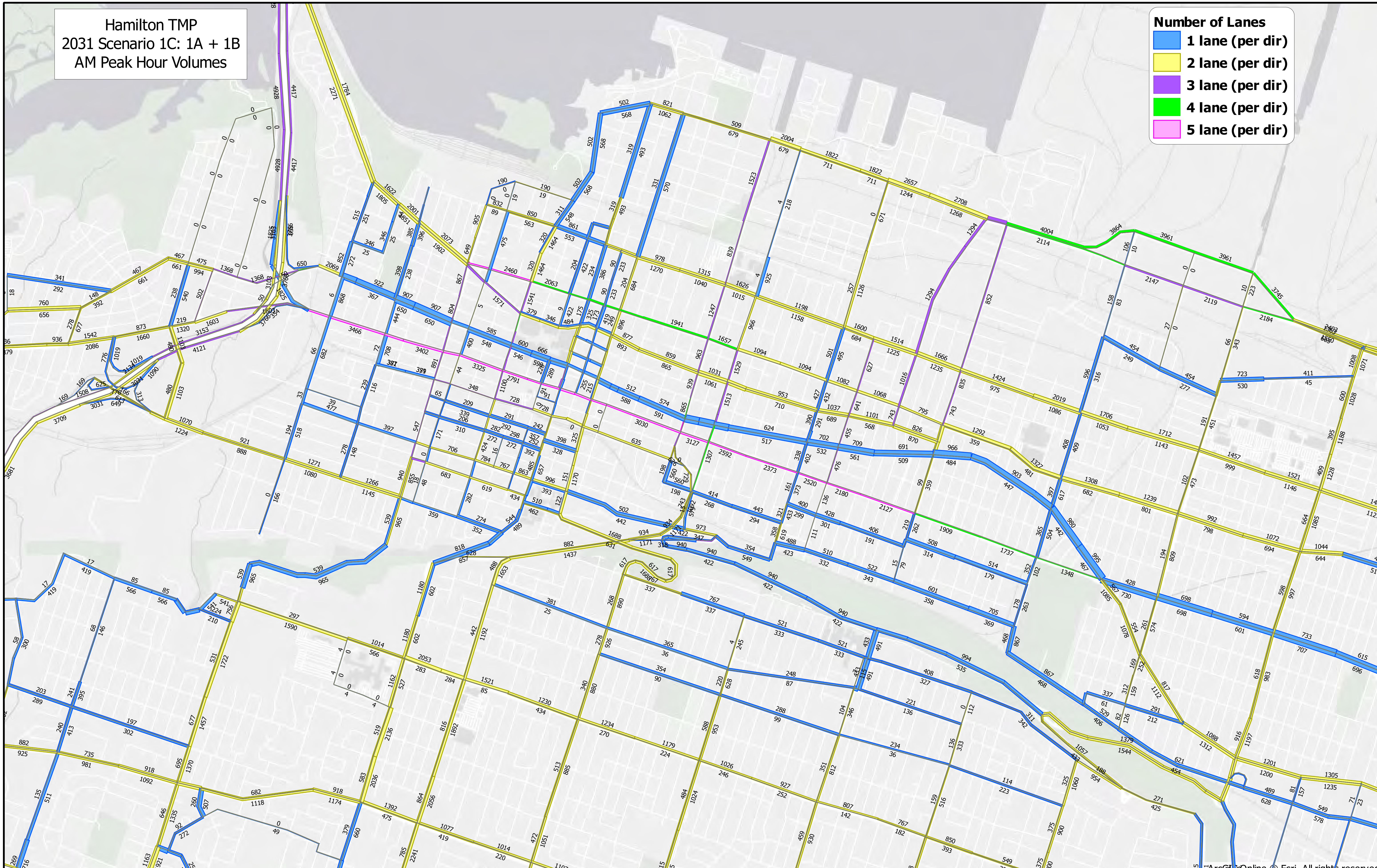
Hamilton TMP
2031 Scenario 1C: 1A + 1B
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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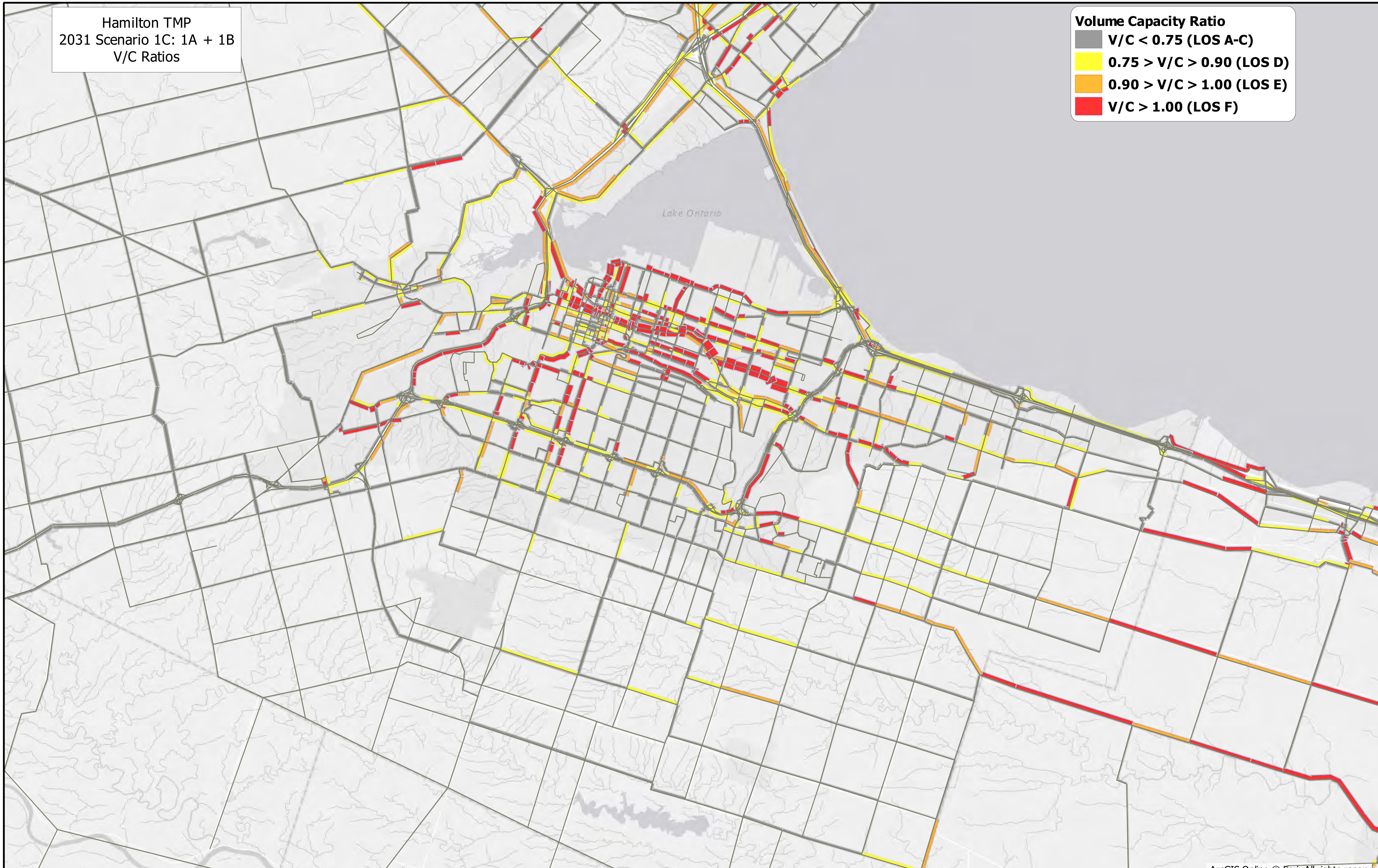
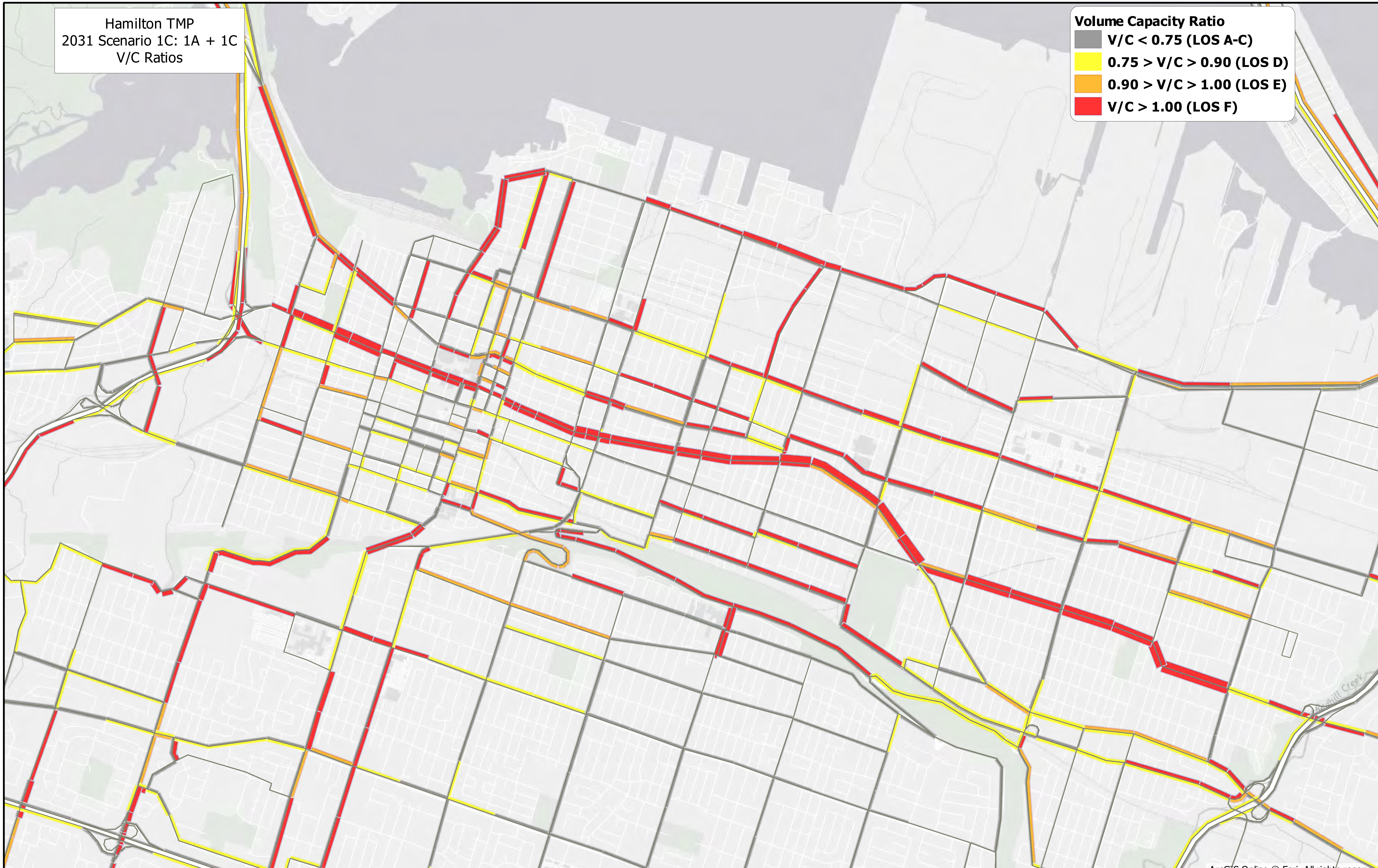
Hamilton TMP
2031 Scenario 1C: 1A + 1B
V/C Ratios




Hamilton TMP
