Appendix K

Long List Screening of Alternatives

DILLON CONSULTING

Memo

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Subject: Proposed Long List Screening of Design Alternatives

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1.1 Introduction

The following memorandum documents the rationale used to pre-screen the long list of design alternatives presented at the June 6th Technical Group Meeting and summarized in Table 1 to a shorter list of alternatives that should be considered in additional detail. Recommended pre-screening of alternatives is based on the following:

- Guidance provided in industry standard design manuals (active transportation);
- Immitigable impacts to major overhead and sub-surface utilities and/or significant impacts to private property with associated costs that would make particular alternatives economically infeasible (roadway alignment); and
- Anticipated property and/or typically unacceptable traffic impacts that would result from implementation of transit priority measures that are not anticipated to be warranted during the study horizon (queue jump lane locations).

The following sub-sections provide an overview of the proposed pre-screening method proposed under each of the aforementioned categories. The final sub-section provides a short-list of alternatives which are recommended for more in-depth evaluation.

Table 1: Overview of Long List Design Alternatives

Alternative	Description	Alignment Options	Transit Variants
1	"Transitioning Avenue" 5 lanes with sidewalks and protected bike lanes on both sides	1.1 Maintain Existing Centreline	1.1A – No Transit Priority Features
			1.1B –Queue Jump Lanes Added
		1.2 Maintain northern curb line	1.2A – No Transit Priority Features
			1.2B –Queue Jump Lanes Added
		1.3 Maintain southern curb line	1.3A – No Transit Priority Features
			1.3B –Queue Jump Lanes Added
2	5 lanes with sidewalks and cycle track on both sides	2.1 Maintain Existing Centreline	2.1A – No Transit Priority Features
			2.1B –Queue Jump Lanes Added
		2.2 Maintain northern curb line	2.2A – No Transit Priority Features
			2.2B –Queue Jump Lanes Added
		2.3 Maintain southern curb line	2.3A – No Transit Priority Features
			2.3B –Queue Jump Lanes Added
		3.4 Hybrid Solution – Maintain existing centreline except where shifting it could mitigate major impacts.	2.4A – No Transit Priority Features
			2.4B –Queue Jump Lanes Added
3	5 lanes with multi-use pathways on both sides	3.1 Maintain Existing Centreline	3.1A – No Transit Priority Features
			3.1B –Queue Jump Lanes Added
		3.2 Maintain northern curb line	3.2A – No Transit Priority Features
			3.2B –Queue Jump Lanes Added
		3.3 Maintain southern curb line	3.3A – No Transit Priority Features
			3.3B –Queue Jump Lanes Added
		3.4 Hybrid Solution – Maintain existing centreline except where shifting it could mitigate major impacts.	3.4A – No Transit Priority Features
			3.4B –Queue Jump Lanes Added

1.2 Recommended Long-List Screening Criteria

1.2.1 Active Transportation Facilities

An initial pre-screening of active transportation facilities was completed using the guidance provided in OTM Book 18 (refer to Table 2) and consideration the recommendations provided in the City's Complete-Livable-Better Streets Guideline. Based on the corridor purpose, average annual daily traffic counts (AADT), and vehicular operating speeds; only physically separated cycling facilities were considered as viable options for Rymal Road between Upper James and Dartnall Road. These options include protected bike lanes, cycle tracks and multi-use pathways.

Table 2: OTM Book 18 Cycle Facility Screening.

Consideration		Description of Existing Condition	Suitable Cycling Facility Types					
			Shared Lane	Paved Shoulder	Cycling Lane	Physically Separated Facility		
						Protected Bike Lane	Cycle Track	Multi-Use Pathway
Facility type recommended through previous study		Multi-use pathway for western segment through TMP. Protected Bike Lane in Complete-Better Livable Street Guide	-	-	-	✓	-	✓
Operating Conditions	Traffic Volume	14390	X	X	X	?	✓	✓
	Vehicle Operating Speed	70km/h						
Function of Street or Road or Highway		Mobility roads such as major collectors and arterials	X	-	✓	✓	✓	✓
Vehicle Mix		Bus stops located along route	X	-	✓	✓	✓	✓

Pedestrian Activity	High pedestrian volumes	✓	-	✓	✓	✓	?
On-Street Parking (for urban situations)	N/A	-	-	-	-	-	-
Frequency of Intersections (for urban situations)	Signalized intersections with high-volume turning conflicts	-	-	✓	✓	✓	X
Feasible Options		X	X	X	?	✓	?

