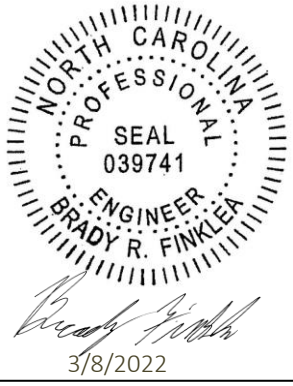
Technical Memorandum

To: Peyton Ratchford, CZO
City of Belmont

From: Brady Finklea, PE
Kimley-Horn

Re: *Culver's Belmont*
Transportation Technical Memorandum
Hawley Avenue, Belmont, North Carolina

Date: March 8, 2022



The purpose of this Transportation Technical Memorandum (TTM) is to evaluate the incremental impacts on the surrounding transportation infrastructure as a result of the proposed Culver's Belmont fast-food restaurant located south of Hawley Avenue and west of Park Street (NC 273) in Belmont, North Carolina (https://goo.gl/maps/aJ8zhhiKqw3piMMf9). The primary objectives of the study are:

- To estimate trip generation and distribution for the proposed development.
- To perform intersection capacity analyses for each of the identified study intersections.
- To determine the potential transportation impacts of the proposed development.
- To identify potential improvements to mitigate the proposed development's transportation impacts.

Review by the City of Belmont Planning Board and staff of the proposed site in context with the surrounding uses, current zoning, and planned transportation projects in the area resulted in the requirement of this TTM. The overall site density did not meet North Carolina Department of Transportation's (NCDOT's) TIA threshold; however, NCDOT was involved in review of the assumptions and methodology documented in this TTM.

Executive Summary

Based on the capacity analyses performed at each of the identified study intersections, along with review of the auxiliary turn-lane warrants and crash analyses contained herein, the following improvements are identified to mitigate the operational impact of the proposed development on the adjacent street network:

2. Park Street (NC 273) and Hawley Avenue/Wendy's Driveway

- Extend the eastbound shared left/through lane along Hawley Avenue from 275 feet to 375 feet by restriping the existing two-way left-turn lane (TWLTL)

5. Hawley Avenue and Pizza Hut Driveway/Access 1

- Construction of Access 1 as a stop-controlled, left-over with a single egress lane and single ingress lane

  The applicant indicated at the TTM Scoping Meeting that driveway configurations would be explored to confirm the delineating measures to ensure the proposed Culver's driveway is restricted to a left-over while still allowing full-movement operations for the Pizza Hut driveway (see **Section 5** under the **Capacity Analysis**).

7. Hawley Avenue and Access 2

- Construction of Access 2 as a full-movement, stop-controlled driveway with a new median opening (subject to approval by City of Belmont) with a single egress lane and single ingress lane
- Westbound left-turn lane along Hawley Avenue with 100 feet of storage

Project Overview

The proposed Culver's Belmont fast-food restaurant is located south of Hawley Avenue and west of Park Street (NC 273) in Belmont, North Carolina (https://goo.gl/maps/aJ8zhhiKqw3piMMf9). Based on the site plan provided by the applicant and shown in **Figure 1** (attached), an approximately 4,400 square-foot fast-food restaurant with a drive-thru window is currently envisioned for this site.

For the purposes of this TTM, the development is assumed to be built-out in 2022 and accessed via two (2) access points (shown in the aerial image below):

- **Access 1** – left-over connection to Hawley Avenue aligned with the existing Pizza Hut driveway
- **Access 2** – full-movement connection to Hawley Avenue approximately 625 feet east of the Loftin Senior Apartments driveway and approximately 225 feet east of the existing median opening along Hawley Avenue for the Home2Suites driveway

Based on input from the applicant at the TTM Scoping Meeting and as shown in the site plan in **Figure 1**, Access 2 is proposed to align with a median break along Hawley Avenue to provide full-movement access. Note that prior to 2021, a median break was located at this location; however, the median cut was recently relocated approximately 225 feet to the west to align with the western access for the recently constructed Home2Suites. The applicant has indicated a request for a new median break at Access 2 while keeping the existing median cut at the Home2Suites. Based on discussions at the TTM Scoping Meeting, this analysis has been performed under the assumption that Access 2 would operate as full-movement; however, full-movement access via a new median break at Access 2 discussed herein is subject to approval by the City of Belmont. Further discussion of the proposed driveway configurations at Access 1 and Access 2 is provided in **Sections 5** and **7** under the **Capacity Analysis**.

A TTM Scoping Meeting was held with City staff and representatives of the applicant virtually on December 8, 2021, to establish the scope and parameters to be included in this TTM. The City's Memorandum of Understanding (MOU) was developed based on discussions from this meeting and was reviewed and agreed upon by the City and applicant. The MOU was also shared with NCDOT and is included in the **Attachments**.

The following AM and PM peak-hour scenarios were analyzed to determine the proposed development's transportation impacts on the surrounding network:

- 2022 Background Conditions
- 2022 Build-out Conditions

As shown in the MOU and **Figure 2** (attached), this TTM evaluated operations under each of the AM and PM peak-hour scenarios above for the following study area intersections:

1. Park Street (NC 273) and Hawley Avenue/Browntown Road
2. Park Street (NC 273) and Hawley Avenue/Wendy's Driveway
3. Park Street (NC 273) and Wilkinson Boulevard (US 74)

4. Wilkinson Boulevard (US 74) and Hawley Avenue
5. Hawley Avenue and Pizza Hut Driveway/Access 1
6. Hawley Avenue and Hawley Avenue/Chick-fil-A Driveway
7. Hawley Avenue and Access 2 *(build-out conditions)*

Traffic Volume Development

2022 Background Traffic Volumes

Existing AM (6:30-8:30) and PM (4:30-7:00) peak-period intersection turning-movement, heavy-vehicle, pedestrian and bicycle counts were collected by Quality Counts, LLC on Wednesday, January 12, 2022 (when Gaston County Schools were in session), at the study intersections listed above.

The projected 2022 background AM and PM peak-hour traffic volumes include increases in traffic volumes caused by approved off-site developments within the vicinity of the study area that were not yet fully constructed at the time of the counts. Based on input from City staff, two (2) approved developments that are expected to impact traffic volumes within the study area were included in the background traffic volumes for this TTM and summarized in **Table 1** below.

Table 1: Approved Developments

Development	Land Use/Intensity	% Build-out	TIA Included?	Required Improvements
The Morris (Wayforth)	325 multifamily units	0%	Yes	No required IMPs at study intersections.
CaroMont Regional Medical Center	220,000 SF hospital 80,000 SF medical office	0%	Yes	No required IMPs at study intersections.

The Morris multifamily development is located southeast of the Park Street (NC 273)/Wilkinson Boulevard (US 74) intersection, while CaroMont Regional Medical Center is located north of I-85 and west of Beatty Drive (NC 273).

The existing laneage for the study area intersections is shown in **Figure 3** (attached) and the 2022 background AM and PM peak-hour traffic volumes are shown in **Figures 4** and **5**, respectively (attached).

2022 Build-out Traffic Volumes

Table 2 summarizes the traffic generation potential for the proposed development using the trip generation rates published in *Trip Generation* (Institute of Transportation Engineers, Tenth Edition, 2017).

Table 2 - Trip Generation

ITE LUC	Land Use	Intensity		Daily	AM Peak Hour			PM Peak Hour			Peak Hour Type/Data Source
					Total	In	Out	Total	In	Out	
934	Fast Food Restaurant w/ DT Window	4,400	SF	2,072	177	90	87	144	75	69	Adj Street/ITE Rate
	ITE 934 Pass-By - 49% AM / 50% PM			*156*	*86*	*43*	*43*	*70*	*35*	*35*	
	Adjacent Street Traffic				*378*			*732*			
	10% Adjacent Street Traffic			*112*	*38*	*19*	*19*	*74*	*37*	*37*	
	Pass-By			108	38	19	19	70	35	35	
Net New External Trips				1,964	139	71	68	74	40	34	

During a typical weekday, the proposed development has the potential to generate 139 and 74 net new external trips during the AM and PM peak hours, respectively.

The proposed development's trips were assigned to the surrounding network based on the distribution approved as part of the MOU by the City of Belmont, NCDOT and applicant and is shown in **Figure 6** (attached). As shown in the figure, of the 60% entering traffic from the north, the analysis assumed an even

split of traffic making westbound left-turns and right-turns at Hawley Avenue (as shown in the image to the right) to enter the site via Access 1 and Access 2, respectively. As discussed above, the proposed median break allowing full-movement access at Access 2 is subject to approval by the City of Belmont. If a new median opening is disallowed at Access 2, the majority of site traffic would likely turn left at Hawley Avenue to enter the site via Access 1.

The 2022 build-out traffic volumes include the assignment of the projected site traffic generation added to the 2022 background traffic volumes. The projected 2022 build-out traffic volumes for the AM and PM peak hours are shown in **Figures 7** and **8**, respectively (attached). Intersection volume development worksheets for all intersections are attached.

