

MEMORANDUM

To: Town of Castle Rock, Public Works Department

From: Steve Tuttle, PE, PTOE

Date: December 14, 2022

Project: Dawson Trails

Subject: Master Transportation Study Addendum for Dawson Trails Boulevard Access Plan

The purpose of this memorandum is to provide revised analysis of the Dawson Trails Boulevard access spacing for the changes necessary to support the proposed Costco development within the Dawson Trails development area. The original Access Plan was included in the Dawson Trails Master Transportation Study (Fox Tuttle Transportation Group, June 7, 2022) (MTS). The Access Plan provided discussion of the proposed intersection and access spacing within the context of the Town of Castle Rock Transportation Design Criteria Manual (2018). The following changes are proposed with the current Costco development site plan:

- Relocation of intersection #103 (collector access just to the north of the proposed Costco site) to the north by approximately 214'
- Reconfiguration of intersection #103 from a $\frac{3}{4}$ -movement access to full-movement roundabout intersection

The proposed access relocation would provide the following adjusted spacing for intersection #103 from the upstream and downstream full-movement intersections:

- Spacing from Dawson Trails Blvd. & Crystal Valley intersection (traffic signal)
 - Per MTS Access Plan = 1,112' (0.21 miles)
 - **Proposed change = 1,326' (0.25 miles)**
- Spacing from intersection #102 (roundabout)
 - Per MTS Access Plan = 1,602' (0.30 miles)
 - **Proposed change = 1,388' (0.26 miles)**

Revised **Figure 16** on the following page highlights these changes.

X,XXX'	INTERSECTION SPACING
	FUTURE FULL-MOVEMENT INTERSECTION
<hr/>	PROJECT BOUNDARY
	COLLECTOR 2-LANE ROADWAY
	ARTERIAL 4-LANE ROADWAY
	ARTERIAL 6-LANE ROADWAY
	NEW PROJECT TRAFFIC CONTROL

Twin Oaks Road
Full, Control TBD

#102. Collector H
Full, Roundabout

#103. Commercial Access

~~3/4 Movement~~
Full, Roundabout

Crystal Valley Blvd
Full, Signal

Note: This intersection was evaluated by the Town with the Crystal Valley Interchange Project. It is not part of the Variance Request, but shown for reference purposes.

#104. Collector H
Full, Roundabout

#105. Collector B
Full, Roundabout

#106. Collector C
Full, Roundabout

#107. Collector D
Full, Roundabout

#108. Commercial & PLD

Full, Roundabout



FOX TUTTLE
TRANSPORTATION GROUP

DAWSON TRAILS MASTER TRANSPORTATION STUDY

PROPOSED FULL MOVEMENT INTERSECTION SPACING

FT Project #	20092	Original Scale	Date	12/14/22	Drawn by	MAR	Figure #	16
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In order to assess the impact of the spacing and intersection control type, revised Synchro and SIDRA analysis was performed for buildout, Year 2040 conditions with full development of the Costco site, adjacent commercial pads, and the entire Dawson Trails development area. The Synchro and SIDRA analysis is used to determine the peak hour operations of the intersections and potential queuing/stacking distances that will occur during peak volume conditions to ensure that there is not queue spillback into adjacent upstream intersections.

Trip rates provided by Costco and specific to their proposed use were used in lieu of the ITE trip rates for the “Discount Club” retail category, as the Costco rates are higher and provide a more refined assessment of adjacent intersection trips. In addition, with refinement of the Costco site and adjacent pad site lot sizes, commercial and retail land use projections for these pad sites were also performed and these trips included in this addendum analysis. Additional recent changes to the F1.2 planning area, to include replacement of previously assumed multifamily residential with commercial use were also included. Note that a Traffic Impact Study specific to the Costco and adjacent parcel sites that will provide a detailed analysis of trip generation assumptions, right-in, right-out access along Dawson Trails Blvd., site access from bordering collector roadways, and internal site access, circulation and queuing is currently being prepared and submitted separate from this addendum memo.

Using the updated trip projections, it was determined that the intersections upstream and downstream from intersection #103 (Dawson Trails Blvd/Crystal Valley and Dawson Trails Blvd./Int #102) would operate similar to (same LOS) as analyzed in the MTS. With a roundabout and full movement at access #103, this intersection is projected to operate acceptably at LOS A/B/C overall in the AM/PM/Saturday peak hours.

Peak hour queues extending upstream from each of these intersections are projected as follows for 2040 buildout conditions:

- Southbound 95th-percentile queues (longest of through or left-turn lanes) on Dawson Trails Blvd. extending north from Crystal Valley Parkway towards Costco/intersection #103
 - AM = 172', PM = 458', Saturday = 579'
- Northbound 95th-percentile queues on Dawson Trails Blvd. extending south from intersection #102 towards intersection #103
 - AM = 69', PM = 61', Saturday = 82'
- Northbound 95th-percentile queues on Dawson Trails Blvd. extending south from intersection #103 towards Crystal Valley Parkway
 - AM = 61', PM = 62', Saturday = 86'
- Southbound 95th-percentile queues on Dawson Trails Blvd. extending north from intersection #103 towards intersection #102
 - AM = 29', PM = 244', Saturday = 739'

The revised Synchro and SIDRA worksheets are attached detailing this information. As shown by these queue modeling results using the revised buildout volume projections, peak hour queues are not anticipated to extend back from any of these intersections to near the next adjacent upstream/adjacent intersections.

Section 3.2.3.4.B of the Transportation Design Criteria Manual states that *“full access to major arterials shall be limited to one-half (1/2) mile intervals or more, plus or minus 200-feet, in order to achieve good speed, capacity and optimal signal progression”*. Half-mile access spacing is widely considered ideal for a signalized intersection as it provides the optimal signal coordination parameters at a speed of 45 miles per hour. As noted in the MTS, where roundabouts are used in lieu of signals along a corridor, this spacing distance is not as critical.

Per the analysis provided in this memorandum, the proposed change to move intersection #103 to the north by 214' and change the traffic control from a restricted $\frac{3}{4}$ -movement access to a full-movement roundabout can be accommodated with minimal impact on Dawson Trails Blvd. operations, while providing improved access to the Costco site, adjacent commercial pad sites, and future uses to the north of this collector road access. The relocation of intersection #103 214' to the north provides some additional spacing from Crystal Valley Parkway traffic signal to mitigate potential queuing impacts during periods where typical peak hour traffic or queues may be exceeded (during weather/incident events).

As noted in this memorandum, a Traffic Impact Study specific to the Costco and adjacent parcel sites is being prepared that will provide a detailed analysis of revised trip generation assumptions, right-in, right-out access along Dawson Trails Blvd., site access from bordering collector roadways, and internal site access, circulation and queuing.

/SGT

Attachments:

Synchro and SIDRA Worksheets for Revised LOS and Queue Analysis

Timings
12/14/2022

2040 Bkgrd+Project - AM Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	153	360	7	998	233	520	22	408	770	212	349	85
Future Volume (vph)	153	360	7	998	233	520	22	408	770	212	349	85
Turn Type	Prot	NA	Perm	Prot	NA	Free	Prot	NA	Free	Prot	NA	Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2			Free			Free			4
Detector Phase	5	2	2	1	6		3	8		7	4	4
Switch Phase												
Minimum Initial (s)	5.0	10.0	10.0	5.0	10.0		5.0	10.0		5.0	10.0	10.0
Minimum Split (s)	11.0	26.0	26.0	11.0	33.0		11.0	33.0		11.0	33.0	33.0
Total Split (s)	24.0	28.0	28.0	42.0	46.0		17.0	33.0		27.0	43.0	43.0
Total Split (%)	18.5%	21.5%	21.5%	32.3%	35.4%		13.1%	25.4%		20.8%	33.1%	33.1%
Yellow Time (s)	3.0	4.0	4.0	3.0	4.0		3.0	4.0		3.0	4.0	4.0
All-Red Time (s)	1.0	2.0	2.0	1.0	2.0		1.0	2.0		1.0	2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	4.0	6.0		4.0	6.0		4.0	6.0	6.0
Lead/Lag	Lead	Lag	Lag	Lead	Lag		Lead	Lag		Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	C-Max	C-Max	None	C-Max		Max	Max		None	Max	Max
Act Effect Green (s)	20.0	27.2	27.2	32.8	40.0	130.0	13.0	36.5	130.0	13.5	37.0	37.0
Actuated g/C Ratio	0.15	0.21	0.21	0.25	0.31	1.00	0.10	0.28	1.00	0.10	0.28	0.28
v/c Ratio	0.29	0.50	0.02	0.81	0.22	0.34	0.12	0.42	0.50	0.61	0.36	0.17
Control Delay	50.4	49.0	0.0	51.0	34.1	0.6	55.3	40.2	1.1	62.8	38.4	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.4	49.0	0.0	51.0	34.1	0.6	55.3	40.2	1.1	62.8	38.4	2.5
LOS	D	D	A	D	C	A	E	D	A	E	D	A
Approach Delay		48.8			33.7			15.4			41.7	
Approach LOS		D			C			B			D	

Intersection Summary

Cycle Length: 130

Actuated Cycle Length: 130

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.81

Intersection Signal Delay: 31.5

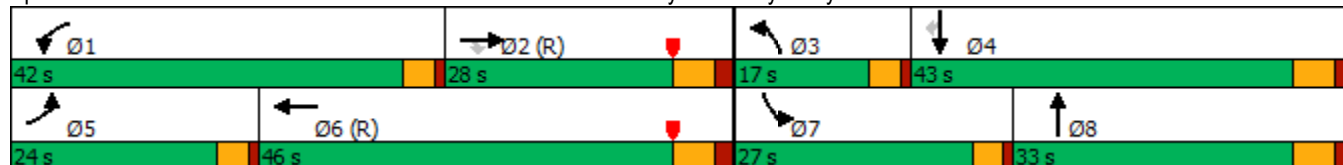
Intersection LOS: C

Intersection Capacity Utilization 62.9%

ICU Level of Service B

Analysis Period (min) 15

Splits and Phases: 7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.



Queues
12/14/2022

2040 Bkgrd+Project - AM Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	156	367	7	1018	238	531	22	416	786	216	356	87
v/c Ratio	0.29	0.50	0.02	0.81	0.22	0.34	0.12	0.42	0.50	0.61	0.36	0.17
Control Delay	50.4	49.0	0.0	51.0	34.1	0.6	55.3	40.2	1.1	62.8	38.4	2.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	50.4	49.0	0.0	51.0	34.1	0.6	55.3	40.2	1.1	62.8	38.4	2.5
Queue Length 50th (ft)	60	145	0	285	78	0	17	150	0	91	126	0
Queue Length 95th (ft)	95	207	0	321	113	0	45	209	0	129	172	15
Internal Link Dist (ft)	1283			1733			1960			1008		
Turn Bay Length (ft)	200		200	500			500		1000	500		500
Base Capacity (vph)	538	739	463	1458	1088	1583	177	993	1583	607	978	527
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.29	0.50	0.02	0.70	0.22	0.34	0.12	0.42	0.50	0.36	0.36	0.17
Intersection Summary												

HCM 6th Signalized Intersection Summary

12/14/2022

2040 Bkgrd+Project - AM Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	153	360	7	998	233	520	22	408	770	212	349	85
Future Volume (veh/h)	153	360	7	998	233	520	22	408	770	212	349	85
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Adj Sat Flow, veh/h/ln	1900	1870	1900	1870	1870	1870	1870	1870	1870	1870	1826	1826
Adj Flow Rate, veh/h	156	367	7	1018	238	0	22	416	0	216	356	87
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	0	2	0	2	2	2	2	2	2	2	5	5
Cap, veh/h	540	805	365	1181	1093		178	1079		280	987	440
Arrive On Green	0.15	0.23	0.23	0.24	0.31	0.00	0.10	0.30	0.00	0.08	0.28	0.28
Sat Flow, veh/h	3510	3554	1610	5023	3554	1585	1781	3554	1585	3456	3469	1547
Grp Volume(v), veh/h	156	367	7	1018	238	0	22	416	0	216	356	87
Grp Sat Flow(s),veh/h/ln	1755	1777	1610	1674	1777	1585	1781	1777	1585	1728	1735	1547
Q Serve(g_s), s	5.1	11.6	0.4	25.3	6.5	0.0	1.5	12.0	0.0	8.0	10.6	5.5
Cycle Q Clear(g_c), s	5.1	11.6	0.4	25.3	6.5	0.0	1.5	12.0	0.0	8.0	10.6	5.5
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	540	805	365	1181	1093		178	1079		280	987	440
V/C Ratio(X)	0.29	0.46	0.02	0.86	0.22		0.12	0.39		0.77	0.36	0.20
Avail Cap(c_a), veh/h	540	805	365	1468	1093		178	1079		611	987	440
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.60	0.60	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	48.7	43.4	39.1	47.7	33.4	0.0	53.3	35.7	0.0	58.6	37.1	35.2
Incr Delay (d2), s/veh	1.3	1.9	0.1	2.8	0.3	0.0	1.4	1.0	0.0	4.5	1.0	1.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	5.3	0.2	10.8	2.9	0.0	0.7	5.4	0.0	3.7	4.7	2.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	50.1	45.2	39.2	50.5	33.7	0.0	54.7	36.7	0.0	63.1	38.1	36.3
LnGrp LOS	D	D	D	D	C		D	D		E	D	D
Approach Vol, veh/h	530				1256				438			
Approach Delay, s/veh	46.6				47.3				37.6			
Approach LOS	D				D				D			
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	34.6	35.4	17.0	43.0	24.0	46.0	14.5	45.5				
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0				
Max Green Setting (Gmax), s	38.0	22.0	13.0	37.0	20.0	40.0	23.0	27.0				
Max Q Clear Time (g_c+I1), s	27.3	13.6	3.5	12.6	7.1	8.5	10.0	14.0				
Green Ext Time (p_c), s	3.3	1.5	0.0	2.7	0.4	1.6	0.6	2.2				

Intersection Summary

HCM 6th Ctrl Delay 45.4
HCM 6th LOS D

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, WBR] is excluded from calculations of the approach delay and intersection delay.

Timings
12/14/2022

2040 Bkgrd+Project - PM Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	384	40	1021	590	573	25	341	1398	801	424	385
Future Volume (vph)	250	384	40	1021	590	573	25	341	1398	801	424	385
Turn Type	Prot	NA	pm+ov	Prot	NA	Free	Prot	NA	Free	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2			Free			Free			4
Detector Phase	5	2	3	1	6		3	8		7	4	5
Switch Phase												
Minimum Initial (s)	5.0	10.0	5.0	5.0	10.0		5.0	10.0		5.0	10.0	5.0
Minimum Split (s)	11.0	23.0	11.0	11.0	23.0		11.0	33.0		11.0	33.0	11.0
Total Split (s)	19.0	27.0	30.0	37.0	45.0		30.0	37.0		49.0	56.0	19.0
Total Split (%)	12.7%	18.0%	20.0%	24.7%	30.0%		20.0%	24.7%		32.7%	37.3%	12.7%
Yellow Time (s)	3.0	4.0	3.0	3.0	4.0		3.0	4.0		3.0	4.0	3.0
All-Red Time (s)	1.0	2.0	1.0	1.0	2.0		1.0	2.0		1.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	C-Max	Max	Max	C-Max		Max	Max		Max	Max	Max
Act Effect Green (s)	15.0	21.0	53.0	33.0	39.0	150.0	26.0	31.0	150.0	45.0	50.0	71.0
Actuated g/C Ratio	0.10	0.14	0.35	0.22	0.26	1.00	0.17	0.21	1.00	0.30	0.33	0.47
v/c Ratio	0.74	0.78	0.06	0.94	0.65	0.37	0.08	0.47	0.89	0.79	0.36	0.41
Control Delay	79.0	74.2	0.2	73.4	53.2	0.6	53.0	54.8	8.6	54.5	39.0	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.0	74.2	0.2	73.4	53.2	0.6	53.0	54.8	8.6	54.5	39.0	3.3
LOS	E	E	A	E	D	A	D	D	A	D	D	A
Approach Delay		71.6			48.8			18.1			38.2	
Approach LOS		E			D			B			D	

Intersection Summary

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.94

Intersection Signal Delay: 39.8

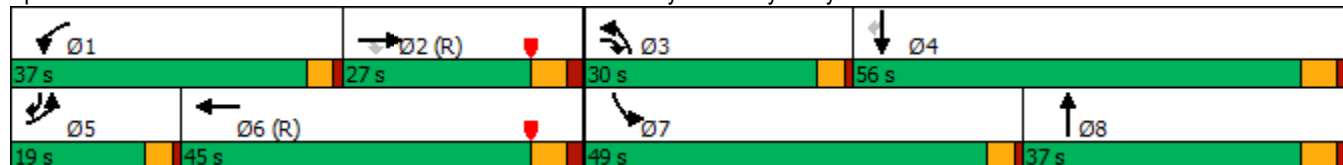
Intersection LOS: D

Intersection Capacity Utilization 79.0%

ICU Level of Service D

Analysis Period (min) 15

Splits and Phases: 7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.



