

# Annex

## Performance Measure Justification

This annex describes the performance measures selected for pedestrians, bicycles, buses, trucks and cars on segments and at signalized and unsignalized intersections. It gives rationale behind the values chosen for each level in the six tier Level of Service (LOS) paradigm.

Many measures given in the MMLOS Guidelines have not been used to evaluate LOS in the past. References are noted where existing research and/or justification is available. In other scenarios, divisions were made to fit the framework of a six tier LOS.

The OTC acknowledges that benchmarking and testing of these measures and metrics will occur on an ongoing basis. Lessons learned will be incorporated into these measures and metrics in future updates of the MMLOS Guidelines.



# Segments





# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Pedestrian Facility Width (m)	Pedestrian Buffer Width (m)		Max Distance between Controlled Crossings (m)
Weight	33 %	33 %		33 %
Notes	Need 1.5m for one person walking to walk by a person in a wheelchair Need 1.8m for two wheelchairs to pass each other Need 3.0m for 2 pairs of walkers to walk by each other Sources: NACTO; OTM Book 18			
Score	Value	Rationale		
A	> 3.0	Provides enough space for social walking		
B	2.6 - 3.0			
C	2.1 - 2.5			
D	1.8 - 2.0	Lower boundary is min space for two wheelchairs to pass		
E	1.5 - 1.7	Lower boundary is min space for a person walking to pass by a wheelchair		
F	< 1.5	Less than the minimum space for a person walking to pass by a wheelchair		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Pedestrian Facility Width (m)	Pedestrian Buffer Width (m)		Max Distance between Controlled Crossings (m)
Weight	33 %	33 %		33 %
Notes	Includes all road elements from the edge of the closest travel lane, including parking lanes, cycletracks, and utility corridors Source: N/A			
Score	Value	Rationale		
A	> 2.5	Pedestrians feel removed from traffic on road		
B	2.1 - 2.5			
C	1.6 - 2.0			
D	1.3 - 1.5			
E	1.0 - 1.2			
F	< 1.0	No appreciable buffer		



# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Pedestrian Facility Width (m)		Pedestrian Buffer Width (m)	Max Distance between Controlled Crossings (m)
Weight	33 %		33 %	33 %
Notes:	Assume walking speed of 1.0 m/s + 30m in walking distance represents a 30 second increase in walk time (one - way), or 1 minute increase in total trip duration. Source: OTM Book 15			
Score	Value	Rationale		
A	200	200m represents a common block length in an MTSA and respects OTM Book 15 minimum spacing for pedestrian crossing control. It represents roughly a 3.5 minute walk at 1.0 m/s.		
B	201 - 230			
C	231 - 260			
D	261 - 290			
E	291 - 320			
F	> 320	Person at mid - point between crossings is more than a 3 minute walk from crossing		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Bike Facility Width (m)	Bike Buffer Width (m)		Conflicts with Other Modes (In-lane conflicts and crossing point conflicts)
Weight	33 %	33 %		33 %
Notes	Single person on bike occupies 0.75m Cyclist in motion needs 1.2m space to account for sway (in motion) Second cyclist needs 0.6m to pass in same direction Two cyclists riding in a pair need 2.4m Source: OTM Book 18			
Score	Value	Rationale		
A	> 2.4	Provides enough space for social cycling		
B	2.2 - 2.4			
C	1.9 - 2.1			
D	1.6 - 1.8	Min width to allow for overtaking, same direction		
E	1.2 - 1.5			
F	< 1.2	Minimum width for one cyclist		



# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Bike Facility Width (m)	Bike Buffer Width (m)	Conflicts with Other Modes (In-lane conflicts and crossing point conflicts)	
Weight	33 %	33 %	33 %	
Notes	Includes all road elements from the edge of the closest travel lane, including parking lanes, utility corridors, and sidewalks Source: N/A			
Score	Value	Rationale		
A	Has physical measures and buffer width > 1.0	Has barrier and enough buffer space for cyclists to feel separate from adjacent vehicles		
B	Has physical measure and buffer width is 0.50 - 1.0	Has barrier and some buffer space for cyclists to feel separate from adjacent vehicles		
C	LOS not used			
D	Has physical measures and buffer width is 0.30 - 0.49  OR  Has no physical measures and width is ≥ 0.50	Has minimum buffer or barrier		
E	LOS not used			
F	No physical measures and buffer width is < 0.50	Has no appreciable buffer		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Bike Facility Width (m)		Bike Buffer Width (m)	Conflicts with Other Modes (In-lane conflicts and crossing point conflicts)
Weight	33 %		33 %	33 %
Notes	<p>The NACTO City Limits Guide considers two factors to determine the “Conflict Density” of a street: modal mixing, or what is referred to as “in-lane conflict” in these guidelines, and crossing point density, which is referred to as “crossing point conflict” in these guidelines. The OTC MMLOS Guidelines quantify these two factors, or “conflict indicators”, and the combination of the two indicator values determines the score for this measure, as noted below.</p> <p>The NACTO City Limits Design Guide and NACTO Urban Bikeway Design Guide were referenced to quantify the “low”, “moderate” and “high” values for the two conflict indicators.</p> <p>The in-lane conflict indicator values are as follows:</p> <ul style="list-style-type: none"><li>• Low: less than 50 veh/h or ped/h,</li><li>• Moderate: 50 to 300 veh/h or ped/h, and</li><li>• High: more than 300 veh/h or ped/h.</li></ul> <p>The crossing point conflict indicator values are as follows:</p> <ul style="list-style-type: none"><li>• Low: less than 3 crossing points per km,</li><li>• Moderate: 3 to 7 crossing points per km, and</li><li>• High: more than 7 crossing points per km.</li></ul> <p>Source: NACTO City Limits Guide and NACTO Urban Bikeway Design Guide</p>			
Score	Value	Rationale		
A	Two “Low” conflict indicators	Optimum condition		
B	One “Low” conflict indicator and one “Moderate” conflict indicator			
C	Two “Moderate” conflict indicators			
D	One “Low” conflict indicator and one “High” conflict indicator			
E	One “Moderate” conflict indicator and one “High” conflict indicator			
F	Two “High” conflict indicators	Least favourable condition		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Facility Type		Transit Passenger Amenities	Pedestrian Level of Service
Weight	33 %		33 %	33 %
Notes	Source: N/A			
Score	Value	Rationale		
A	Dedicated lanes	Optimum condition - highest level of service for transit vehicles		
B	Intersection priority measures	Transit vehicles are provided with delay reduction measures at points of high avoidable delay		
C	LOS not used			
D	Mixed traffic with >1 lane per direction	Transit vehicles are not delayed by conflicts/ friction from vehicles making left turns		
E	LOS not used			