Capacity Analysis

Synchro Version 11 software along with SimTraffic microsimulation analysis were used to evaluate the AM and PM peak-hour operating characteristics of the study intersections. The capacity of an intersection quantifies its ability to accommodate traffic volumes and is expressed in terms of level-of-service (LOS), measured in average delay per vehicle and describes motorists' perceptions within a traffic stream. The Transportation Research Board's Highway Capacity Manual (HCM) defines six (6) levels of service, LOS A through LOS F, with LOS A as the highest (best traffic flow and least delay), LOS E as saturated or at-capacity conditions, and LOS F as the lowest (oversaturated conditions).

The LOS grades shown below quantify and categorize the driver's discomfort, frustration, fuel consumption, and travel times experienced as a result of intersection control and the resulting traffic queuing. A detailed description of each LOS rating can be found in **Table 3.**

Table 3 – Level-of-Service Descriptions

LOS	Avg Control Delay [sec/veh]			Description
	Unsignalized		Signalized	
A	Short Delays	≤ 10	≤ 10	Minimal control delay; traffic operates at primarily free-flow conditions; unimpeded movement within traffic stream.
B		> 10 – 15	> 10 – 20	Minor control delay at signalized intersections; traffic operates at a fairly unimpeded level with slightly restricted movement within traffic stream.
C		> 15 – 25	> 20 – 35	Moderate control delay; movement within traffic stream more restricted than at LOS B; formation of queues contributes to lower avg travel speeds.
D	Moderate Delays	> 25 – 35	> 35 – 55	Considerable control delay that may be substantially increased by small increases in flow; average travel speeds continue to decrease.
E		> 35 – 50	> 55 – 80	High control delay; average travel speed no more than 33 percent of free flow speed.
F	Long Delays	> 50	> 80	Extremely high control delay; extensive queuing and high volumes create exceedingly restricted traffic flow.

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay and is reported for the side-street approaches. Control delay includes initial deceleration delay, queue move-up time,

stopped delay, and final acceleration delay. With respect to field measurements, control delay is defined as the total elapsed time from the time a vehicle stops at the end of the queue to the time the vehicle departs from the stop line. It is typical for stop sign-controlled side streets and driveways intersecting major streets to experience long delays during peak hours, particularly for left-turn movements. The majority of the traffic moving through the intersection on the major street experiences little or no delay.

LOS for signalized intersections is reported for the intersection as a whole, and typically during the highest volume periods of the day, the AM and PM peak periods. One or more movements at an intersection may experience a low level-of service, while the intersection as a whole may operate acceptably.

Based on the requirements set forth by the *City of Belmont Land Development Code – Section 16.14 Transportation Impact Analysis* and in accordance with the traffic study guidelines in the *NCDOT Policy on Street and Driveway Access to North Carolina Highways*, capacity analyses were performed at the study area intersections for each of the following AM and PM peak-hour scenarios:

- 2022 Background Conditions
- 2022 Build-out Conditions

NCDOT provided the signal geometric plans for each of the following signalized intersections (each of which are part of the Belmont Closed Loop Signal System), which were used in the development of the background conditions Synchro network:

- Park Street (NC 273) and Hawley Avenue/Wendy's Driveway
- Park Street (NC 273) and Wilkinson Boulevard (US 74)
- Wilkinson Boulevard (US 74) and Hawley Avenue

Based on the provided signal plans, all signalized study intersections are part of the Belmont Closed Loop Signal System; therefore, cycle lengths and splits were optimized as a system given the timing inputs and in accordance with NCDOT *Congestion Management Capacity Analysis Guidelines*. Cycle lengths and splits were maintained throughout the build-out scenarios. Signal geometric plans are attached.

The following modifications from the background data collected were applied to the capacity analyses to meet NCDOT *Congestion Management Capacity Analysis Guidelines*:

- Right-turn-on-red (RTOR) operations were not allowed.
- Lost time adjust was added to the yellow and all-red times provided in the existing signal plans to maintain a total lost time of five (5) seconds for each movement.

A 0.9 peak-hour factor was used in all conditions, and heavy-vehicle percentages collected with the counts were used and maintained for all scenarios, subject to a two-percent (2%) minimum.

Mitigation for transportation impacts caused by the proposed development were identified based on City of Belmont mitigation requirements. When determining the proposed development's transportation impact to the study area intersections, the 2022 background and 2022 build-out conditions were compared. Based on the *City of Belmont Land Development Code – Section 16.14 Transportation Impact Analysis*, "the applicant shall be required to identify mitigation improvements to the roadway network if at least one of the following conditions exists when comparing future year background conditions to future year build-out conditions:

- the total average delay at an intersection or individual approach increases by 25% or greater, while maintaining the same LOS,
- the LOS degrades by at least one level,
- or the LOS is "D" or worse in background conditions and the proposed project shows a negative impact on the intersection or approach"

Capacity analysis reports generated by Synchro Version 11 software are attached along with queueing and blocking reports generated by the SimTraffic microsimulation model.

1. Park Street (NC 273) and Hawley Avenue/Browntown Road

This intersection is an unsignalized intersection with free-flow operations along the northbound/southbound approaches of Park Street (NC 273), full-movement stop-controlled operations along the westbound approach of Browntown Road, and channelized right-in/right-out (RIRO) yield-controlled operations along the eastbound approach of Hawley Avenue. The intersection configuration is shown in the aerial to the right.

Table 4 shows that the side-street approaches are expected to operate with short delays during both peak hours under 2022 background conditions. Note that this intersection was evaluated using HCM 2000, as HCM 6th Edition does not report delay for yield-controlled approaches.

When the proposed site traffic is added to the 2022 background traffic volumes, both side-street approaches are expected to continue to operate with similar operations under 2022 build-out conditions with minimal increases in approach delay. Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no improvements are recommended as mitigation for the proposed Culver's Belmont restaurant.

Table 4 - Park Street (NC 273) and Hawley Avenue/Browntown Road

Condition	Measure	EB	WB	NB	SB		
		EBR	WBLR	NBTR	SBL*	SBT	SBR
AM Peak Hour							
2022 Background	LOS (Delay)	B (12.0)	B (13.5)	A (0.0)	B (13.8)	A (0.0)	
	Synchro 95th Q	5'	8'	0'	13'	0'	0'
2022 Build-out	LOS (Delay)	B (12.1)	B (13.3)	A (0.0)	B (14.2)	A (0.0)	
	Synchro 95th Q	6'	8'	0'	14'	0'	0'
PM Peak Hour							
2022 Background	LOS (Delay)	C (15.0)	B (14.6)	A (0.0)	B (14.6)	A (0.0)	
	Synchro 95th Q	9'	31'	0'	17'	0'	0'
2022 Build-out	LOS (Delay)	C (15.1)	B (14.9)	A (0.0)	B (14.8)	A (0.0)	
	Synchro 95th Q	9'	30'	0'	17'	0'	0'
Background Storage					200'		200'

*Conflicting left-turn movements are broken out per NCDOT guidelines

2. Park Street (NC 273) and Hawley Avenue/Wendy's Driveway

Table 5 - Park Street (NC 273) and Hawley Avenue/Wendy's Driveway										
Condition	Measure	EB		WB	NB		SB			Intersection
		EBLT	EBR	WBLTR	NBL	NBTR	SBL	SBT	SBR	LOS (Delay)
AM Peak Hour										
2022 Background	LOS (Delay)	E (55.9)		D (44.2)	A (2.9)		A (5.8)			A (9.3)
	Synchro 95th Q	170'	70'	75'	m5'	62'	30'	167'	14'	
2022 Build-out	LOS (Delay)	E (56.0)		D (40.1)	A (4.0)		A (7.4)			B (11.3)
	Synchro 95th Q	212'	73'	72'	m7'	64'	34'	190'	18'	
PM Peak Hour										
2022 Background	LOS (Delay)	E (57.3)		D (42.0)	A (6.3)		B (12.3)			B (15.8)
	Synchro 95th Q	#319'	96'	129'	m19'	m118'	50'	339'	39'	
2022 Build-out	LOS (Delay)	E (60.3)		D (40.9)	A (7.0)		B (13.0)			B (17.1)
	Synchro 95th Q	#363'	97'	130'	m21'	m118'	50'	341'	40'	
Background Storage		275'			75'		75'		150'	

95th percentile volume exceeds capacity, queue may be longer
m Volume for 95th percentile queue is metered by upstream signal

Table 5 shows that the signalized intersection is expected to operate at LOS A during the AM peak hour and LOS B during the PM peak hour under 2022 background conditions, with the minor-street eastbound approach of Hawley Avenue operating at LOS E during both peak hours.