												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	255	392	41	1042	602	585	26	348	1427	817	433	393
v/c Ratio	0.74	0.78	0.06	0.94	0.65	0.37	0.08	0.47	0.89	0.79	0.36	0.41
Control Delay	79.0	74.2	0.2	73.4	53.2	0.6	53.0	54.8	8.6	54.5	39.0	3.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	79.0	74.2	0.2	73.4	53.2	0.6	53.0	54.8	8.6	54.5	39.0	3.3
Queue Length 50th (ft)	127	197	0	359	277	0	22	159	0	378	169	0
Queue Length 95th (ft)	177	259	0	#444	346	0	51	211	0	458	218	57
Internal Link Dist (ft)	1283			1733			1960			1008		
Turn Bay Length (ft)	200		200	500			500		1000	500		500
Base Capacity (vph)	346	500	635	1108	929	1599	309	738	1599	1040	1191	963
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.74	0.78	0.06	0.94	0.65	0.37	0.08	0.47	0.89	0.79	0.36	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary

12/14/2022

2040 Bkgrd+Project - PM Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	250	384	40	1021	590	573	25	341	1398	801	424	385
Future Volume (veh/h)	250	384	40	1021	590	573	25	341	1398	801	424	385
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Adj Sat Flow, veh/h/ln	1885	1885	1885	1885	1885	1885	1885	1885	1885	1885	1885	1885
Adj Flow Rate, veh/h	255	392	41	1042	602	0	26	348	0	817	433	393
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	1	1	1	1	1	1	1	1	1	1	1	1
Cap, veh/h	348	501	501	1114	931		311	740		1045	1194	692
Arrive On Green	0.10	0.14	0.14	0.22	0.26	0.00	0.17	0.21	0.00	0.30	0.33	0.33
Sat Flow, veh/h	3483	3582	1598	5063	3582	1598	1795	3582	1598	3483	3582	1598
Grp Volume(v), veh/h	255	392	41	1042	602	0	26	348	0	817	433	393
Grp Sat Flow(s),veh/h/ln	1742	1791	1598	1688	1791	1598	1795	1791	1598	1742	1791	1598
Q Serve(g_s), s	10.7	15.9	2.7	30.3	22.4	0.0	1.8	12.8	0.0	32.2	13.8	27.7
Cycle Q Clear(g_c), s	10.7	15.9	2.7	30.3	22.4	0.0	1.8	12.8	0.0	32.2	13.8	27.7
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	348	501	501	1114	931		311	740		1045	1194	692
V/C Ratio(X)	0.73	0.78	0.08	0.94	0.65		0.08	0.47		0.78	0.36	0.57
Avail Cap(c_a), veh/h	348	501	501	1114	931		311	740		1045	1194	692
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.66	0.66	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	65.5	62.3	36.3	57.5	49.4	0.0	52.0	52.3	0.0	48.0	37.9	31.9
Incr Delay (d2), s/veh	12.8	11.5	0.3	11.2	2.3	0.0	0.5	2.1	0.0	5.8	0.9	3.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.4	8.0	1.1	14.1	10.4	0.0	0.9	6.0	0.0	14.9	6.3	11.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	78.3	73.8	36.6	68.6	51.7	0.0	52.5	54.4	0.0	53.8	38.8	35.3
LnGrp LOS	E	E	D	E	D		D	D		D	D	D
Approach Vol, veh/h	688				1644				374			
Approach Delay, s/veh	73.3				62.4				54.3			
Approach LOS	E				E				D			
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	37.0	27.0	30.0	56.0	19.0	45.0	49.0	37.0				
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0				
Max Green Setting (Gmax), s	33.0	21.0	26.0	50.0	15.0	39.0	45.0	31.0				
Max Q Clear Time (g_c+I1), s	32.3	17.9	3.8	29.7	12.7	24.4	34.2	14.8				
Green Ext Time (p_c), s	0.4	0.8	0.0	4.3	0.2	3.5	2.5	2.0				

Intersection Summary

HCM 6th Ctrl Delay 57.0
HCM 6th LOS E

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, WBR] is excluded from calculations of the approach delay and intersection delay.

Timings
12/14/2022

2040 Bkgrd+Project - Saturday Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	200	477	6	924	675	789	17	443	1005	866	755	349
Future Volume (vph)	200	477	6	924	675	789	17	443	1005	866	755	349
Turn Type	Prot	NA	pm+ov	Prot	NA	Free	Prot	NA	Free	Prot	NA	pm+ov
Protected Phases	5	2	3	1	6		3	8		7	4	5
Permitted Phases			2			Free			Free			4
Detector Phase	5	2	3	1	6		3	8		7	4	5
Switch Phase												
Minimum Initial (s)	5.0	10.0	5.0	5.0	10.0		5.0	10.0		5.0	10.0	5.0
Minimum Split (s)	11.0	23.0	11.0	11.0	33.0		11.0	32.0		11.0	33.0	11.0
Total Split (s)	26.0	29.0	15.0	37.0	40.0		15.0	40.0		44.0	69.0	26.0
Total Split (%)	17.3%	19.3%	10.0%	24.7%	26.7%		10.0%	26.7%		29.3%	46.0%	17.3%
Yellow Time (s)	3.0	4.0	3.0	3.0	4.0		3.0	4.0		3.0	4.0	3.0
All-Red Time (s)	1.0	2.0	1.0	1.0	2.0		1.0	2.0		1.0	2.0	1.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	4.0	4.0	6.0		4.0	6.0		4.0	6.0	4.0
Lead/Lag	Lead	Lag	Lead	Lead	Lag		Lead	Lag		Lead	Lag	Lead
Lead-Lag Optimize?	Yes	Yes	Yes	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Recall Mode	Max	C-Max	Max	None	C-Max		Max	Max		Max	Max	Max
Act Effect Green (s)	22.0	24.0	41.0	32.0	34.0	150.0	11.0	34.0	150.0	40.0	63.0	91.0
Actuated g/C Ratio	0.15	0.16	0.27	0.21	0.23	1.00	0.07	0.23	1.00	0.27	0.42	0.61
v/c Ratio	0.40	0.86	0.01	0.89	0.86	0.51	0.13	0.56	0.65	0.97	0.53	0.35
Control Delay	60.6	77.1	0.0	68.1	67.4	1.2	67.6	54.6	2.1	76.6	34.2	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	77.1	0.0	68.1	67.4	1.2	67.6	54.6	2.1	76.6	34.2	5.7
LOS	E	E	A	E	E	A	E	D	A	E	C	A
Approach Delay		71.6			45.8			18.7			47.8	
Approach LOS		E			D			B			D	

Intersection Summary

Cycle Length: 150

Actuated Cycle Length: 150

Offset: 0 (0%), Referenced to phase 2:EBT and 6:WBT, Start of Yellow

Natural Cycle: 110

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.97

Intersection Signal Delay: 43.0

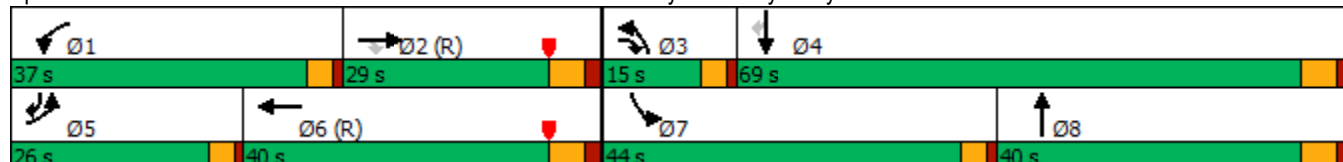
Intersection LOS: D

Intersection Capacity Utilization 84.4%

ICU Level of Service E

Analysis Period (min) 15

Splits and Phases: 7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.



Queues
12/14/2022

2040 Bkgrd+Project - Saturday Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	204	487	6	943	689	805	17	452	1026	884	770	356
v/c Ratio	0.40	0.86	0.01	0.89	0.86	0.51	0.13	0.56	0.65	0.97	0.53	0.35
Control Delay	60.6	77.1	0.0	68.1	67.4	1.2	67.6	54.6	2.1	76.6	34.2	5.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	60.6	77.1	0.0	68.1	67.4	1.2	67.6	54.6	2.1	76.6	34.2	5.7
Queue Length 50th (ft)	94	250	0	317	344	0	16	208	0	443	294	51
Queue Length 95th (ft)	136	#350	0	372	#429	0	43	267	0	#579	358	105
Internal Link Dist (ft)		1283			1733			1960			1008	
Turn Bay Length (ft)	200		200	500			500		1000	500		500
Base Capacity (vph)	513	566	520	1097	802	1583	129	802	1583	915	1443	1023
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.86	0.01	0.86	0.86	0.51	0.13	0.56	0.65	0.97	0.53	0.35

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM 6th Signalized Intersection Summary

12/14/2022

2040 Bkgrd+Project - Saturday Peak
7: Dawson Trails Blvd. & Collector Road A/Crystal Valley Pkwy.

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	200	477	6	924	675	789	17	443	1005	866	755	349
Future Volume (veh/h)	200	477	6	924	675	789	17	443	1005	866	755	349
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach	No			No			No			No		
Adj Sat Flow, veh/h/ln	1900	1870	1900	1870	1870	1870	1870	1870	1870	1870	1826	1826
Adj Flow Rate, veh/h	204	487	6	943	689	0	17	452	0	884	770	356
Peak Hour Factor	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Percent Heavy Veh, %	0	2	0	2	2	2	2	2	2	2	5	5
Cap, veh/h	515	594	387	1036	806		131	806		922	1457	877
Arrive On Green	0.15	0.17	0.17	0.21	0.23	0.00	0.07	0.23	0.00	0.27	0.42	0.42
Sat Flow, veh/h	3510	3554	1610	5023	3554	1585	1781	3554	1585	3456	3469	1547
Grp Volume(v), veh/h	204	487	6	943	689	0	17	452	0	884	770	356
Grp Sat Flow(s),veh/h/ln	1755	1777	1610	1674	1777	1585	1781	1777	1585	1728	1735	1547
Q Serve(g_s), s	7.9	19.8	0.4	27.5	27.9	0.0	1.3	16.9	0.0	37.8	24.8	19.4
Cycle Q Clear(g_c), s	7.9	19.8	0.4	27.5	27.9	0.0	1.3	16.9	0.0	37.8	24.8	19.4
Prop In Lane	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	515	594	387	1036	806		131	806		922	1457	877
V/C Ratio(X)	0.40	0.82	0.02	0.91	0.86		0.13	0.56		0.96	0.53	0.41
Avail Cap(c_a), veh/h	515	594	387	1105	806		131	806		922	1457	877
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	0.70	0.70	0.00	1.00	1.00	0.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	58.0	60.3	43.4	58.2	55.6	0.0	65.0	51.4	0.0	54.2	32.4	18.3
Incr Delay (d2), s/veh	2.3	12.0	0.1	7.9	8.2	0.0	2.1	2.8	0.0	21.3	1.4	1.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.7	10.0	0.2	12.4	13.4	0.0	0.7	7.9	0.0	19.2	10.8	7.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	60.3	72.3	43.5	66.1	63.9	0.0	67.1	54.2	0.0	75.5	33.8	19.7
LnGrp LOS	E	E	D	E	E		E	D		E	C	B
Approach Vol, veh/h	697				1632				469			
Approach Delay, s/veh	68.6				65.2				54.7			
Approach LOS	E				E				D			
Timer - Assigned Phs	1	2	3	4	5	6	7	8				
Phs Duration (G+Y+Rc), s	34.9	31.1	15.0	69.0	26.0	40.0	44.0	40.0				
Change Period (Y+Rc), s	4.0	6.0	4.0	6.0	4.0	6.0	4.0	6.0				
Max Green Setting (Gmax), s	33.0	23.0	11.0	63.0	22.0	34.0	40.0	34.0				
Max Q Clear Time (g_c+I1), s	29.5	21.8	3.3	26.8	9.9	29.9	39.8	18.9				
Green Ext Time (p_c), s	1.4	0.4	0.0	8.1	0.5	1.7	0.1	2.6				

Intersection Summary

HCM 6th Ctrl Delay 58.1
HCM 6th LOS E

Notes

User approved pedestrian interval to be less than phase max green.

Unsignalized Delay for [NBR, WBR] is excluded from calculations of the approach delay and intersection delay.

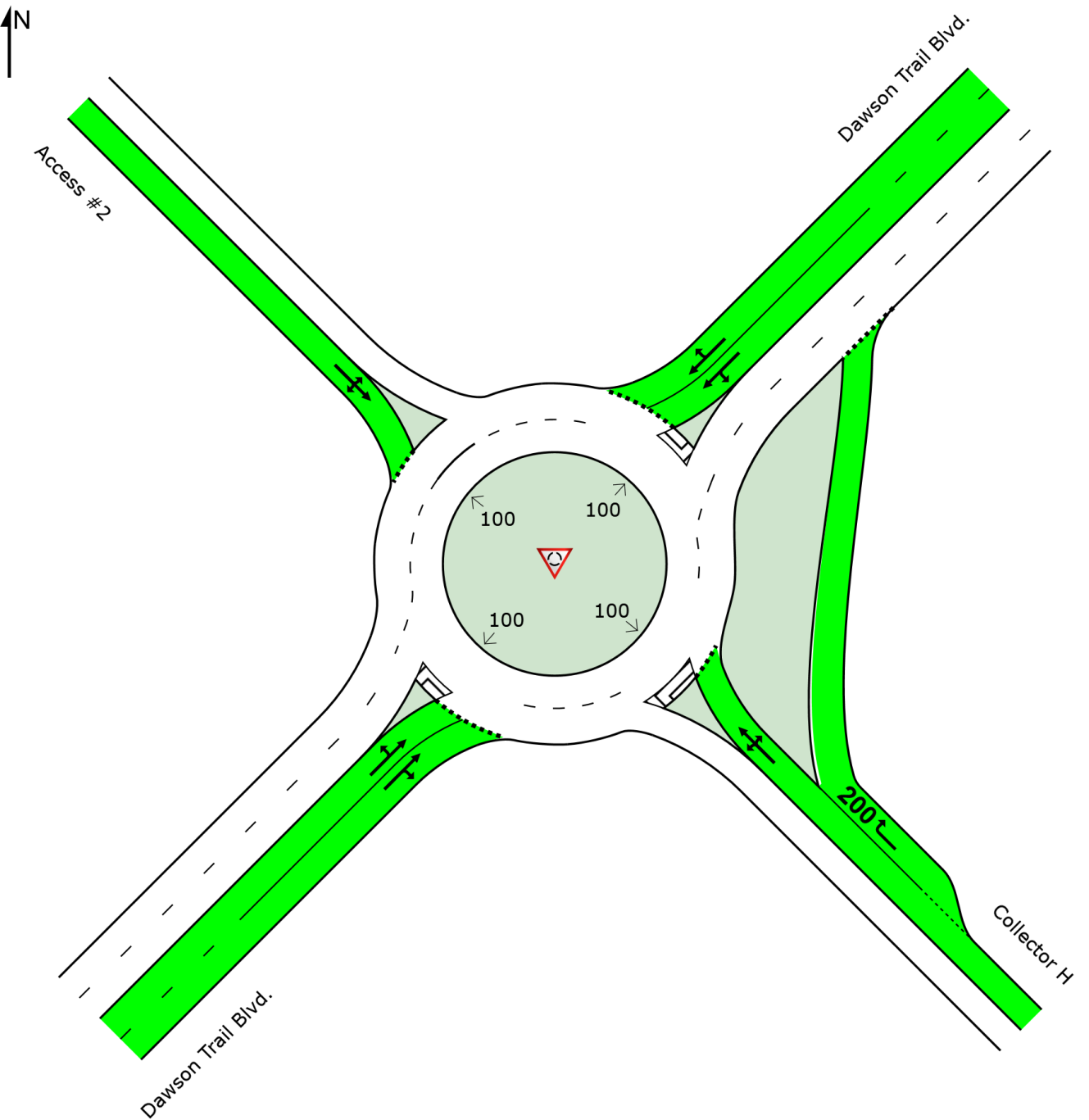
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	A	A	A	A	A



