Kimley»Horn

TRANSPORTATION TECHNICAL MEMORANDUM

To: Shelley DeHart, AICP – City of Belmont

From: Brady Finklea, PE – Kimley-Horn

Date: June 12, 2018

Subject: ***Tucker Road Transportation Technical Memorandum (TTM)***
Belmont, North Carolina

As requested by the City of Belmont, Kimley-Horn has performed a traffic evaluation to determine the potential traffic impacts on the surrounding transportation infrastructure for the proposed Tucker Road residential development. Based on discussions with City staff, a sketch plan for the proposed site was submitted to the City prior to the adoption of the City's TIA Ordinance on March 6, 2017. Given that the site is expected to generate enough trips to meet the City's TIA Ordinance for a Traffic Impact Analysis (TIA), along with the timing of the initial submittal, the City requested Transportation Technical Memorandum (TTM) be performed. A TTM scoping meeting was held with the City of Belmont and representatives of the applicant in Belmont on April 18, 2018, to obtain background information and to ascertain the scope and parameters to be included in this TTM. A Memorandum of Understanding (MOU) was developed based on discussions from this meeting that documented all scoping parameters to be used for the TTM and was reviewed and agreed upon by the City of Belmont and the applicant.

The primary objectives of this evaluation are:

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

The site is located south of Tucker Road approximately 2,500 feet west of S Point Road (NC 273) in Belmont, North Carolina. Based on the site plan provided by the applicant, the proposed development is currently envisioned to consist of approximately 140 single-family homes. For the purposes of this TTM, the development is assumed to be completed (built-out) in 2023 and is proposed to include five access points to North Carolina Department of Transportation's (NCDOT) roadway system, including two driveways along Tucker Road, two driveways along Tanglewood Cove and one driveway along Canal Road. This TTM includes an evaluation of each of the five proposed driveways, along with the Tucker Road and Canal Road connections to S Point Road (NC 273). The intersection of S Point Road (NC 273) and Boat Club Road was also evaluated, given the short distance between Tucker Road and Boat Club Road.

The study area/site location and proposed site plan can be seen in **Figure 1** and **Figure 2**, respectively.

EXISTING TRAFFIC CONDITIONS

Based on coordination with the City and applicant, the study area for this analysis includes the following existing intersections:

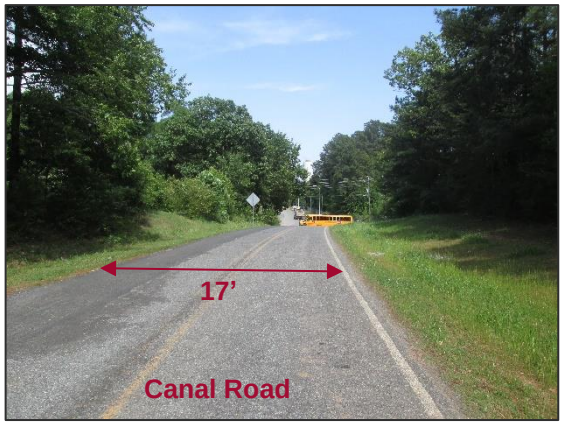
1. S Point Road (NC 273) and Boat Club Road
2. S Point Road (NC 273) and Tucker Road
3. S Point Road (NC 273) and Canal Road

S Point Road (NC 273) is a two-lane, undivided minor arterial with intermittent turn lanes throughout the study area and a posted speed limit of 45 mph in the vicinity of the proposed site. S Point Road (NC 273) serves as the primary north/south route along the peninsula formed between the Catawba River and South Fork River, where portions of Belmont and Gaston County exist. This route serves both North Carolina and South Carolina commuters via a bridged connection to York County, South Carolina. S Point Road (NC 273) carries an average daily traffic (ADT) volume of 8,300 vehicles per day (vpd) south of Tucker Road and 12,000 vpd just north of Forest Hill Road based on the NCDOT ADT maps. During the AM peak hour, the traffic flow is heavily distributed northbound towards I-85, Belmont, Charlotte and Gastonia; the reciprocal heavy southbound flow is experienced during the PM peak hour.

Tucker Road is an NCDOT-maintained, two-lane, undivided local roadway based on NCDOT's functional classification system with no posted speed limit. This road currently serves a limited number of residential users along Tucker Road and is currently very narrow, varying between 16.5 to 17 feet, with no shoulders. During field observations, many vehicles were seen driving in the center of the road across the marked double-yellow due to the narrow width.

Boat Club Road is an NCDOT-maintained, two-lane, undivided local roadway based on NCDOT's functional classification system with a posted speed limit of 35 mph. Boat Club Road was included in this evaluation due to its close proximity to the intersection of S Point Road (NC 273) and Tucker Road. Boat Club Road is located approximately 100 feet north of Tucker Road.

Canal Road is an NCDOT-maintained, two-lane, undivided local roadway based on NCDOT's functional classification system with a posted speed limit of 35 mph. Like Tucker Road, this road currently serves a limited number of residential users along Canal Road and Tanglewood Cove, and is currently very narrow, measured at approximately 17 feet with no shoulders. During field observations, many vehicles were also seen driving in the center of Canal Road across the faintly-marked double-yellow due to the narrow width.



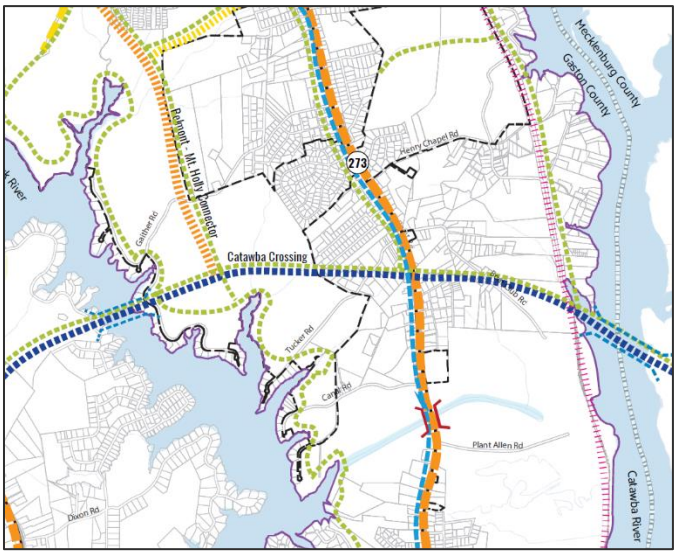
Tanglewood Cove is an NCDOT-maintained, two-lane, unmarked local roadway based on NCDOT's functional classification system with a posted speed limit of 15 mph. This road serves bidirectional traffic; however, the road was measured at approximately 12 feet with no striping nor shoulders. During field observations, it was observed that two vehicles travelling in opposite directions could not pass one another; instead, one vehicle would pull off on the side of the road to wait for the other vehicle to pass.

Existing roadway geometry at the study intersections can be seen in **Figure 3**.

PROJECTS IDENTIFIED IN TRANSPORTATION PLANS

Based on review of the adopted transportation plans for the area, there are four future projects that that have been identified within the study area. However, none of these are currently funded based on the current planning documents. The four identified future projects include:

- Catawba Crossings
- Belmont-Mount Holly Southern Loop
- Proposed Multi-Use Path or Greenway along South Fork River
- Proposed Bike Lane/Paved Shoulder along Tucker Rd



The Catawba Crossings is a proposed boulevard that would provide new bridged connections over the Catawba and South Fork Rivers to connect I-485 in Mecklenburg County to NC 279 in Gaston County. This project is identified within Belmont's Comprehensive Land Use Plan and in the 2035 Horizon Year of Gaston-Cleveland-Lincoln Metropolitan Planning Organization's (GCLMPO) 2045 Metropolitan Transportation Plan (MTP). Belmont's Future Transportation Map (from the Comprehensive Land Use Plan) shown to the right indicates the future Catawba Crossings alignment crossing Tucker Road north of the proposed site between the site and S Point Road (NC 273). Note that the alignment is considered conceptual and the design is subject to change. However, consideration should be given to how Tucker Road would need to be modified and how access to the proposed site would be impacted if the alignment is constructed as shown in this plan.

Below is additional information found in the adopted transportation planning documents relative to each of these four projects:

- **Catawba Crossings -** New Boulevard from I-485 to NC 279
  - Plans show the future alignment near or through proposed site
  - Included in the following transportation planning documents:
    - Belmont 2018 Comprehensive Land Use Plan
    - GCLMPO 2045 MTP – 2035 Horizon Year
    - GCLMPO Comprehensive Transportation Plan (CTP)
- **Belmont-Mount Holly Southern Loop** - New 4-lane divided facility from NC 273 to US 29/74
  - GCLMPO shows preliminary functional design tying into S Point Rd near Tucker Rd
  - Included in the following transportation planning documents:
    - Belmont 2018 Comprehensive Land Use Plan
    - GCLMPO 2045 MTP – Unfunded
    - GCLMPO CTP
- **Proposed Multi-Use Path or Greenway** - along South Fork River
  - Included in the following transportation planning documents:
    - Belmont 2018 Comprehensive Land Use Plan
    - GCLMPO CTP (Bike, Ped)
- **Proposed Bike Lane/Paved Shoulder** - along Tucker Rd to S Point Road (NC 273)
  - Included in the following transportation planning documents:
    - Belmont 2012 Bicycle Plan
    - GCLMPO CTP (Bike)

TRAFFIC VOLUME DEVELOPMENT

Existing

Intersection turning-movement, heavy-vehicle, pedestrian and bicycle counts were performed by National Data & Surveying on Wednesday, May 2, 2018, for the AM (6:30-8:30 AM) and PM (4:30-7:00 PM) peak periods at the following intersections:

1. S Point Road (NC 273) and Tucker Road
2. S Point Road (NC 273) and Boat Club Road
3. S Point Road (NC 273) and Canal Road

Based on these counts, the network peak hours were determined to be 6:45-7:45 AM and 5:00-6:00 PM. Traffic volumes were balanced along S Point Road (NC 273) between Tucker Road and Boat Club Road. However, no volume balancing was performed between Tucker Road and Canal Road due to the spacing of the intersections and the presence of residential and other driveways between these locations.

