

7729 Carlyle Ave., Miami Beach, FL, 33141

TRAFFIC STUDY LEVEL ONE

ENGINEER's CERTIFICATION

I, hereby certify that I am a registered professional engineer in the State of Florida, duly licensed under chapter 471, Florida Statutes, Professional License Number 58341, by the State of Florida, Department of Professional Regulation, Board of Professional Engineers, and that I have prepared or approved the evaluation, findings, opinions, conclusions, or technical advice hereby reported for:

Project: 7729 Carlyle Avenue
Location: Miami Beach, Florida
Client: Pnina Revach Property Management, Inc.

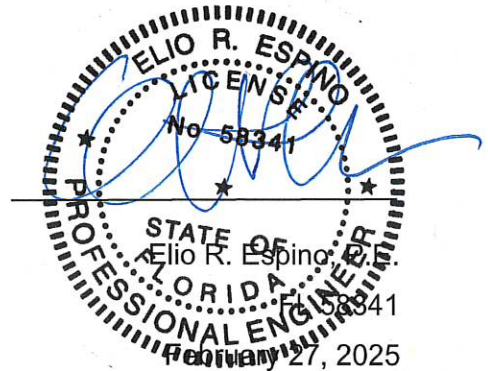
I acknowledge that the procedures and references used to develop the results contained in this report are standards to the professional practice of transportation engineering as applied through professional judgement and experience.

Signature:

Name:

License No.

Date:



7729 Carlyle Avenue
c/o Pnina Revach Property Management Inc,

February 27th, 2025

Re: 7729 Carlyle Avenue – Traffic Impact Statement, Level One

To Whom it May Concern

I have prepared this traffic impact statement for the proposed re-development of an existing Single-family Detached Housing (Land Use Code 210) located at 7729 Carlyle Avenue, Miami Beach, Florida 33141 (refer to Figure 1). The proposed development will consist of a four-story multi-family development (Land Use Code 220) with a total of six units. The proposed site plan is included as part of Attachment A. The traffic impact analysis has been performed according to the traffic methodology letter approved by the City's Planning Department and will address the following topics:

- Trip Generation/Distribution
- Driveway Assignment
- Entry Gates/Queuing
- Parking
- Transportation Demand Management

Please note that parking maneuverability analysis using a Chevy Suburban design vehicle for parking spaces 1, 4 and 6 as well as the available sight distance for the proposed driveways will be included as part of the proposed site plan submission.

Trip Generation and Trip Distribution

A trip generation comparison analysis was performed for the site using the average trip generation rates for the existing and proposed development published in the Institute of Transportation Engineer's (ITE) *Trip Generation Manual (11th Edition)*. The average trip generation rates were used instead of the trip generation equation since the number of proposed units are below the range of units included in the development of the trip generation equations. The analyses were performed for daily, AM peak hour, and PM peak hour conditions. The trip generation rates for each scenario are presented below (refer to Attachment B).

Single -Family Home Detached Housing (Land Use Code 210)

Daily Trips

$T = 9.43 (X)$

Where T = average daily vehicle trip ends and X = number of units

AM Peak Hour

$T = 0.70 (X)$ with 25% entering and 75% exiting

Where T = AM peak hour trip ends and X = number of units

PM Peak Hour

T = 0.94 (X) with 63% entering and 37% exiting

Where T = PM peak hour trip ends and X = number of units

Multifamily Housing – Low Rise (ITE Land Use 220)

Daily Trips

T = 6.74 (X)

Where T = average daily vehicle trip ends and X = number of units

AM Peak Hour

T = 0.40 (X) with 24% entering and 76% exiting

Where T = AM peak hour trip ends and X = number of units

PM Peak Hour

T = 0.51 (X) with 63% entering and 37% exiting

Where T = PM peak hour trip ends and X = number of units

Using the trip generation rates shown above for daily, AM and PM peaks a trip generation comparison analysis was undertaken for the existing and proposed re-development scenario for 7729 Carlyle Avenue, Miami Beach, Florida 33141. The results of the comparison are shown in Tables 1 and 2. As shown in the tables the existing single-family unit is estimated to generate approximately nine (9) daily trips and approximately one (1) trip during the AM and PM peak hours. On the other hand, the proposed development is estimated to generate 40 daily trips, two (2) trips during the AM peak hour and three (3) trips during the PM peak hour. Based on the results the proposed development will result in minimal impact to the adjacent street network.