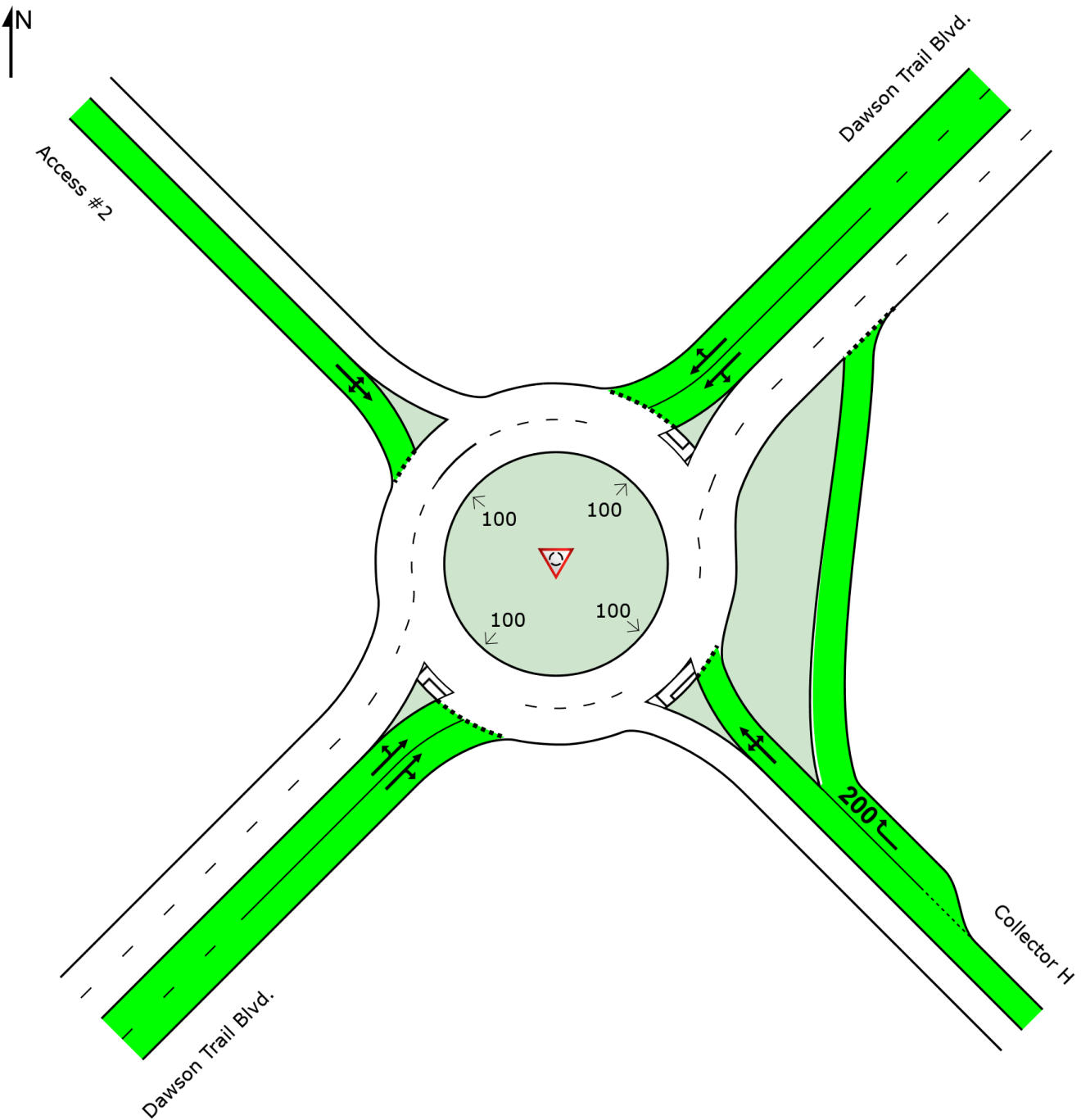
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	A	A	A	A	A



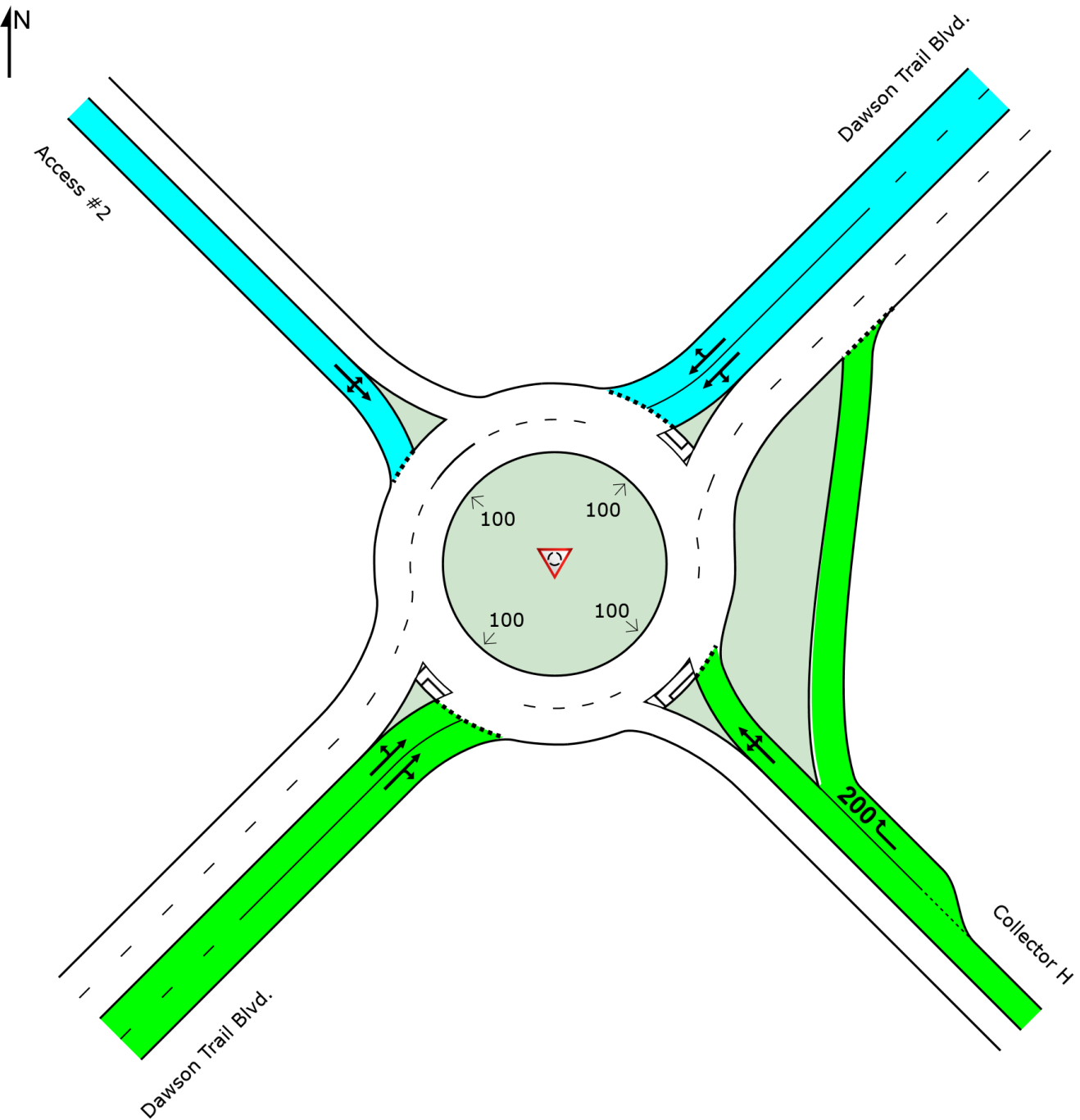
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	A	B	B	A	B



DELAY (CONTROL)

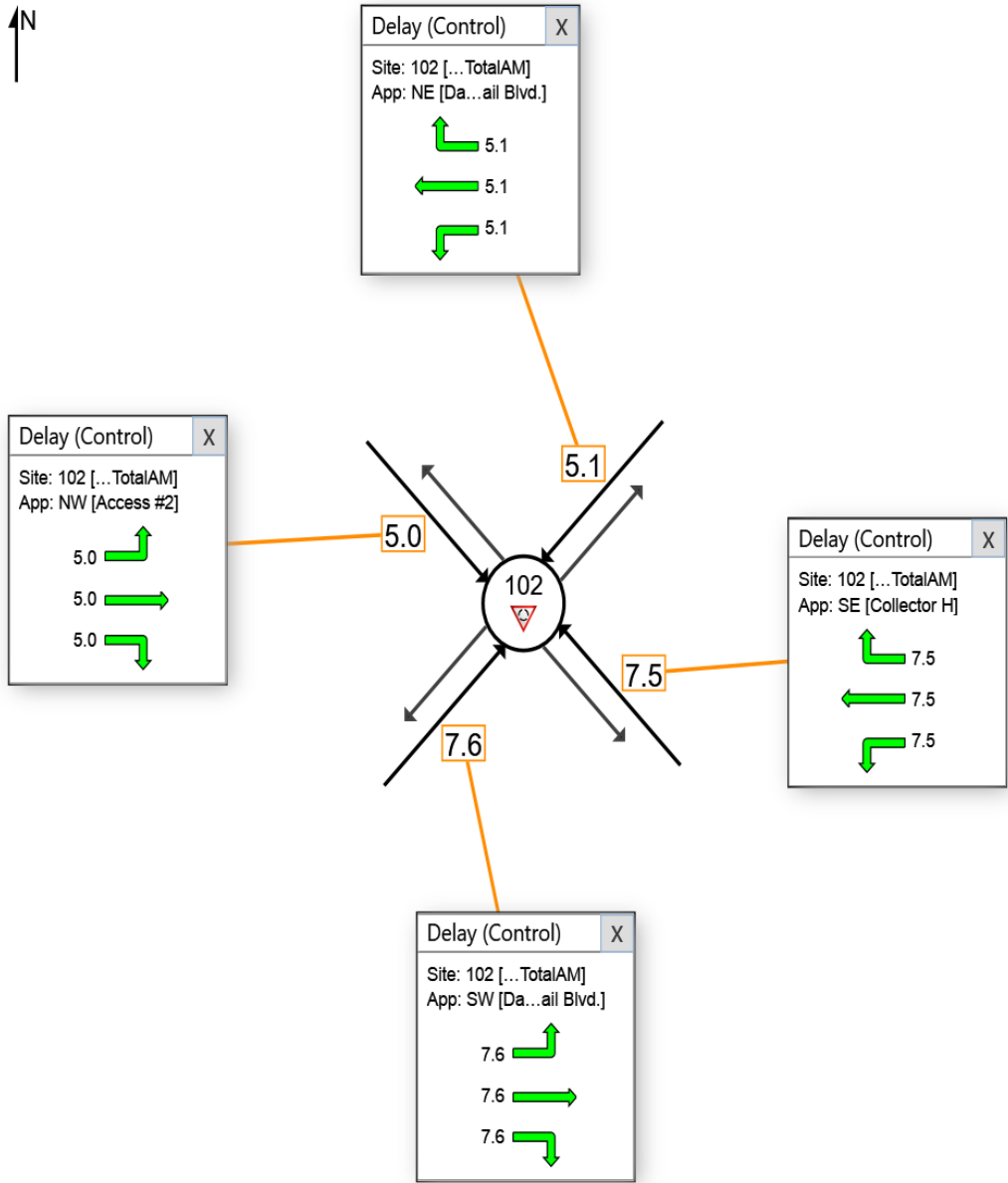
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

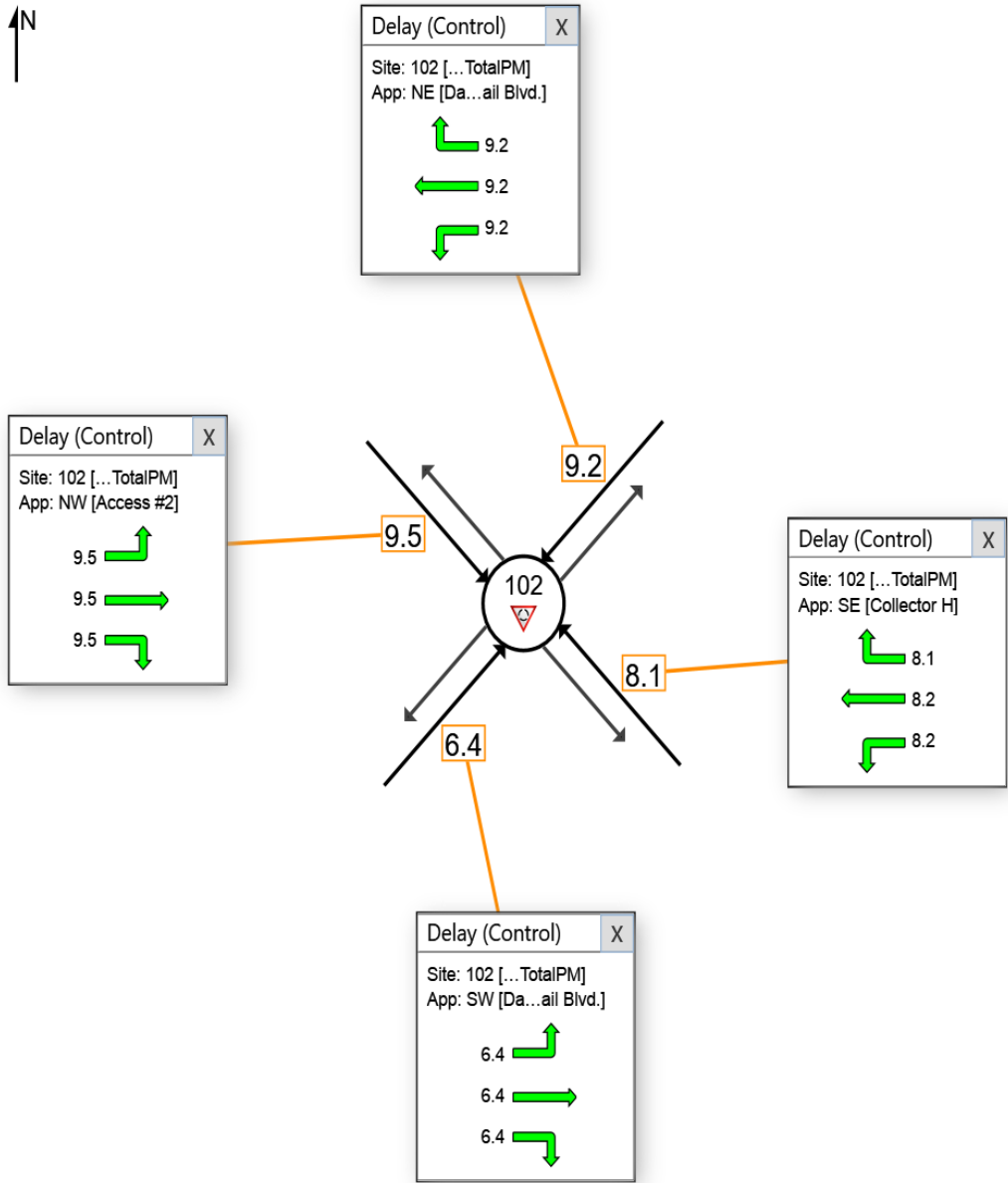
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