When the proposed site traffic is added to the 2022 background traffic volumes, the overall intersection is expected to drop from LOS A to LOS B during the AM peak hour and continue to operate at LOS B during the PM peak hour, with minor increases in delay along the eastbound approach of Hawley Avenue. The LOS degradation for the overall intersection is a result of the background delay hovering just below (0.7 seconds) the LOS A/B demarcation at 10 seconds, where the site traffic pushes the delay just beyond (1.3 seconds) this demarcation, with an increase in delay of two (2) seconds per vehicle for the overall intersection. Therefore, no capacity improvements are recommended as mitigation for the proposed Culver's Belmont restaurant; however, review of the queue lengths is discussed below.

Based on review of the Synchro 95th percentile queue lengths shown in **Table 5**, the eastbound shared left/through queue is expected to increase with the addition of proposed site traffic, exceeding the existing striped storage of 275 feet during the PM peak hour. The existing 275 feet of storage currently terminates by transitioning into an existing two-way left-turn lane (TWLTL) provided along the three-lane section of Hawley Avenue. As the primary exit route for the proposed site traffic to access I-85, **Figures 7** and **8** show 44 and 23 vehicles expected to be added to this movement during the AM and PM peak hours, respectively, upon build-out of the proposed fast-food restaurant. Therefore, **the following improvement is identified to mitigate the operational impact and accommodate the addition of the proposed Culver's Belmont site traffic:**

- **Extend the eastbound shared left/through lane along Hawley Avenue from 275 feet to 375 feet by restriping the existing two-way left-turn lane.**

Note the decrease in delay shown in **Table 5** along the westbound approach between background to build-out conditions is a reflection of the increased demand for green time along the side streets, which allows additional green time for both the eastbound and westbound approaches.

3. Park Street (NC 273) and Wilkinson Boulevard (US 74)

Table 6 - Park Street (NC 273) and Wilkinson Boulevard (US 74)											
Condition	Measure	EB		WB		NB		SB		Intersection
		EBL	EBTR	WBL	WBTR	NBL	NBTR	SBL	SBTR	LOS (Delay)
AM Peak Hour										
2022 Background	LOS (Delay)	D (39.9)		D (53.5)		D (48.7)		D (36.8)		D (43.9)
	Synchro 95th Q	#282'	287'	#140'	168'	116'	#508'	#252'	211'	
2022 Build-out	LOS (Delay)	D (40.0)		D (53.8)		D (49.4)		D (39.0)		D (44.7)
	Synchro 95th Q	#282'	287'	#140'	171'	116'	#530'	#265'	249'	
PM Peak Hour										
2022 Background	LOS (Delay)	E (64.2)		E (63.3)		F (89.9)		E (79.4)		E (73.9)
	Synchro 95th Q	#380'	177'	257'	#505'	#291'	#538'	#423'	#600'	
2022 Build-out	LOS (Delay)	E (64.6)		E (64.2)		F (91.1)		F (80.2)		E (74.8)
	Synchro 95th Q	#380'	177'	257'	#507'	#291'	#542'	#429'	#603'	
Background Storage		310'		190'		210'		150'		

95th percentile volume exceeds capacity, queue may be longer

Table 6 shows that the signalized intersection is expected to operate at LOS D during the AM peak hour and LOS E during the PM peak hour under 2022 background conditions.

When the proposed site traffic is added to the 2022 background traffic volumes, the overall intersection is expected to continue to operate with similar operations under 2022 build-out conditions as compared to 2022 background conditions with minimal increases in approach and overall intersection delays. Note that the LOS degradation for the southbound approach during the PM peak hour is a result of the background delay hovering just below (0.6 seconds) the LOS E/F demarcation at 80 seconds, where the site traffic pushes the approach delay just beyond (0.2 seconds) this demarcation, with an increase in delay of less than one (1) second per vehicle along this approach. **Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no improvements are recommended as mitigation for the proposed Culver's Belmont restaurant.**

Also note that NCDOT TIP Project No. U-5959 is planned to improve the intersection of Park Street (NC 273) and Wilkinson Boulevard (US 74). Based on the current NCDOT STIP as of February 2022, the schedule for U-5959 has been delayed where right-of-way and utilities are funded for FY 2029 and construction is now shown outside the 10-year funded STIP window. Based on the latest coordination with NCDOT, the preferred intersection configuration and specific improvements have not yet been determined.

4. Wilkinson Boulevard (US 74) and Hawley Avenue

Table 7 - Wilkinson Boulevard (US 74) and Hawley Avenue											
Condition	Measure	EB		WB			NB	SB			Intersection
		EBL	EBTR	WBL	WBT	WBR	NBLTR	SBL	SBLT	SBR	LOS (Delay)
AM Peak Hour											
2022 Background	LOS (Delay)	A (9.6)		B (11.5)			E (59.4)	D (47.6)			B (12.7)
	Synchro 95th Q	20'	199'	m34'	90'	m23'	53'	48'	48'	41'	
2022 Build-out	LOS (Delay)	B (10.1)		B (12.0)			E (60.0)	D (47.0)			B (13.5)
	Synchro 95th Q	26'	203'	m34'	95'	m23'	59'	48'	49'	47'	
PM Peak Hour											
2022 Background	LOS (Delay)	B (15.8)		A (7.2)			E (65.1)	D (47.8)			B (15.4)
	Synchro 95th Q	54'	138'	m16'	m93'	m17'	116'	120'	122'	80'	
2022 Build-out	LOS (Delay)	B (16.5)		A (7.6)			E (65.4)	D (48.2)			B (16.0)
	Synchro 95th Q	56'	138'	m16'	m92'	m17'	118'	m122'	m122'	m83'	
Background Storage		200'		150'		150'		125'			

m Volume for 95th percentile queue is metered by upstream signal

Table 7 shows that the signalized intersection is expected to operate at LOS B during both peak hours under 2022 background conditions.

When the proposed site traffic is added to the 2022 background traffic volumes, the overall intersection is expected to continue to operate with similar operations under 2022 build-out conditions as compared to 2022 background conditions with minimal increases in approach and overall intersection delays. Note that the LOS degradation for the eastbound approach during the AM peak hour is a result of the background delay hovering just below (0.4 seconds) the LOS A/B demarcation at 10 seconds, where the site traffic pushes the approach delay just beyond (0.1 seconds) this demarcation, with an increase in delay of less than one (1) second per vehicle along this approach. Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no improvements are recommended as mitigation for the proposed Culver's Belmont restaurant.

5. Hawley Avenue and Pizza Hut Driveway/Access 1

Table 8 shows that the stop-controlled westbound approach of the Pizza Hut driveway along Hawley Avenue is expected to operate with short delays during both peak hours under 2022 background conditions. Note that there is a two-way left-turn lane (TWLTL) along Hawley Avenue that currently functions as a southbound left-turn lane for the Pizza Hut driveway.

Table 8 - Hawley Avenue and Pizza Hut Driveway/Access 1

Condition	Measure	EB	WB	NB		SB	
		EBR	WBLTR	NBL*	NBTR	SBL*	SBTR
AM Peak Hour							
2022 Background	LOS (Delay)	-	A (9.3)	A (0.0)		A (7.3)	A (0.0)
	Synchro 95th Q	-	0'	-	0'	0'	0'
2022 Build-out	LOS (Delay)	A (9.7)	B (10.1)	A (7.7)	A (0.0)	A (7.3)	A (0.0)
	Synchro 95th Q	5'	0'	3'	0'	0'	0'
PM Peak Hour							
2022 Background	LOS (Delay)	-	B (10.9)	A (0.0)		A (7.6)	A (0.0)
	Synchro 95th Q	-	3'	-	0'	0'	0'
2022 Build-out	LOS (Delay)	B (10.4)	B (13.1)	A (8.0)	A (0.0)	A (7.6)	A (0.0)
	Synchro 95th Q	5'	3'	3'	0'	0'	0'
Background Storage				TWLTL		TWLTL	

*Conflicting left-turn movements are broken out per NCDOT guidelines

Access 1 is proposed to create the fourth leg to the current unsignalized tee-intersection; the existing TWLTL was assumed to function as a northbound left-turn lane into the proposed Access 1. Based on discussions at the TTM Scoping Meeting, it was determined that the proximity of Access 1 to the adjacent intersection at Hawley Avenue may create a safety concern if left-turns out of the site were allowed here; furthermore, the connectivity of the adjacent network suggests that turning right out of Access 1 to access the full-movement signal at Park Street (NC 273) would provide sufficient access options if left-turn movements were restricted. Therefore, Access 1 was evaluated under a left-over configuration, in which left-turn movements are allowed into the site but left-turn movements out of the site are restricted. Note that as also discussed at the TTM Scoping Meeting, full-movement operations should still be allowed for the Pizza Hut driveway to allow left-turn access onto Hawley Avenue to access the full-movement signal at Park Street (NC 273). Typically, left-over configurations are enforced by installing monolithic concrete islands along the mainline, which would impact turn movements on either side of the street. The applicant indicated at the TTM Scoping Meeting that driveway configurations would be explored to confirm the delineating measures to ensure the proposed Culver's driveway is restricted to a left-over while still allowing full-movement operations for the Pizza Hut driveway.

When the proposed site traffic is added to the 2022 background traffic volumes along with the addition of the fourth leg, the stop-controlled approaches are expected to operate with short delays under 2022 build-out conditions.