2031 Scenario 1C: 1A + 1C
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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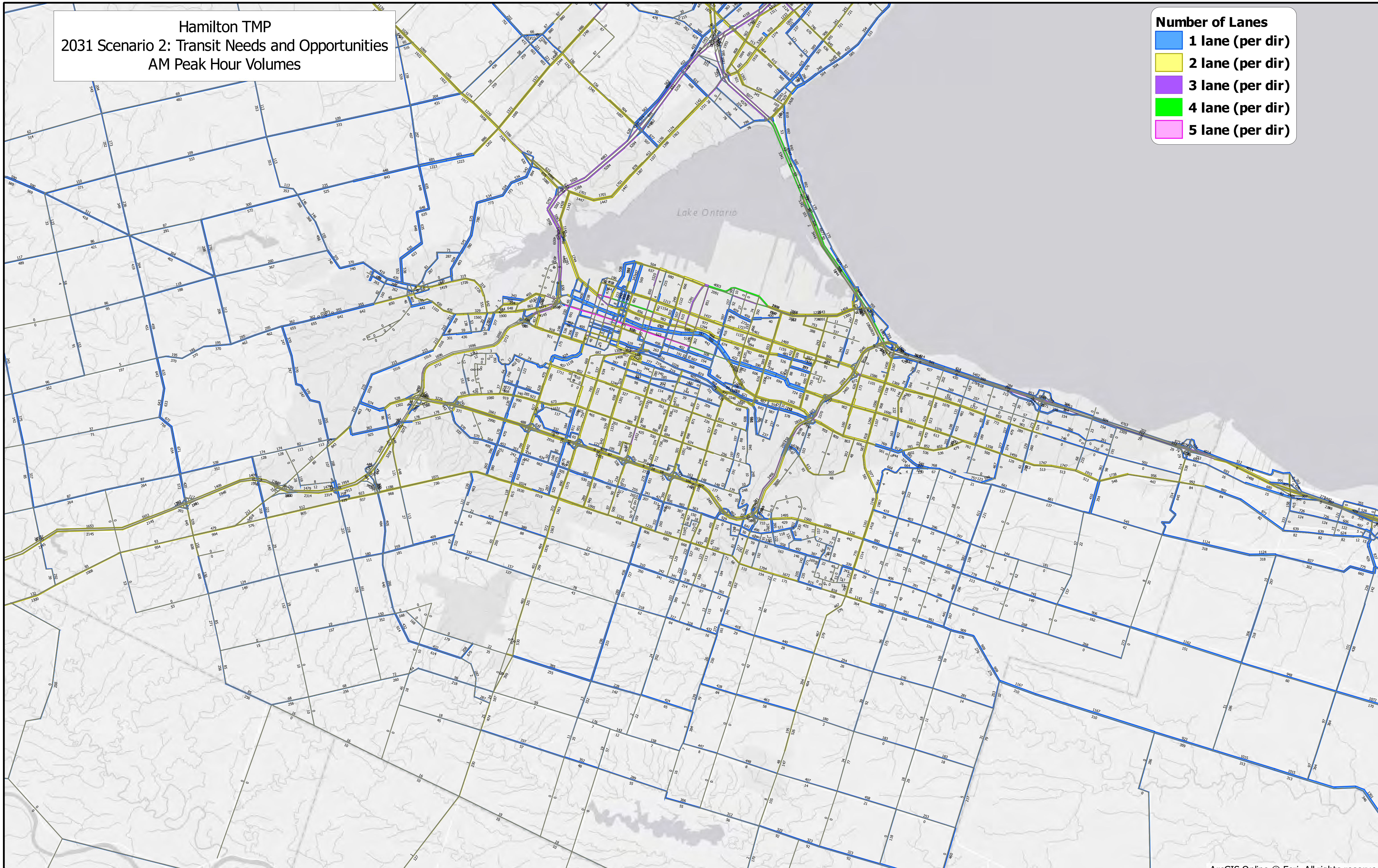
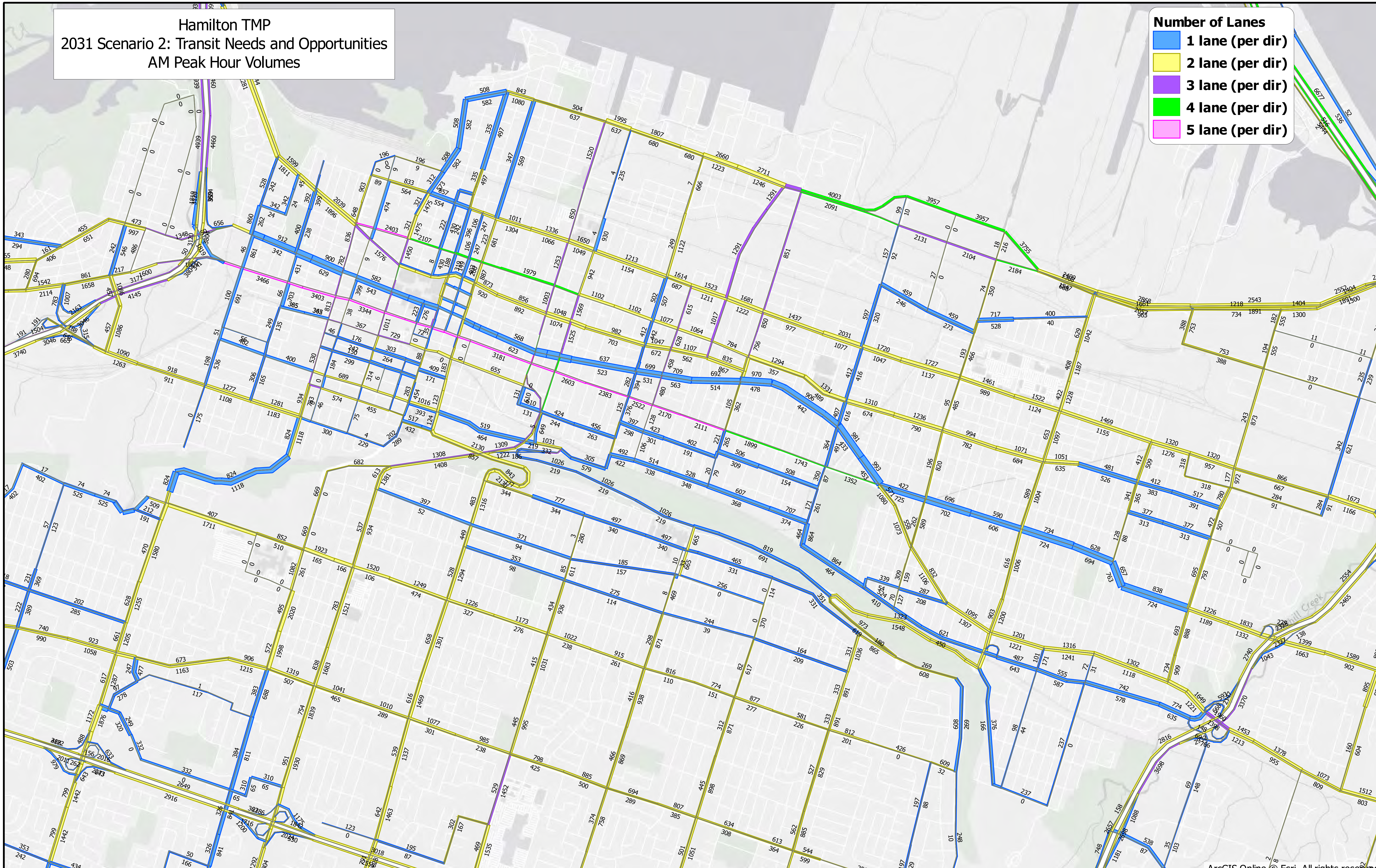
Hamilton TMP
2031 Scenario 2: Transit Needs and Opportunities
AM Peak Hour Volumes




Hamilton TMP
2031 Scenario 2: Transit Needs and Opportunities