Guidance provided in OTM Book 18 further recommends that use of protected bike lanes only be considered where motor vehicle operating speeds are less than 60 km/h and AADT volumes are less than 10,000 vehicles per day. Current AADT within the study corridor is estimated at 14,400 pvd, with a measured 85th percentile operating speed (Nebo Road to Dartnall Road) approaching 70 km/h. This information, combined with the significant number and frequency of residential and commercial driveways that will require breaks in the physical protection, result in a recommendation to screen out the protected bike lane option.

The two remaining physically separated cycling alternatives include multi-use pathways and cycle track (paired with sidewalks). The City has further requested consideration for a combination of multi-use pathway on the north side and sidewalk only on the south side of Rymal Road, for consistency with the segment of Rymal Road to the west of the study area.

Multi-modal level of service (MMLOS) analysis may further screen active transportation alternatives based on desired cycling level of service along the corridor.

1.2.2 Horizontal Alignment

Several combinations of active transportation and horizontal alignment alternatives were initially considered. This included options that widened evenly from the existing centreline, held the north limit and widened towards the south, held the south limit and widened north, as well as a hybrid option that shifted the centreline only when required to mitigate impacts to property, mature trees, and major utility infrastructure. Alternatives that contemplated only widening north or south ultimately resulted in designs that had very limited or non-existent boulevard space. In some segments, the space would be so constrained between the curb and property line that recommended active transportation facility widths would need to be compromised to provide streetlighting. Alternatives that contemplated holding the north limit and widening towards the south additionally resulted in significant impacts to a major hydro pole line that follows the south edge of pavement. Ability to relocate the pole line is impacted not only by the significant financial cost of doing so, but also by property limits and the presence of a watermain, trunk storm and sanitary sewer that limit the locations to which the pole line

could be moved. Alternatives that considered holding the south limit and widening towards the north resulted in: significant impact to private property, shortening of some private driveways to the point of being unusable, loss of mature trees, and additional impact to overhead utilities.

Based on the preliminary assessment of conceptual designs, alternative horizontal alignments that vary significantly from the existing centreline of road are not recommended to be carried forward. Only alternatives that maintain the existing centreline or include localized realignments to avoid impacts to major constraints (hybrid alternative) are recommended for further consideration.

1.2.3 Queue Jump Lanes

Rymal Road, from its western limit to Centennial Boulevard (east of the study limits) makes up a portion of the City's overall BLAST Rapid Transit network. Based on recommendations made in the *Metrolinx Regional Transportation Plan (RTP, 2018)*, and confirmed through a dedicated *S-Line Transit Ridership Study* (Dillon, 2021), the affected portion of Rymal Road will ultimately function as a 'Transit Priority Corridor'. Transit Priority Corridors include features such as high occupancy vehicle (HOV) lanes and queue jump lanes, with the objective of allowing transit vehicles to operate at a faster speed than vehicles in mixed traffic. While anticipated ridership levels are unlikely to warrant dedicated transit priority features during the current study's 2041 planning horizon, consideration for where they may be warranted beyond 2041 will limit the need for future road realignments and/or property acquisition.

The City of Hamilton has expressed a desire to implement transit priority measures at each of its Route 44 Express Stops. These stops will ultimately serve as Bus Rapid Transit (BRT) stops when growth in anticipated transit ridership is within reach of warranting that type of transit service. As the S-Line runs east-west through each express stop along the corridor, transit priority measures will be focussed on mitigating delays in the through-bound travel direction. Left turn priority measures are not currently being contemplated.

Through movement transit priority is primarily provided through implementation of features known as "queue jump lanes". Queue jump lanes are short segments of dedicated lane that allow buses to jump ahead of a line of traffic at signalized intersections. They have the potential to significantly reduce transit runtime delays – particularly at congestion along a corridor increases. Queue jumps can be designed to accommodate either stops that are located either nearside or far-side (preferred). When transit stops are located nearside, right turn movements are not permitted from the curb lane. After serving their nearside stop, buses move forward onto a loop detector which triggers the advanced transit signal to allow buses to move ahead of the next convoy of through-moving vehicles. When transit stops are located on the far-side of the intersection and right turn volumes do not warrant a dedicated lane, a shared right turn / transit priority lane can be used to move buses to the head of the line. A dedicated transit/right turn signal phase can then allow buses to move ahead to serve their stop, move out ahead of traffic after serving their stop, or bypass the stop and get ahead other through-moving vehicles.