6. Hawley Avenue and Hawley Avenue/Chick-fil-A Driveway

This unsignalized, tee-intersection is shown in the aerial image to the right, where the short connector between Park Street (NC 273) and Hawley Avenue is also labeled Hawley Avenue on GIS platforms. Note that Chick-fil-A ties into the connector approximately 50 feet east of the Hawley Avenue intersection, yet does not directly serve as an approach to the intersection.

Table 9 shows that the stop-controlled westbound approach of the Hawley Avenue connector is expected to operate with short delays during both peak hours under 2022 background conditions.

When the proposed site traffic is added to the 2022 background traffic volumes, the unsignalized intersection is expected to continue to operate with similar operations under 2022 build-out conditions. Since the proposed development is not expected to have a significant adverse impact on operations at this intersection, no improvements are recommended as mitigation for the proposed Culver's Belmont restaurant.

Note that as shown in **Figure 6** (attached), of the 60% entering traffic from the north, the analysis assumed an even split of traffic making westbound left-turns and right-turns at this intersection to enter the site via Access 1 and Access 2, respectively. As discussed below in **Section 7** under the **Capacity Analysis**, the proposed median break allowing full-movement access at Access 2 is subject to approval by the City of Belmont. If a new median opening is disallowed at Access 2, the amount of site traffic turning left at this intersection to enter the site via Access 1 would likely increase beyond an even split as assumed in this analysis. The short delays shown in **Table 9** indicate additional capacity available to accommodate the increase in left-turn traffic if full-movement access is not allowed at Access 2; however, it is important to note that increased left-turn movements would likely increase queuing at this intersection, increasing the likelihood of blocking the egress for the existing Chick-fil-A restaurant.

Table 9 - Hawley Avenue and Hawley Avenue/Chick-fil-A Driveway

Condition	Measure	WB		NB	SB	
		WBL	WBR	NBTR	SBL*	SBT
AM Peak Hour						
2022 Background	LOS (Delay)	A (9.7)		A (0.0)	A (7.4)	A (0.0)
	Synchro 95th Q	13'	10'	0'	3'	0'
2022 Build-out	LOS (Delay)	B (10.0)		A (0.0)	A (7.4)	A (0.0)
	Synchro 95th Q	18'	13'	0'	3'	0'
PM Peak Hour						
2022 Background	LOS (Delay)	B (11.4)		A (0.0)	A (7.7)	A (0.0)
	Synchro 95th Q	23'	25'	0'	3'	0'
2022 Build-out	LOS (Delay)	B (11.6)		A (0.0)	A (7.7)	A (0.0)
	Synchro 95th Q	25'	28'	0'	3'	0'
Background Storage			175'		TWLTL	

*Conflicting left-turn movements are broken out per NCDOT guidelines

7. Hawley Avenue and Access 2

Based on the site plan and input from the applicant, Access 2 is proposed to serve as a full-movement connection to Hawley Avenue located approximately 625 feet east of the Loftin Senior Apartments driveway and approximately 225 feet east of the existing median opening along Hawley Avenue for the Home2Suites driveway.

Table 10 - Hawley Avenue and Access 2

Condition	Measure	EB	WB		NB
		EBTR	WBL*	WBT	NBLR
AM Peak Hour					
2022 Build-out	LOS (Delay)	A (0.0)	A (7.6)	A (0.0)	A (9.8)
	Synchro 95th Q	0'	3'	0'	3'
PM Peak Hour					
2022 Build-out	LOS (Delay)	A (0.0)	A (7.9)	A (0.0)	B (11.5)
	Synchro 95th Q	0'	3'	0'	5'

*Conflicting left-turn movements are broken out per NCDOT guidelines

Table 10 shows that the proposed stop-controlled northbound approach of Access 2 is expected to operate with short delays during both peak hours. The results shown reflects full-movement access with a single-lane northbound approach and no turn lanes along Hawley Avenue (as shown in the site plan attached as Figure 1).

Note that prior to 2021, a median break was located at this location; however, the median cut was recently relocated approximately 225 feet to the west to align with the western access for the recently constructed Home2Suites. The applicant has indicated a request for a new median break at Access 2 while keeping the existing median cut at the Home2Suites. Based on discussions at the TTM Scoping Meeting, this analysis has been performed under the assumption that Access 2 would operate as full-movement; however, full-movement access via a new median break at Access 2 discussed herein is subject to approval by the City of Belmont.

The proposed median opening to allow full-movement operations at Access 2 is considered appropriate based upon the following considerations:

- By allowing left-turns into the site at Access 2, motorists may be encouraged to make a right turn at the intersection of Hawley Avenue and Hawley Avenue/Chick-fil-A Driveway, which could reduce queuing and congestion at that intersection.
- Since Access 1 is planned as a left-over configuration, full movement at Access 2 would allow exiting traffic to turn left onto Hawley Avenue to travel west; otherwise, a RIRO at Access 2 may cause illegal U-turns at the eastern end of the median along Hawley Avenue.
- A new median opening at this location would likely attract some exiting traffic from the Home2Suites turning right from its eastern driveway to make a U-turn at the new median opening to travel east. The new opening would be located approximately 150 feet west of the eastern Home2Suites driveway, forcing those motorists to quickly shift over two (2) lanes in a short distance. However, the amount of traffic from the Home2Suites during the peak hours is relatively low; furthermore, exiting traffic from Home2Suites have options to either utilize the western full-movement driveway to turn left, or utilize the eastern driveway and continue past Access 2 if unable to shift over two (2) lanes within the short distance (150 feet) and instead make a U-turn at the existing median opening where the western driveway is located.

Based on the considerations listed above, Access 2 is recommended to be constructed as a full-movement, stop-controlled driveway with a new median opening (subject to approval by City of Belmont) with a single egress lane and single ingress lane.

Review of auxiliary turn-lane warrants at this intersection is described below.

Auxiliary Turn Lane Warrants

Warrants for additional turn-lane improvements for unsignalized driveways beyond those necessary for capacity were determined based on a review of the figure titled 'Warrant for Left and Right-Turn Lanes' found on page 80 in the NCDOT *Policy on Street and Driveway Access to North Carolina Highways*.

Hawley Avenue and Access 2

The results of the warrants for left and right-turn lanes under 2022 build-out conditions indicate that a westbound left-turn lane along Hawley Avenue with a minimum storage length of 50 feet is warranted at Access 2. Based on NCDOT *Congestion Management Capacity Analysis Guidelines*, full storage for both right- and left-turn lanes should accommodate a minimum of 100 feet; therefore, a westbound left-turn lane along Hawley Avenue with a minimum storage length of 100 feet is recommended for Access 2. Note that this would be installed within the existing median along Hawley Avenue and subject to approval by the City of Belmont of the median opening at Access 2 as described in detail in **Section 7** under the **Capacity Analysis**.

Crash Data Analysis

Crash data was obtained at the study intersections for crashes that occurred between November 1, 2018, and October 31, 2021. Over this three-year period, 169 total crashes were reported at the existing study intersections. The breakdown of crashes at these study intersections by severity, frequency and crash type are shown in the tables below.

Table 11.1 – Crash Severity Summary

Crash Type	Number of Crashes
Fatal Crashes	0
Class A	0
Class B	4
Class C	19
Property Damage Only	146
Total	**169**

Table 11.1 above shows the total number of crashes by severity type from most to least severe. As shown, 86% of the crashes over the past three (3) years at the study intersections had no injury reported. The crash types are defined as follows:

- Class A - crashes where serious injury is suspected and can include significant loss of blood or broken bones.
- Class B - crashes where minor injury is suspected, such as bruises or minor cuts.
- Class C - crashes wherein possible injuries occur, which are injuries reported by the person or indicated by his/her behavior, but no wounds or injuries are physically present, such as limping or complaint of neck pain.
- Property Damage Only (PDO) – crashes where no injury is reported.

Table 11.2 – Crash Frequency Summary	
Location	Crashes/100 MEV
1. Park St (NC 273) and Hawley Ave/Browntown Rd	143.02
2. Park St (NC 273) and Hawley Ave/Wendy's DW	97.36
3. Park St (NC 273) and Wilkinson Blvd (US 74)	141.69
4. Wilkinson Blvd (US 74) and Hawley Ave	72.84
5. Hawley Ave and Pizza Hut DW	0.00
6. Hawley Ave and Hawley Ave/Chick-fil-A DW	12.67
Average	***113.64***

Table 11.2 shows the crash rates at the study area intersections resulted in a weighted average crash rate of 113.64 crashes per 100 million entering vehicles (MEV), with the highest rates occurring at the unsignalized intersection of Park Street (NC 273) and Hawley Avenue/Browntown Road, and the signalized intersection of Park Street (NC 273) and Wilkinson Boulevard (US 74). There have been 116 total crashes reported over this three-year period at these intersections.