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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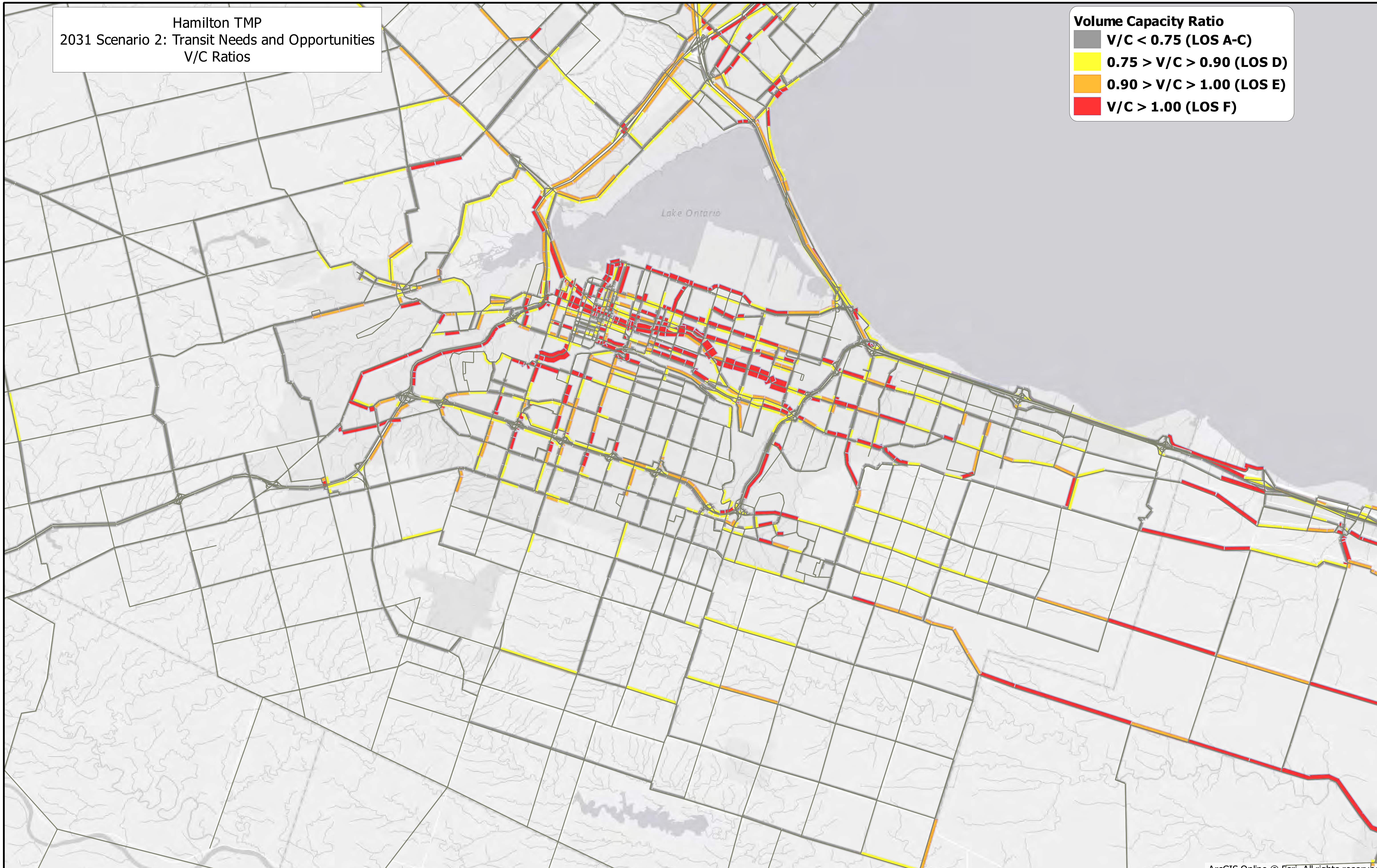
Hamilton TMP
2031 Scenario 2: Transit Needs and Opportunities
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
Lake Ontario
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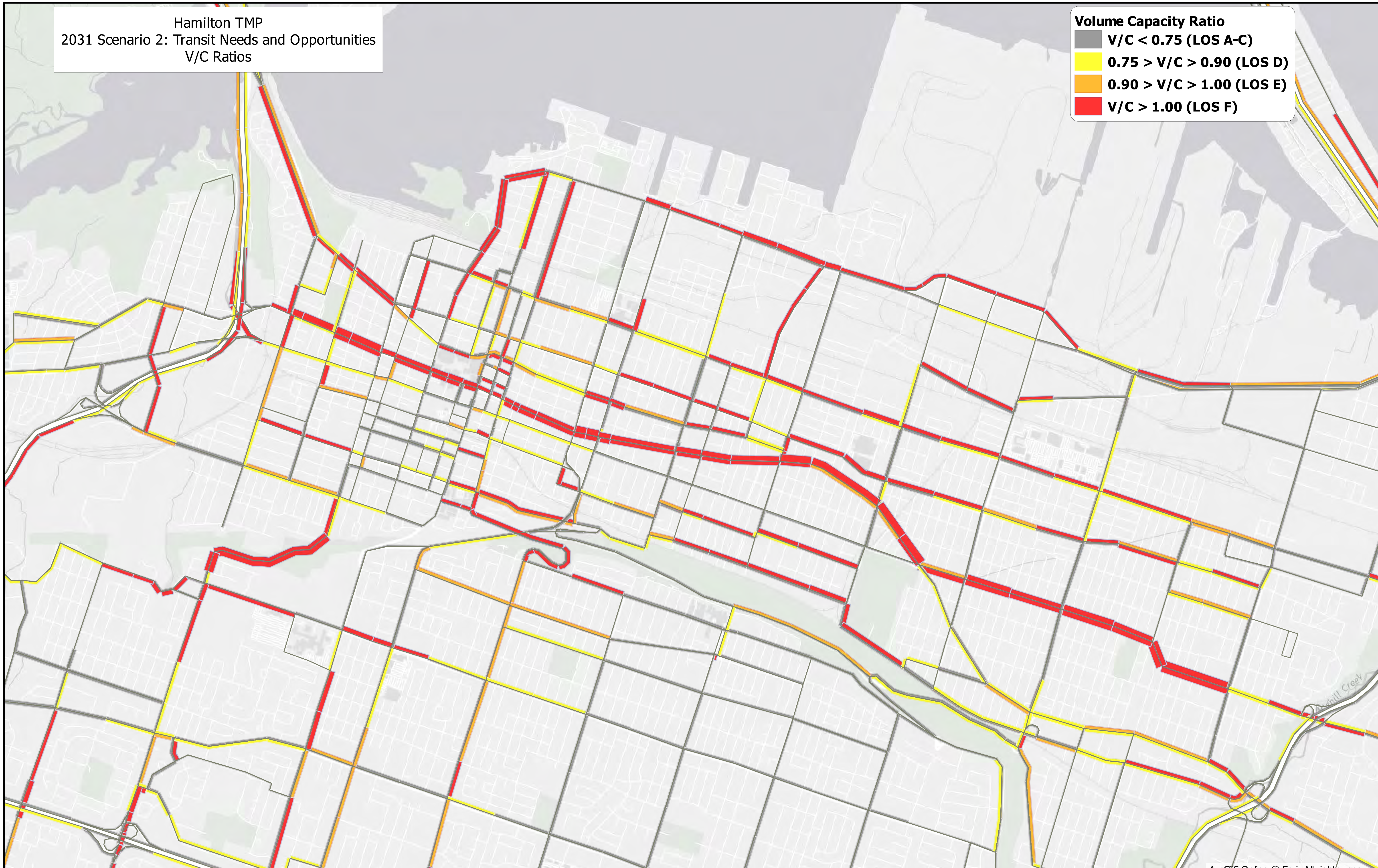
