



**SM ROCHA, LLC**

TRAFFIC AND TRANSPORTATION CONSULTANTS

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November 5, 2019

Jody Newton  
Wash 'N Go of Colorado, LLC  
3740 Dacoro Lane, Suite 200  
Castle Rock, Colorado 80109

**RE: Wash N Go / Traffic Generation Analysis  
Aurora, Colorado**

Dear Jody,

SM ROCHA, LLC is pleased to provide traffic generation information for the development entitled Wash N Go. This development is located on the south side of East Mississippi Avenue between Troy Street and Uvalda Street in Aurora, Colorado.

This information has been revised to address City Staff review comments dated September 6, 2019 regarding updates to trip distribution, general formatting, and queueing analysis.

The intent of this analysis is to present traffic volume likely generated by the proposed development and consider potential impacts to the adjacent roadway network.

The following is a summary of analysis results.

### **Site Description and Access**

Land for the development is currently vacant. The proposed building is approximately 2,800 square feet. The site is surrounded by a mix of commercial, residential, and educational land uses.

Development site traffic is accommodated by four access locations as part of the existing commercial development area. Access locations include: one full-movement access onto Troy Street, two right-in / right-out only accesses onto Mississippi Avenue, and one full-movement access onto Uvalda Street. Access locations are existing and operate under stop-controlled conditions.

General site and access locations are shown on Figure 1.

A conceptual site plan, as prepared by Proof Civil is shown on Figure 2. This plan is provided for illustrative purposes.



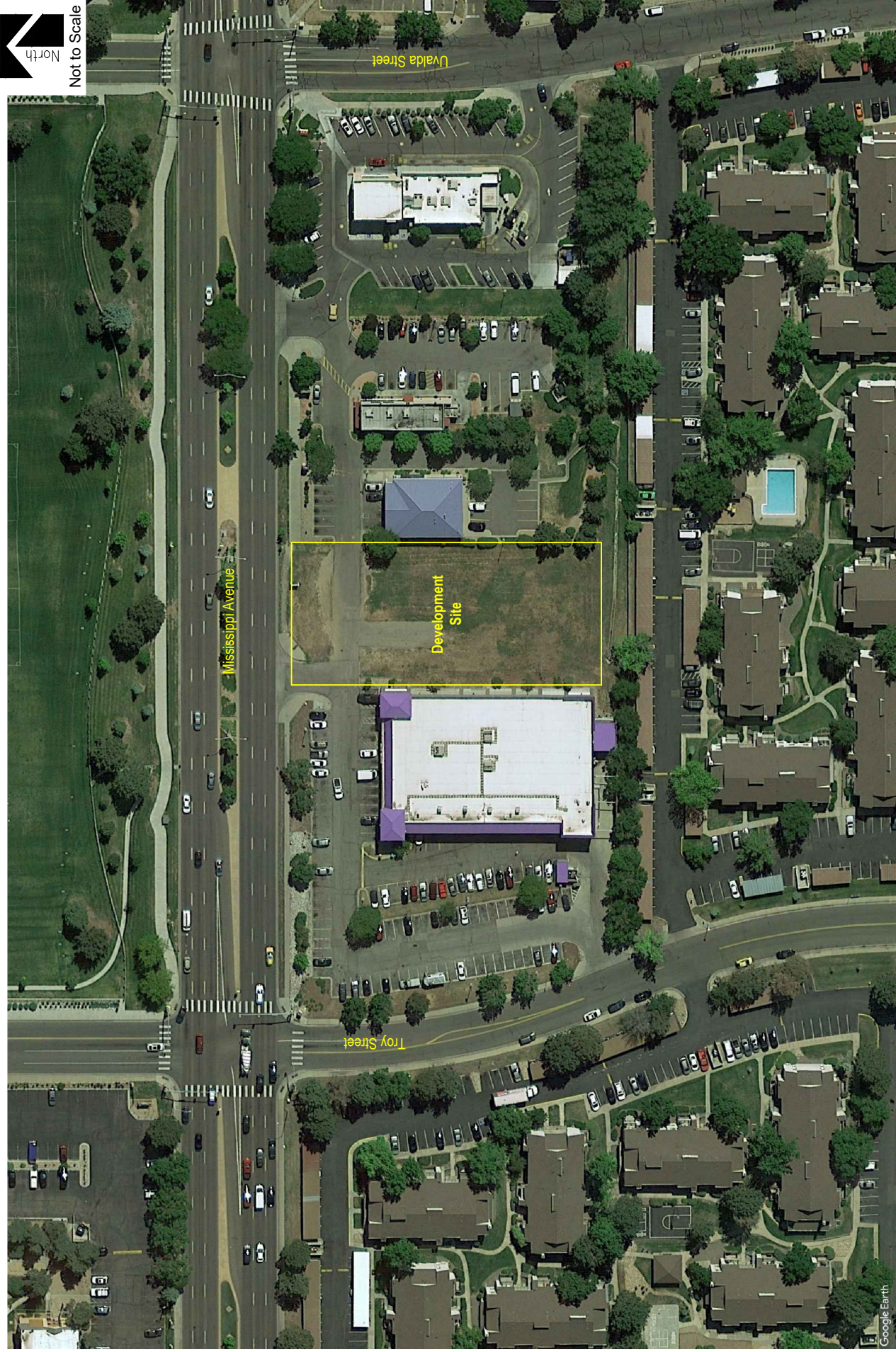
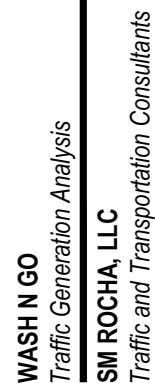