Table 11.3 – Crash Type Summary					
Crash Type	1. Park St (NC 273) and Hawley Ave /Browntown Rd	2. Park St (NC 273) and Hawley Ave/Wendy's DW	3. Park St (NC 273) and Wilkinson Blvd (US 74)	4. Wilkinson Blvd (US 74) and Hawley Ave	6. Hawley Ave and Hawley Ave/CFA DW
Angle	5	11	11	3	0
Backing Up	0	2	1	0	0
Head On	0	1	0	0	0
Left-Turn, Different Roadways	3	1	0	0	0
Left-Turn, Same Roadway	2	5	2	1	0
Other Collision with Vehicle	0	0	1	0	0
Pedestrian	0	1	1	0	0
Ran off Road - Left	1	0	0	0	0
Ran off Road - Right	1	0	0	0	0
Rear End, Slow or Stop	27	9	40	8	0
Rear End, Turn	1	0	0	0	0
Right-Turn, Different Roadways	0	0	0	1	0
Right-Turn, Same Roadway	0	2	1	0	1
Sideswipe, Same Direction	10	1	8	4	0
Sideswipe, Opposite Direction	0	2	1	0	0
Total	***50***	***35***	***66***	***17***	***1***

The most common crash type within the study area were rear-end collisions, making up 50% of total crashes. As shown in Table 11.3, rear-end collisions were most prevalent at the unsignalized intersection of Park Street (NC 273) and Hawley Avenue/Browntown Road, and the signalized intersection of Park Street (NC 273) and Wilkinson Boulevard (US 74).

Rear-end collisions are often associated with higher levels of congestion at both signalized and unsignalized intersections. Based on further review of the crash data at these intersections, the rear-end collisions were reported on all approaches, rather than focused on just one area of the intersections, further indicating the cause to most likely be due to relative congestion along this corridor.

As noted in Section 3 under the Capacity Analysis, the intersection of Park Street (NC 273) and Wilkinson Boulevard (US 74) has been identified for intersection improvements through NCDOT TIP Project No. U-5959. This project would be designed to address the safety and congestion issues by increasing capacity and improving mobility through this corridor.

Additionally, as discussed through the **Capacity Analysis**, the proposed Culver's Belmont restaurant is not expected to significantly increase congestion at these intersections, and therefore is not expected to have a significant impact on safety at these intersections upon build-out of the proposed site.

Crash data provided by NCDOT is attached.

Conclusions

Based on the capacity analyses performed at each of the identified study intersections, along with review of the auxiliary turn-lane warrants and crash analyses contained herein, the following improvements are identified to mitigate the operational impact of the proposed development on the adjacent street network:

2. Park Street (NC 273) and Hawley Avenue/Wendy's Driveway

- Extend the eastbound shared left/through lane along Hawley Avenue from 275 feet to 375 feet by restriping the existing two-way left-turn lane (TWLTL)

5. Hawley Avenue and Pizza Hut Driveway/Access 1

- Construction of Access 1 as a stop-controlled, left-over with a single egress lane and single ingress lane

  The applicant indicated at the TTM Scoping Meeting that driveway configurations would be explored to confirm the delineating measures to ensure the proposed Culver's driveway is restricted to a left-over while still allowing full-movement operations for the Pizza Hut driveway (see **Section 5** under the **Capacity Analysis**).

7. Hawley Avenue and Access 2

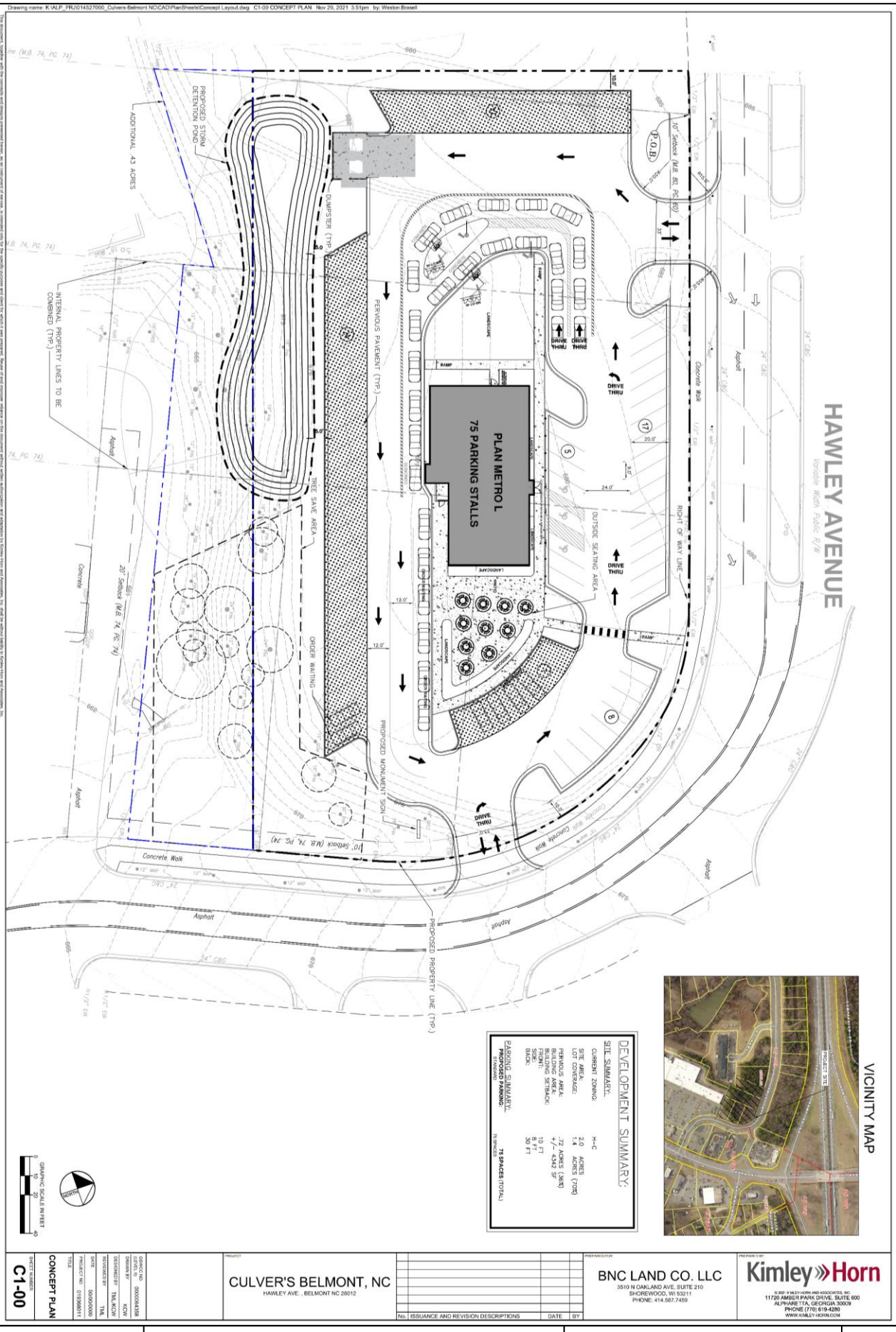
- Construction of Access 2 as a full-movement, stop-controlled driveway with a new median opening (subject to approval by City of Belmont) with a single egress lane and single ingress lane
- Westbound left-turn lane along Hawley Avenue with 100 feet of storage

The mitigation improvements identified withing the study area are shown in **Figure 9** (attached). These improvements are subject to approval by NCDOT and the City of Belmont. All additions and attachments to the State and City roadway system shall be properly permitted, designed, and constructed in conformance to standards maintained by the agencies.