TABLE 1 Trip Generation Summary (Existing Use) 7729 Carlyle Avenue, Miami Beach, FL, 33141								
Land Use	Size	Daily Trips	AM Peak Hour			PM Peak Hour		
			Total Trips	Inbound	Outbound	Total Trips	Inbound	Outbound
Single-Family Detached Housing (Land Use Code 210)	1 Unit	9	1	0	1	1	1	0
External Trips		9	1	0	1	1	1	0
Source: ITE Trip Generation Manual (11th Edition)								
TABLE 2 Trip Generation Summary (Proposed Use) 7729 Carlyle Avenue, Miami Beach, FL, 33141								
Land Use	Size	Daily Trips	AM Peak Hour			PM Peak Hour		
			Total Trips	Inbound	Outbound	Total Trips	Inbound	Outbound
Multi-Family Housing Low Rise (Land Use Code 220)	6 Units	40	2	1	1	3	2	1
External Trips		40	2	1	1	3	2	1
Source: ITE Trip Generation Manual (11th Edition)								
Difference		Daily Trips	AM Peak Hour			PM Peak Hour		
			Total Trips	Inbound	Outbound	Total Trips	Inbound	Outbound
Proposed-Existing		+31	+1	+1	0	+2	+1	+1

The trip distribution and traffic assignment for the project’s peak trips was based on Miami-Dade County’s Cardinal Distribution information for the study area. Table 3 summarizes the County’s cardinal distribution data for Traffic Analysis Zone 620, which is applicable to the project site from the latest SERPM data published by Miami-Dade Transportation Planning Organization (TPO) (refer to Attachment C).

TABLE 3 Project Trip Distribution TAZ 620 for 7729 Carlyle Avenue, Miami Beach, FL, 33141								
Year	Movement							
	NNE	ENE	ESE	SSE	SSW	WSW	WNW	NNW
2015	1.2%	0%	0%	5.4%	26.8%	25.1%	11.4%	30.1%
2045	1.3%	0%	0%	3.1%	24.1%	30.3%	13.1%	28.2%
2026*	1.2%	0%	0%	4.6%	25.8%	27.0%	12.0%	27.5%

Notes: * Interpolated Values
Source: Miami-Dade County (2015 & 2045 SERPM Models)

Based on small number of trips generated by the proposed development and the projected trip distribution at opening (2026) the following traffic assignment is estimated for the six (6) proposed units at 7729 Carlyle Avenue.

- 60% to/from the northwest via Carlyle Avenue
- 40% to/from the southwest via Carlyle Avenue

Driveway Assignment

As shown in the site plan contained in Attachment A, access to the project will be provided via one entering/exiting driveway. Figure 2 shows the AM and PM peak hour entering and exiting traffic volumes at the proposed driveway.

Entry Gate and Queuing

An entry gate is proposed at the single entrance proposed, as shown on the site plan. The distance between the parking garage gate and the right-of-way line is approximately 40 feet (sufficient to accommodate two (2) vehicles).

A queuing analysis was conducted for the entry gate. The access to the parking is proposed to be controlled by a gate system and transponder. Residents will have a vehicle card reader to operate the gate to minimize delays and queues. Visitors will not be allowed to use the gated entrance (they will use the 19 on-street parking spaces). The queuing analysis was performed based on the following assumptions:

- During the peak inbound period (PM), three inbound vehicles are anticipated.

- Several gate systems will be available for this project. Depending on the gate system implemented, the time to open the gate could vary between 3 and 12 seconds. For purposes of this evaluation, 12 seconds were assumed, for a service rate of 300 vehicle per hour.

Using the above assumptions, a queuing of one (1) vehicle is anticipated. Since the entrance to the garage is located approximately 40 feet from the property line, traffic entering the site will not spill onto Carlyle Avenue. Attachment D includes a description of the queuing analysis and calculation details.