Background

The southern portion of Belmont is uniquely situated along a peninsula formed between the Catawba River and South Fork River, where S Point Road (NC 273) serves as the only north/south collector route along the peninsula. Therefore, as the southern portion of the peninsula has developed, and continues to develop, most, if not all, generated traffic is forced to use S Point Road (NC 273). Additionally, this route also serves South Carolina commuters via a bridged connection to York County, South Carolina. The upper state of South Carolina, and in particular York County, has

experienced tremendous growth over the past decade, specifically new residential developments bringing in new residents looking to commute to Charlotte for work. The impacts of this growth are felt in Belmont and Gaston County and along S Point Road (NC 273). Based on NCDOT ADT maps, S Point Road (NC 273) has experienced 7.7% annual growth between 2012 and 2016 south of the proposed site near Plant Allen Road, and 4.5% annual growth between the same timeframe north of the site near Bowen Road. Considering that this study also includes growth from two specific approved developments (described below), the non-specific annual growth rate determined and agreed to be used to calculate base 2023 background traffic volumes was slightly lower at 4% per year. This growth rate was coordinated with City staff and the applicant as shown in the approved MOU, and was applied to the 2018 existing peak-hour traffic volumes for five years.

At the direction of the City of Belmont, two future off-site developments that are expected to impact traffic volumes within the study area were included in the background traffic volumes for this TTM. These developments, land uses/intensities, and current build-out percentages are outlined in **Table 1**, along with the improvements shown as being required within these respective studies.

Table 1 – Approved Developments

Development	Land Use/Intensity	% Build-out	Required Improvements
McLean (Armstrong Rd)	810 Single-Family units 100 Multifamily units 125,000 SF Shopping Center	15%	No required improvements at study intersections.
Belmont Town Center (N of Stowe Rd)	16 Single-Family units 92 Townhome units 27,800 SF General Office 21,600 SF Specialty Retail 53,000 SF Supermarket 4,330 SF Fast Food Restaurant 14 FP Gas Station	60% *(of approved trip gen)*	No required improvements at study intersections.

Based on discussions with the City of Belmont and NCDOT, a middle school is proposed south of South Point High School; however, this school has not been approved, and a TIA will be required prior to approval. Therefore, the school was not included in this TTM as an approved development.

Volumes for the McLean and Belmont Town Center developments were obtained from the *Hope Armstrong Peninsula Development TIA* (J.M. Teague, May 2014) and the *Belmont Town Center Revised TIA* (Ramey Kemp, July 2015), respectively. The existing turning-movement splits were used to carry and assign volumes appropriately at study area intersections that were not included in the approved TIAs.

Figure 4 illustrates the location of both approved developments. **Figures 5** and **6** show the 2023 background AM and PM peak-hour traffic volumes, respectively, that include the historical growth traffic (2023 traffic without the approved development trips) and approved development trips.

Build-Out

The traffic generation potential of the proposed 140-unit Tucker Road residential development was calculated using the trip generation rates published in *Trip Generation* (Institute of Transportation Engineers, Ninth Edition, 2012).

Table 2 summarizes the projected trip generation for the proposed development. During a typical weekday, the proposed development has the potential to generate 105 and 140 net new external trips during the AM and PM peak hours, respectively.

Table 2 - Trip Generation

Land Use	Intensity		Daily	AM Peak Hour			PM Peak Hour		
				Total	In	Out	Total	In	Out
Single-Family Homes	140	DU	1,333	105	26	79	140	88	52
Net New External Trips			**1,333**	**105**	**26**	**79**	**140**	**88**	**52**
Note: Trip generation was calculated using the following data:									
Daily Traffic Generation									
Single-Family Homes	[ITE 210]	=	T = 9.52 X; (50% in, 50% out)						
AM Peak-Hour Traffic Generation									
Single-Family Homes	[ITE 210]	=	T = 0.75 X; (25% in, 75% out)						
PM Peak-Hour Traffic Generation									
Single-Family Homes	[ITE 210]	=	T = 1.00 X; (63% in, 37% out)						

The proposed development's trips were assigned to the surrounding network based on existing peak-hour turning movements, surrounding land uses, potential destinations for the new residents and population densities in the area. The following site traffic distribution was reviewed and approved as part of the MOU by City of Belmont staff and the applicant:

- 90% to/from the north along S Point Road (NC 273)
- 10% to/from the south along S Point Road (NC 273)

The overall site traffic distribution and assignment are shown in **Figure 7**.

The 2023 build-out traffic volumes include the assignment of the projected site traffic generation added to the 2023 background traffic volumes. **Figures 8** and **9** show the projected 2023 build-out traffic volumes (including the 2023 background volumes and the projected site trips) for the AM and PM peak hours, respectively.

CAPACITY ANALYSIS

Synchro Version 9 software along with SimTraffic microsimulation analysis were used to evaluate the AM and PM peak-hour operating characteristics of the study area intersections. **Table 3** lists the level-of-service (LOS) control delay thresholds published in the *Highway Capacity Manual* (HCM) for unsignalized intersections.

Table 3
Vehicular LOS Control Delay Thresholds for Unsignalized Intersections

Level-of-Service	Average Control Delay per Vehicle [sec/veh]	
A	≤ 10	Short Delays
B	> 10 – 15	
C	> 15 – 25	
D	> 25 – 35	Moderate Delays
E	> 35 – 50	
F	> 50	Long Delays

The *Highway Capacity Manual* (HCM) defines LOS as a "quantitative stratification of a performance measure or measures representing quality of service", and is used to "translate complex numerical performance results into a simple A-F system representative of travelers' perceptions of the quality of service provided by a facility or service". The HCM defines six levels of service, LOS A through LOS F, with A having the best operating conditions from the traveler's perspective and F having the worst. However, it must be understood that "the LOS letter result hides much of the complexity of facility performance", and that "the appropriate LOS for a given system element in the community is a decision for local policy makers". According to the HCM, "for cost, environmental impact, and other reasons, roadways are typically designed not to provide LOS A conditions during peak periods but instead to provide some lower LOS that balances individual travelers' desires against society's desires and financial resources. Nevertheless, during low-volume periods of the day, a system element may operate at LOS A."

LOS for a two-way stop-controlled (TWSC) intersection is determined by the control delay on the side-street approaches, typically during the highest volume periods of the day, the AM and PM peak periods. 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. However, if drivers are forced to utilize a poorly-operating side-street without viable alternatives, there is a potential that safety becomes compromised as drivers choose to take unsafe gaps in the major-street traffic to turn off the side street.

Mitigation for traffic impacts caused by the proposed development were noted and recommended based on City of Belmont mitigation requirements. When determining the proposed development's

traffic impact to the study area intersections, the 2023 background and 2023 build-out conditions were compared. Based on the *City of Belmont Land Development Code*, "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:

a) the total average delay at an intersection or individual approach increases by 25% or greater, while maintaining the same LOS,
b) the LOS degrades by at least one level,
c) 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 9 software are attached. Additionally, queueing and blocking reports generated by the SimTraffic microsimulation model are also attached.

Background vs Build Comparison

Table 4 provides a comparison of the projected operations under 2023 background conditions to the 2023 build-out conditions during both the AM and PM peak hours at the three unsignalized study area intersections along S Point Road (NC 273). Note that for the purposes of this analysis, the westbound approach at Tucker Road is assumed to be the northernmost driveway at the Sonoco Gas Station (Sunoco currently has three closely-spaced full-movement driveways along S Point Road (NC 273)).

Table 4 - Background vs Build-out Conditions
Along S Point Rd (NC 273)

Condition	Measure	AM Peak Hour					PM Peak Hour				
		EB	WB	NB	SB		EB	WB	NB	SB	
		EBLTR	WBLTR	NBLTR	SBL	SBTR	EBLTR	WBLTR	NBLTR	SBL	SBTR
2023 Background											
Boat Club Road	LOS (Delay)		D (28.3)	A (0.0)	A (0.2)			D (31.0)	A (0.0)	A (2.7)	
	Synchro 95th Q		15'	0'	-	1'		9'	0'	-	5'
Tucker Road	LOS (Delay)	F (95.7)	F (63.3)	A (0.0)	A (1.0)		F (133.9)	F (63.8)	A (0.2)	A (1.0)	
	Synchro 95th Q	30'	30'	0'	-	3'	36'	64'	0'	-	2'
Canal Road	LOS (Delay)	F (58.5)	F (61.2)	A (0.1)	A (0.5)		D (33.5)	D (30.3)	A (0.0)	A (0.0)	
	Synchro 95th Q	15'	1'	0'	3'	0'	4'	10'	0'	0'	0'
2023 Build-out											
Boat Club Road	LOS (Delay)		D (31.8)	A (0.0)	A (0.2)			E (36.1)	A (0.0)	A (3.4)	
	Synchro 95th Q		17'	0'	-	1'		11'	0'	-	6'
Tucker Road	LOS (Delay)	F (359.7)	F (69.7)	A (0.0)	A (1.0)		F (696.4)	F (78.5)	A (0.4)	A (1.2)	
	Synchro 95th Q	163'	32'	0'	-	3'	158'	74'	1'	-	2'
Canal Road	LOS (Delay)	F (105.4)	F (63.6)	A (0.2)	A (0.5)		F (149.6)	D (31.6)	A (0.4)	A (0.0)	
	Synchro 95th Q	68'	1'	0'	3'	0'	56'	11'	1'	0'	0'

As previously discussed, LOS for unsignalized intersections are determined by the control delay on the side-street approaches. As shown in **Table 4**, based on the negative impact expected at each of the side street approaches caused by the addition of the proposed site traffic, mitigation is required to

be identified for all three study intersections along S Point Road (NC 273) per the *City of Belmont Land Development Code*. If no improvements are in place with the addition of site traffic, given the lack of other viable alternatives to access S Point Road (NC 273), the long delays expected (particularly along the eastbound approaches of both the Tucker Road and the Canal Road intersections) could potentially introduce safety concerns as drivers would be more likely to take unsafe gaps in the major-street traffic to turn off the side street onto S Point Road (NC 273). The increase in delay for the westbound approaches at each intersection is due to the reduction in the gaps available to be able to turn onto the mainline, caused by the added site traffic.

Given the negative impact shown in **Table 4**, the following options for laneage and access improvements were evaluated along this corridor to identify improvements to mitigate the increase in delay and improve safety to accommodate the added site traffic, while minimizing disruption to the background traffic already travelling along S Point Road (NC 273):

1. Full-movement at all intersections
2. Restricted Crossing U-Turn (RCUT) at Tucker Road
3. Align Tucker Road and Boat Club Road

Note that a preliminary signal warrant analysis was performed at each of the three intersections with S Point Road (NC 273) based on the peak-hour volumes. However, based on the 2023 build-out volumes, the peak-hour signal warrant was not met for any intersection. Therefore, the three alternatives discussed below assume unsignalized treatments only.