Attachments

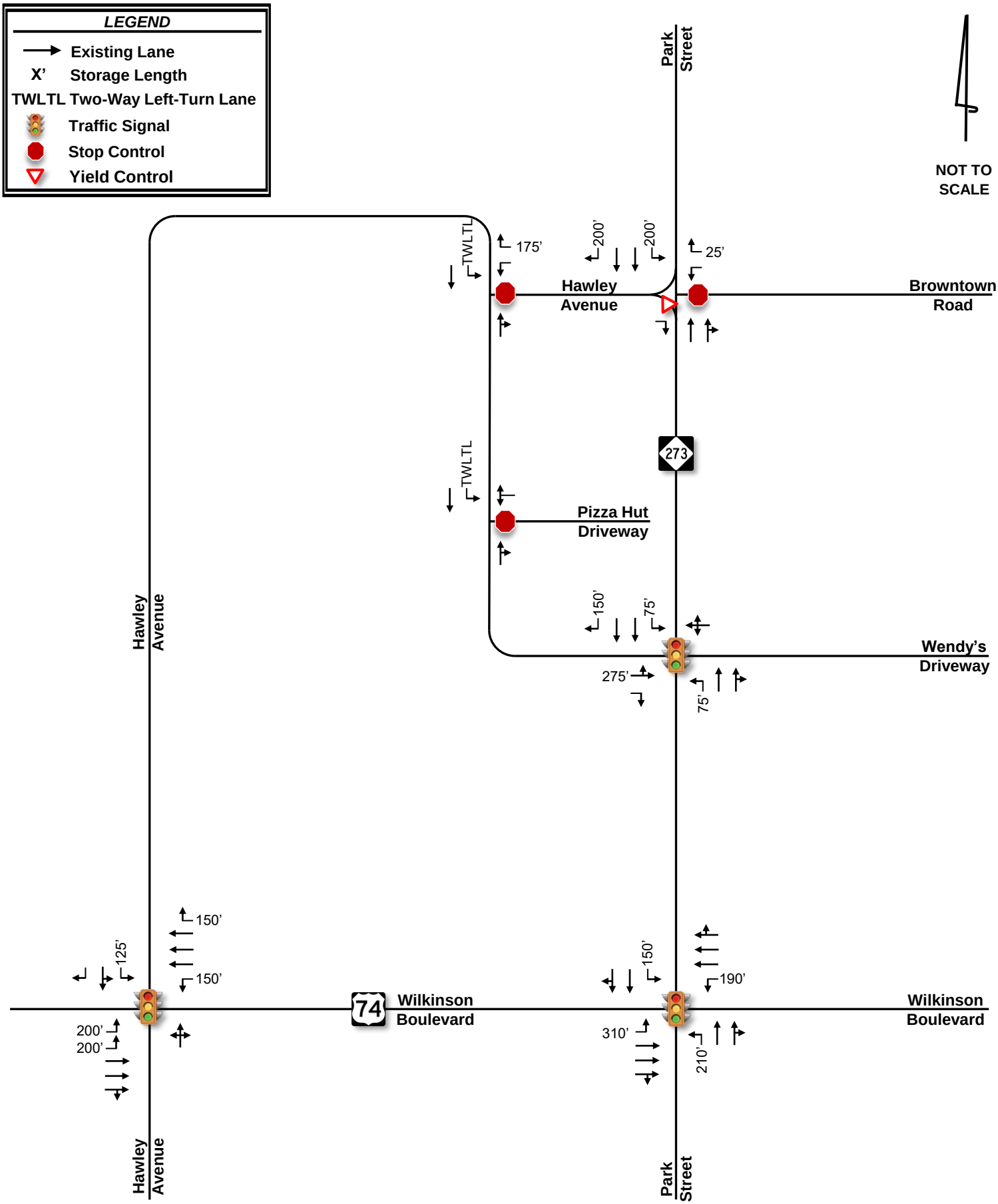
1. Figures 1-9 (under same cover)
2. Memorandum of Understanding
3. Intersection Volume Development Worksheets
4. Signal Geometric Plans
5. Synchro Capacity Analysis Reports
6. Queueing and Blocking Reports
7. Auxiliary Turn Lane Warrants
8. Crash Data

Cc:	Shelley DeHart, AICP	City of Belmont
	Blake Guffey	NCDOT

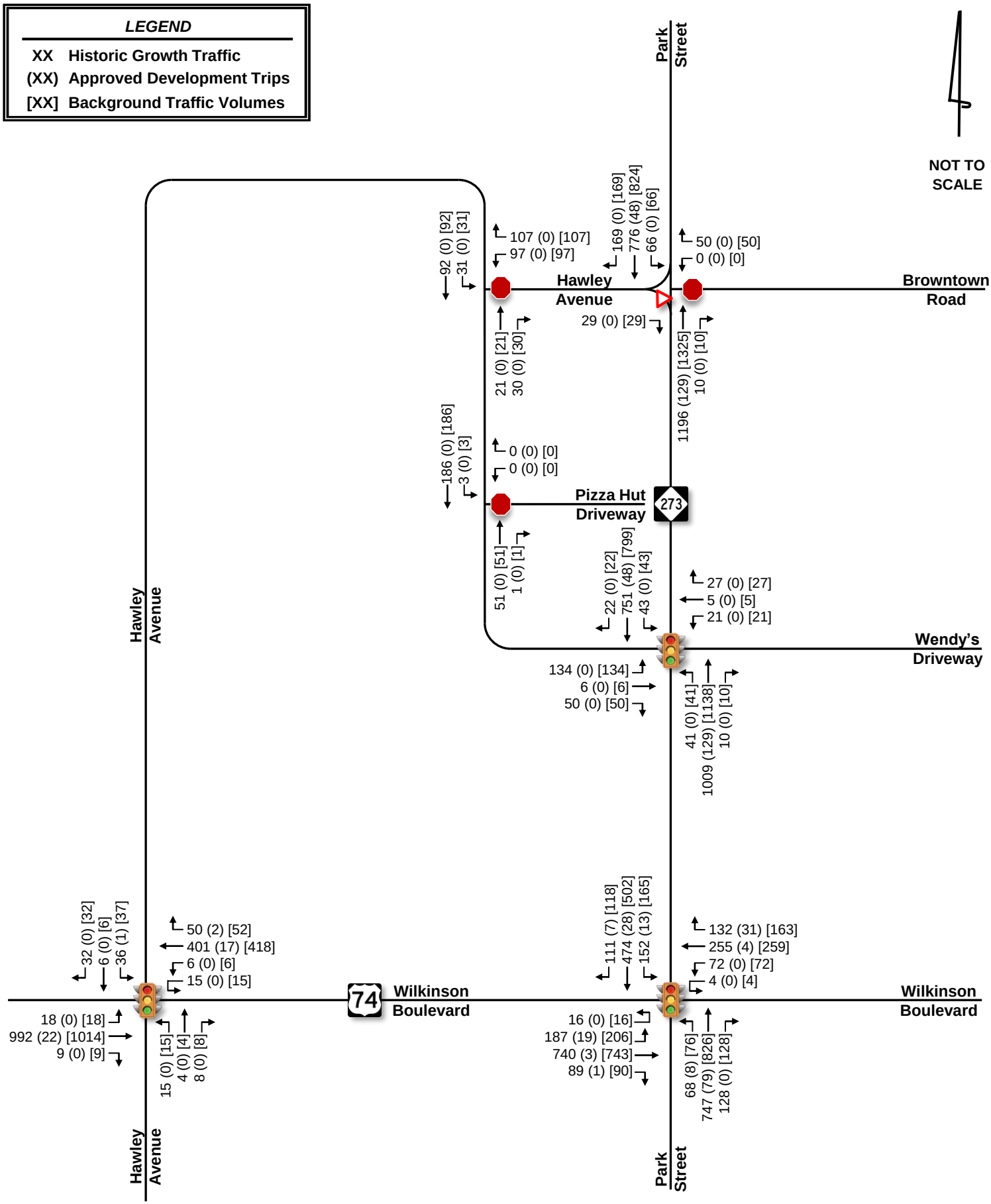


BELMONT NORTH CAROLINA / Kimley»Horn	**Culver's Belmont Transportation Technical Memorandum**	**Proposed Site Plan**	**Figure 1**

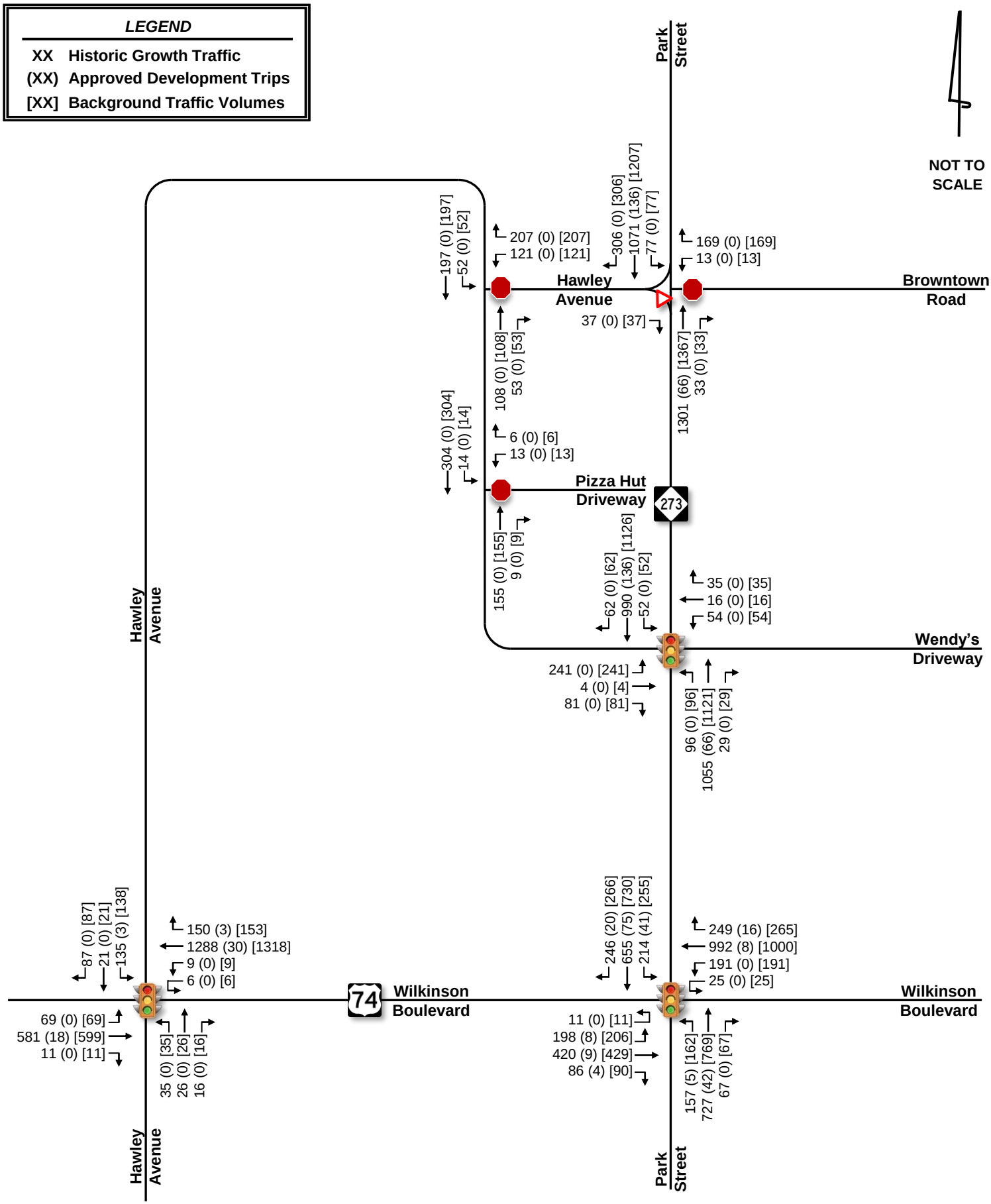
BELMONT NORTH CAROLINA Kimley»Horn	**Culver's Belmont Transportation Technical Memorandum**	**Study Area/ Site Location**	**Figure 2**