Hamilton TMP
2031 Scenario 2: Transit Needs and Opportunities
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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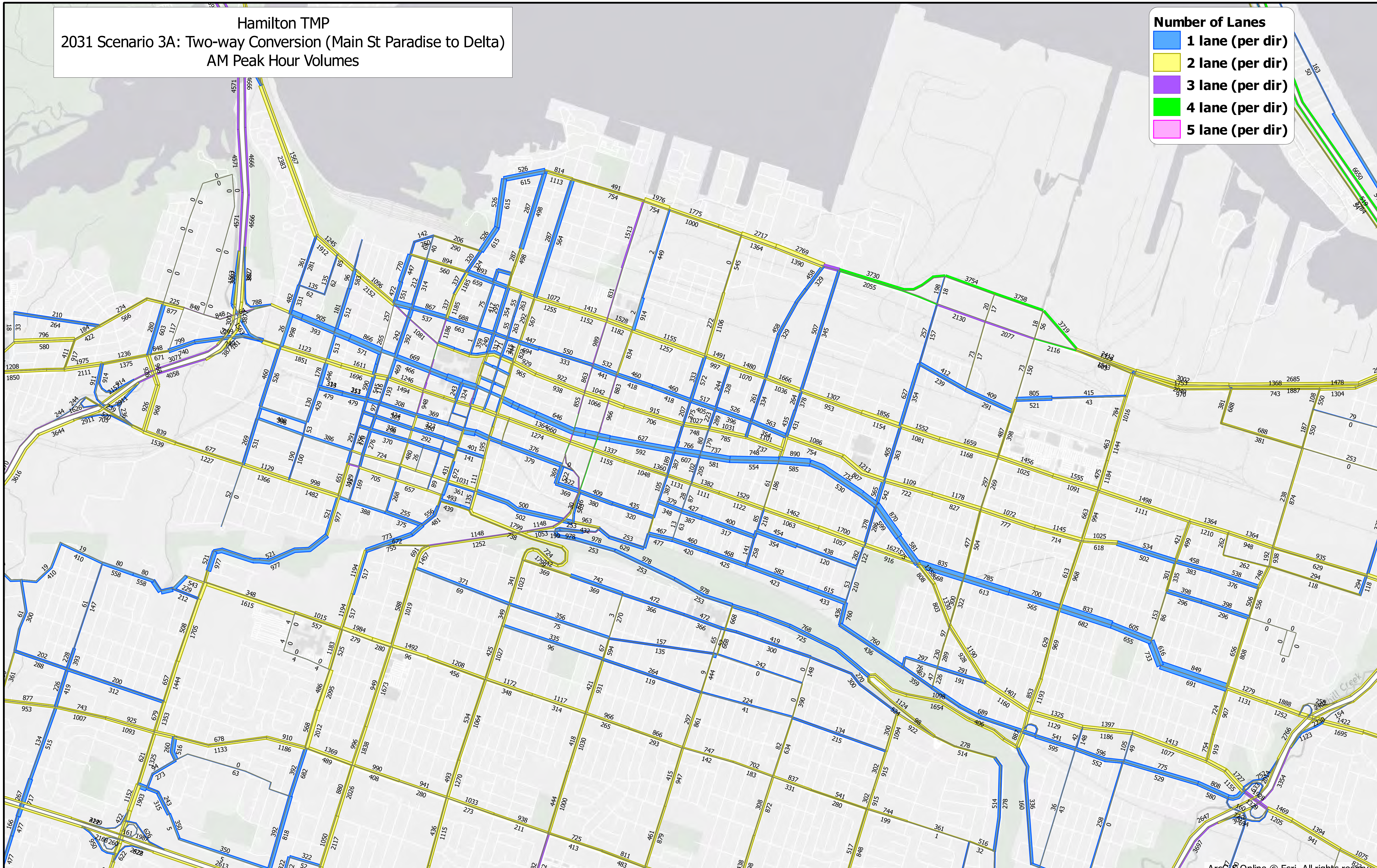

Hamilton TMP
2031 Scenario 3A: Two-way Conversion (Main St Paradise to Delta)