Alternative 1 – Full-Movement at All Intersections

Alternative 1 evaluated the three unsignalized intersections by maintaining their existing full-movement access with the following turn lanes added (based on the auxiliary turn-lane warrants found in the *NCDOT Policy On Street And Driveway Access to North Carolina Highways)*:

- Southbound right-turn lane at Tucker Road
- Southbound right-turn lane at Canal Road

Note that a southbound left-turn lane at Boat Club Road should also be considered based on NCDOT's auxiliary turn-lane warrants. However, based on a comparison of the background to build-out traffic volumes, the proposed site is not expected to drive the need for this turn lane. Therefore, this turn lane was not included in the evaluation of Alternative 1.

Table 5 summarizes the projected operations for Alternative 1 with the above turn lanes in place during both the AM and PM peak hours at the three unsignalized study area intersections along S Point Road (NC 273).

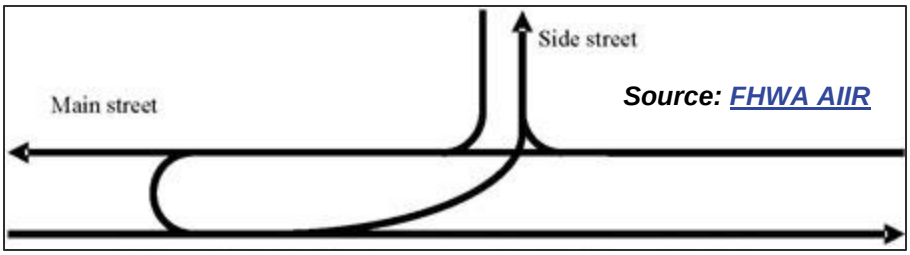
Table 5 - Alternative 1 Full-Movement at All Intersections (w/ Turn Lanes)							
Condition	Measure	EB	WB	NB	SB		
		EBLTR	WBLTR	NBLTR	SBL	SBT	SBR
AM Peak Hour							
Boat Club Road	LOS (Delay)		D (31.8)	A (0.0)	A (0.2)		
	Synchro 95th Q		17'	0'	-	1'	-
Tucker Road	LOS (Delay)	F (349.6)	F (68.6)	A (0.0)	A (1.0)		
	Synchro 95th Q	161'	32'	0'	-	3'	0'
Canal Road	LOS (Delay)	F (103.9)	F (63.6)	A (0.2)	A (0.5)		
	Synchro 95th Q	68'	1'	0'	3'	0'	0'
PM Peak Hour							
Boat Club Road	LOS (Delay)		E (36.1)	A (0.0)	A (3.4)		
	Synchro 95th Q		11'	0'	-	6'	-
Tucker Road	LOS (Delay)	F (638.8)	F (72.4)	A (0.4)	A (1.0)		
	Synchro 95th Q	154'	70'	1'	-	2'	0'
Canal Road	LOS (Delay)	F (141.8)	D (31.5)	A (0.4)	A (0.0)		
	Synchro 95th Q	54'	11'	1'	0'	0'	0'

Table 5 shows that the southbound right-turn lanes along S Point Road (NC 273) at Tucker Road and Canal Road add minimal benefit to the projected delays for the side-street approaches of these unsignalized intersections. Alternative 1 does not fully mitigate any of the side-street approaches and long delays would still be expected along with potential safety concerns. Therefore, Alternative 1, which allows all three unsignalized intersections to remain under full-movement access with the addition of turn lanes, is not recommended to mitigate the proposed site traffic impacts.

Alternative 2 – RCUT at Tucker Road

Alternative 2 evaluated the Tucker Road intersection under a Restricted Crossing U-Turn (RCUT) access configuration, while allowing the Boat Club Road and the Canal Road intersections to remain full-movement. The RCUT access configuration incorporates a directional left-turn crossover to allow the northbound left-turn movement, but prohibits left-turn and through movements from the side-street approaches. Eastbound left-turn traffic from Tucker Road would first turn right onto S Point Road (NC 273), proceed to a downstream U-turn crossover, and then execute a U-turn. The distance between Tucker Road and the U-turn crossover would need to be determined within the design phase, and should consider the turn lane length needed to accommodate the southbound U-turn, as well as

property impacts as a U-turn bulb-out would be necessary to accommodate the turning movements. The schematic below illustrates the conceptual RCUT configuration for a 3-legged intersection.



Note that the existing Sunoco Gas Station currently has five closely-spaced driveways, three along S Point Road (NC 273) and two others along Boat Club Road. Alternative 2 assumes that left turns into or out of the gas station along S Point Road (NC 273) would be restricted by the RCUT and would need to use Boat Club Road.

Based on information provided in the Institute of Transportation Engineers (ITE) *Unsignalized Intersection Improvement Guide* (UIIG), RCUTs are typically used to treat unsignalized locations with poor operational performance or safety concerns, and address issues caused by insufficient gaps in the major road traffic for left-turn movements from the minor road.

Note that based on the auxiliary turn-lane warrants found in the *NCDOT Policy On Street And Driveway Access to North Carolina Highways*, southbound right-turn lanes were assumed to be in place along S Point Road (NC 273) at Tucker Road and at Canal Road. In this alternative, a short northbound left-turn lane was also assumed at Canal Road. Based on the approved site trip distribution, only ten percent was assumed to be distributed to/from the south along S Point Road (NC 273). Still, Canal Road would be the first opportunity for drivers to enter the site from the south. Additionally, as shown in the image to the right, there is already a southbound left-turn lane, which creates pavement currently striped out on the northbound approach that could be restriped to allow for a short left-turn lane to allow northbound through vehicles to bypass left turns into the site.

Table 6A summarizes the projected operations for Alternative 2 with the RCUT in place at Tucker Road along with the turn lanes discussed above.

Table 6A - Alternative 2 RCUT at Tucker Road								
Condition	Measure	EB	WB	NB		SB		
		EBLTR	WBLTR	NBL	NBLTR	SBL	SBT	SBR
AM Peak Hour								
Boat Club Road	LOS (Delay)		F (57.9)	A (0.0)		A (0.5)		
	Synchro 95th Q		45'	-	0'	4'	0'	-
Tucker Road	LOS (Delay)	B (12.4)	D (26.0)	A (0.0)		A (0.0)		
	Synchro 95th Q	11'	5'	0'	0'	-	0'	0'
Canal Road	LOS (Delay)	F (103.8)	F (63.6)	A (0.0)		A (0.5)		
	Synchro 95th Q	68'	1'	0'	0'	3'	0'	0'
PM Peak Hour								
Boat Club Road	LOS (Delay)		F (135.6)	A (0.0)		A (0.5)		
	Synchro 95th Q		57'	-	0'	8'	0'	-
Tucker Road	LOS (Delay)	D (27.4)	C (17.8)	A (0.1)		A (0.0)		
	Synchro 95th Q	24'	14'	1'	0'	-	0'	0'
Canal Road	LOS (Delay)	F (141.3)	D (31.5)	A (0.1)		A (0.0)		
	Synchro 95th Q	54'	11'	1'	0'	0'	0'	0'

Table 6A shows that modifying the Tucker Road access to an RCUT configuration and converting the eastbound left turns from Tucker Road to eastbound right turns greatly improves this intersection. Comparing **Table 5** to **Table 6A**, the LOS for the eastbound approach improves from a LOS F to a LOS B during the AM peak hour and LOS F to a LOS D during the PM peak hour, improving the delay by over 300 seconds and over 600 seconds per vehicle during the AM and PM peak hours, respectively.

Since the RCUT configuration adds a southbound U-turn maneuver for the eastbound left-turn traffic, **Table 6B** shows the projected LOS and delay for the southbound U-turn that would be located along S Point Road (NC 273) south of Tucker Road.

Table 6B – Alternative 2 RCUT at Tucker Road S Point Road (NC 273) at Southbound U-Turn Bulb		
Condition	Measure	SB
		SBU
AM Peak Hour		
2023 Build Improved Alternative 3	LOS (Delay)	B (10.7)
	SimTraffic Max Q	60'
PM Peak Hour		
2023 Build Improved Alternative 3	LOS (Delay)	A (4.5)
	SimTraffic Max Q	43'

Table 6B shows that the southbound U-turn movement is expected to operate at LOS B during the AM peak hour and LOS A during the PM peak hour. Comparing the eastbound left-turn delay on Tucker Road shown in **Table 5** to the sum of the eastbound right-turn on Tucker Road in **Table 6A** and the southbound U-turn in **Table 6B**, Alternative 2 shows a 326-second improvement during the AM peak hour and a 607-second improvement during the PM peak hour as compared to Alternative 1.

By also taking into consideration travel time between Tucker Road and the U-turn, and then back up north past Tucker Road again, **Table 6C** provides a comparison of the average amount of time it would be expected to travel from eastbound Tucker Road to pass Boat Club Road northbound along S Point Road (NC 273) between Alternatives 1 and 2.

Table 6C – Alternative 1 vs Alternative 2
Average Travel Time from EB Tucker Rd to NB NC 273

Condition	**Alternative 1** **Full-Movement**	**Alternative 2** **RCUT**
AM Peak Hour	349.6 sec/veh	41.6 sec/veh
PM Peak Hour	638.8 sec/veh	53.7 sec/veh

Table 6C shows that even with the additional turning maneuver and travel distance for the vehicles traveling north on S Point Road (NC 273) from Tucker Road, the right-turn/U-turn combination associated with the RCUT configuration under Alternative 2 is expected to improve the travel time by approximately 90% as compared to the difficulty to turn left with full-movement access under Alternative 1. Therefore, Alternative 2 is recommended to mitigate the proposed site traffic impacts.

Alternative 2 allows drivers a safe option with acceptable travel times to exit the site and travel north. Given the connectivity that will be provided by the proposed site between Tucker Road and Canal Road and the delays shown at Canal Road in **Table 6A,** site traffic shown in **Figures 7** and **8** exiting the site using Canal Road would be likely to use Tucker Road instead, particularly during the AM and PM peak hours. Considering this, along with the truck access for the Allen Plant Steam Station on the westbound approach of Canal Road, Canal Road is recommended to remain full-movement.

Note that **Table 6A** shows that the westbound approach of Boat Club Road is expected to operate at LOS F under Alternative 2. This is due to left-turn movements added onto and off Boat Club Road that are currently utilizing the Sunoco Gas Station driveways. Consideration should be given to potentially convert Boat Club Road access to RCUT access in the opposite direction (with a U-turn bulb north of the intersection).