F	Mixed traffic with only 1 lane per direction	Least favourable condition		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Facility Type	Transit Passenger Amenities		Pedestrian Level of Service
Weight	33 %	33 %		33 %
Notes	Source: N/A			
Score	Value	Rationale		
A	Abundance of passenger amenities such as shelters, seating, shade trees, etc.	Optimum condition		
B	Moderate presence of passenger amenities such as shelters, seating, shade trees, etc.			
C	LOS not used			
D	Low presence of passenger amenities such as shelters, seating, shade trees, etc.			
E	LOS not used			
F	No presence of passenger amenities such as shelters, seating, shade trees, etc.	Least favourable condition		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Facility Type		Transit Passenger Amenities	Pedestrian Level of Service
Weight	33 %		33 %	33 %
Notes	Pedestrian access to transit facilities and services is a key factor in its success.  Transit performance is determined in part by the experience of riders accessing the transit system. Therefore, the pedestrian LOS also has a significant impact on the LOS for transit users and has been selected as a key performance measure.  Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Width of the Curb Lane		Car Level of Service	
Weight	50 %		50 %	
Notes	Common lane width for a curb lane on a multi-lane road is 3.5m Curb lane width does not include the typical curb offset of 0.25m Source: TAC Geometric Design Guide			
Score	Value	Rationale		
A	> 4.0	Lane width allows for some minor maneuvering within the lane to avoid friction on the curb		
B	3.9 - 4.0			
C	3.7 - 3.8			
D	3.4 - 3.6			
E	LOS not used			
F	< 3.4	Lane width allows no maneuvering within the lane to avoid friction on the curb		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Width of the Curb Lane		Car Level of Service	
Weight	50 %		50 %	
Notes	Network performance/LOS for trucks is dictated by many of the same factors that dictate network performance/LOS for cars. Given this, car LOS has been chosen as an indicator of the general performance of the network for trucks.  Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Mid-block V/C Ratio		Curb Lane Conflicts (conflicts/km)	
Weight	50 %		50 %	
Notes	Source: Highway Capacity Manual 6th Edition			
Score	Value	Rationale		
A	< 0.60	Follows historical HCM values		
B	0.60 - 0.69	Follows historical HCM values		
C	0.70 - 0.79	Follows historical HCM values		
D	0.80 - 0.89	Follows historical HCM values		
E	0.90 - 1.0	Follows historical HCM values		
F	> 1.0	Follows historical HCM values		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Segment		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Mid - block V/C Ratio		Curb Lane Conflicts (conflicts/km)	
Weight	50 %		50 %	
Notes	Source: NACTO City Limits Guide			
Score	Value	Rationale		
A	None	Optimum condition		
B	1 - 2			
C	3 - 4	NACTO defines segments with two or three “crossing points” per 1/4 mile as having a moderate density of crossing points. This is approximately equivalent to 5 to 7.5 crossing points per kilometre.		
D	5 - 6			
E	7 - 8	NACTO defines segments with three or more “crossing points” per 1/4 mile as having a high density of crossing points. This is approximately equivalent to 7.5 or more crossing points per kilometre.		
F	9+	Least favourable condition		