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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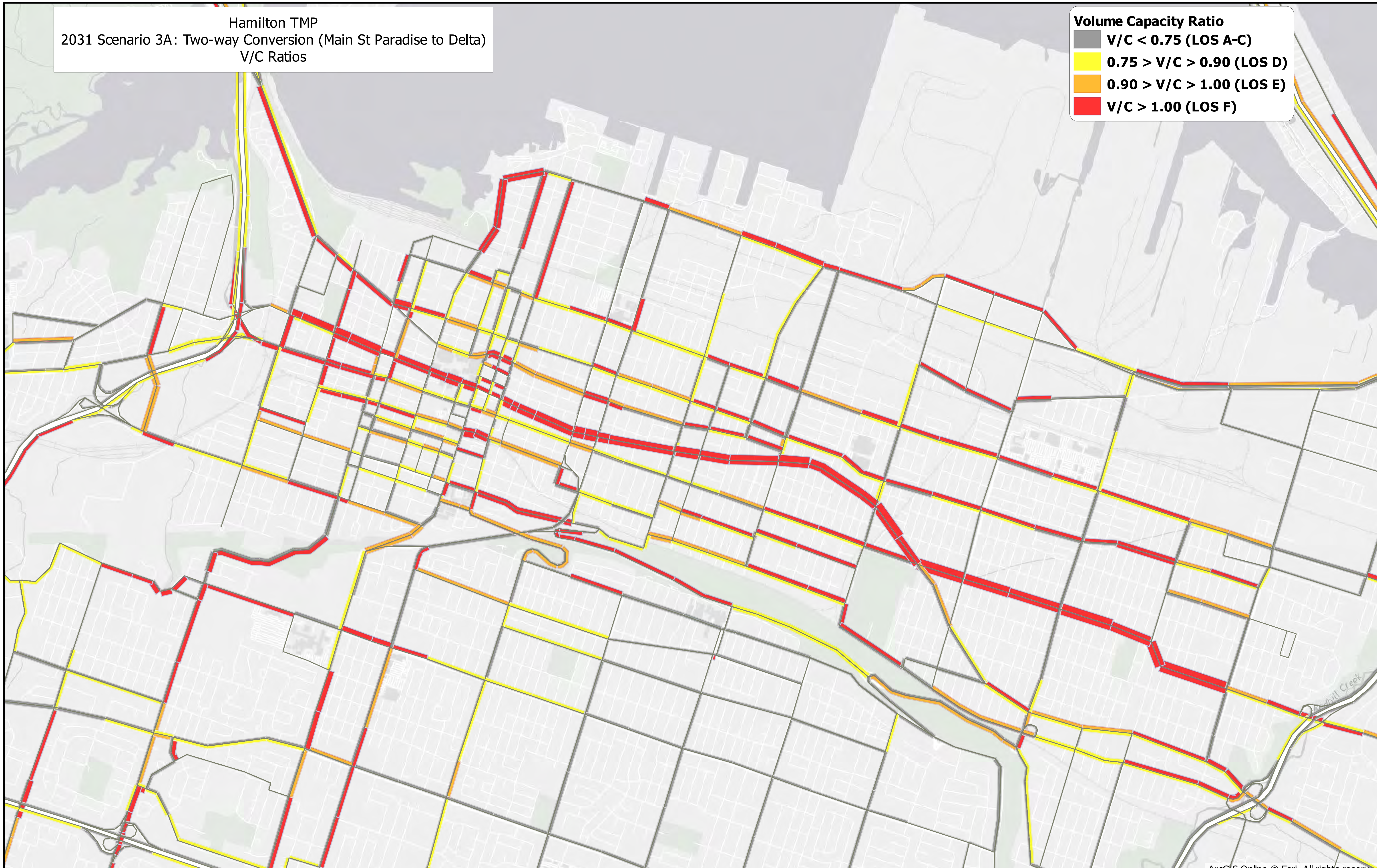
Hamilton TMP
2031 Scenario 3A: Two-way Conversion (Main St Paradise to Delta)
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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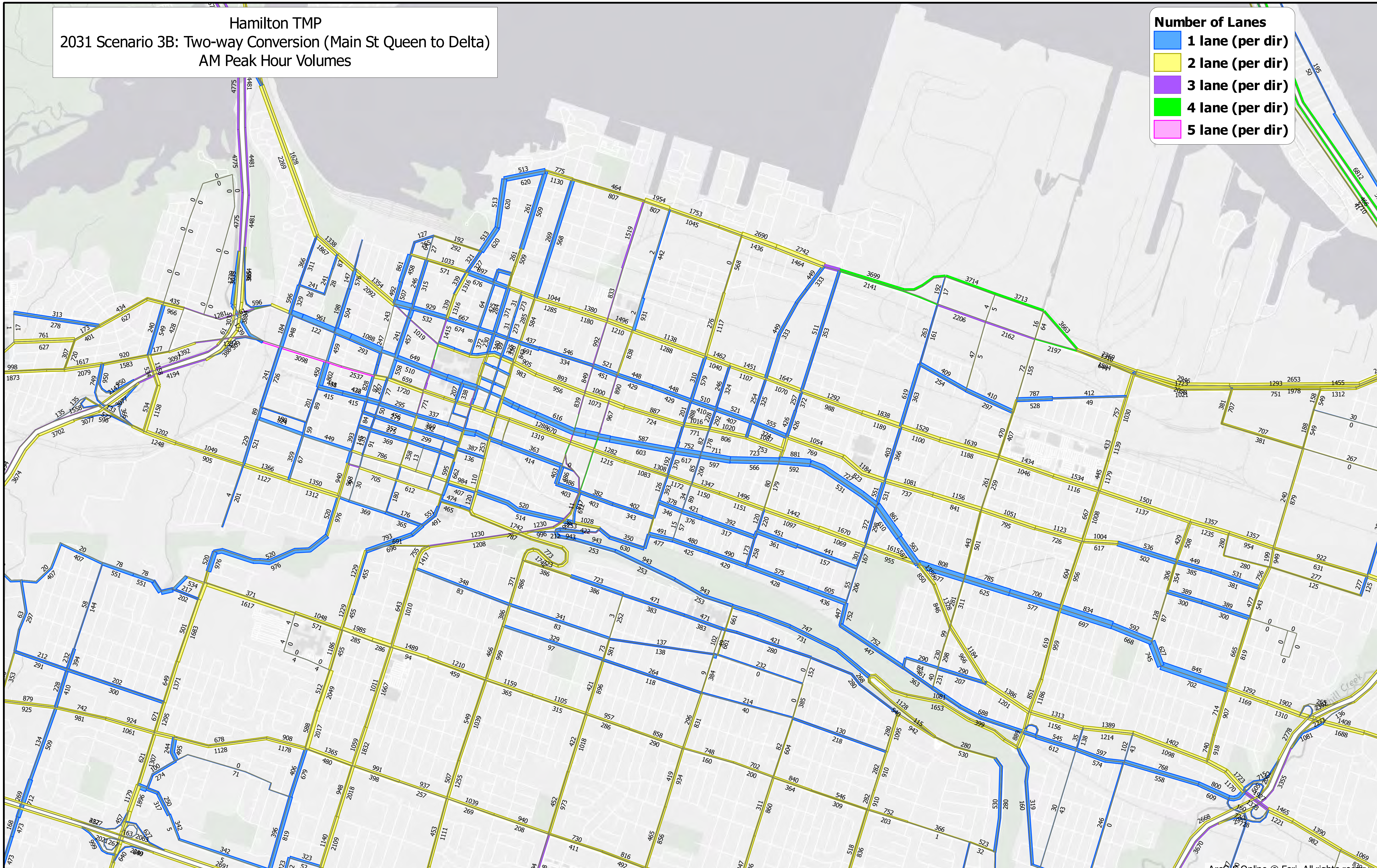