Alternative 3 - Align Tucker Road and Boat Club Road

Alternative 3 was a potential third option that evaluated operations if Tucker Road was realigned to intersect S Point Road (NC 273) at Boat Club Road, forming a single four-leg intersection as opposed to the current offset between these two intersections. The intersection was evaluated under unsignalized, full-movement operations with a southbound right-turn lane. The Canal Road intersection was assumed to operate similarly under unsignalized, full-movement operations with the

previously-mentioned southbound right-turn lane and northbound left-turn lane, as well as an eastbound right-turn lane along Canal Road.

Table 7 summarizes the projected operations for Alternative 3 with the realignment of Tucker Road along with the turn lanes discussed above.

Table 7 - Alternative 3
Align Tucker Road and Boat Club Road

Condition	Measure	EB		WB	NB		SB		
		EBLT	EBR	WBLTR	NBL	NBTR	SBL	SBT	SBR
AM Peak Hour									
Tucker Road / Boat Club Road	LOS (Delay)	F (412.3)		D (30.3)	A (0.0)		A (0.2)		
	Synchro 95th Q	169'	-	16'	-	0'	-	1'	0'
Canal Road	LOS (Delay)	F (97.9)		F (63.1)	A (0.0)		A (0.5)		
	Synchro 95th Q	66'	0'	1'	0'	0'	3'	0'	0'
PM Peak Hour									
Tucker Road / Boat Club Road	LOS (Delay)	F (673.7)		E (44.8)	A (0.3)		A (2.7)		
	Synchro 95th Q	154'	-	13'	-	1'	-	5'	0'
Canal Road	LOS (Delay)	F (125.8)		D (31.4)	A (0.1)		A (0.0)		
	Synchro 95th Q	50'	0'	11'	1'	0'	0'	0'	0'

Table 7 shows that the realignment Tucker Road to align with Boat Club Road adds minimal benefit to the projected delays for the side-street approaches of these unsignalized intersections. Alternative 3 does not fully mitigate any of the side-street approaches, and long delays would still be expected along with potential safety concerns. Therefore, Alternative 3, which includes unsignalized, full-movement operations at both site access points to S Point Road (NC 273) is not recommended to mitigate the proposed site traffic impacts.

Additionally, as previously discussed, the Catawba Crossings project is a future planned, but not yet funded project that would provide new bridged connections over the Catawba and South Fork Rivers to connect I-485 in Mecklenburg County to NC 279 in Gaston County. Based on Belmont's Future Transportation Map (from the Comprehensive Land Use Plan), the current conceptual alignment crosses Tucker Road north of the proposed site between the site and S Point Road (NC 273). Therefore, there is potential that Tucker Road could be modified if and when this project is funded. Therefore, acquiring right-of-way to realign Tucker Road is not recommended at this time.

Based on review of the turn lanes evaluated at the Canal Road intersection, a short northbound left-turn lane is recommended along S Point Road (NC 273) at Canal Road by utilizing the existing pavement and restriping to provide a short turn lane to accommodate one to two vehicles. Based on the approved site trip distribution, only ten percent was assumed to be distributed to/from the south along S Point Road (NC 273). Still, Canal Road would be the first opportunity for drivers to enter the site from the south. Additionally, there is already a southbound left-turn lane, which creates pavement currently striped out on the northbound approach that could be restriped to allow for a short left-turn lane to allow northbound through vehicles to bypass left turns into the site.

The southbound right-turn lane at Canal Road is not recommended based on the negligible benefit shown in the capacity analysis with consideration of the right-of-way impacts to the single-family properties in the northwest quadrant of the intersection. The eastbound right-turn lane along Canal Road is also not recommended given the relatively low volume expected between the left- and right-turn movements from Canal Road.

Proposed Site Driveways

Table 8 summarizes the LOS, control delay (seconds per vehicle), and 95th percentile queue lengths at the five proposed site driveways under 2023 build conditions. All site driveways were assumed to operate under unsignalized, full-movement operations with single-lane approaches.

Table 8 - 2023 Build Conditions at Proposed Site Driveways

Intersection	Measure	EB	WB	NB	SB
AM Peak Hour					
Tucker Road at Driveway #1	LOS (Delay)	A (0.0)	A (4.4)	A (8.6)	
	Synchro 95th Q	0'	1'	3'	
Tucker Road at Driveway #2	LOS (Delay)	A (0.0)	A (5.5)	A (8.5)	
	Synchro 95th Q	0'	0'	1'	
Tanglewood Cove at Driveway #3	LOS (Delay)	A (0.0)	A (2.4)	A (8.4)	A (8.7)
	Synchro 95th Q	0'	0'	0'	0'
Tanglewood Cove at Driveway #4	LOS (Delay)	A (0.0)	A (3.1)	A (8.4)	A (8.9)
	Synchro 95th Q	0'	0'	1'	0'
Canal Road at Driveway #5	LOS (Delay)	A (0.0)	A (0.0)		A (8.6)
	Synchro 95th Q	0'	0'		0'
PM Peak Hour					
Tucker Road at Driveway #1	LOS (Delay)	A (0.0)	A (4.1)	A (8.5)	
	Synchro 95th Q	0'	2'	2'	
Tucker Road at Driveway #2	LOS (Delay)	A (0.0)	A (4.3)	A (8.4)	
	Synchro 95th Q	0'	1'	1'	
Tanglewood Cove at Driveway #3	LOS (Delay)	A (0.0)	A (2.7)	A (8.3)	A (8.7)
	Synchro 95th Q	0'	0'	0'	0'
Tanglewood Cove at Driveway #4	LOS (Delay)	A (0.0)	A (3.6)	A (8.4)	A (9.0)
	Synchro 95th Q	0'	1'	1'	0'
Canal Road at Driveway #5	LOS (Delay)	A (0.0)	A (0.0)		A (8.6)
	Synchro 95th Q	0'	0'		0'

Table 8 shows that each of the proposed site driveways are expected to operate with short delays during both the AM and PM peak hours under build-out conditions.

Review of auxiliary turn-lane warrants are provided in the following section. No further improvements were identified at the site driveways for capacity purposes.

AUXILIARY TURN LANE WARRANTS

Warrants for additional turn-lane improvements for the study intersections 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*. The results of the warrants for left and right-turn lanes under 2023 background and build-out conditions are summarized by intersection below and are attached. Note that build-out conditions reflect access along S Point Road (NC 273) recommended under Alternative 2.

2023 Background Conditions

S Point Road (NC 273) and Boat Club Road

- Southbound left-turn lane along S Point Road (NC 273) with a minimum storage length of 75 feet

2023 Build-out Conditions

S Point Road (NC 273) and Boat Club Road

- Southbound left-turn lane along S Point Road (NC 273) with a minimum storage length of 100 feet

The recommended RCUT access configuration with a northbound left-turn lane at Tucker Road will require S Point Road (NC 273) to be widened out along this section, allowing space for a southbound left-turn lane at Boat Club Road. Additionally, the mitigation treatment for the proposed site traffic at Tucker Road would force the existing gas station traffic to utilize Boat Club Road.

S Point Road (NC 273) and Tucker Road

- Southbound right-turn lane along S Point Road (NC 273) with a minimum storage length of 75 feet

S Point Road (NC 273) and Canal Road

- Southbound right-turn lane along S Point Road (NC 273) with a minimum storage length of 50 feet

Based on the site plan, this driveway will likely operate as a secondary entrance to the site. Therefore, the southbound right-turn lane at Canal Road is not recommended based on the negligible capacity benefit shown in the capacity analysis with consideration of the right-of-way impacts to the single-family properties in the northwest quadrant of the intersection.

SIGHT DISTANCE REVIEW

As requested in the approved MOU, horizonal intersection sight distance at the proposed site driveways was reviewed as part of this TTM to determine if the conceptual driveway placements shown in the proposed site plan can accommodate adequate sight distance as it relates to the horizontal curvature of the existing roadways. However, note that vertical sight distance will still be reviewed in conjunction with horizontal sight distance by the applicant using survey as part of the site plan review.

Figure 10 and **Figure 11** show images of the current sight distance observed during field observations at the approximate locations of the proposed site driveways based on the current site plan. Observation notes are summarized by driveway below:

Tucker Road at Site Driveway #1

- Visibility to the East: approximately 350'; requires further analysis
- Visibility to the West: approximately 220'; requires further analysis

Tucker Road at Site Driveway #2

- Visibility to the East: greater than 500'; considered acceptable
- Visibility to the West: approximately 300'; requires further analysis

Tanglewood Road at Site Drive #3

- Visibility to the East: greater than 400'; considered acceptable based on the current speed limit of 15 mph
- Visibility to the West: greater than 400'; considered acceptable based on the current speed limit of 15 mph

Tanglewood Road at Site Drive #4

- Visibility to the East: greater than 210'; requires further analysis
- Visibility to the West: greater than 230'; considered acceptable based on the current speed limit of 15 mph

Canal Road at Site Drive #5

- Visibility to the East: approximately 265'; requires further analysis
- Visibility to the West: approximately 400'; requires further analysis

REVIEW OF LANE WIDTHS

The proposed site is planned to access three existing NCDOT facilities, Tucker Road, Canal Road and Tanglewood Cove. Each of these currently serve a limited number of residential users and are all currently very narrow with no shoulders. The width along all three streets are currently less than NCDOT minimum standards. As previously discussed, Tucker Road varies between 16.5 to 17 feet in width, Canal Road is approximately 17 feet wide, and Tanglewood Cove is extremely narrow at 12 feet. During field observations, many vehicles were seen driving in the center of Tucker Road and Canal Road across the faintly-marked double-yellow due to the narrow width. On Tanglewood Cove, two vehicles travelling in opposite directions could not pass one another; instead, one vehicle would pull off on the side of the road to wait for the other vehicle to pass.

Therefore, given the significant amount of additional traffic added to these streets by the proposed site, Tucker Road, Canal Road and Tanglewood Cove are recommended to be improved to meet standards outlined in the *NCDOT Subdivision Roads Minimum Construction Standards*, which requires a minimum of 18' of pavement.

CRASH DATA ANALYSIS

Crash data was obtained at study intersections for crashes that occurred between April 1, 2015, and March 31, 2018. Over this three-year period, four total crashes were reported at the three existing study intersections. The breakdown of crashes at the study intersections by severity, frequency and crash type can be seen the tables below.