# Signalized Intersections





## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Pedestrian Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25 %	25 %	25 %	25 %
Notes	Common lane width is 3.5m  Enhanced pedestrian measures are normalized to number of approaches to account for the fact that not all intersections have four legs.  Source: TAC Geometric Design Guide			
Score	Value	Rationale		
A	> 1.0	All pedestrian crossings have at least one enhanced measure and at least one crossing has more than one enhanced measure, OR more than one pedestrian crossing has multiple enhanced measures.		
B	0.76 - 1.0			
C	0.51 - 0.75	More than half of the pedestrian crossings have enhanced pedestrian measures.		
D	0.26 - 0.50	Up to half of the pedestrian crossing have enhanced pedestrian measures.		
E	0.01 - 0.25			
F	0	No pedestrian crossings have enhanced measures.		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Pedestrian Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25 %	25 %	25 %	25 %
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	< 9.0	Vehicle turning speed is < 15 kph		
B	9.0 - 10.9			
C	11.0 - 12.9	Vehicle turning speed is 20 kph		
D	13.0 - 14.9	Vehicle turning speed is 25 kph		
E	15.0 - 17.9			
F	≥ 18	Vehicle turning speed is > 30 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Pedestrian Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25 %	25 %	25 %	25 %
Notes	Minimum cycle length in common use is 60 seconds Typical walking speed for crossing is 1m/s Source: N/A			
Score	Value	Rationale		
A	< 60	Intersection uses minimum common cycle length		
B	61 - 75	Pedestrians potentially delayed 15 seconds above minimum		
C	76 - 90	Pedestrians potentially delayed 30 seconds above minimum		
D	91 - 105	Pedestrians potentially delayed 45 seconds above minimum		
E	106 - 120	Pedestrians potentially delayed 60 seconds above minimum		
F	>120	Pedestrians potentially delayed more than 60 seconds above minimum		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Pedestrian Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/ approach)
Weight	25 %	25 %	25 %	25 %
Notes	<p>Total number of potential conflicts at a 4 legged intersection: 12</p> <ul style="list-style-type: none"><li>• 4 right turn/ pedestrian on green</li><li>• 4 left turn/ pedestrian on green ball</li><li>• 4 right turn/ pedestrian on red</li></ul> <p>Conflicts are normalized to the number of approaches to account for the fact that not all intersections have four legs.</p> <p>Unlikely that the right turn on green/ pedestrian conflict would be controlled, except at very high pedestrian volume locations.</p> <p>Source: N/A</p>			
Score	Value	Rationale		
A	1	All left turn/ pedestrian and right turn on red/ pedestrian conflicts are controlled/ eliminated		
B	1.1 - 1.5			
C	1.6 - 2.0			
D	2.1 - 2.5			
E	2.6 - 3			
F	> 3	All common conflicts are uncontrolled and additional conflict points are introduced due to the use of islands		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Bicycle Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25 %	25 %	25 %	25 %
Notes	Enhanced bicycle measures are considered anything beyond the presence of a basic bike facility, including but not limited to crossrides, green conflict markings, dedicated intersection features, protected intersection features, bicycle signal heads, leading bike intervals (LBIs) and protected phases.  Number of enhanced measures are normalized to the number of approaches to account for the fact that not all intersections have four legs.  Source: N/A			
Score	Value	Rationale		
A	> 1.0	All approaches have at least one enhanced bicycle measure OR more than one approach has more than one enhanced bicycle measure.		
B	0.76 - 1.0			
C	0.51 - 0.75	More than half of the intersection approaches have enhanced bicycle measures.		
D	0.26 - 0.50	Up to half of the approaches have enhanced bicycle measures.		
E	0.01 - 0.25			
F	0	No approaches have enhanced bicycle measures.		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Bicycle Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25 %	25 %	25 %	25 %
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	< 9.0	Vehicle turning speed is < 15 kph		
B	9.0 - 10.9			
C	11.0 - 12.9	Vehicle turning speed is 20 kph		
D	13.0 - 14.9	Vehicle turning speed is 25 kph		
E	15.0 - 17.9			
F	≥ 18	Vehicle turning speed is > 30 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Bicycle Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/approach)
Weight	25%	25 %	25 %	25 %
Notes:	Minimum cycle length in common use is 60 seconds Typical walking speed for crossing is 1m/s or 1.1m/s Source: N/A			
Score	Value	Rationale		
A	< 60	Intersection uses minimum common cycle length		
B	61 - 75	Cyclists potentially delayed 15 seconds above minimum		
C	76 - 90	Cyclists potentially delayed 30 seconds above minimum		
D	91 - 105	Cyclists potentially delayed 45 seconds above minimum		
E	106 - 120	Cyclists potentially delayed 60 seconds above minimum		
F	> 120	Cyclists potentially delayed more than 60 seconds above minimum		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Enhanced Bicycle Measures	Average Effective Turning Radius (m)	Cycle Length (s)	Number of Uncontrolled Conflicts (conflicts/ approach)
Weight	25 %	25 %	25 %	25 %
Notes	Total number of potential conflicts at a 4-legged intersection: 12 <ul style="list-style-type: none"><li>• 4 legged intersection - 12 points of conflict</li><li>• 4 right turn/ cyclist on green</li><li>• 4 left turn/ cyclist on green ball</li><li>• 4 right turn/ cyclist on red</li></ul> Conflicts are normalized to the number of approaches to account for the fact that not all intersections have four legs.  Unlikely that the right turn on green/ cyclist conflict would be controlled  Source: N/A			
Score	Value	Rationale		
A	1	All left turn/ cyclist and right turn on red/ cyclist conflicts are controlled/ eliminated		
B	1.1 - 1.5	Left turn/cyclist or right turn on red/cyclist conflicts are controlled or eliminated.		
C	1.6 - 2.0			
D	2.1 - 2.5			
E	2.6 - 3.0			
F	> 3.0	All common conflicts are uncontrolled and additional conflict points are introduced due to the use of islands		

# Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Priority Measures		Transit Movement Delay (s)	Pedestrian Level of Service
Weight	33 %		33 %	33 %
Notes	Source: N/A			
Score	Value	Rationale		
A	Implementation of transit priority measures at all approaches for transit	Optimum condition		
B	LOS not used			
C	Implementation of transit priority measures at a minimum of one but not all approaches for transit	Moderately favourable condition.		
D	LOS not used			
E	LOS not used			
F	No transit priority measures at any approaches for transit	Least favourable condition		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Priority Measures		Transit Movement Delay (s)	Pedestrian Level of Service
Weight	33 %		33 %	33 %
Notes	Source: Highway Capacity Manual 6th Edition			
Score	Value	Rationale		
A	0 - 10	Follows HCM		
B	11 - 20	Follows HCM		
C	21 - 35	Follows HCM		
D	36 - 55	Follows HCM		
E	56 - 80	Follows HCM		
F	> 80	Follows HCM		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Priority Measures		Transit Movement Delay (s)	Pedestrian Level of Service
Weight	33 %		33 %	33 %
Notes	Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Effective Turning Radius (m)		Car Level of Service	
Weight	50 %		50 %	
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	> 18	Vehicle turning speed is > 30 kph		
B	17 - 18			
C	15 - 16	Vehicle turning speed is 25 kph		
D	13 - 14	Vehicle turning speed is 20 kph		
E	11 - 12			
F	< 11	Vehicle turning speed is < 15 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Effective Turning Radius (m)		Car Level of Service	
Weight	50 %		50 %	
Notes	Network performance/LOS for trucks is dictated by many of the same factors that dictate network performance/LOS for cars. Given this, car LOS has been chosen as an indicator of the general performance of the transportation network for trucks.  Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Percentage of Turning Movements with Dedicated Lanes		Intersection Delay (s)	
Weight	50 %		50 %	
Notes	Source: N/A			
Score	Value	Rationale		
A	85 - 100 %	At least 7 dedicated turn lanes at a 4 legged intersection		
B	60 - 84 %	At least 5 dedicated turn lanes		
C	35 - 59 %	At least 3 dedicated turn lanes		
D	10 - 34 %	At least one dedicated turn lane		
E	LOS not used			
F	< 10 %	No dedicated turn lanes		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Signalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Percentage of Turning Movements with Dedicated Lanes		Intersection Delay (s)	
Weight	50 %		50 %	
Notes	Source: Highway Capacity Manual 6th Edition			
Score	Value	Rationale		
A	0 - 10	Follows HCM		
B	11 - 20	Follows HCM		
C	21 - 35	Follows HCM		
D	36 - 55	Follows HCM		
E	56 - 80	Follows HCM		
F	> 80	Follows HCM		

# Unsignalized Intersections



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersections		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Crossing Distance (m)	Marked Crossings	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes	Common lane width is 3.5m Calculation of width includes medians. Source: TAC Geometric Design Guide			
Score	Value	Rationale		
A	< 7.0	One lane on all approach and departure legs.		
B	7.0 - 8.9	50% or fewer legs have three lanes, remaining legs have two lanes.		
C	LOS not used			
D	9.0 - 11.0	Three lanes on more than 50% of legs of the intersection.		
E	LOS not used			
F	> 11.0	More than three lanes on at least one leg of the intersection, at least three lanes on the remaining legs.		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Crossing Distance (m)	Marked Crossings	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes	Source: N/A			
Score	Value	Rationale		
A	100 %	All legs have marked crossings		
B	LOS not used			
C	LOS not used			
D	LOS not used			
E	50 %	Only minor street has marked crossings.		
F	< 50 %	Only one leg of minor street has a marked crossing.		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Crossing Distance (m)	Marked Crossings	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	< 9.0	Vehicle turning speed is < 15 kph		
B	9.0 - 10.9			
C	11.0 - 12.9	Vehicle turning speed is 20 kph		
D	13.0 - 14.9	Vehicle turning speed is 25 kph		
E	15.0 - 17.9			
F	≥ 18	Vehicle turning speed is > 30 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Presence of Bike Facilities	Requirement to Stop	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes	Source: N/A			
Score	Value	Rationale		
A	Bike facility on all approaches	Optimum condition		
B	Bike facility on ¾ or ⅔ approaches	More than 50% of approaches have bicycle facilities.		
C	LOS not used			
D	Bike facility on ½ or ⅓ approaches	50% or fewer approaches have bicycle facilities.		
E	LOS not used			
F	No bike facility	Least favourable condition		



## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Presence of Bike Facilities	Requirement to Stop	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes:	Source: N/A			
Score	Value	Rationale		
A	0 - 15 %	Most or all bicycles do not need to stop at the intersection (major street serves most bicycles travelling through the intersection)		
B	16 - 30 %			
C	31 - 50 %	More than half of bicycles do not need to stop at the intersection (nearly even split between bicycles travelling on the major and minor streets with more bicycles travelling on the major street)		
D	51 - 70%	More than half of bicycles need to stop at the intersection (nearly even split between bicycles travelling on the major and minor streets with more bicycles travelling on the minor street)		
E	71 - 85 %			
F	> 85 %	Most or all bicycles need to stop at the intersection (all-way stop or more cyclists travelling on minor road than major road)		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Presence of Bike Facilities	Requirement to Stop	Average Effective Turning Radius (m)	
Weight	33 %	33 %	33 %	
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	< 9.0	Vehicle turning speed is < 15 kph		
B	9.0 - 10.9			
C	11.0 - 12.9	Vehicle turning speed is 20 kph		
D	13.0 - 14.9	Vehicle turning speed is 25 kph		
E	15.0 - 17.9			
F	≥ 18	Vehicle turning speed is > 30 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Movement Delay (s)		Pedestrian Level of Service	
Weight	50 %		50 %	
Notes	Source: Highway Capacity Manual 6th Edition			
Score	Value	Rationale		
A	0 - 10	Follows HCM		
B	11 - 20	Follows HCM		
C	21 - 35	Follows HCM		
D	36 - 55	Follows HCM		
E	56 - 80	Follows HCM		
F	> 80	Follows HCM		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Transit Movement Delay (s)		Pedestrian Level of Service	
Weight	50 %		50 %	
Notes	Transit performance is determined in part by the experience of riders accessing the transit system. Therefore, the pedestrian LOS also has a significant impact on the LOS for transit users and has been selected as a key performance measure. Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Effective Turning Radius (m)		Car Level of Service	
Weight	50 %		50 %	
Notes	Source: NACTO Urban Street Design Guide			
Score	Value	Rationale		
A	> 18	Vehicle turning speed is > 30 kph		
B	17 - 18			
C	15 - 16	Vehicle turning speed is 25 kph		
D	13 - 14	Vehicle turning speed is 20 kph		
E	11 - 12			
F	< 11	Vehicle turning speed is < 15 kph		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Average Effective Turning Radius (m)		Car Level of Service	
Weight	50 %		50 %	
Notes	Network performance/LOS for trucks is dictated by many of the same factors that dictate network performance/LOS for cars. Given this, car LOS has been chosen as an indicator of the general performance of the network for trucks.  Source: N/A			
Score	Value	Rationale		
A	A	Direct conversion		
B	B	Direct conversion		
C	C	Direct conversion		
D	D	Direct conversion		
E	E	Direct conversion		
F	F	Direct conversion		

## Performance Measures and Metrics Rationale

Study Area		Type of Studies that use this Measure		
Unsignalized Intersection		Operations Only	Both Planning and Operations	
Travel Mode				
Pedestrian	Bicycle	Transit	Trucks	Cars
Measure	Intersection Delay (s)			
Weight	100 %			
Notes	Source: Highway Capacity Manual 6th Edition			
Score	Value	Rationale		
A	0 - 10	Follows HCM		
B	11 - 20	Follows HCM		
C	21 - 35	Follows HCM		
D	36 - 55	Follows HCM		
E	56 - 80	Follows HCM		
F	> 80	Follows HCM		