Parking

The proposed development includes six (6) parking stalls on-site, one for each of the proposed units. In addition, along the segment on Carlyle Avenue from 77th Street to 78th Street there are 19 parallel on-street parking spaces, including one handicap space. These spaces are available to visitors and residents of the proposed development at 7729 Carlyle Avenue.

Transportation Demand Management

As shown in the trip generation analysis the proposed development will only add one (1) additional trip during the AM peak hour and two (2) additional trips during the PM peak hour. Therefore, the traffic impacts of the development are negligible. However, the project is proposing to provide designated bicycle parking as a strategy to reduce the use of private automobiles. negligible tr

Please do not hesitate to contact me should you have any questions/comments regarding the analysis performed as part of this traffic impact statement.



Elio R. Espino, P.E.
Senior Traffic Engineer

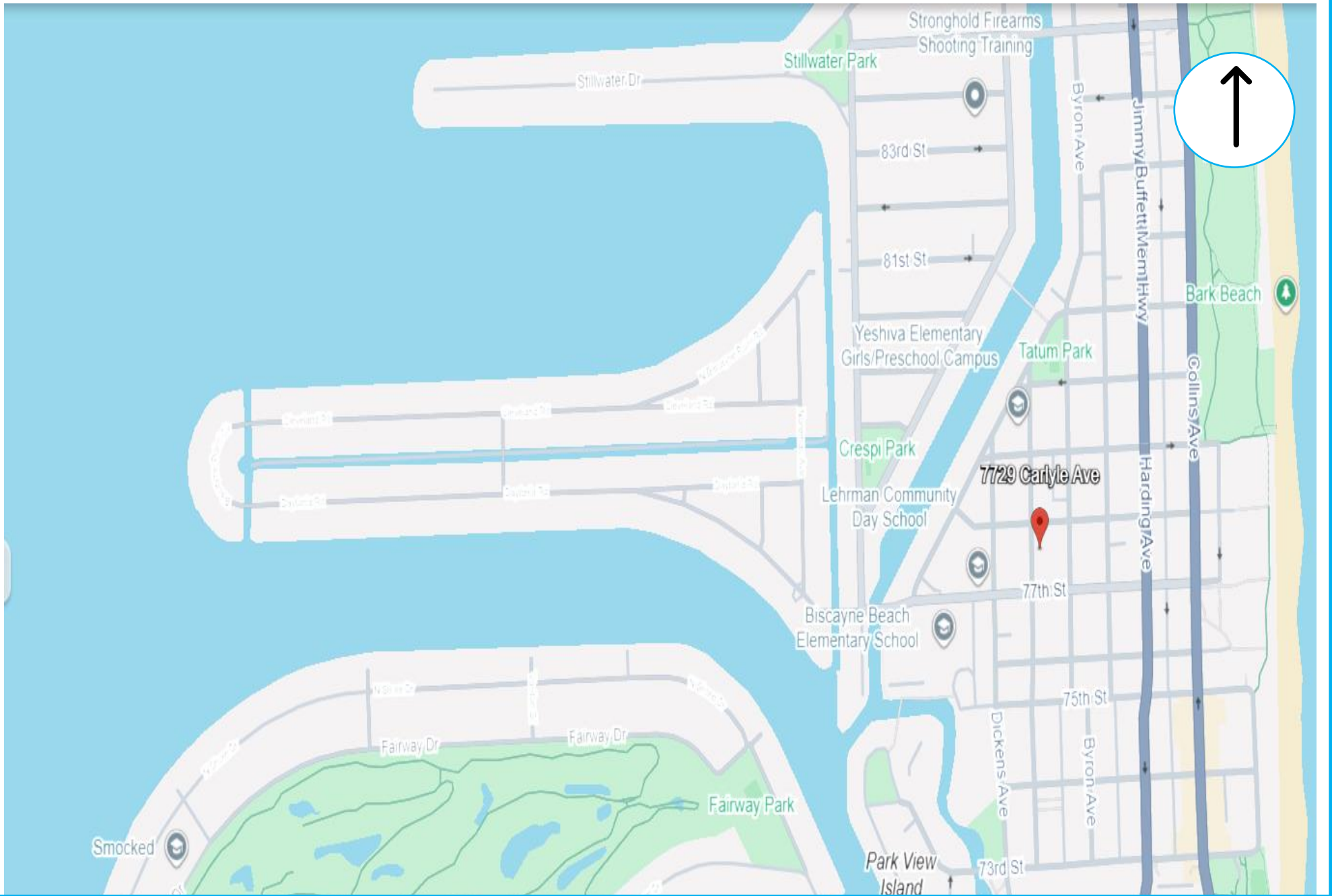
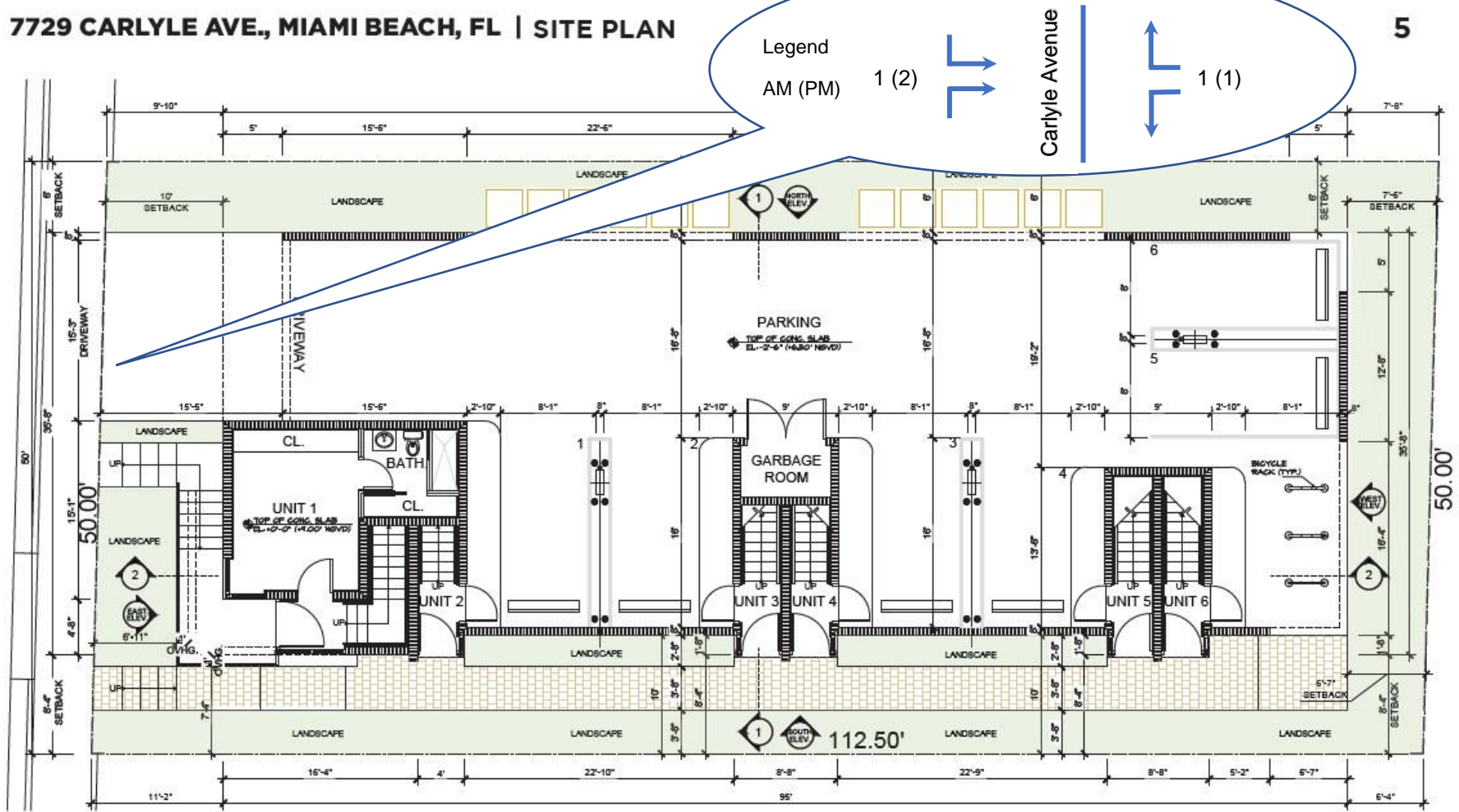