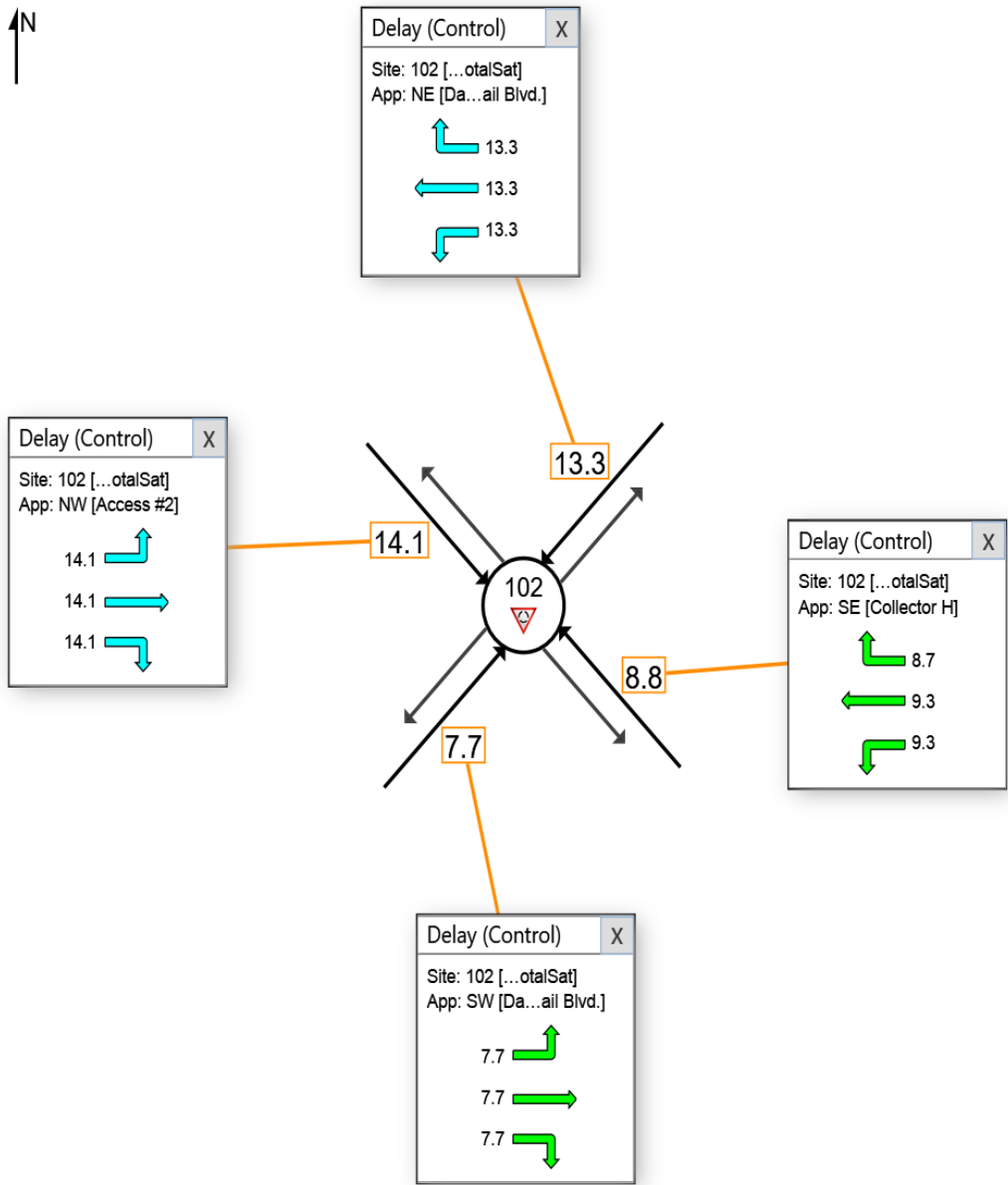
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

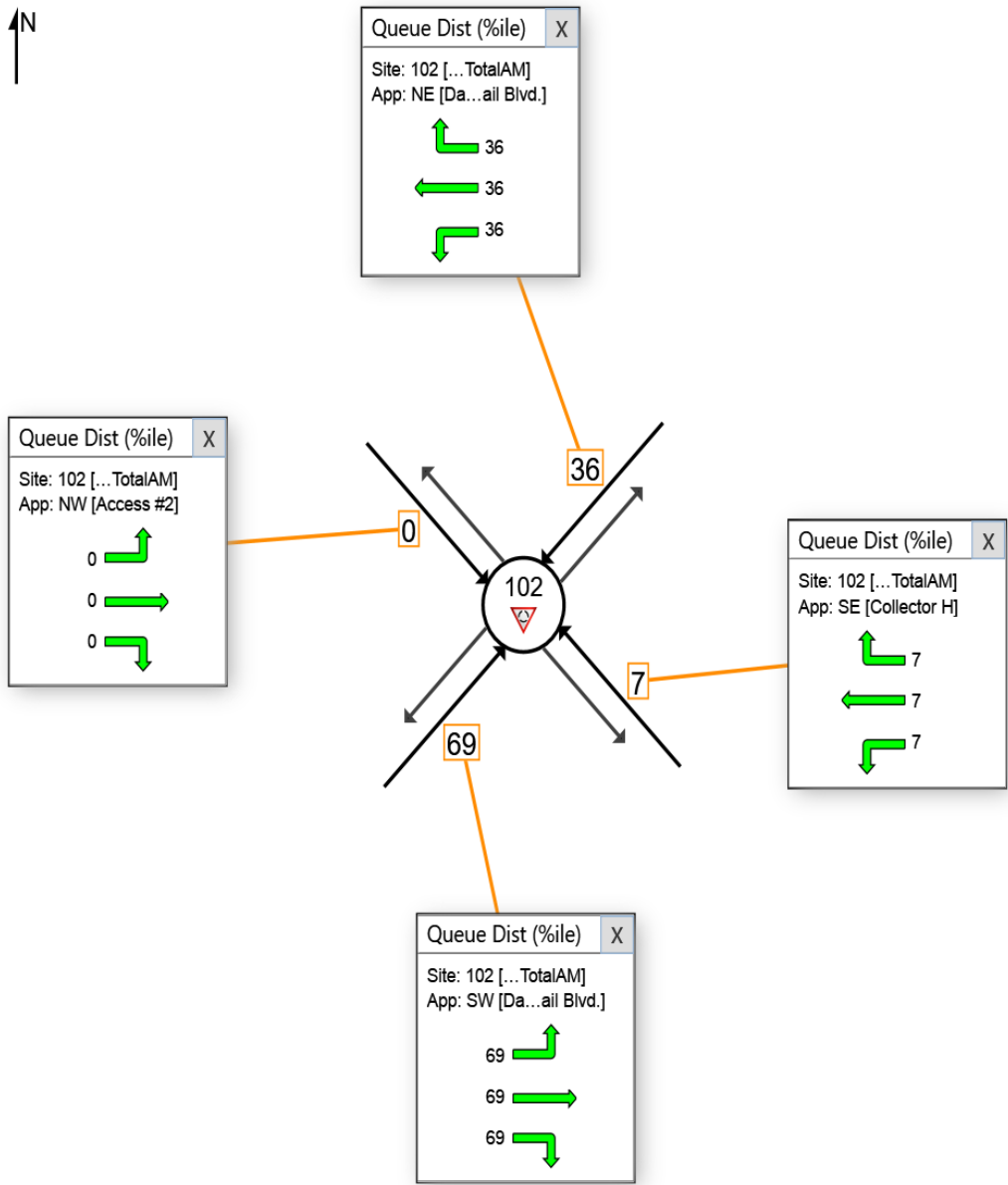
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

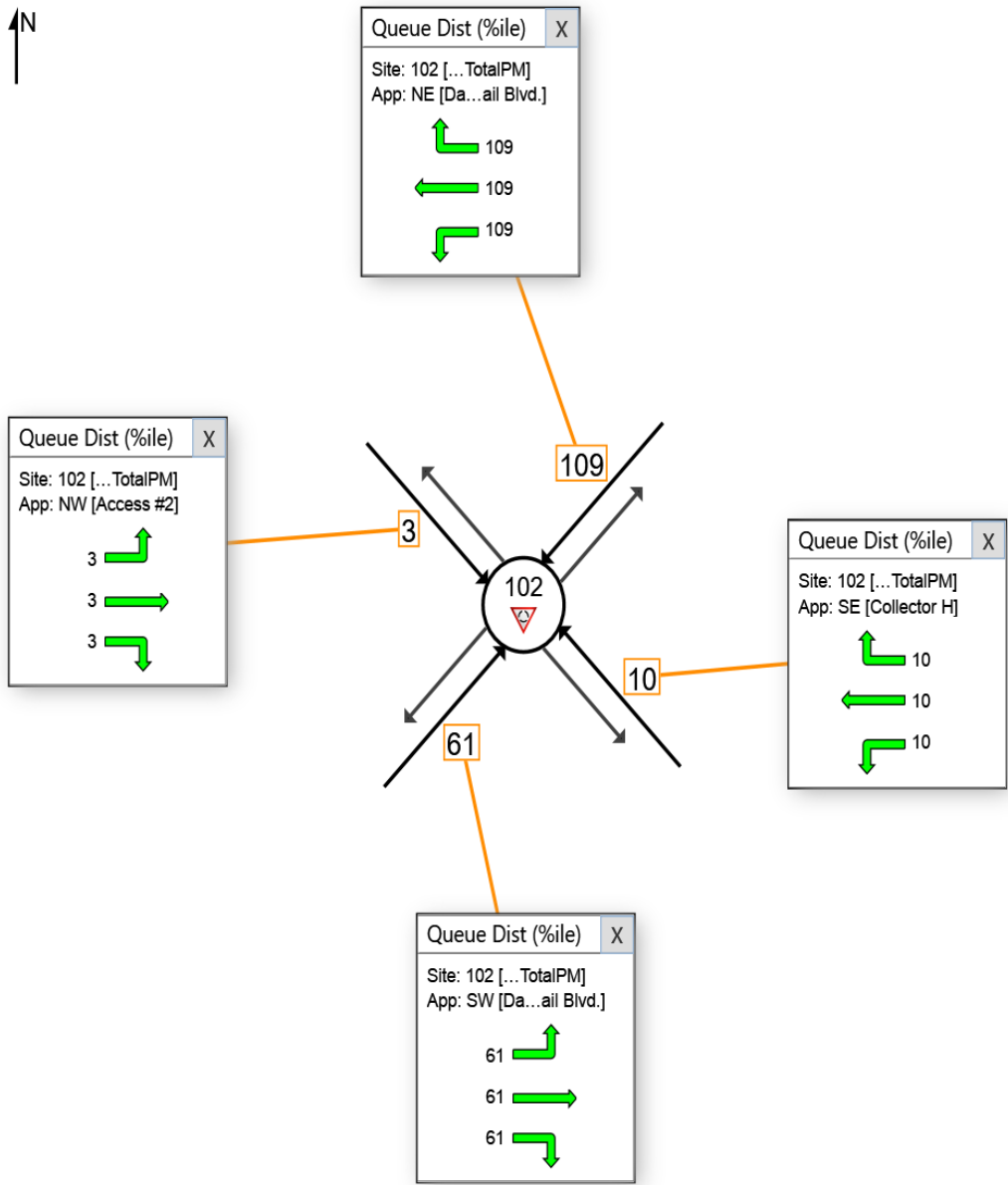
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

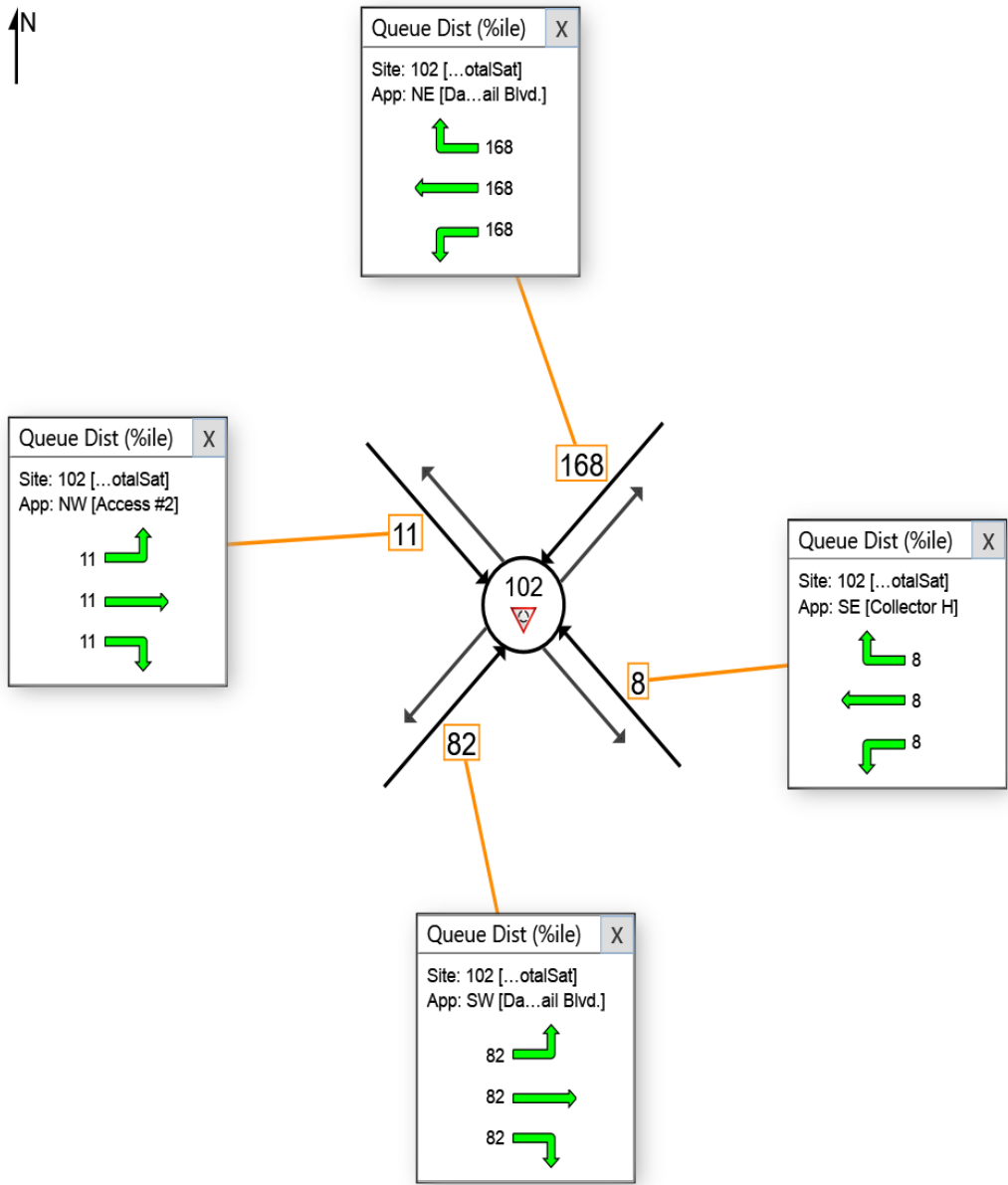
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