Figure 1  
SITE LOCATION







## Vehicle Trip Generation

Standard traffic generation characteristics compiled by the Institute of Transportation Engineers (ITE) in their report entitled Trip Generation, 10<sup>th</sup> Edition, were applied to the proposed land use in order to estimate the average daily traffic (ADT) and peak hour vehicle trips. A vehicle trip is defined as a one-way vehicle movement from point of origin to point of destination.

Table 1 presents average trip generation rates for the development area proposed. Use of average trip generation rates presents a conservative analysis. ITE land use code 948 (Automated Car Wash) was used for analysis because of its best fit to the proposed land use. It is noted that ITE does not provide data for 24-hour trip generation for a land use of this type. 24-hour trip generation is estimated based on a typical relationship between PM peak hour generation and 24-hour generation of ten percent.

TABLE 1 TRIP GENERATION RATES									
ITE CODE	LAND USE	UNIT	TRIP GENERATION RATES						
			24 HOUR	AM PEAK HOUR			PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
948	Automated Car Wash	KSF	142.00	*	*	*	7.10	7.10	14.20

Key: KSF = Thousand Square Feet Gross Floor Area.

\* = ITE does not report significant AM peak hour generation due to the nature of the business.

Note: All data and calculations above are subject to being rounded to nearest value.

Table 2 summarizes the projected average daily traffic (ADT) and peak hour traffic volumes likely generated by the additional land use area proposed.

TABLE 2 TRIP GENERATION SUMMARY									
ITE CODE	LAND USE	SIZE	TOTAL TRIPS GENERATED						
			24 HOUR	AM PEAK HOUR			PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
948	Automated Car Wash	2.8 KSF	399	*	*	*	20	20	40
Total:			399	*	*	*	20	20	40

Note: All data and calculations above are subject to being rounded to nearest value.

As Table 2 shows, the development area has the potential to generate approximately 399 daily trips with 40 of those occurring during the afternoon peak hour.