Figure 1: Project Location Map

7729 Carlyle Avenue, Miami Beach, FL, 33141

7729 CARLYLE AVE., MIAMI BEACH, FL | SITE PLAN



GUSTAVO J. RAMOS ARCHITECTURE | PLANNING | INTERIORS
 8935 NW 35th LN, STE. # 204, DORAL, FL 33172 | PHONE 305 589 4847

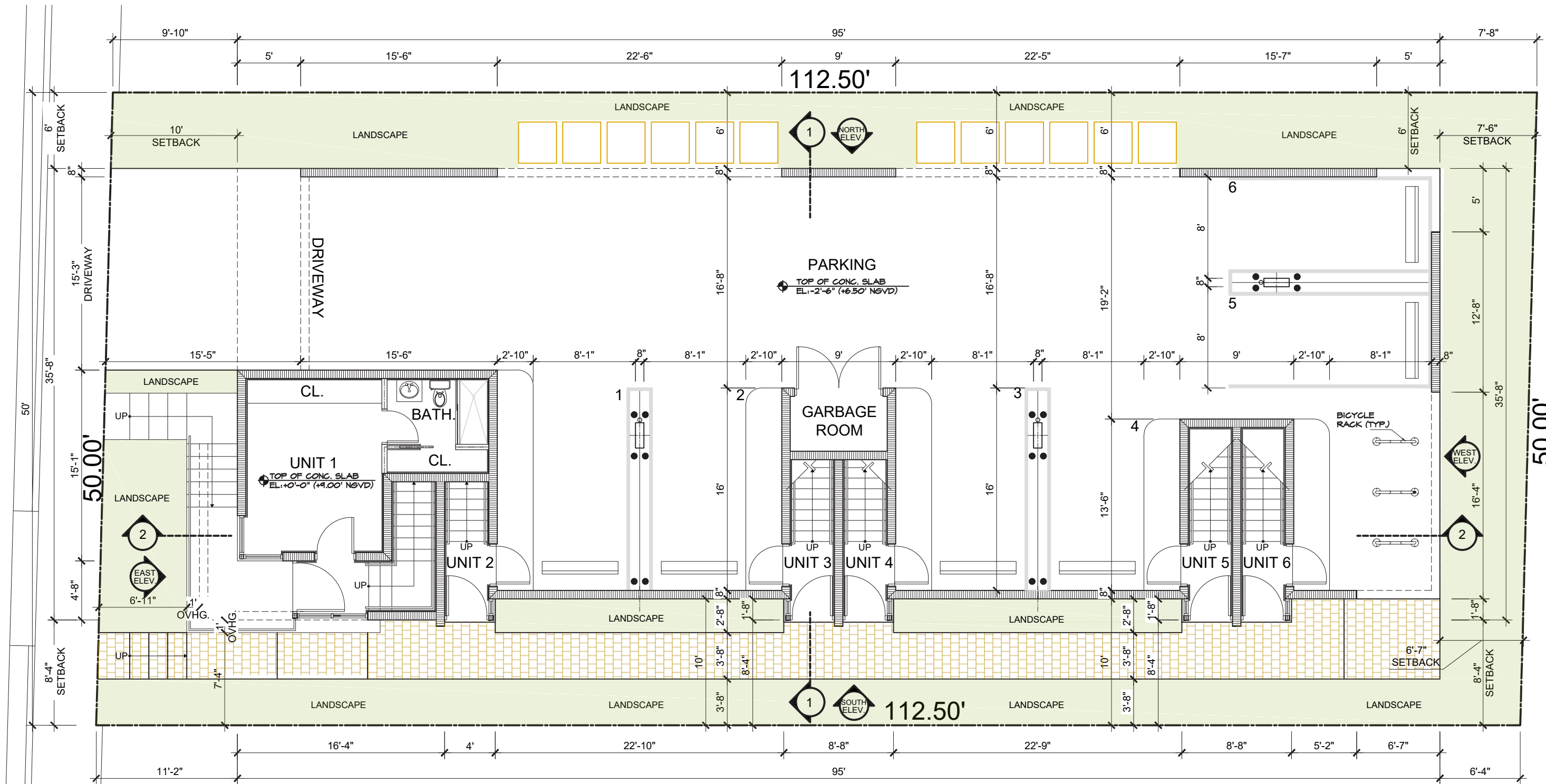


SITE PLAN
 SCALE 1/8" = 1'-0"