Table 8.1 – Crash Severity Summary

Crash Type	Number of Crashes
Fatal Crashes	0
Class A	0
Class B	1
Class C	3
Property Damage Only	0
Total	***4***

Table 8.1 above displays the total number of crashes by severity type from most to least severe. As shown, there were no fatal or 'Class A' crashes reported in the study area intersections over the past three years. 'Class A' incidents are crashes in which serious injury is suspected, which can include significant loss of blood or broken bones. There was one 'Class B' crash in the past three years, which is a crash where minor injury is suspected, such as bruises or minor cuts. There were three 'Class C' crashes reported, which are defined as 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. There were no crashes in which only property damage occurred.

Table 8.2 – Accident Frequency Summary

Location	Crashes/100 MEV
Boat Club Road	8.53
Tucker Road	8.77
Canal Road	17.05
Average	***11.47***

Table 8.2 shows the crash rates for the three intersections along S Point Road (NC 273). As shown, the average crash rate at the study intersections was 11.47 crashes per 100 million entering vehicles (MEV). The *Henry Chapel Residential Development Traffic Impact Analysis (Kimley-Horn, February 2018)*, which reported the crashes per 100 MEV at the intersections of Armstrong Road, Henry Chapel Road, and R L Stowe Road / Nixon Road along S Point Road (NC 273), reported an average crash rate of 49.52 crashes per 100 MEV. Relatively, these intersections are reporting much lower crash rates than those at nearby intersections. As shown, Canal Road has the highest crash rate of the three study intersections, at 17.05 crashes per 100 MEV.

Table 8.3 – Crash Type Summary

Accident Type	Boat Club Road	Tucker Road	Canal Road
Angle	0	0	2
Moveable Object	1	0	0
Rear End, Slow or Stop	0	1	0
Total	***1***	***1***	***2***

At the three study intersections, the most common crash type was an angle crash, occurring twice at Canal Road over the three-year period. This crash type is often associated with unsignalized turning movements. There was one rear-end crash, caused by a slowing or stopping leading vehicle, and one collision with a moving object. These two crash types are typically on the lower end of the severity spectrum, which correlates with the data presented in **Table 8.1**.

MITIGATION IMPROVEMENTS

Based on the capacity analyses, review of auxiliary turn-lane warrants, and sight D contained herein, the following improvement is recommended to be constructed at the study intersection to accommodate the proposed development:

S Point Road (NC 273) at Boat Club Road

- Construction of a southbound left-turn lane along S Point Road (NC 273) with a minimum of 100 feet of storage

Consideration should also be given to potentially convert Boat Club Road access to RCUT access in the opposite direction (with a U-turn bulb north of the intersection).

S Point Road (NC 273) at Tucker Road/Gas Station Driveway

- Installation of a Restricted Crossing U-Turn (RCUT) access configuration that incorporates a directional left-turn crossover to allow the northbound left-turn movement, but prohibits left-turn and through movements from the side-street approaches; a minimum of 50 feet of storage should be provided for the northbound left-turn lane.
- Construction of a new U-turn crossover along S Point Road (NC 273) south of Tucker Road. The distance between Tucker Road and the U-turn crossover would need to be determined within the design phase, and should consider the turn lane length needed to accommodate the southbound U-turn, as well as property impacts as a U-turn bulb-out would be necessary to accommodate the turning movements.
- Restriction of left-turn movements into or out of the existing gas station along S Point Road (NC 273). These left-turn movements should utilize the full-movement access points on Boat Club Road.
- Construction of a southbound right-turn lane along S Point Road (NC 273) with a minimum of 75 feet of storage

S Point Road (NC 273) at Canal Road

- Installation of a northbound left-turn lane along S Point Road (NC 273) by utilizing the existing pavement and restriping to provide a short turn lane to accommodate one to two vehicles

Tucker Road from Driveway #2 to S Point Road (NC 273)

- Improve and widen to meet standards outlined in *the NCDOT Subdivision Roads Minimum Construction Standards*, which requires a minimum of 18' of pavement

Tanglewood Cove from Driveway #3/#5 to Canal Road

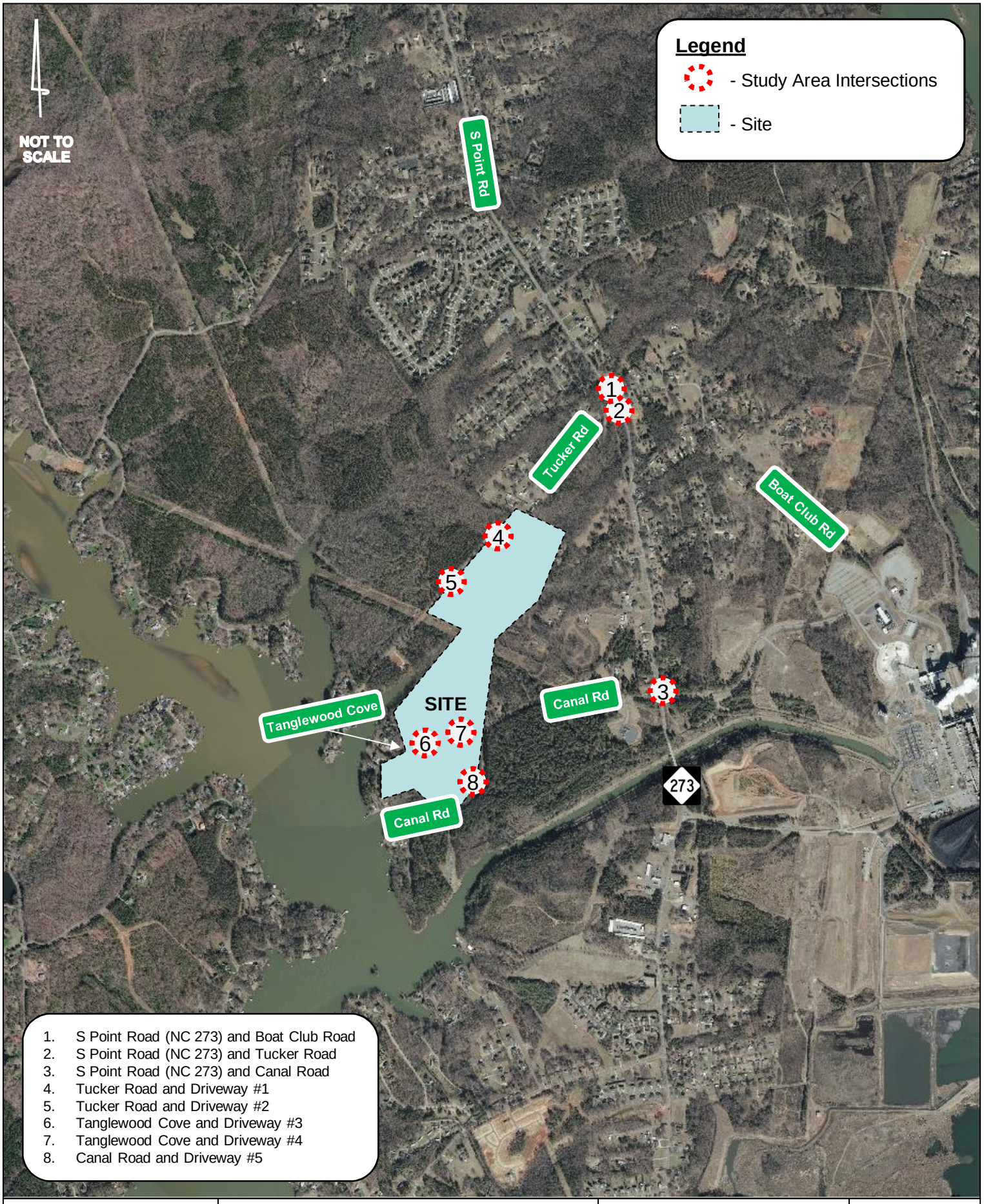
- Improve and widen to meet standards outlined in *the NCDOT Subdivision Roads Minimum Construction Standards*, which requires a minimum of 18' of pavement

Canal Road from Driveway #5 to S Point Road (NC 273)

- Improve and widen to meet standards outlined in *the NCDOT Subdivision Roads Minimum Construction Standards*, which requires a minimum of 18' of pavement

Attachments

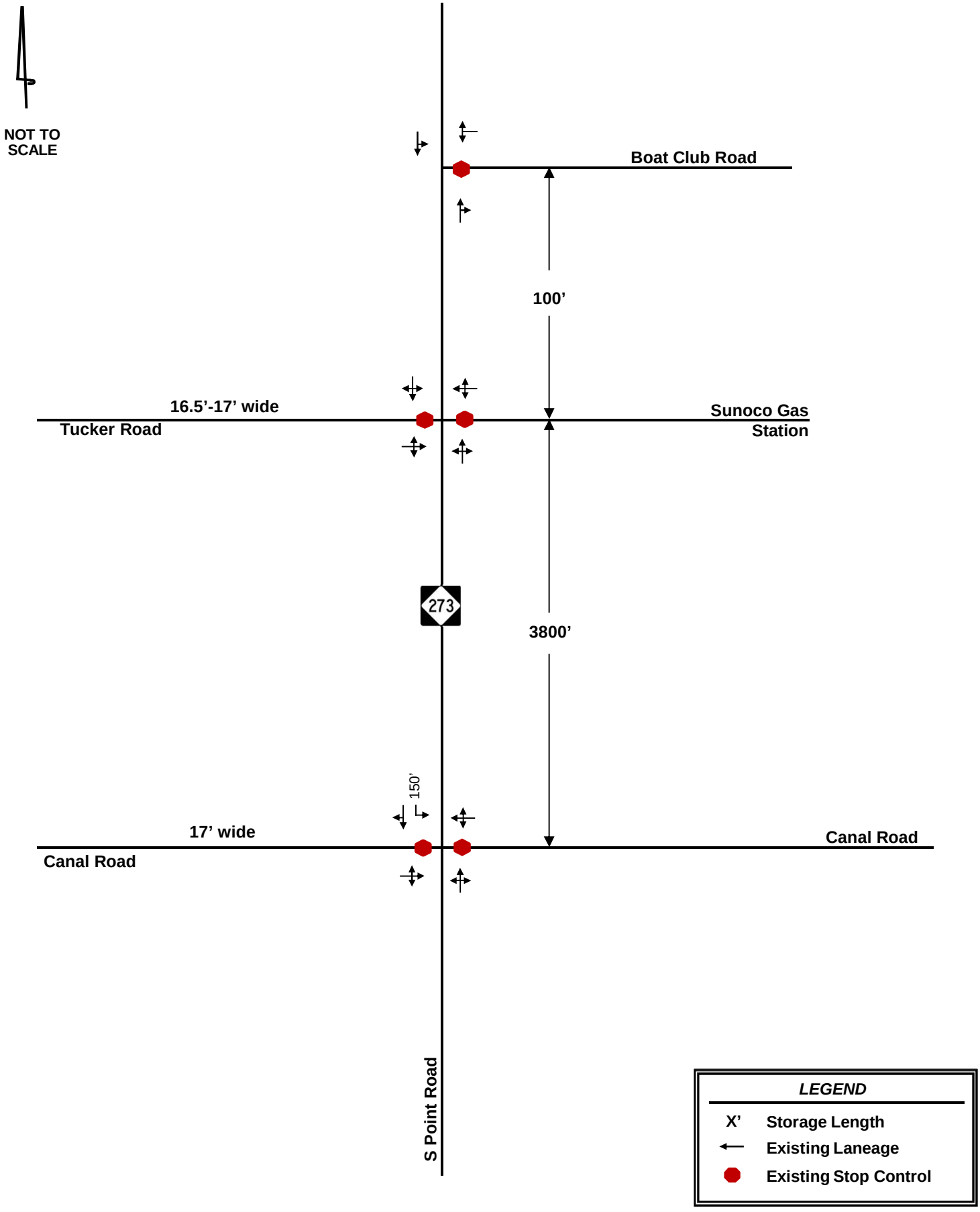
Figures 1-12
TTM Memorandum of Understanding (MOU)
Synchro Capacity Analysis Reports
SimTraffic Queueing and Blocking Reports
Auxiliary Turn-Lane Warrants