Hamilton TMP
2031 Scenario 3B: Two-way Conversion (Main St Queen to Delta)
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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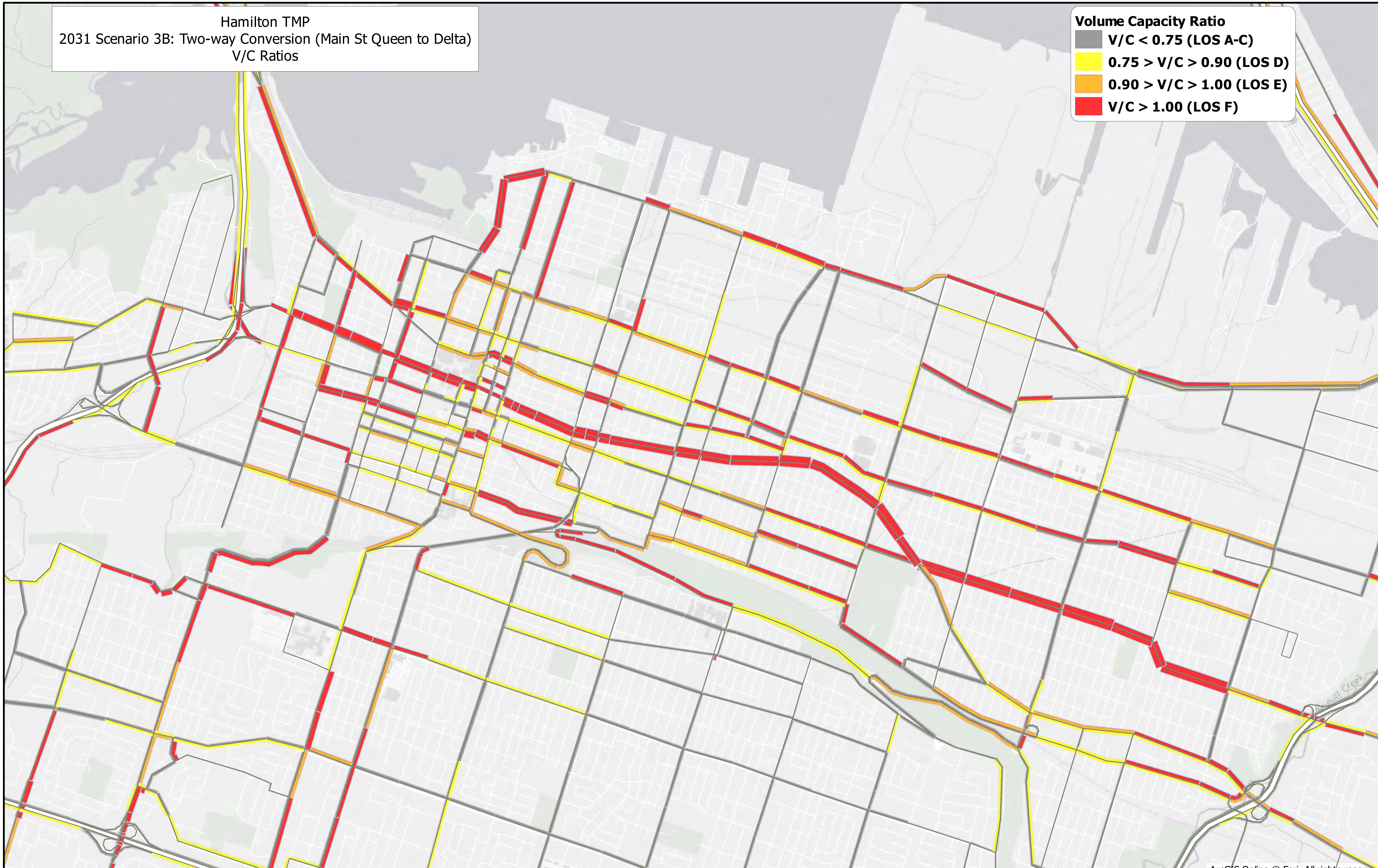

Hamilton TMP
2031 Scenario 3B: Two-way Conversion (Main St Queen to Delta)
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