There are two design options for implementing through-movement queue jump lane at signalized intersections:

1. A new outside lane is added on approach to the intersection, with a short segment of receiving lane on the farside of the intersection if that is where the stop is located. The lane should be added sufficiently far from the intersection to allow transit vehicles to move into the lane before encountering queuing associated with the intersection. If right turn volumes do not warrant their own lane and the stop is not located nearside, then the nearside portion of this new lane can be shared with right-turning vehicles.
2. An existing outside lane can be transitioned to function as transit-only or "right turn only with buses exempted" on the nearside of an intersection and transit-only for a short segment on the farside of the intersection.

The opportunities and challenges associated with each of these options are summarized in Table 3.

Table 3: Opportunities and Challenges Associated with Different Queue Jump Design Options.

Queue Jump Design Type	Opportunities	Challenges
Lane Addition	• Improve overall transit travel times, particularly within congested corridors. • Improves general traffic operations along the corridor by removing transit and right turning vehicles[a] from through lanes at signalized intersections.	• Additional construction and maintenance costs associated with the new lane and signal infrastructure/utility relocations. • Increased crossing distances for vulnerable road users. • Requires adequate property be available for construction.
Lane Conversion	• Improve overall transit travel times, particularly within congested corridors. • Minimal cost to implement. • No increase in crossing distances for vulnerable road users.	• Reduces the effect cross-section of the roadway by one lane on approach to the intersection, resulting in an overall worsening of traffic operations for non-transit vehicles. • Not recommended where reducing the through bound capacity would result in a level of service of D or worse for the affected intersection approach. • Results in increased weaving on approach to intersections. • Has the potential to increase speeding in the corridor as vehicles try to move ahead of vehicle convoys between intersections.

[a] If bus stop is implemented farside of the intersection.

1.2.3.1 Feasibility of Implementing Queue Jumps Through Lane Addition

Implementation of a queue jump lane through addition of a dedicated lane is ideal in terms of overall traffic operations, but will be particularly challenging within the limited Rymal Road right-of-way. Table 4 provides a high-level assessment of locations where queue jump lanes and transit pads/shelters are likely to fit within the existing right-of-way.

Table 4: Initial Assessment of Feasibilty for Implementing Additional Queue Jump Lanes.

Intersecting Roadway	Travel Direction	Ideal Queue Jump Length[b]	Discussion on Feasibility of Implementing a Queue Jump Through Lane Addition
Upper James Street	Eastbound	Unknown	City staff have indicated that additional property is not available in the eastbound direction. Additional property would be required in order to implement an eastbound queue jump through lane addition at this location.
	Westbound	Unknown	Adequate property exists to provide a queue jump and transit pad on the nearside of the intersection. As there is inadequate space farside of the intersection to accommodate a transit stop, and a nearside stop would ideally include removal of the right turn permissions, it is recommended that a queue jump lane not be provided in this location due the anticipated volume of right turning vehicles.
Upper Wellington	Eastbound	90 m	Inadequate space to provide a separate right turn queue jump lane and shelter without acquiring private property from residents or Mount Hamilton Cemetery. Roadway could potentially be shifted north accommodate, but that would result in the inability to accommodate a westbound queue jump, which is the more critical travel direction.
	Westbound	40 m	Adequate property exists to provide a queue jump and transit pad on the farside of the intersection.
Upper Wentworth	Eastbound	10 m	Inadequate space to provide a separate right turn queue jump lane and shelter without acquiring private property.
	Westbound	80 m	Inadequate space to provide a separate right turn queue jump lane and shelter without acquiring private property.
Upper Sherman	Eastbound	40 m	Inadequate space to provide a separate right turn queue jump lane and shelter without

[b] Numbers have been rounded to the nearest 5 for simplicity.