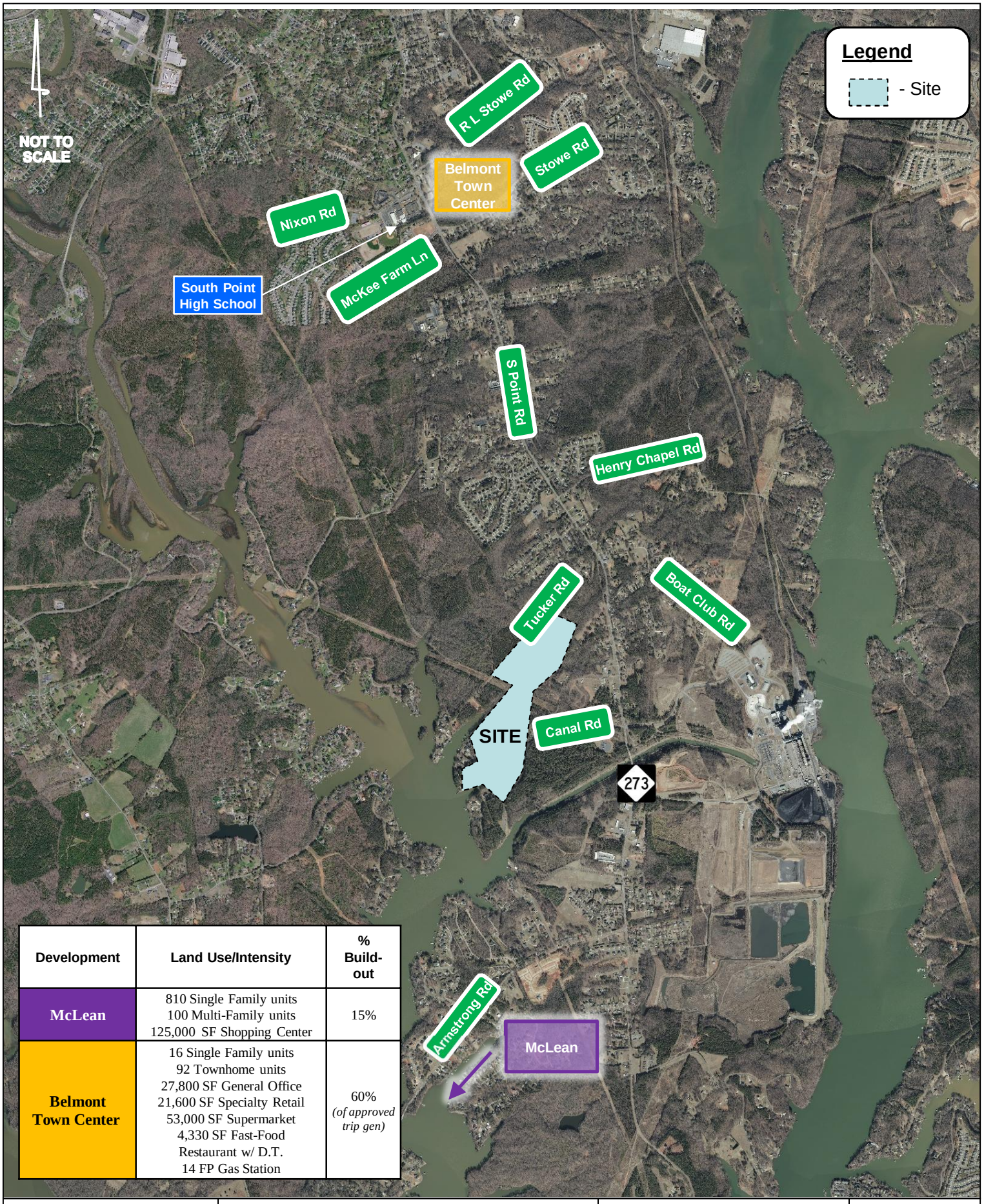
1. S Point Road (NC 273) and Boat Club Road
2. S Point Road (NC 273) and Tucker Road
3. S Point Road (NC 273) and Canal Road
4. Tucker Road and Driveway #1
5. Tucker Road and Driveway #2
6. Tanglewood Cove and Driveway #3
7. Tanglewood Cove and Driveway #4
8. Canal Road and Driveway #5

Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**Study Area/Site Location**	**Figure 1**

Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**Site Plan**	**Figure 2**

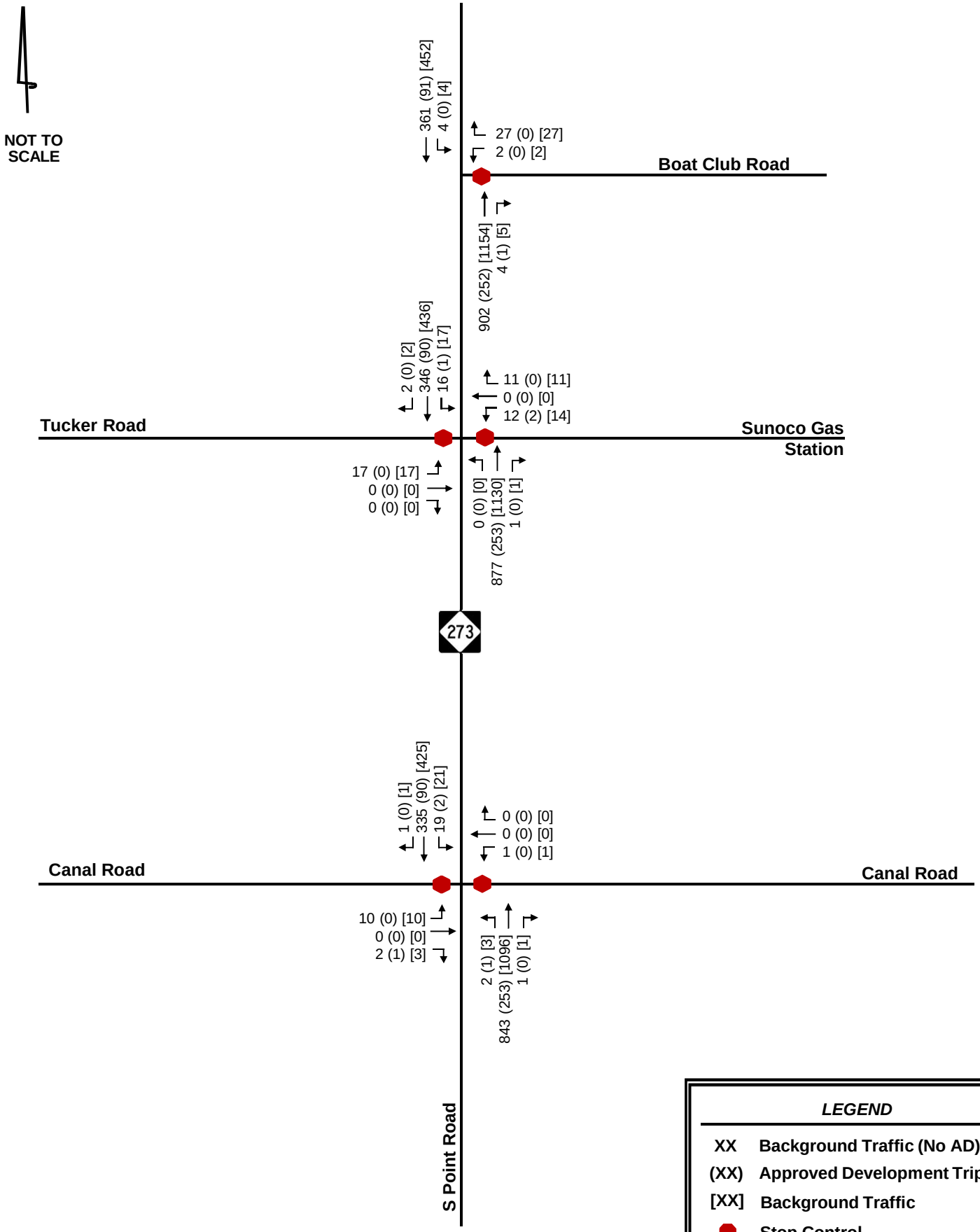


Kimley»Horn	Tucker Road Transportation Technical Memorandum	Existing Roadway Laneage	Figure 3