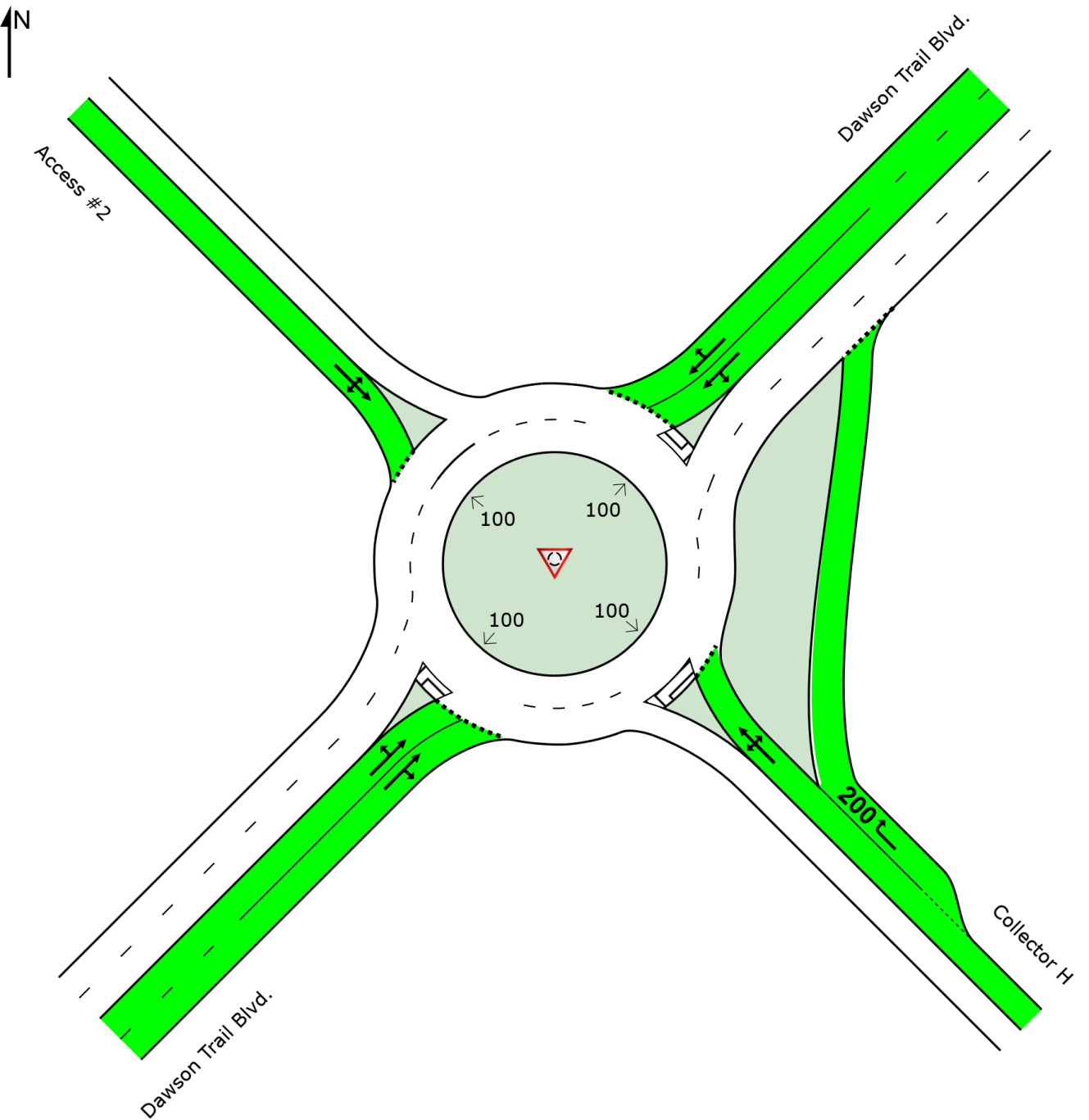
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	A	A	A	A	A



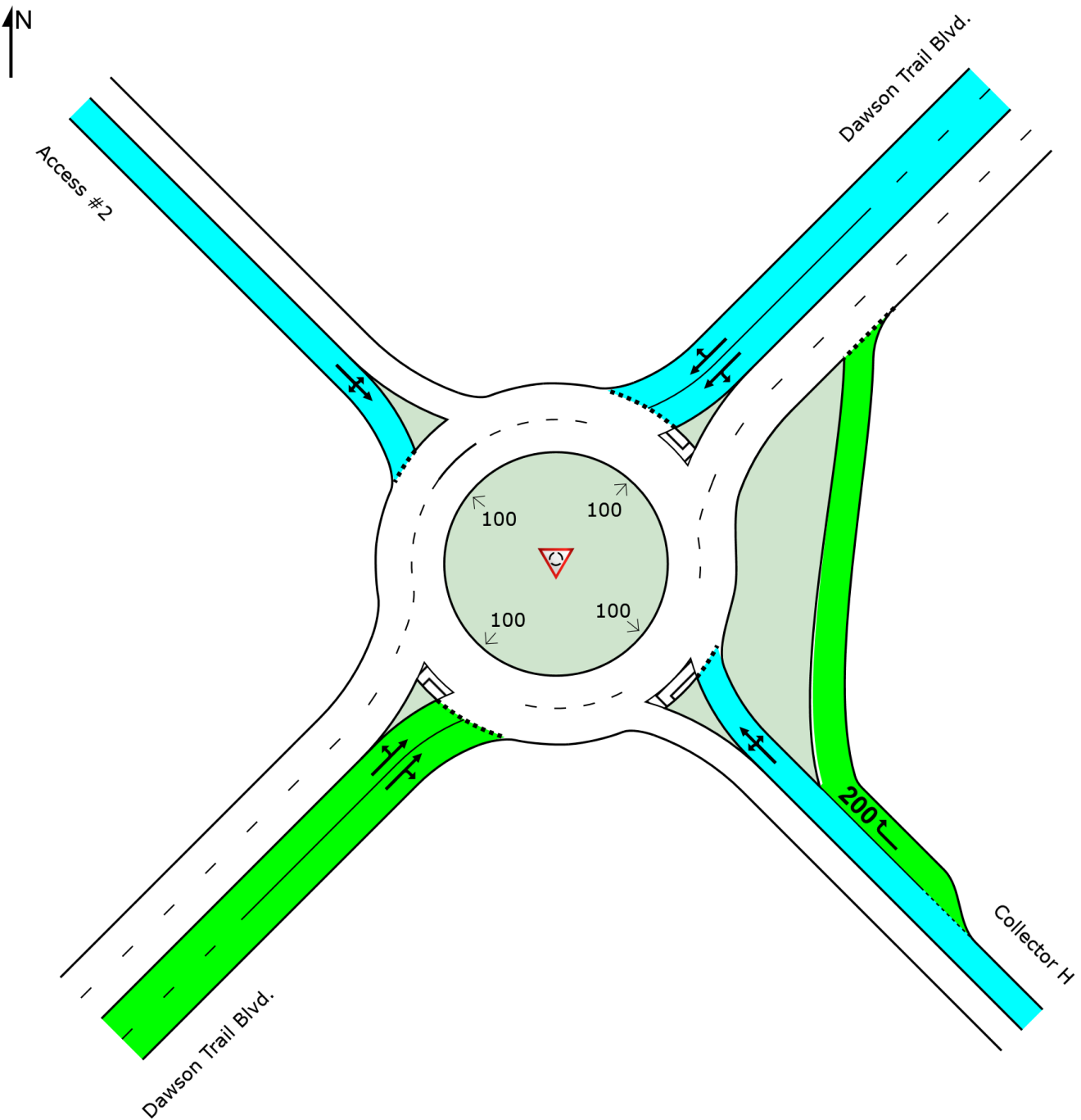
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	B	B	B	A	B



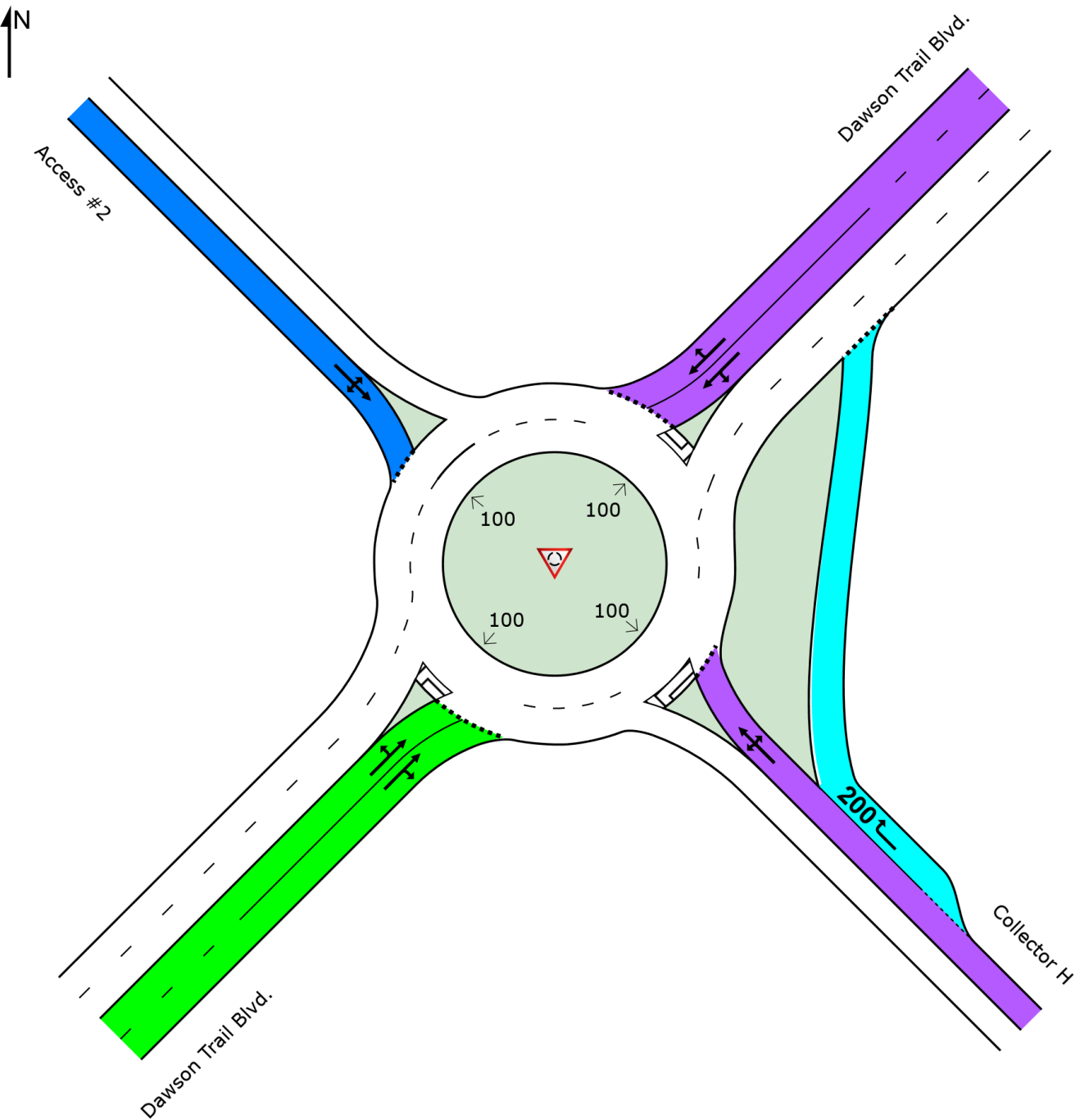
LEVEL OF SERVICE

Lane Level of Service

 Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	C	D	C	A	C



DELAY (CONTROL)

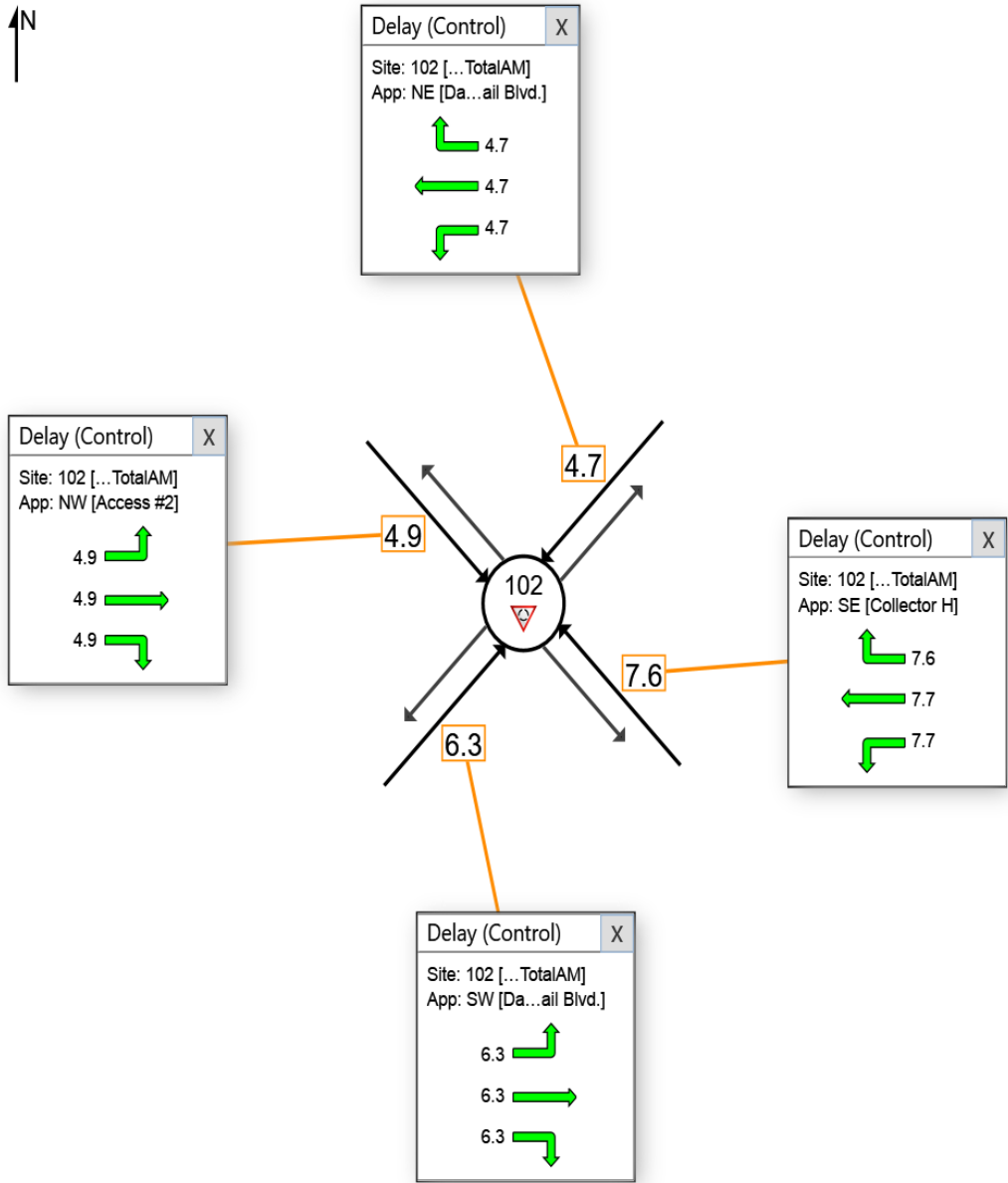
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

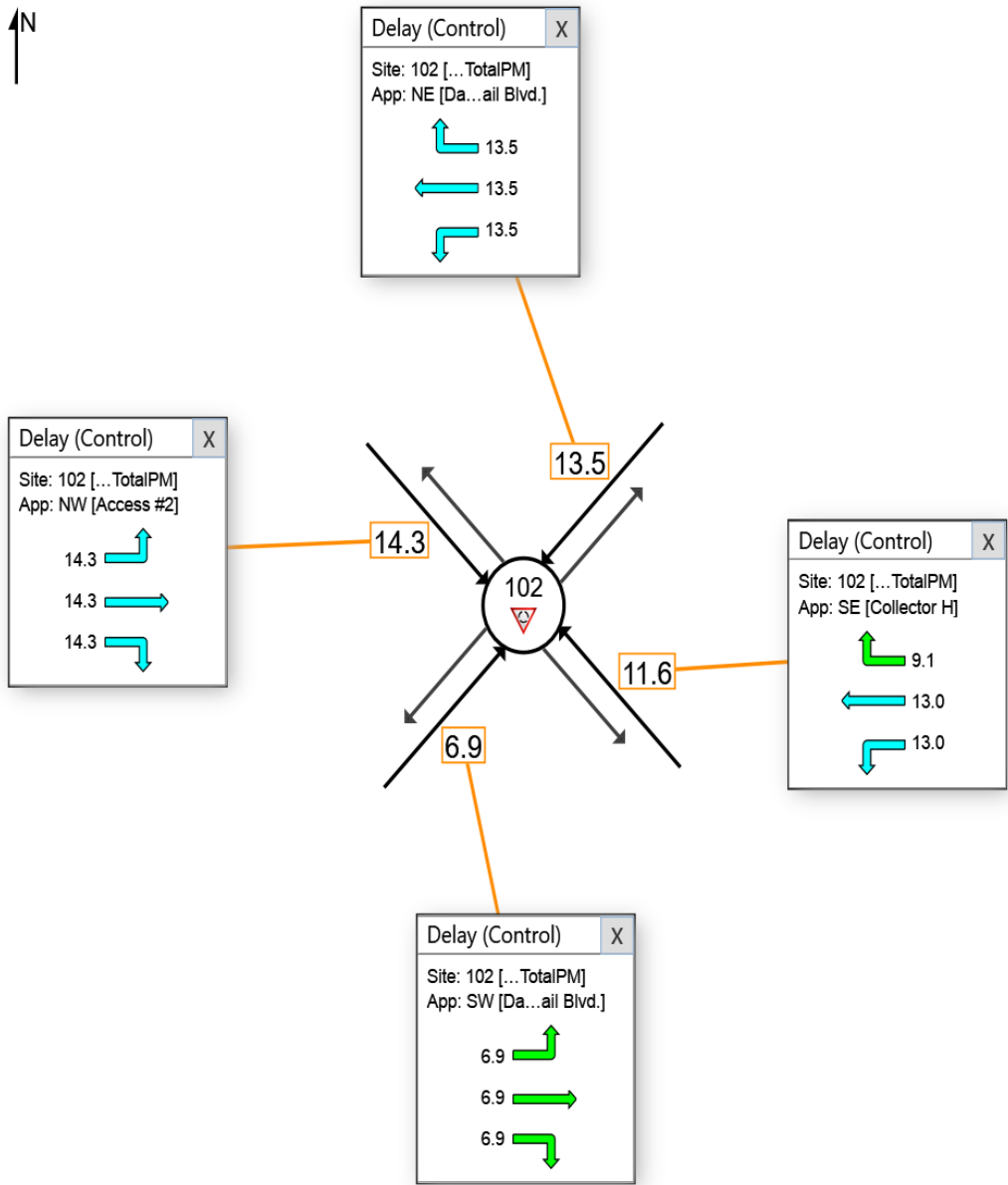
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