			acquiring private property.
	Westbound	55 m	Inadequate space to provide a separate right turn queue jump lane and shelter without acquiring private property.
Upper Gage	Eastbound	15 m	Adequate property exists to provide a queue jump and transit pad on the farside of the intersection.
	Westbound	25 m	Adequate property exists to provide a queue jump and transit pad on the nearside of the intersection. As there is inadequate space farside of the intersection to accommodate a transit stop, and a nearside stop would require removal of the right turn permissions, it is recommended that a queue jump lane not be provided in this location due the anticipated volume of right turning vehicles (255 vph).
Upper Ottawa	Eastbound	150 m	Adequate property exists to provide a queue jump and transit pad on the nearside of the intersection. Provision of a nearside queue jump generally requires removal of right turn permissions. Peak right turn volumes are anticipated to be 87 vph in 2041 at this location. Could potentially consider providing a nearside stop.
	Westbound	190 m	Inadequate space to provide a separate right turn / queue jump lane and shelter without acquiring private property. Due to anticipated through movement volumes in this location, consideration should be given to shifting the alignment southerly to accommodate a westbound queue jump with a farside stop. This would eliminate the potential to provide an eastbound queue jump lane.
Dartnall Road	Eastbound	95 m	Adequate property exists to provide a queue jump and transit pad on the nearside of the intersection. Provision of a nearside queue jump generally requires removal of right turn permissions. Peak right turn volumes are expected to reach 67 vph by 2041 at this location. Could potentially consider providing a nearside stop.
	Westbound	80 m	Existing westbound cross-section includes a dedicated right turn lane. As there is inadequate space farside of the intersection to accommodate a transit stop, and a nearside stop would require removal of the right turn

			permissions, it is recommended that a queue jump lane not be provided in this location.

1.2.3.2 Feasibility of Implementing Queue Jumps Through Lane Conversion

An initial screening of the feasibility of implementing queue jumps through lane conversion was completed by reviewing future (2041) intersection operations using the existing single through lane condition. The outcome of this screening is presented in Table 5 and Table 6. Note that this assessment assumes that adequate space exists within the right-of-way to accommodate farside stops. Where assessment of the physical layout identifies that adequate space for a farside stop is not available, then consideration needs to be given to the impact of removing right turn permissions at the intersection. These considerations are not included within the current memo.

Table 5: Assessment of Feasibility of Implementing Eastbound Queue Jumps Through Lane Conversion Based on Future "Do Nothing" Peak Volumes.

Intersecting Roadway	Through Lane Volume	Volume/ Capacity of Through Lane	Level of Service	Suitable for Lane Conversion?(Y/N)
Upper James Street[c]	746[d]	1.30[g]	Not Available[h]	No
Upper Wellington	900[d]	0.73[g]	Not Available[h]	Yes
Upper Wentworth	828[d]	0.74	A	Yes
Upper Sherman	890[d]	0.82	C	Yes
Upper Gage	900[d]	0.74[g]	Not Available[h]	Yes
Upper Ottawa	930[d]	1.02[g]	Not Available[h]	No
Dartnall Road[c]	742[d]	0.75[g]	Not Available[h]	Yes

Table 6: Assessment of Feasibility of Implementing Westbound Queue Jumps Through Lane Conversion Based on Future "Do Nothing" Peak Volumes.

Intersecting Roadway	Through Lane Volume	Volume/ Capacity of Through Lane	Level of Service	Suitable for Lane Conversion? (Y/N)
Upper James Street[e]	698[f]	1.30[g]	Not Available[h]	No

[c] Two eastbound through lanes provided in the existing condition.
[d] Highest peak hour volumes occur during the PM Peak Period.
[e] Two westbound through lanes provided in the existing condition.
[f] Highest peak hour volumes occur during the PM Peak Period.

Upper Wellington	897[f]	0.87[g]	Not Available[h]	Maybe
Upper Wentworth	885[f]	1.03	D	No
Upper Sherman	977[f]	1.08	E	No
Upper Gage	816[f]	0.84	C	Yes
Upper Ottawa	886[f]	1.15	F	No
Dartnall Road[e]	722[f]	0.57	B	Yes

1.2.3.3 Summary of Feasible Queue Jump Implementation

The following table provides a summary of anticipated feasibility of implementing queue jump either through lane addition or conversion at each of the express stops within the Rymal Road study corridor. Conceptual layouts of the options presented in the table will be prepared to further assess feasibility.

Table 7: Outcomes of Initial Feasibility Assessment of Queue Jump Locations and Designs.