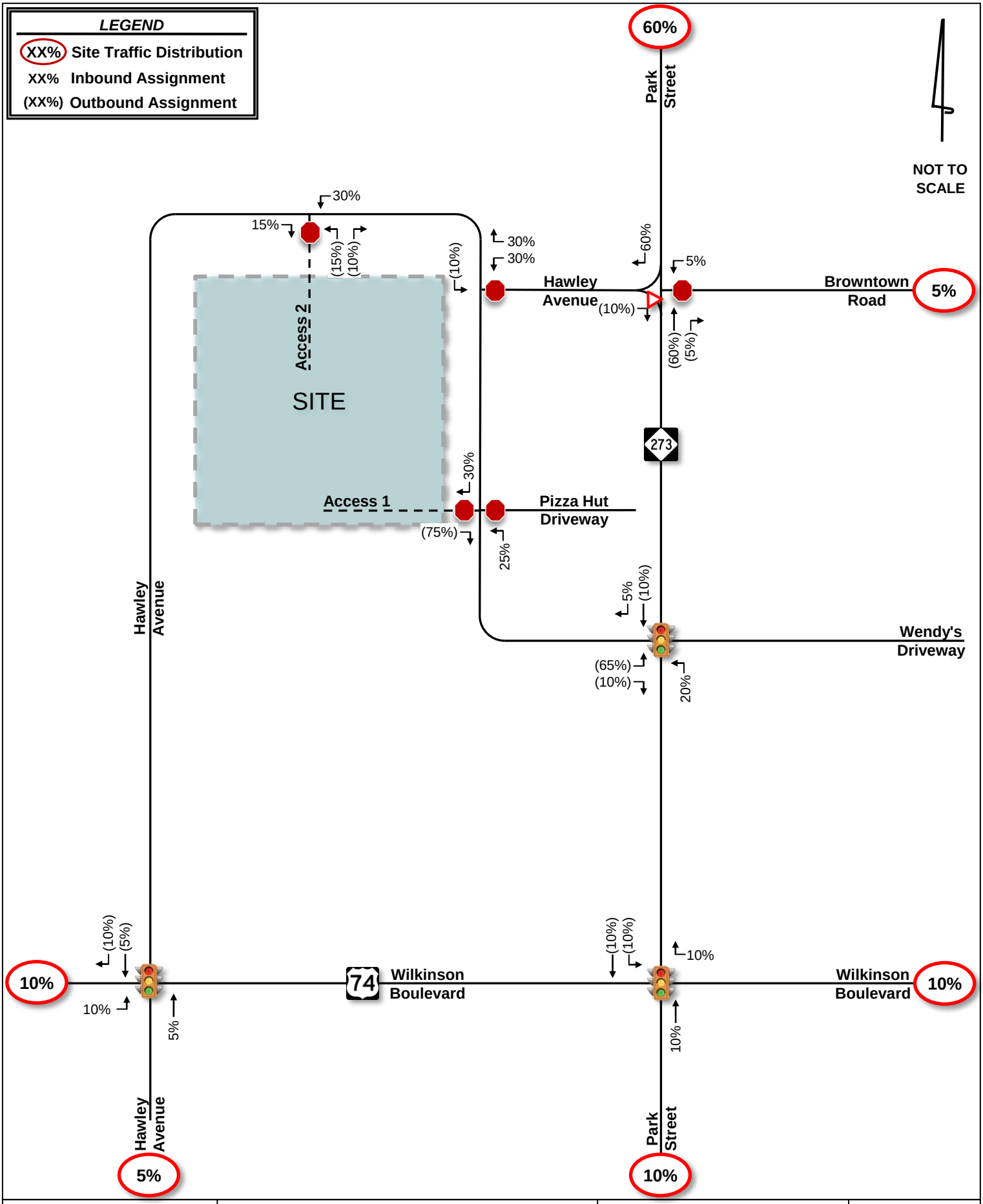
BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	2022 Existing Laneage	Figure 3



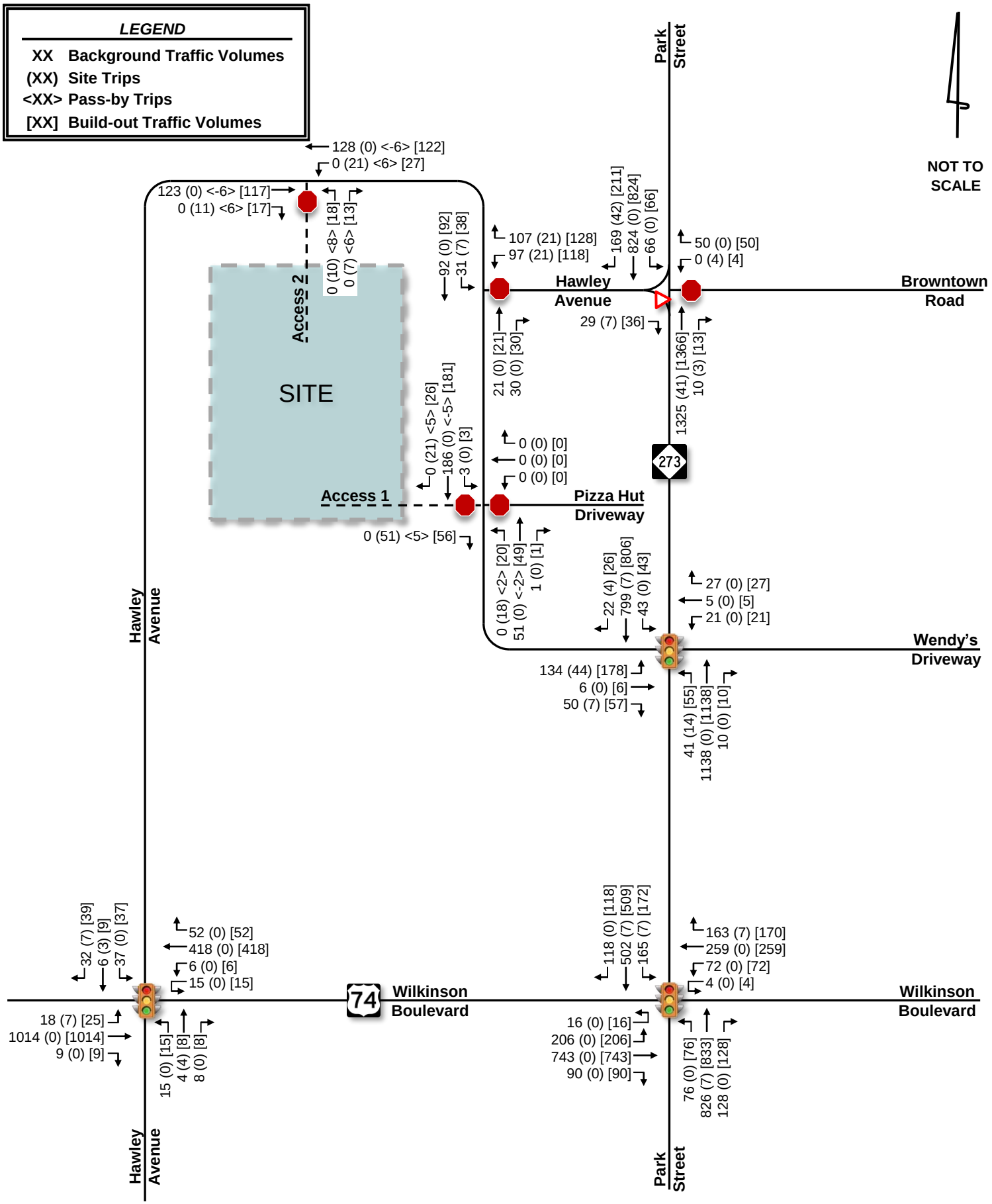
BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	2022 Background AM Peak-Hour Traffic Volumes	Figure 4