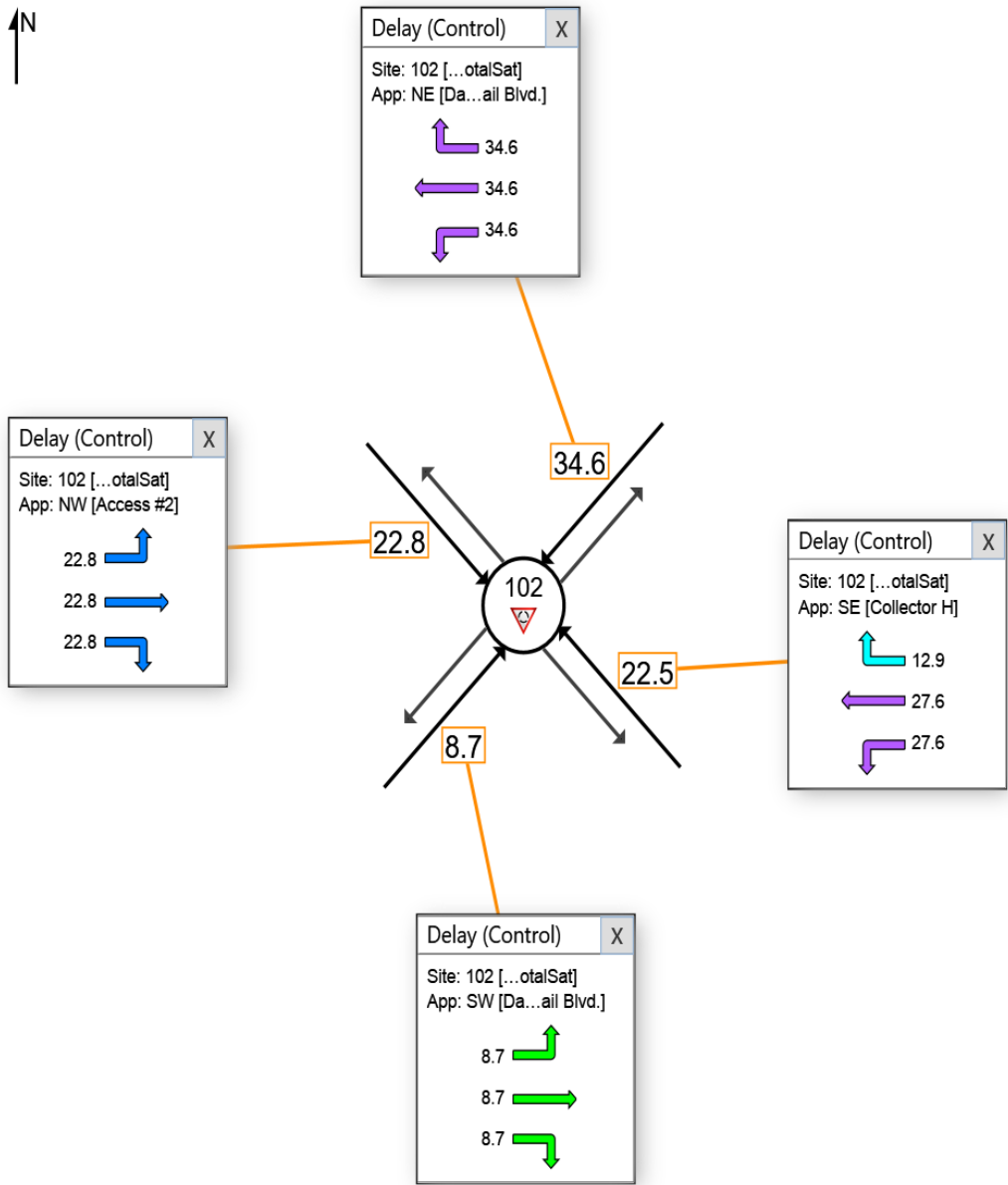
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

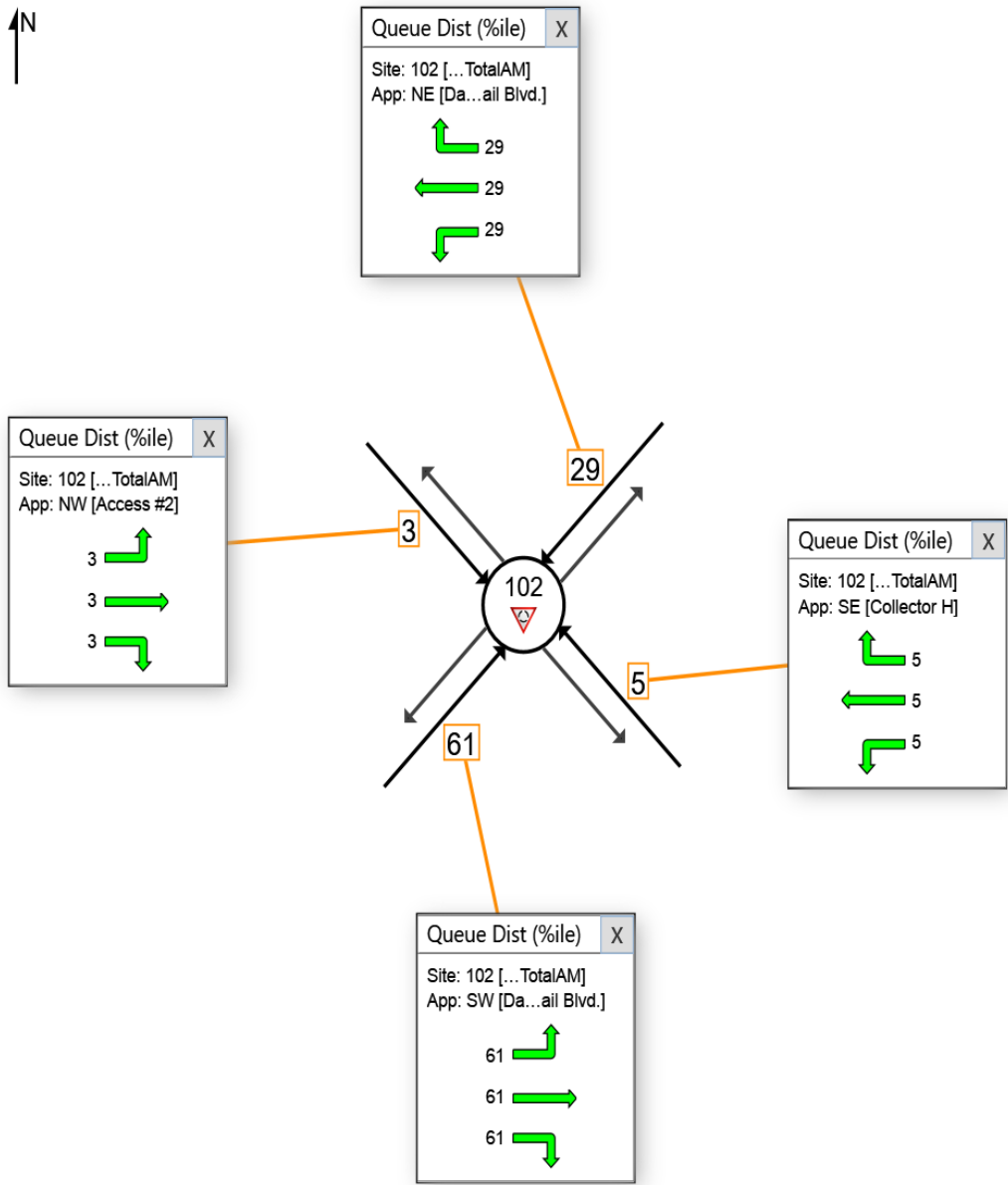
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 102 [Int #102_2040 Total_AM (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

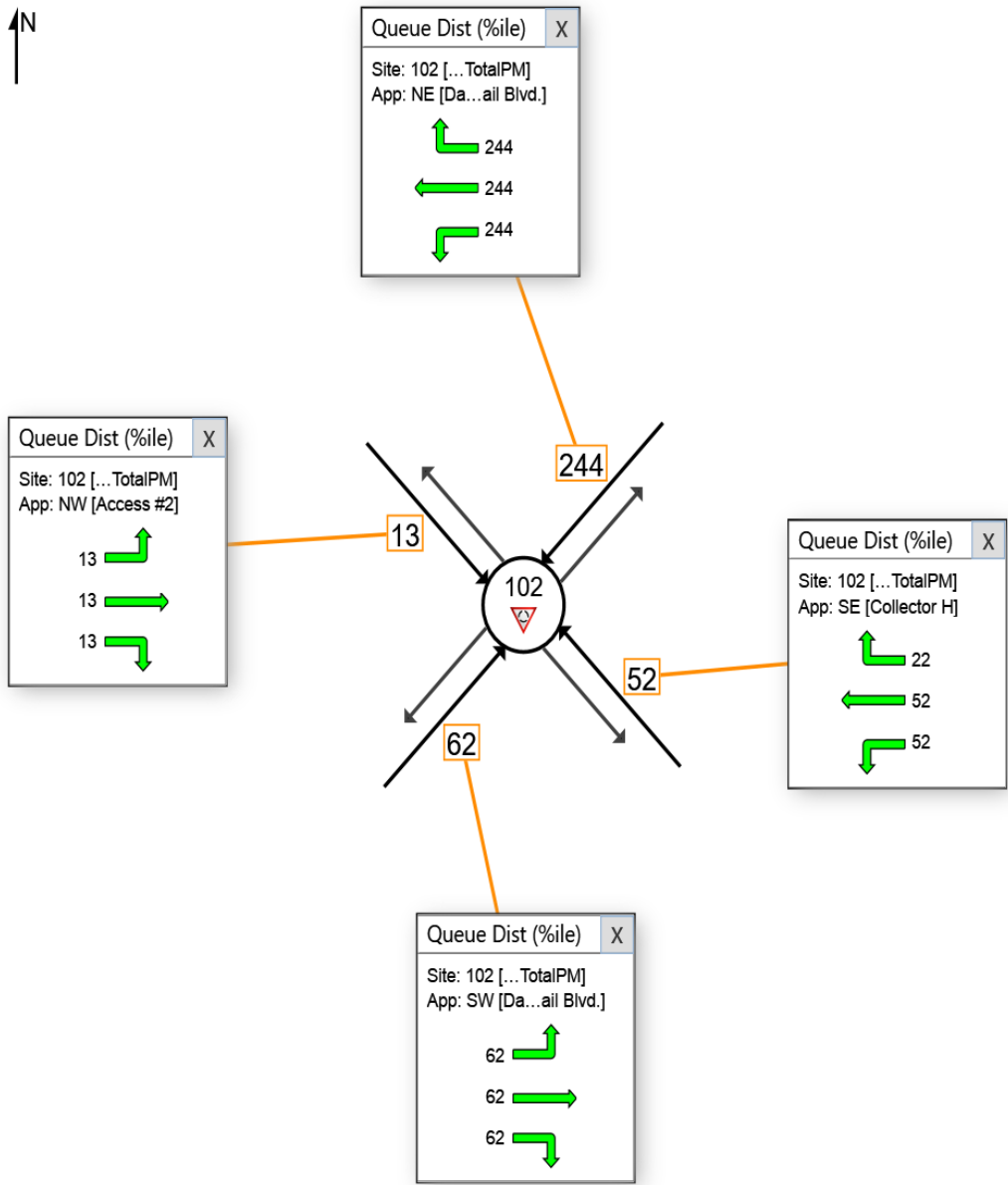
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 102 [Int #102_2040 Total_PM (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

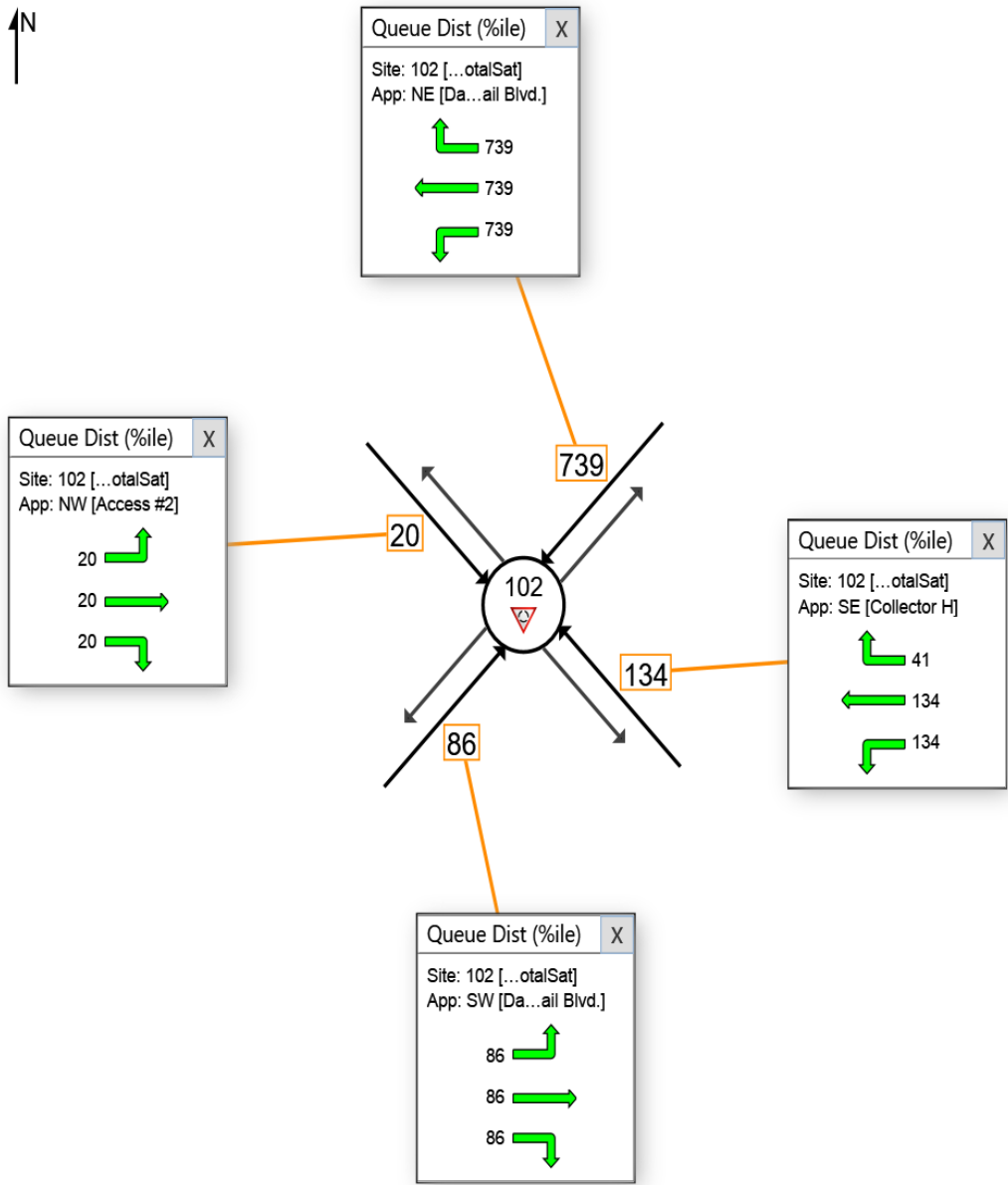
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 Site: 102 [Int #102_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