Intersecting Roadway	Travel Direction	Feasible Queue Jump Design Type		Recommended Queue Jump Design Type
		Lane Addition	Lane Conversion	
Upper James Street	Eastbound	X	X	None
	Westbound	X	X	None
Upper Wellington	Eastbound	X	✓	Lane Conversion
	Westbound	✓	✓	Either
Upper Wentworth	Eastbound	X	✓	Lane Conversion
	Westbound	X	X	None
Upper Sherman	Eastbound	X	✓	Lane Conversion
	Westbound	X	X	None
Upper Gage	Eastbound	✓	✓	Either
	Westbound	X	✓	Lane Conversion
Upper Ottawa	Eastbound	✓	X	Lane Addition
	Westbound	?[i]	X	Lane Addition[i]
Dartnall Road	Eastbound	?	✓	Lane Conversion
	Westbound	X	X	None

[g] Value is estimated by multiplying the combined through/right V/C from Synchro by the ratio of through volumes only divided by through + right turn volumes. Where two existing through lanes will be reduced to a single through lane, the through volumes are multiplied by two.

[h] Separate through and right turn lanes not modelled in Synchro.

[i] Feasibility to be explored further. Providing both an eastbound and westbound queue jump would not be feasible within the existing right-of-way. Provision of a westbound queue jump with farside stop is likely only feasible if the road alignment can be adequately shifted to the south.

1.3 Recommended Short-List Options for Further Consideration

The list of alternative design solutions recommended for more detailed evaluation are summarized in Table 8, with a brief explanation of screening rationale.

Table 8: Overview of Alternatives Recommended to be Carried Forward for Further Consideration.

Alternative	Description	Alignment Options	Transit Variants	Brief Rationale for Screening	Carry Forward (✓ or X)
1	"Transitioning Avenue" 5 lanes with sidewalk and protected bike lanes	1.1 Maintain Existing Centreline	1.1A – No Transit Priority Features	All of alternative 1 is screened out as Protected Bike Lanes are not an appropriate solution for a corridor with the traffic volumes and operating speeds that have been measured on Rymal Road.	X
			1.1B –Queue Jump Lanes Added		
		1.2 Maintain northern curb line	1.2A – No Transit Priority Features		
			1.2B –Queue Jump Lanes Added		
		1.3 Maintain southern curb line	1.3A – No Transit Priority Features		
			1.3B –Queue Jump Lanes Added		
2	5 lanes with sidewalk and cycle track	2.1 Maintain Existing Centreline	2.1A – No Transit Priority Features	Alternative recommended for further consideration.	✓
			2.1B –Queue Jump Lanes Added		
		2.2 Maintain northern curb line	2.2A – No Transit Priority Features	Widening to the south results in significant impacts to an existing high voltage utility line, watermain, trunk storm sewer, sanitary sewer and property. Alternative is screened out.	X
			2.2B –Queue Jump Lanes Added		
		2.3 Maintain southern curb line	2.3A – No Transit Priority Features	Widening to the north results in significant impacts to private property. Additionally, widening to the north removes the potential to implement queue jump lanes through lane addition in the westbound (and most critical) travel direction. Alternative is screened out.	X
			2.3B –Queue Jump Lanes Added		
		3.4 Hybrid Solution – Maintain existing centreline except where shifting it could mitigate major impacts.	2.4A – No Transit Priority Features	Alternative recommended for further consideration.	✓
			2.4B –Queue Jump Lanes Added		
3	5 lanes with multi-use pathways	3.1 Maintain Existing Centreline	3.1A – No Transit Priority Features	Alternative recommended for further consideration.	✓
			3.1B –Queue Jump Lanes Added		
		3.2 Maintain northern curb line	3.2A – No Transit Priority Features	Widening to the south results in significant impacts to an existing high voltage utility line, watermain, trunk storm sewer, sanitary sewer and property. Alternative is screened out.	X
			3.2B –Queue Jump Lanes Added		
		3.3 Maintain southern curb line	3.3A – No Transit Priority Features	Widening to the north results in significant impacts to private property. Additionally, widening to the north removes the potential to implement queue jump lanes through lane addition in the westbound (and most critical) travel direction. Alternative is screened out.	X
			3.3B –Queue Jump Lanes Added		
		3.4 Hybrid Solution – Maintain existing centreline except where shifting it could mitigate major impacts.	3.4A – No Transit Priority Features	Alternative recommended for further consideration.	✓
			3.4B –Queue Jump Lanes Added		