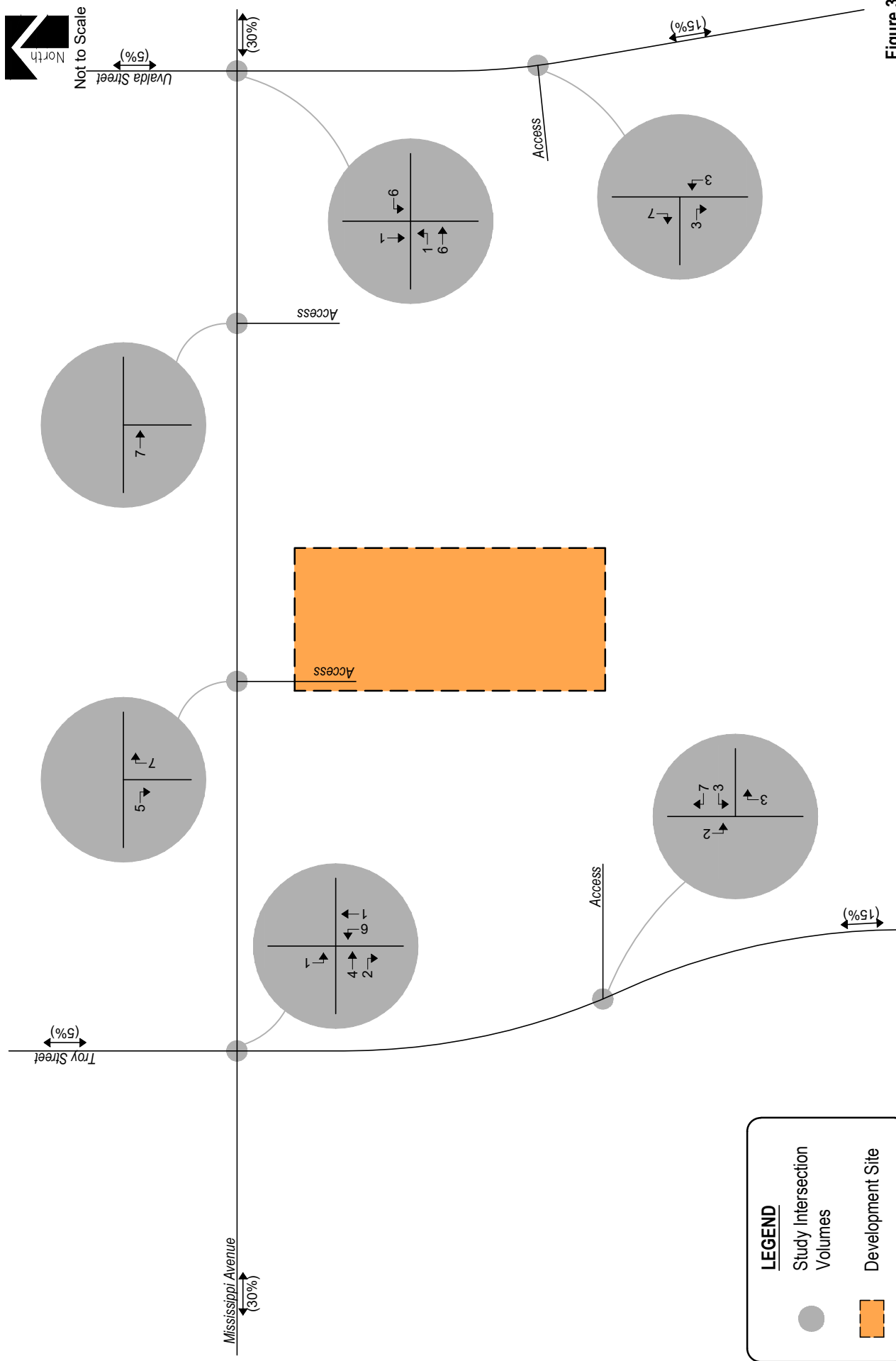
## **Adjustments to Trip Generation Rates**

While a development of this type is likely to attract trips from within area land uses as well as pass-by or diverted link trips from the adjacent roadway system, no trip reduction was taken in this analysis. This assumption provides for a conservative analysis.