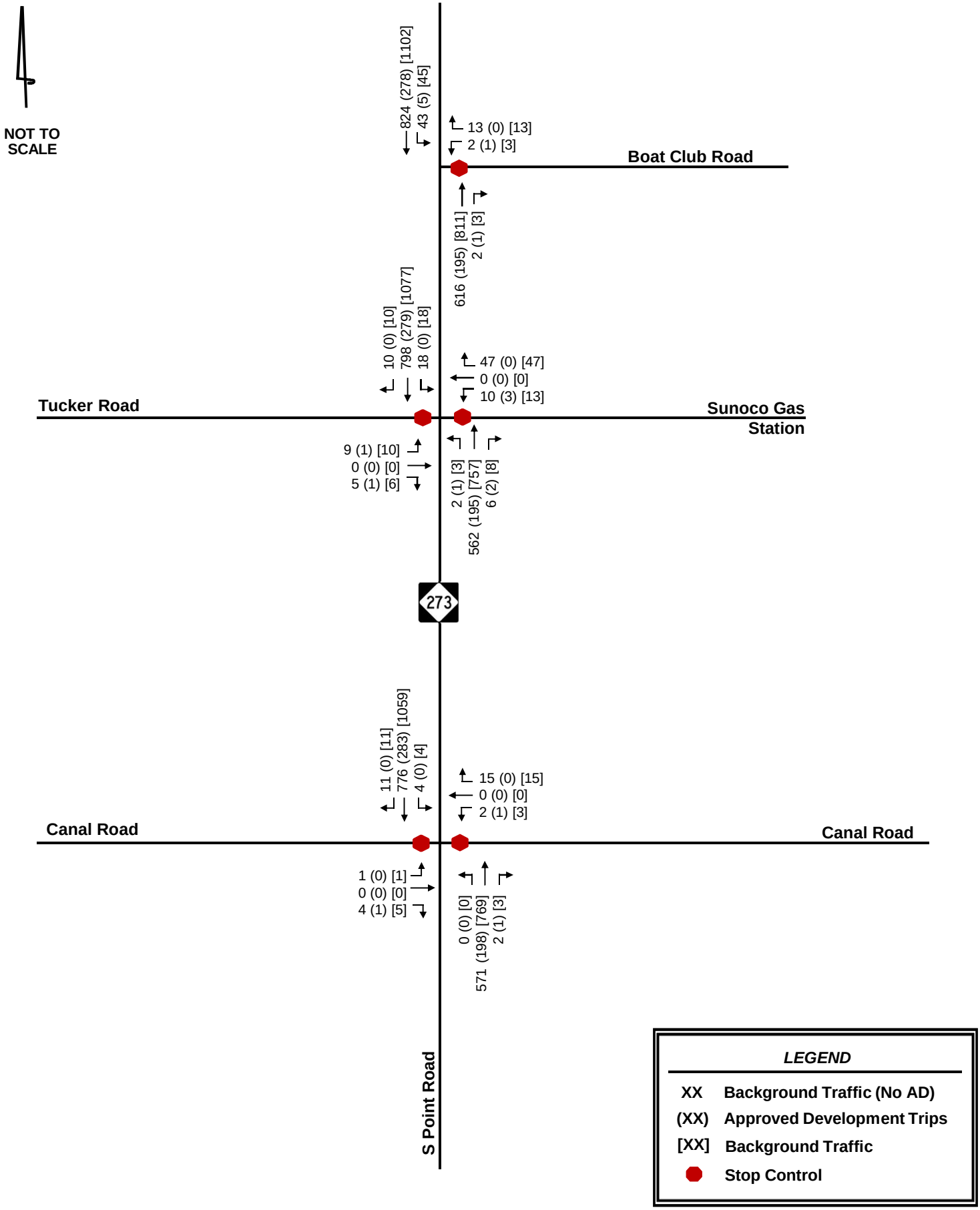


Development	Land Use/Intensity	% Build-out
McLean	810 Single Family units 100 Multi-Family units 125,000 SF Shopping Center	15%
Belmont Town Center	16 Single Family units 92 Townhome units 27,800 SF General Office 21,600 SF Specialty Retail 53,000 SF Supermarket 4,330 SF Fast-Food Restaurant w/ D.T. 14 FP Gas Station	60% *(of approved trip gen)*

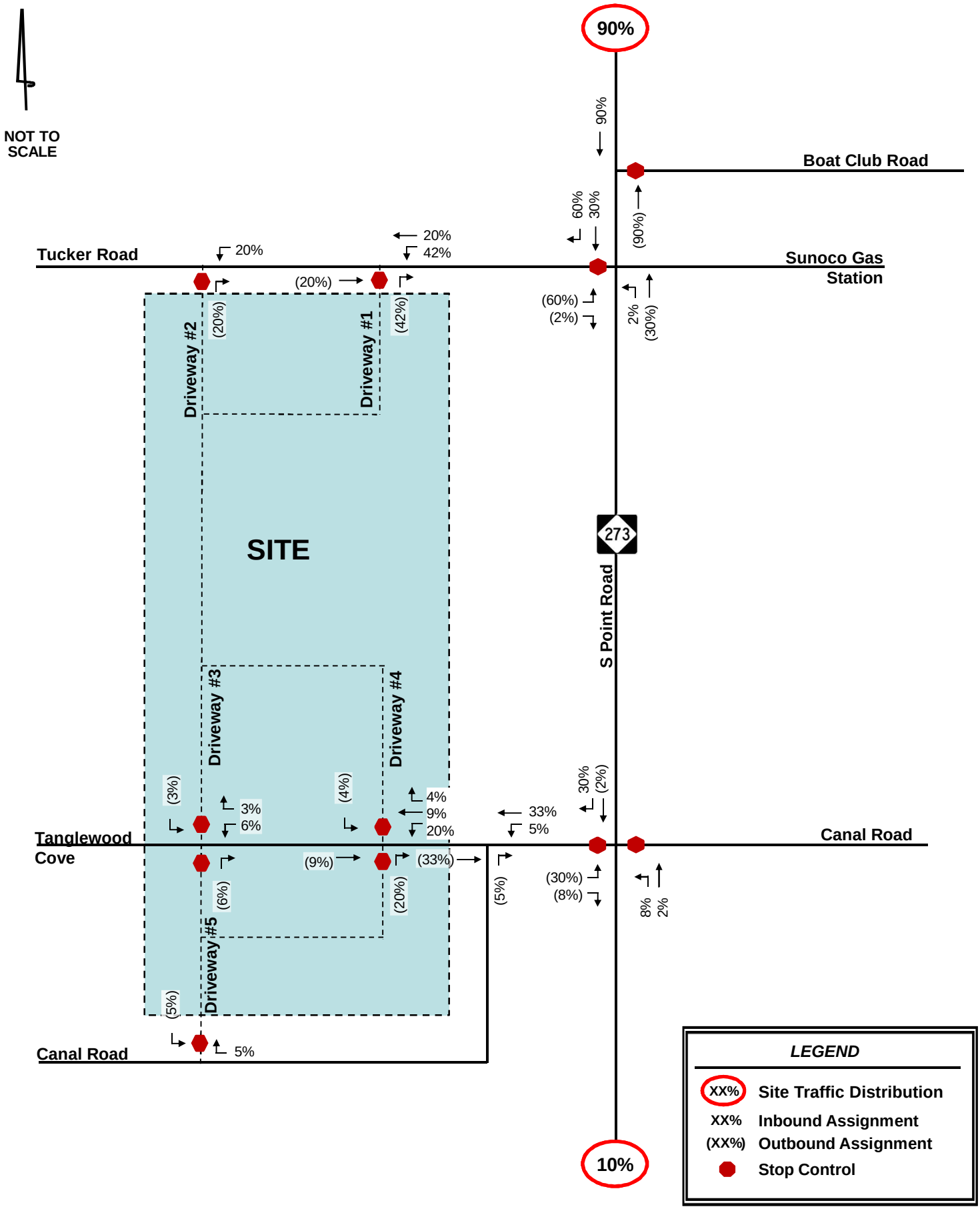
Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**Approved Development Location Map**	**Figure 4**



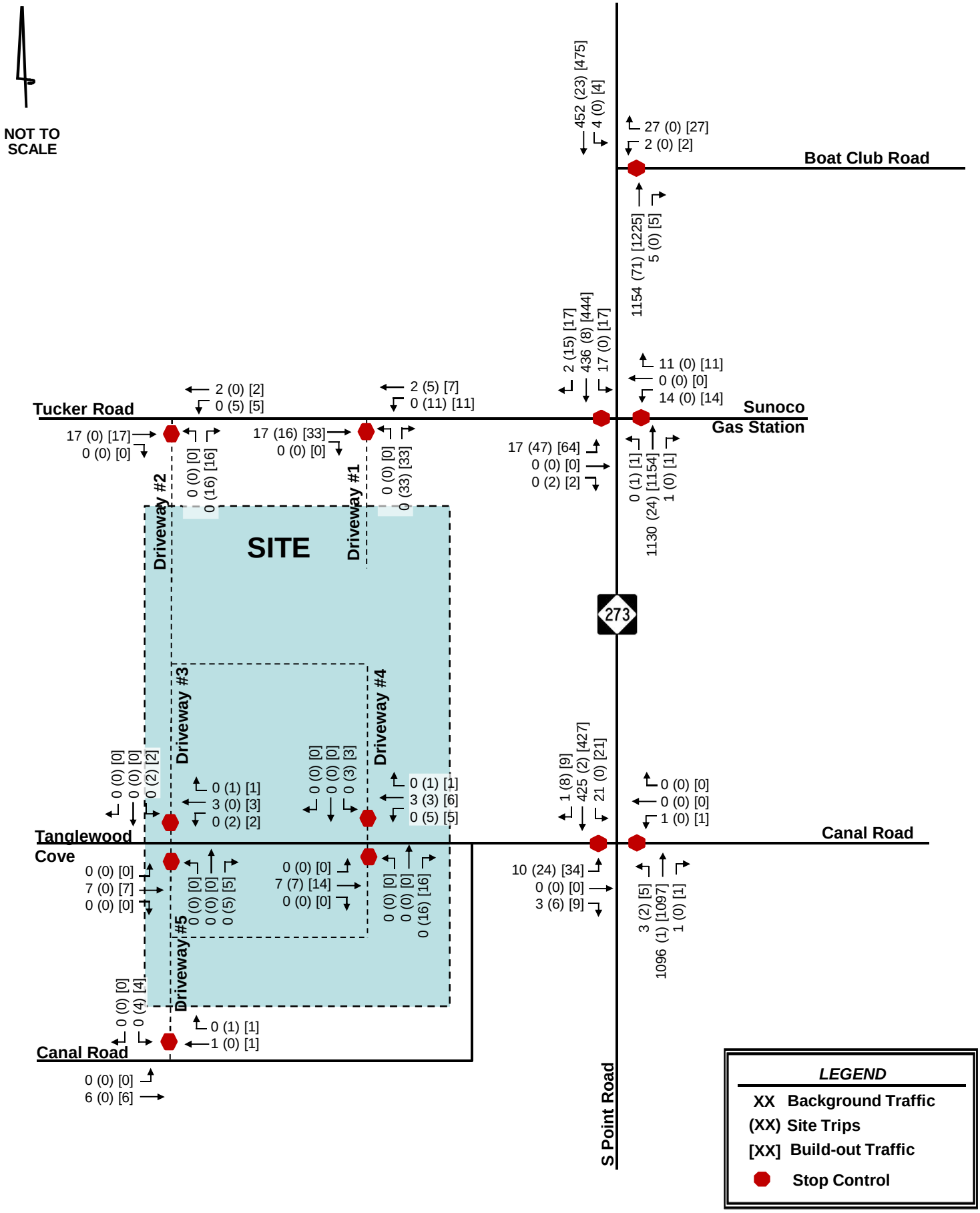
Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**2023 Background AM Peak-Hour Traffic Volumes**	**Figure 5**