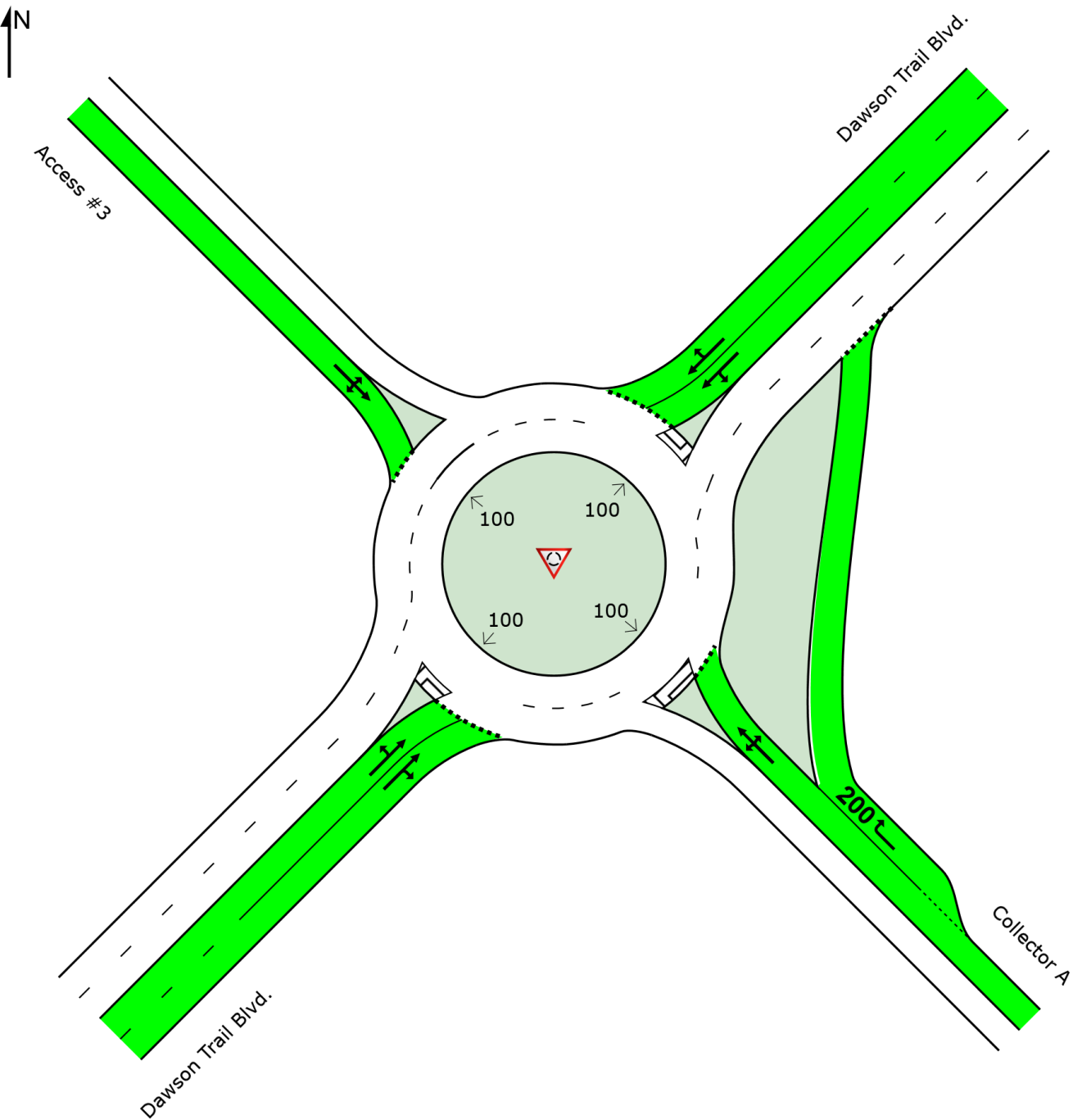
LEVEL OF SERVICE

Lane Level of Service

 Site: 103 [Int #103_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	A	A	A	A	A



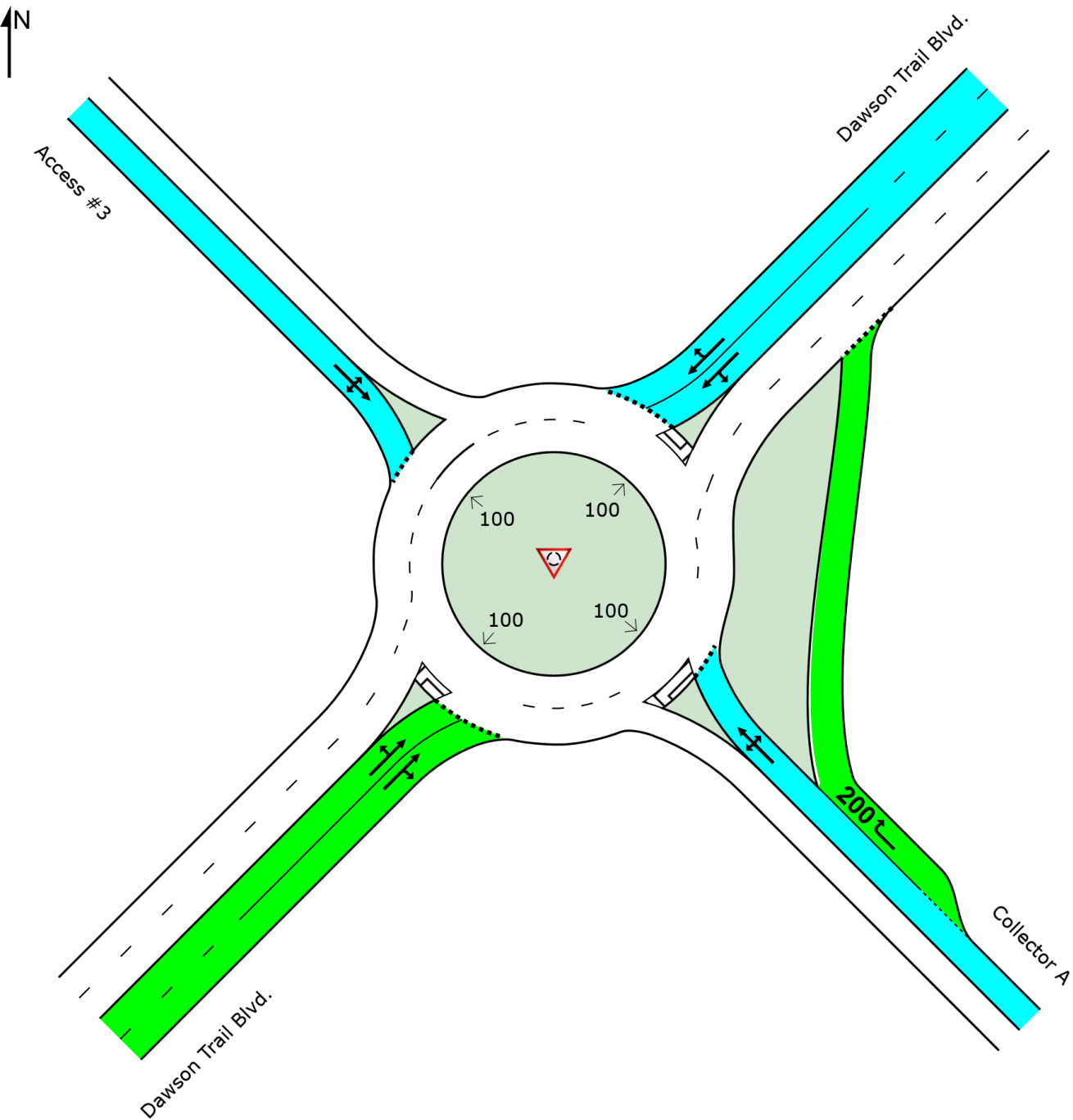
LEVEL OF SERVICE

Lane Level of Service

 Site: 103 [Int #103_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	B	B	B	A	B



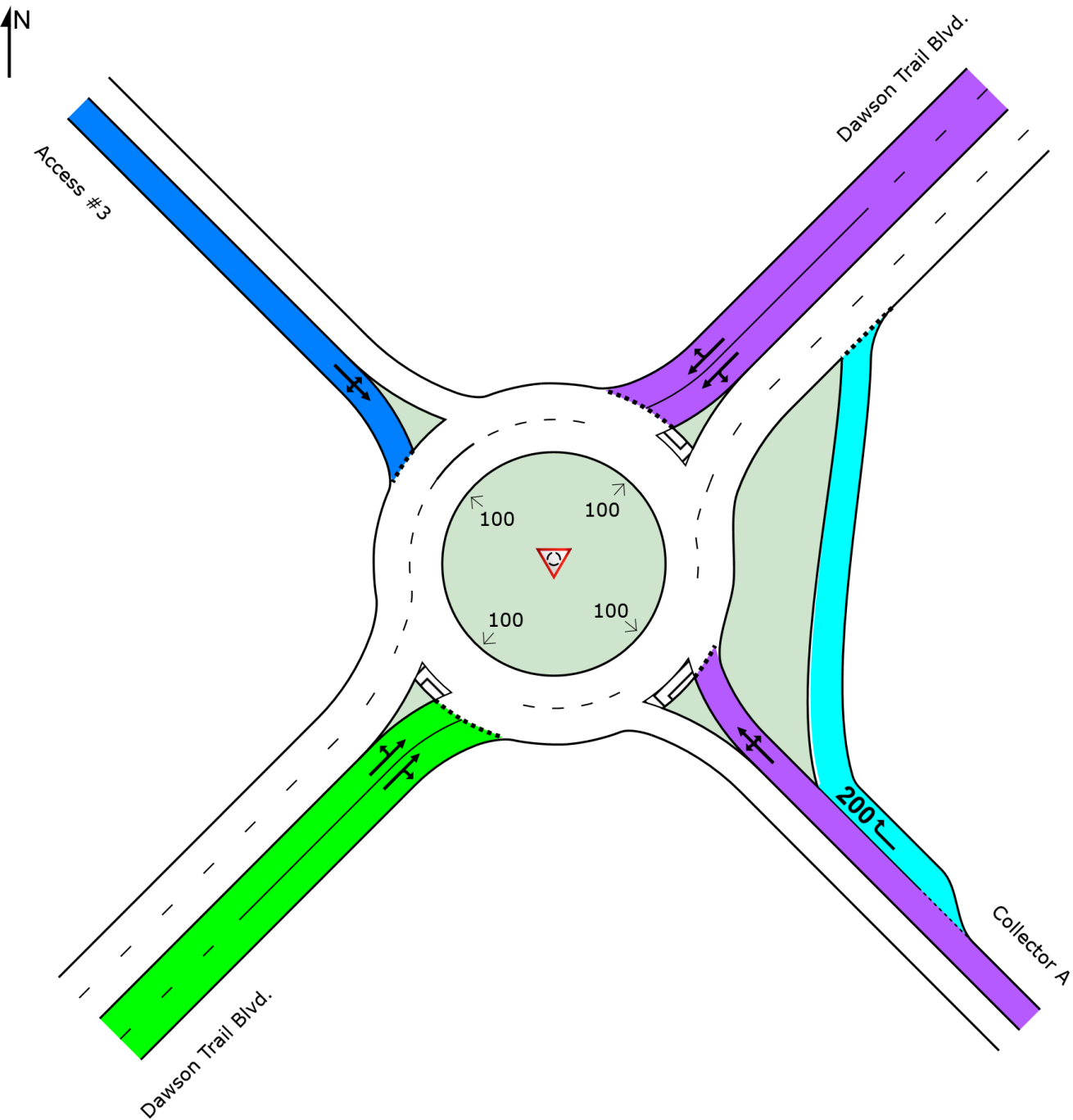
LEVEL OF SERVICE

Lane Level of Service

 Site: 103 [Int #103_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

	Approaches				Intersection
	Southeast	Northeast	Northwest	Southwest	
LOS	C	D	C	A	C



DELAY (CONTROL)

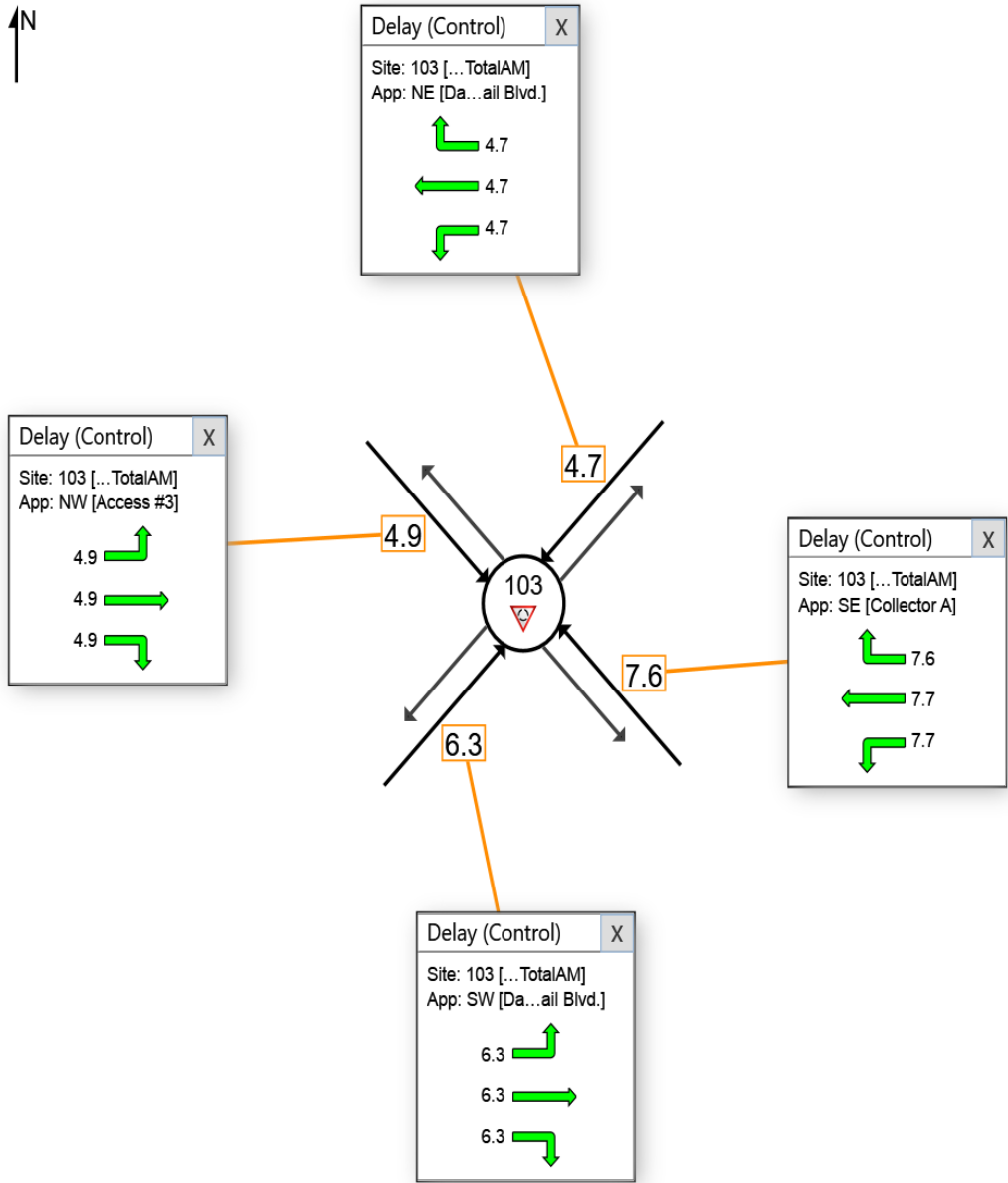
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 103 [Int #103_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