## **Trip Generation Distribution and Assignment**

Overall directional distribution of site-generated traffic was determined based on existing area land uses, the site location within the City, and the available roadway network. Site-generated traffic is anticipated to be distributed through each existing access. Distribution along Mississippi Avenue is general and assumed to be 30 percent to/from the east and 30 percent to/from the west. Distribution along both Troy Street and Uvalda Street is assumed to be 5 percent to/from the north and 15 percent to/from the south.

Traffic assignment is how the site-generated and distributed trips are expected to be loaded on the roadway network. Applying assumed trip distribution patterns to site-generated traffic provides the peak hour trip volume assignments for existing accesses. These volumes are then divided further upon travel through adjacent roadways serving the overall development area. Figure 3 uses the trip generation volumes from Table 2 and denotes projected traffic volumes at each existing access and adjacent intersections.



## **Car Wash Queue Analysis**

Vehicle storage associated with the proposed car wash was evaluated against established City Design Standards, ITE research, publications and recommendations.

Pursuant to the City of Aurora Municipal Code Section 146-1504, Table 15.1, automated self-service car wash facilities require a minimum of two vehicle stacking spaces, each at least twenty feet in length, and at least one additional space after the washing module for drying.

ITE research and associated publications recommend 140 feet of storage length for car wash establishments. This storage length provides for seven cars of total storage and is based on an 85<sup>th</sup> percentile queue which has a fifteen percent chance of occurring. However, it should be noted that there is a substantial drive-through queue length range (1-10 vehicles) between establishments. It is suggested that this is primarily a function of the level of washing service provided which may vary depending on the duration of washing processes offered and customer choice. It is generally understood that car wash facilities may take several minutes between customers served. Customers who are accustomed to a specific establishment's processing time likely will adapt to the wait time and may choose to go elsewhere should a queue appear to be too long.

Vehicle queueing calculations were performed using standard probability equations based on the highest number of vehicles entering the site during peak hour and assumed service rate. Based on these calculations, an 85<sup>th</sup> percentile queue length of between six and seven vehicles was established. This equates to a drive through length of 120 to 140 feet and coincides with the ITE suggested range. Probability calculations are provided for reference as a worksheet attachment.

The above analyses and recommendations were then applied to the proposed site plan. It is concluded that the proposed site plan more than meets the City Code and ITE requirements for queue length, and adequate vehicle storage is provided on-site. Vehicle queueing beyond the provided storage length is not anticipated.

## **Development Impacts**

As Table 2 shows, there is an increase in peak hour traffic volumes anticipated for the proposed development which are considered minor. These minor volumes are not likely to negatively impact operations of Mississippi Avenue or other adjacent roadways or intersections.

## Conclusion

This analysis assessed traffic generation for the Wash N Go development and potential impacts to the adjacent roadway network.

It is our professional opinion that the proposed site-generated traffic is expected to create no negative impact to traffic operations for the surrounding roadway network and existing site accesses, nor at the Mississippi Avenue intersections with Troy Street and Uvalda Street. Analysis of site-generated traffic concludes that the proposed development traffic volume is minor.

We trust that our findings will assist in the planning and approval of the Wash N Go development. Please contact us should further assistance be needed.

Sincerely,

**SM ROCHA, LLC**

*Traffic and Transportation Consultants*



Stephen Simon, EIT  
Traffic Engineer



Fred Lantz, PE  
Traffic Engineer





Queue Length Probability Analysis Worksheet

Provide input (red) values in the indicated fields.

Input

Output (blue) values are shown as indicated.

Output

Values in black are constants and do not change.