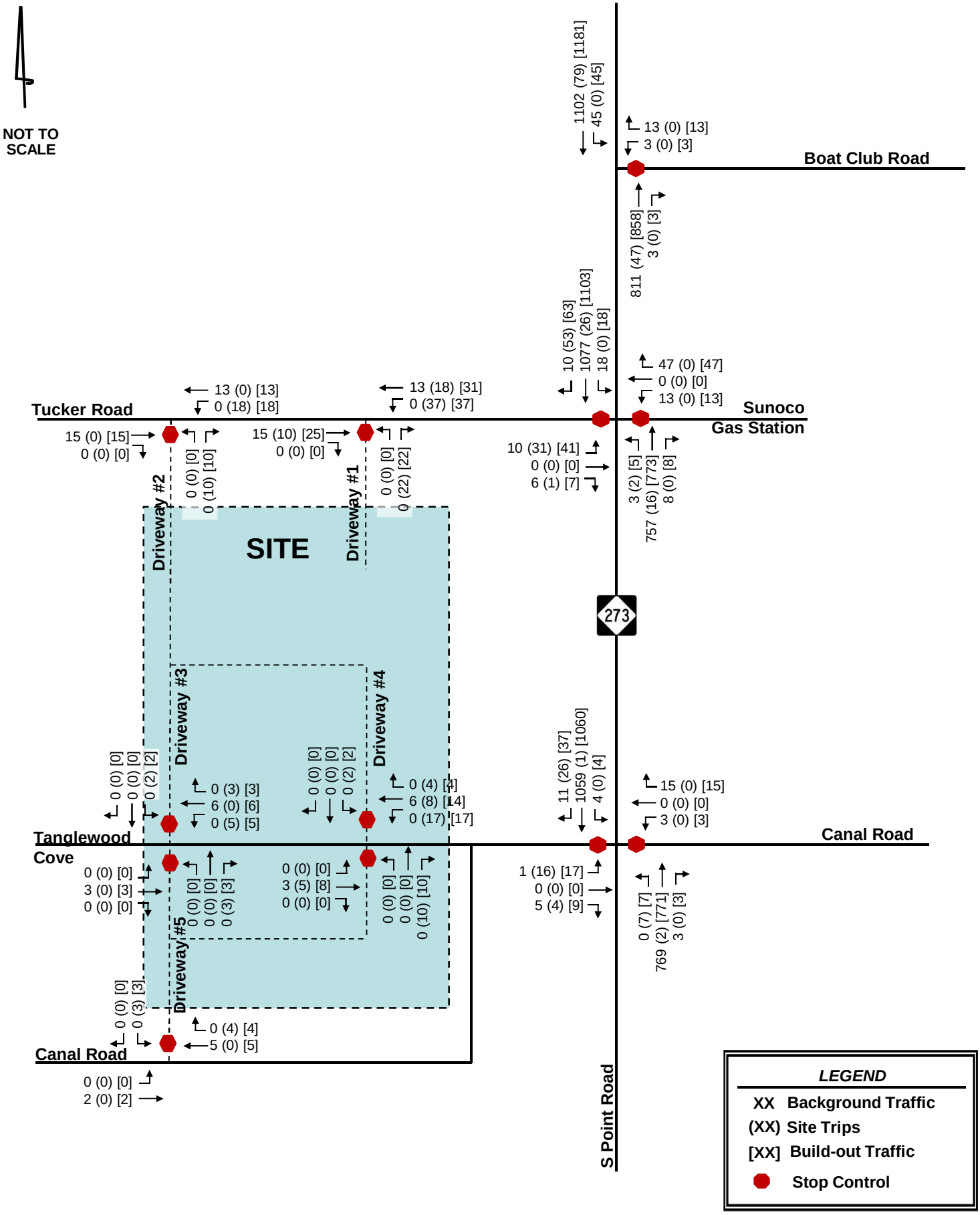
Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**2023 Background PM Peak-Hour Traffic Volumes**	**Figure 6**



Kimley»Horn	Tucker Road Transportation Technical Memorandum	Site Trip Distribution and Assignment	Figure 7



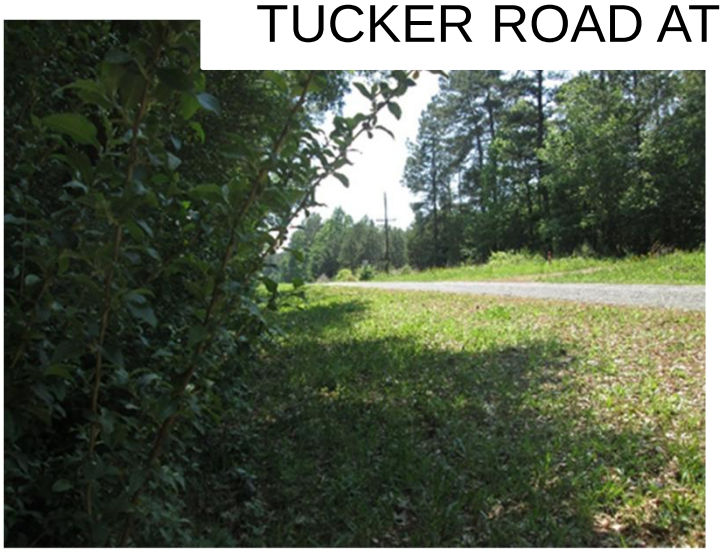
Kimley»Horn	Tucker Road Transportation Technical Memorandum	2023 Build-out AM Peak Hour Traffic Volumes	Figure 8



Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**2023 Build-out PM Peak Hour Traffic Volumes**	**Figure 9**

TUCKER ROAD AT SITE DRIVEWAY #1

TUCKER ROAD AT SITE DRIVEWAY #2



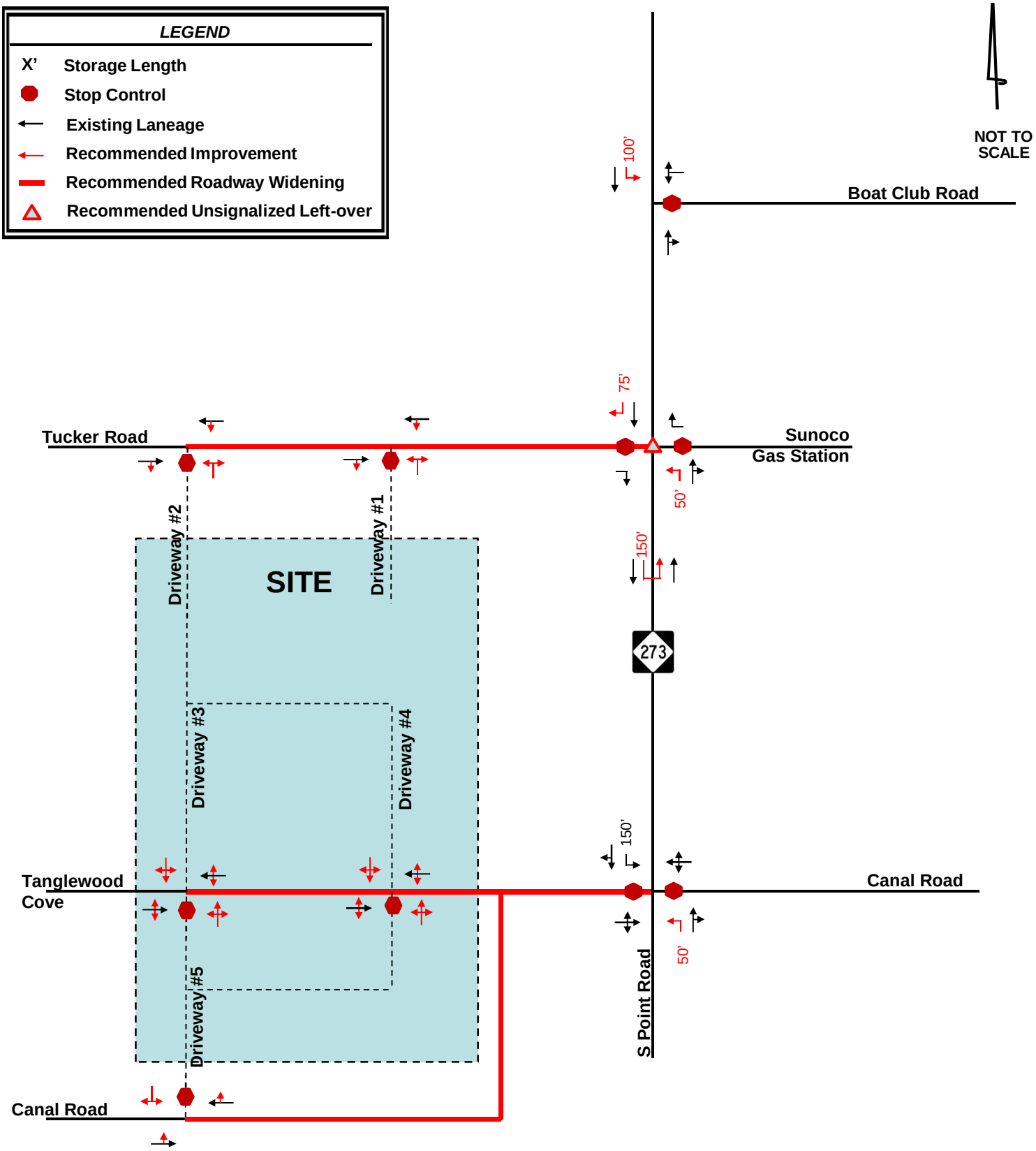
TANGLEWOOD COVE AT SITE DRIVEWAY #3

Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**Sight Distance at Site Driveways #1-3**	**Figure 10**

TANGLEWOOD COVE AT SITE DRIVEWAY #4

CANAL ROAD AT SITE DRIVEWAY #5

Kimley»Horn	**Tucker Road Transportation Technical Memorandum**	**Sight Distance at Site Driveways #4-5**	**Figure 11**



Kimley»Horn	Tucker Road Transportation Technical Memorandum	2023 Recommended Laneage	Figure 12