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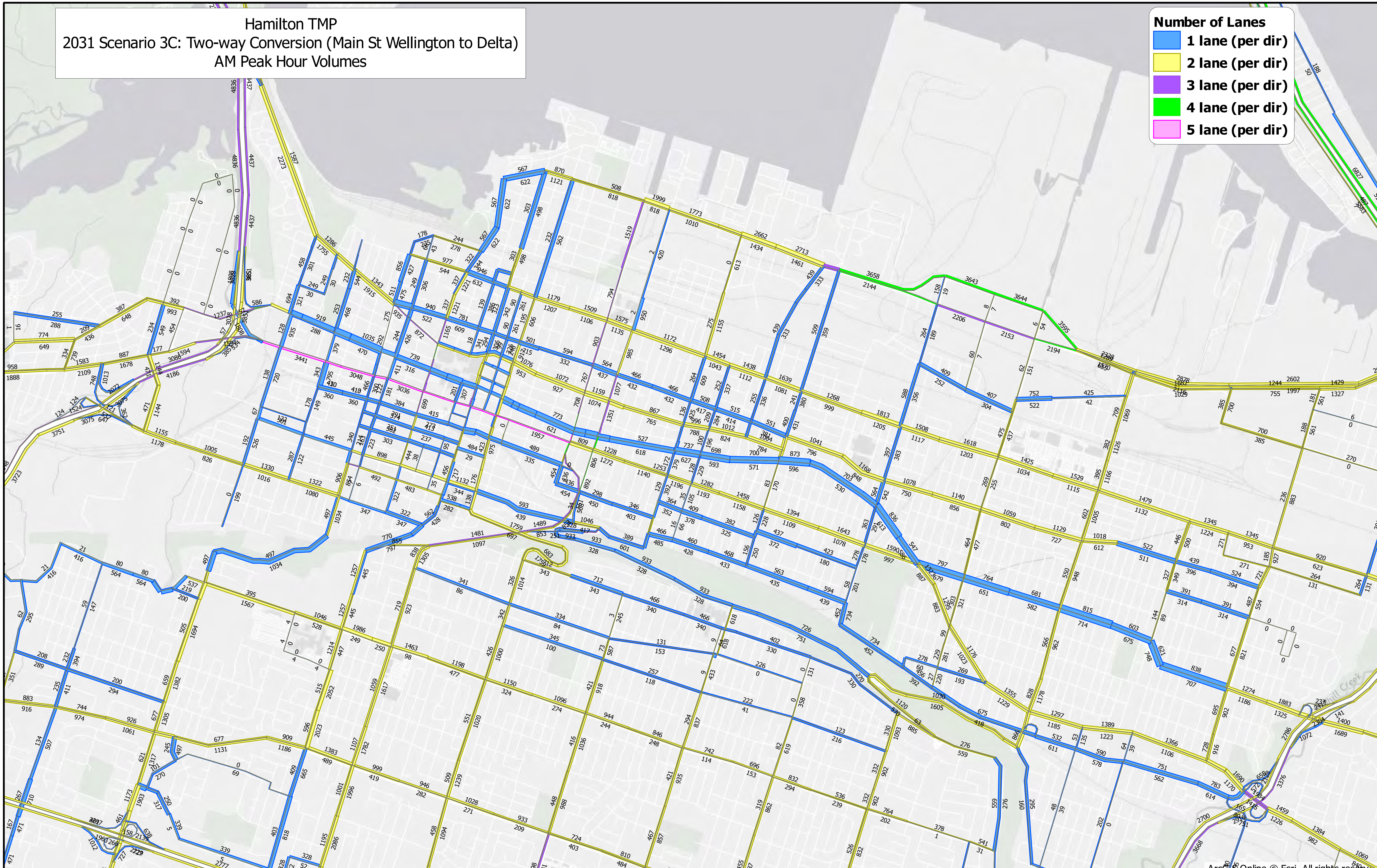
Hamilton TMP
2031 Scenario 3C: Two-way Conversion (Main St Wellington to Delta)
AM Peak Hour Volumes
Number of Lanes
1 lane (per dir)
2 lane (per dir)
3 lane (per dir)
4 lane (per dir)
5 lane (per dir)