Constant

PM Peak Hour Trips Entering: 20 vehicles  
Assumed % Drive-Thru Trips: 100 %  
Assumed Service Rate: 120 seconds

Traffic Intensity

$$\rho = \frac{\lambda}{\mu}$$

$\lambda$  = mean arrival rate per min  
 $\mu$  = mean service rate per min

$\lambda$  = 0.33 veh/min  
 $\mu$  = 0.5 veh/min  
 $\rho$  = 0.66 veh/min

Average Vehicle Queue

$$E(n) = \frac{\rho}{1 - \rho}$$

$\rho$  = 0.66 veh/min  
 $E(n)$  = 1.9 veh  
Queue = 39 ft

Average Drive-Thru Wait Time

$$E(v) = \frac{1}{\mu(1 - \rho)}$$

$\rho$  = 0.66 veh/min  
 $\mu$  = 0.5 veh/min  
 $E(v)$  = 5.88 min

Average Order Board-Window Wait Time

$$E(w) = \frac{\rho}{\mu(1 - \rho)}$$

$\rho$  = 0.66 veh/min  
 $\mu$  = 0.5 veh/min  
 $E(w)$  = 3.88 min

Queue Probability Equation

$$P(n) = \rho^n(1 - \rho)$$

Percentile

$$\sum_0^n P(n) \geq \%$$

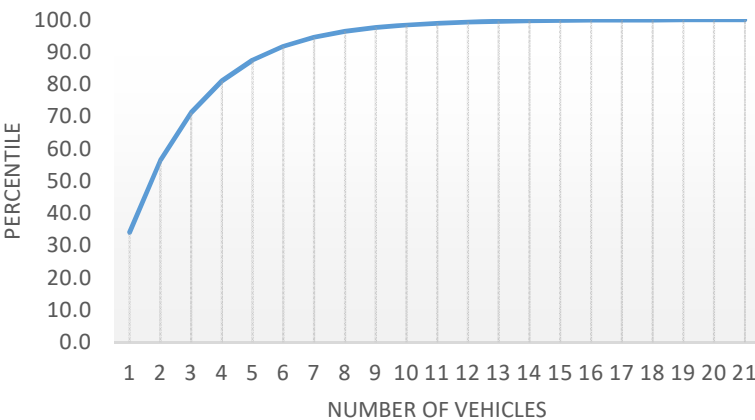
50th Percentile

85th Percentile

95th Percentile

Number of Vehicles in Queue (n)	Probability of Occurance P(n) (%)	Percentile
0	34.00	34.0
1	22.44	56.4
2	14.81	71.3
3	9.77	81.0
4	6.45	87.5
5	4.26	91.7
6	2.81	94.5
7	1.85	96.4
8	1.22	97.6
9	0.81	98.4
10	0.53	99.0
11	0.35	99.3
12	0.23	99.6
13	0.15	99.7
14	0.10	99.8
15	0.07	99.9
16	0.04	99.9
17	0.03	99.9
18	0.02	100.0
19	0.01	100.0
20	0.01	100.0

Vehicle Queue Length



Notes:

1. The **greatest** volume of entering peak hour trips should be used (AM is shown to typically be the highest).

2. Percent drive-through trips are determined based on land use, and confirmed (when possible) with client/developer/owner.

3. Service rate is defined as the rate at which vehicles pass a given point in the queue; or, the average time a vehicle spends in a given queue position before progressing to the next position. For a Car Wash facility this is assumed to be approximately two minutes on average. It is noted that this may be subject to different levels of washing services provided. See the **average wait time** outputs for average time spent in the queue as a whole.

4. Traffic intensity must be less than 1. An intensity greater than 1 indicates an over-saturated queue (vehicles arrive faster than they can be served). When a queue is at capacity (intensity = 1) the next vehicle will typically choose to park or go elsewhere to avoid a long delay.

Standard Vehicle Length

20 Feet

Recommended Queue Design Length

Length	50th Queue	85th Queue	95th Queue
Vehicles	1	4	6
Feet	20	80	120