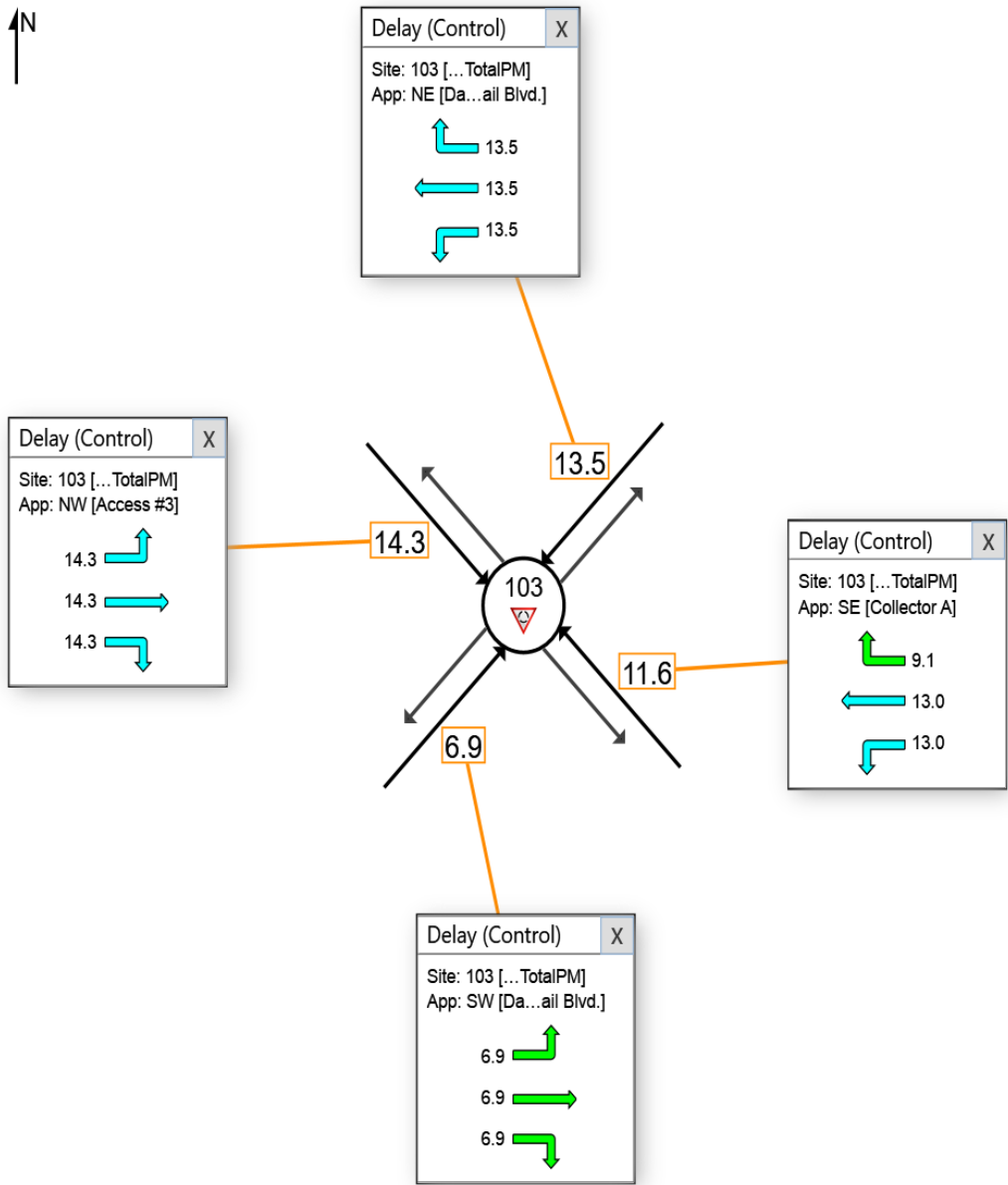
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 103 [Int #103_2040 Total_PM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



DELAY (CONTROL)

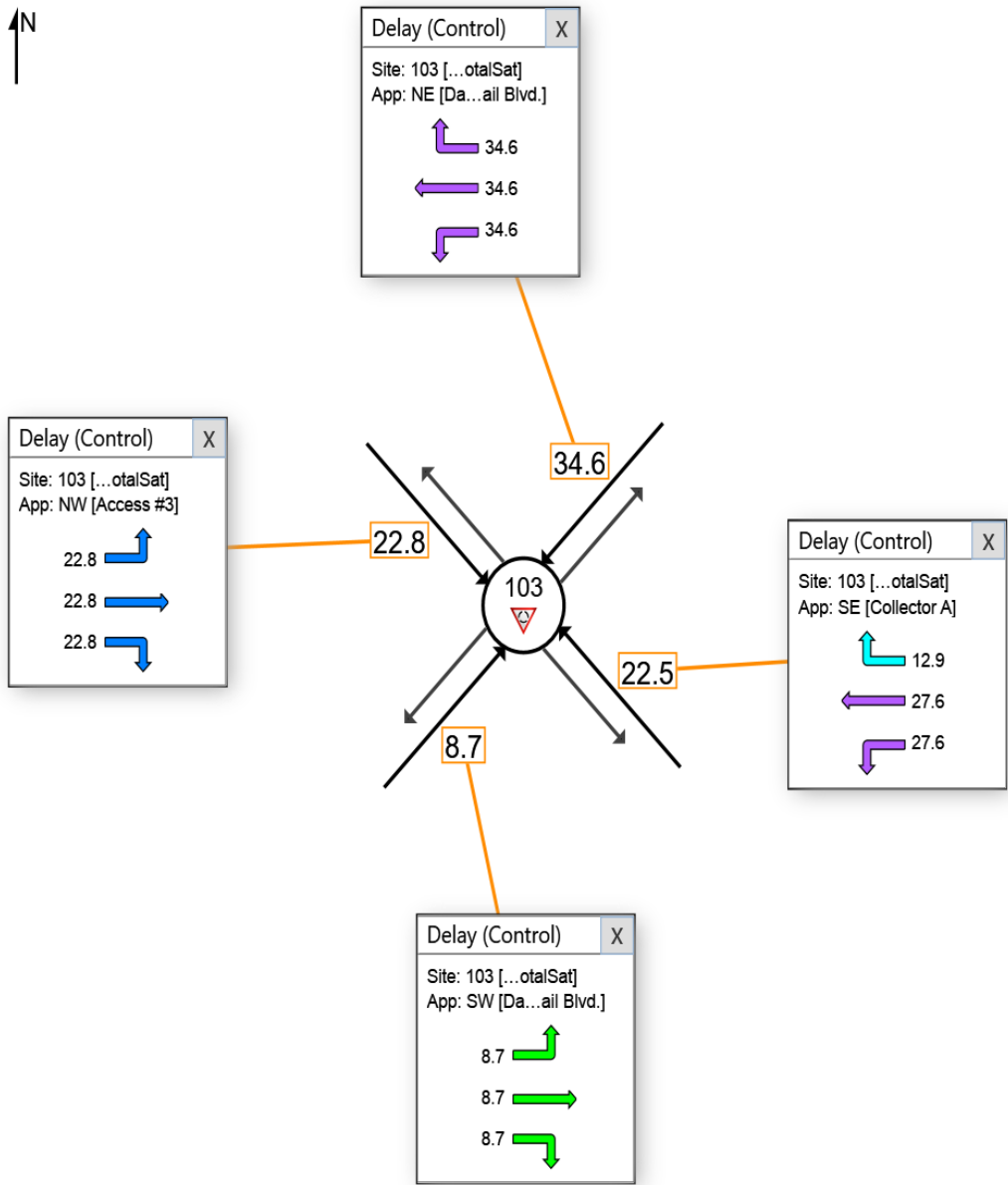
Average control delay per vehicle, or average pedestrian delay (seconds)

 Site: 103 [Int #103_2040 Total_Sat (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

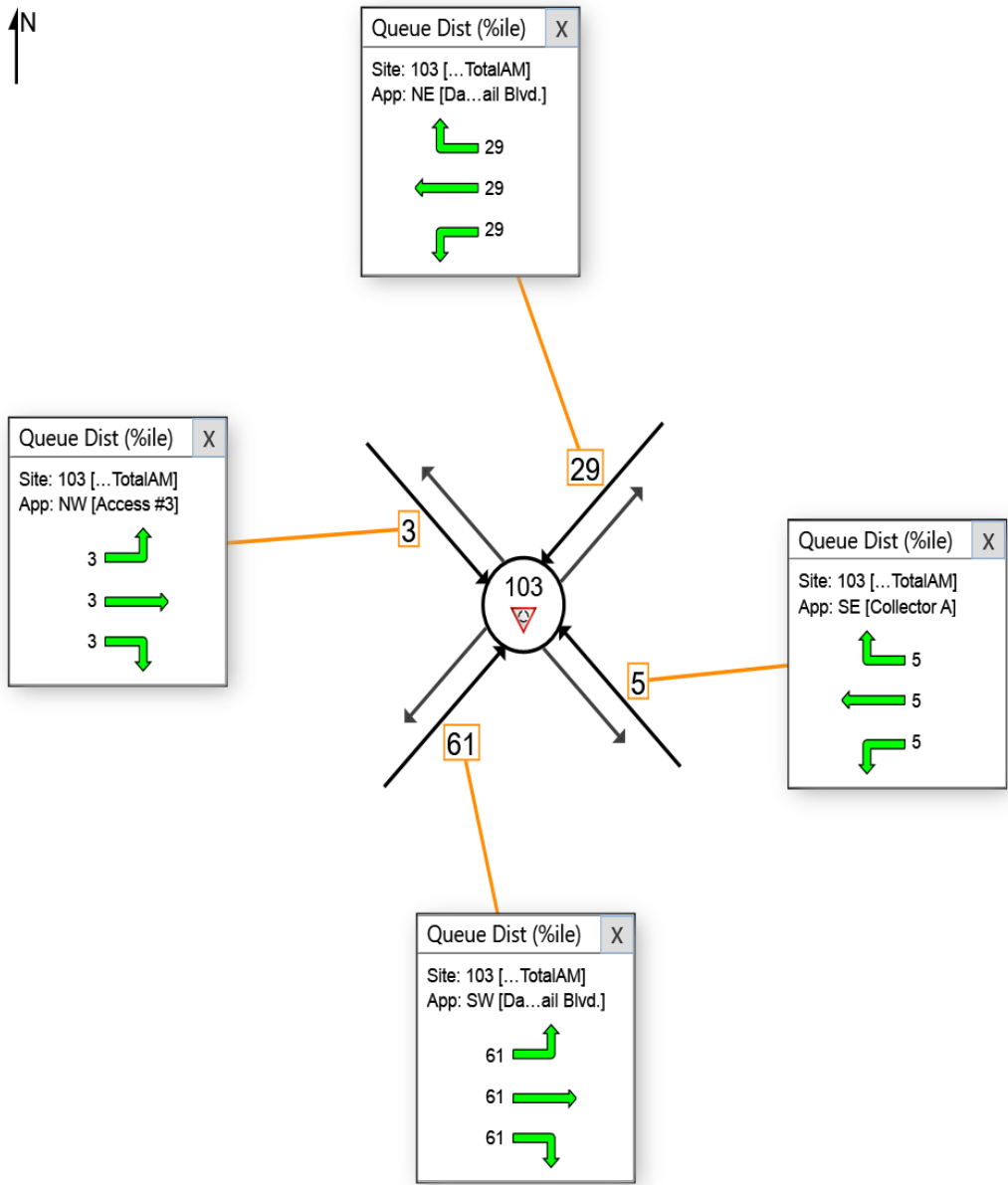
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 Site: 103 [Int #103_2040 Total_AM (Site Folder: General)]

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

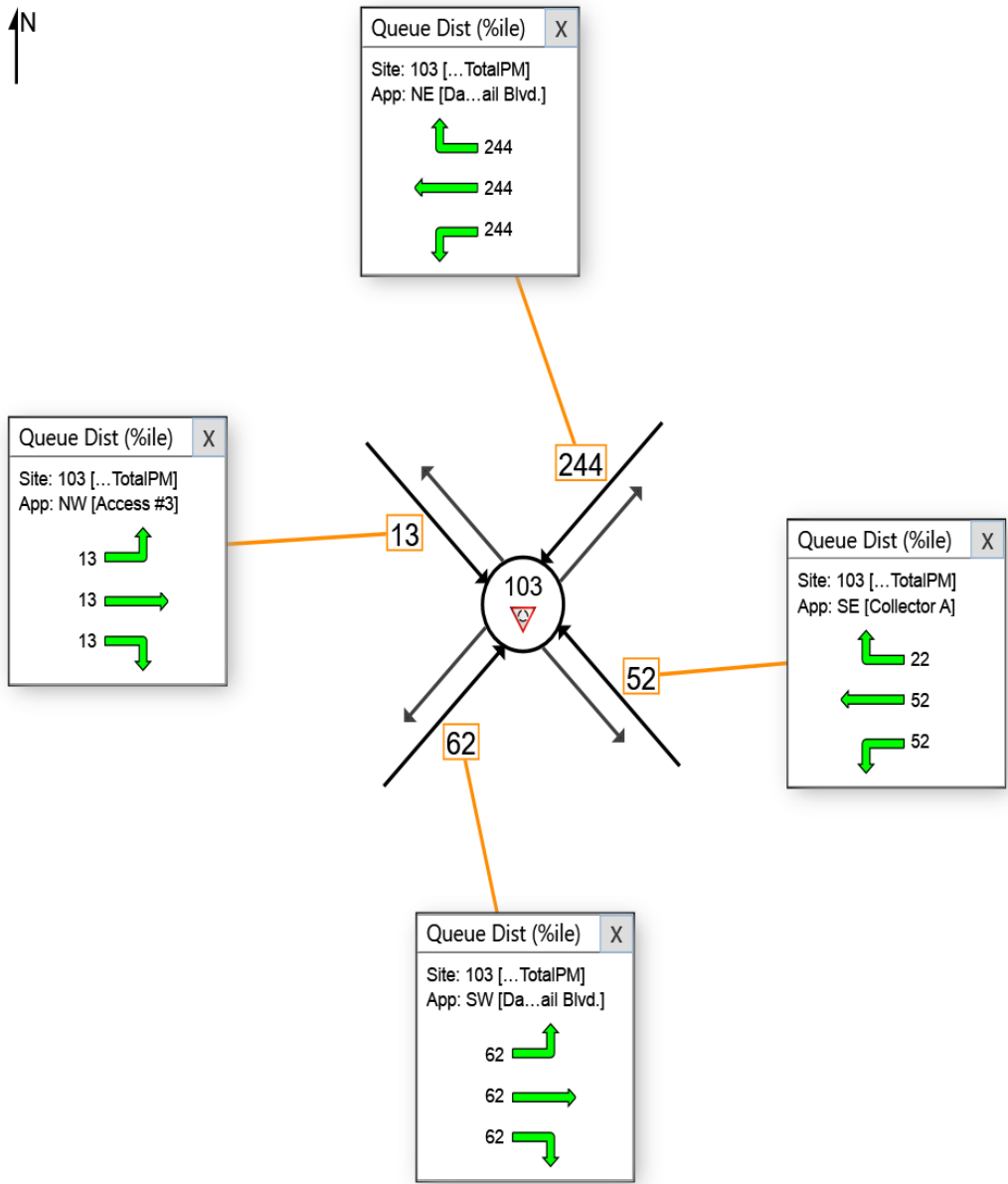
Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 103 [Int #103_2040 Total_PM (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups



QUEUE DISTANCE (PERCENTILE)

Largest 95% Back of Queue Distance for any lane used by the vehicle movement (feet)

 **Site: 103 [Int #103_2040 Total_Sat (Site Folder: General)]**

New Site
Site Category: (None)
Roundabout

Use the button below to open or close all popup boxes. Click value labels to open selected ones.
Click and drag popup boxes to move to preferred positions.

Close All Popups