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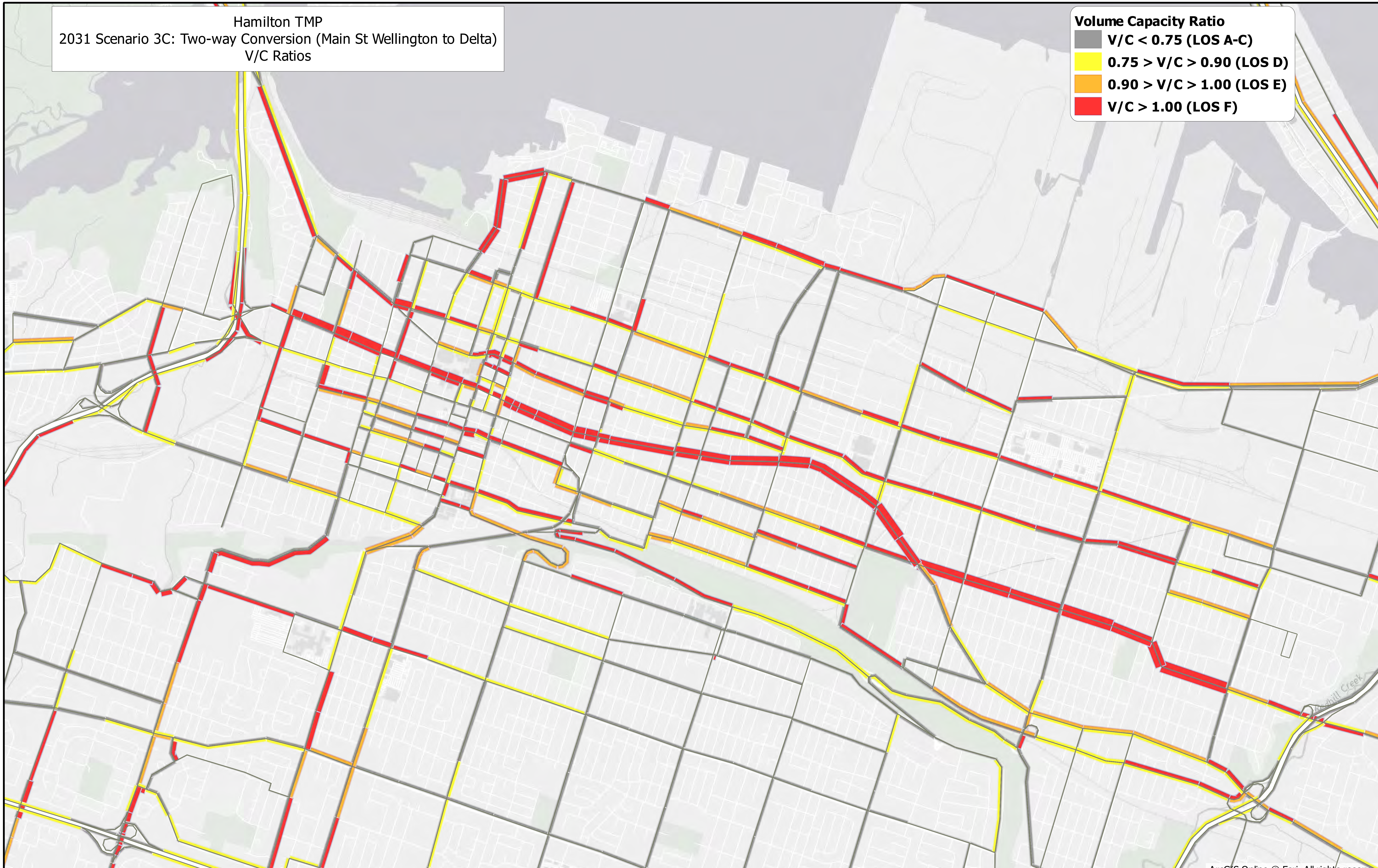

Hamilton TMP
2031 Scenario 3C: Two-way Conversion (Main St Wellington to Delta)
V/C Ratios
Volume Capacity Ratio
V/C < 0.75 (LOS A-C)
0.75 > V/C > 0.90 (LOS D)
0.90 > V/C > 1.00 (LOS E)
V/C > 1.00 (LOS F)
Redhill Creek
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