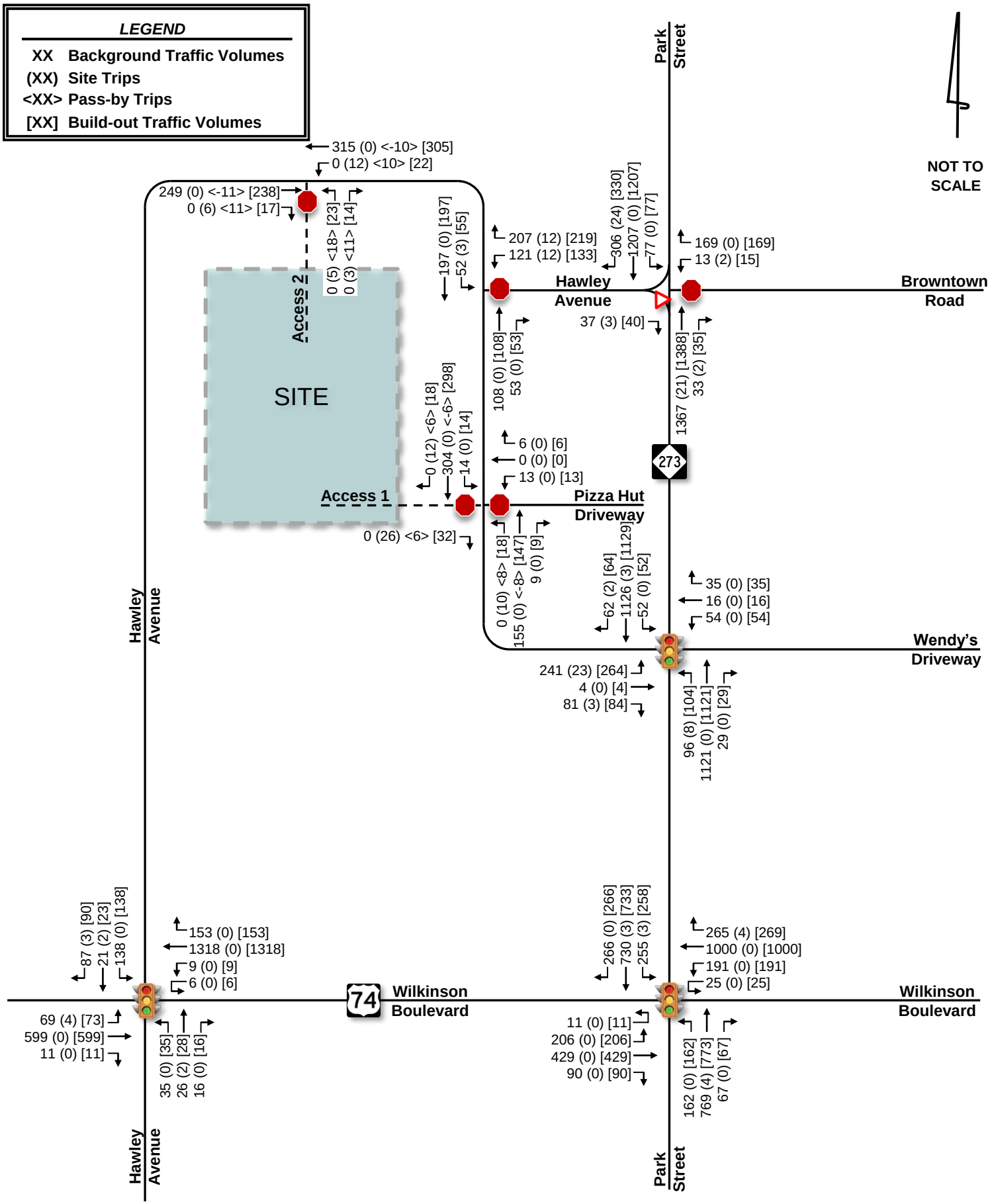
BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	2022 Background PM Peak-Hour Traffic Volumes	Figure 5



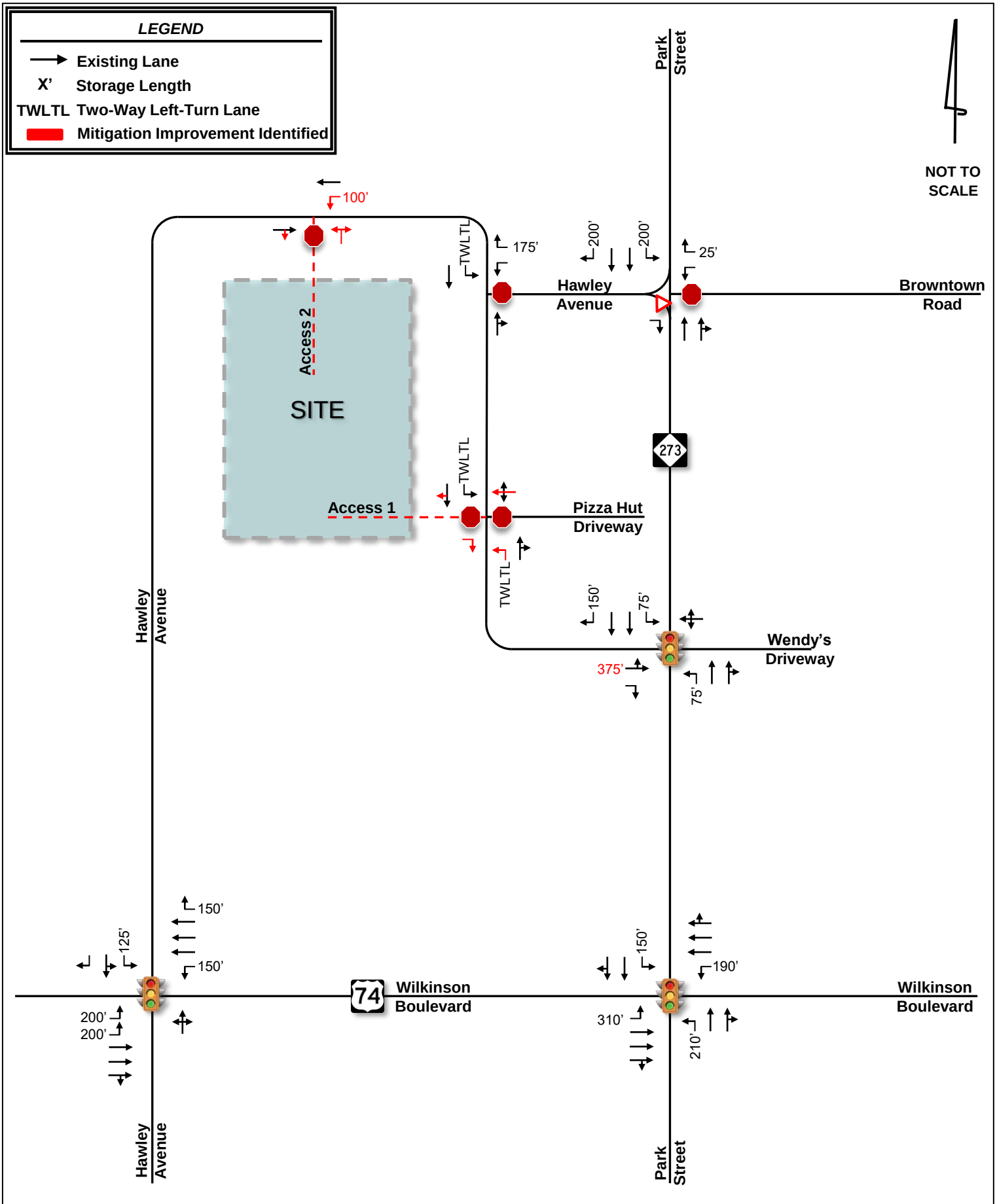
BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	Site Trip Distribution and Assignment	Figure 6



BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	2022 Build-out AM Peak-Hour Traffic Volumes	Figure 7



BELMONT NORTH CAROLINA Kimley»Horn	**Culver's Belmont Transportation Technical Memorandum**	**2022 Build-out PM Peak-Hour Traffic Volumes**	**Figure 8**



BELMONT NORTH CAROLINA Kimley»Horn	Culver's Belmont Transportation Technical Memorandum	Identified Mitigation Improvements	Figure 9