Figure 2: Traffic Assignment

7729 Carlyle Avenue, Miami Beach, FL, 33141

ATTACHMENT A
Site Plan for 7729 Carlyle Avenue

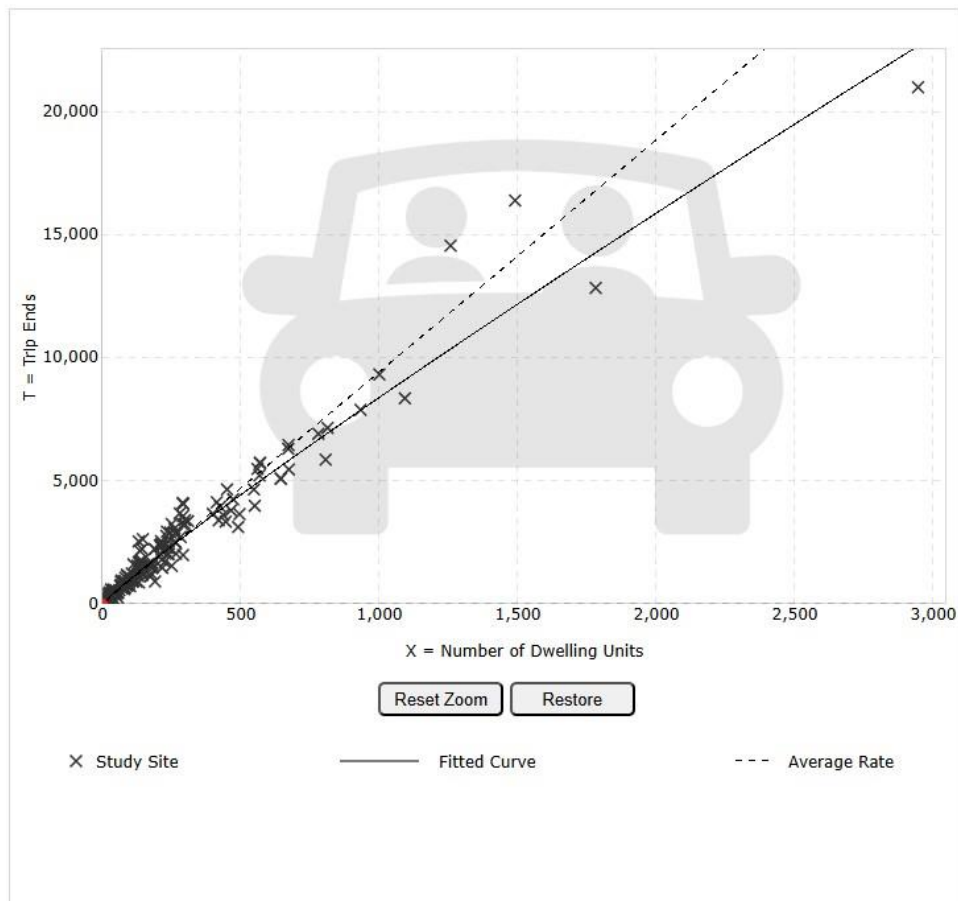


ATTACHMENT B

ITE Trip Generation Rates for

LUC 210 (Detached Housing) and LUC 220 (Mid Rise)

Data Plot and Equation



DATA STATISTICS

Land Use:

Single-Family Detached Housing (210) [Click for Description and Data Plots](#)

Independent Variable:

Dwelling Units

Time Period:

Weekday

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

174

Avg. Num. of Dwelling Units:

246

Average Rate:

9.43

Range of Rates:

4.45 - 22.61

Standard Deviation:

2.13

Fitted Curve Equation:

$\ln(T) = 0.92 \ln(X) + 2.68$

R²:

0.95

Directional Distribution:

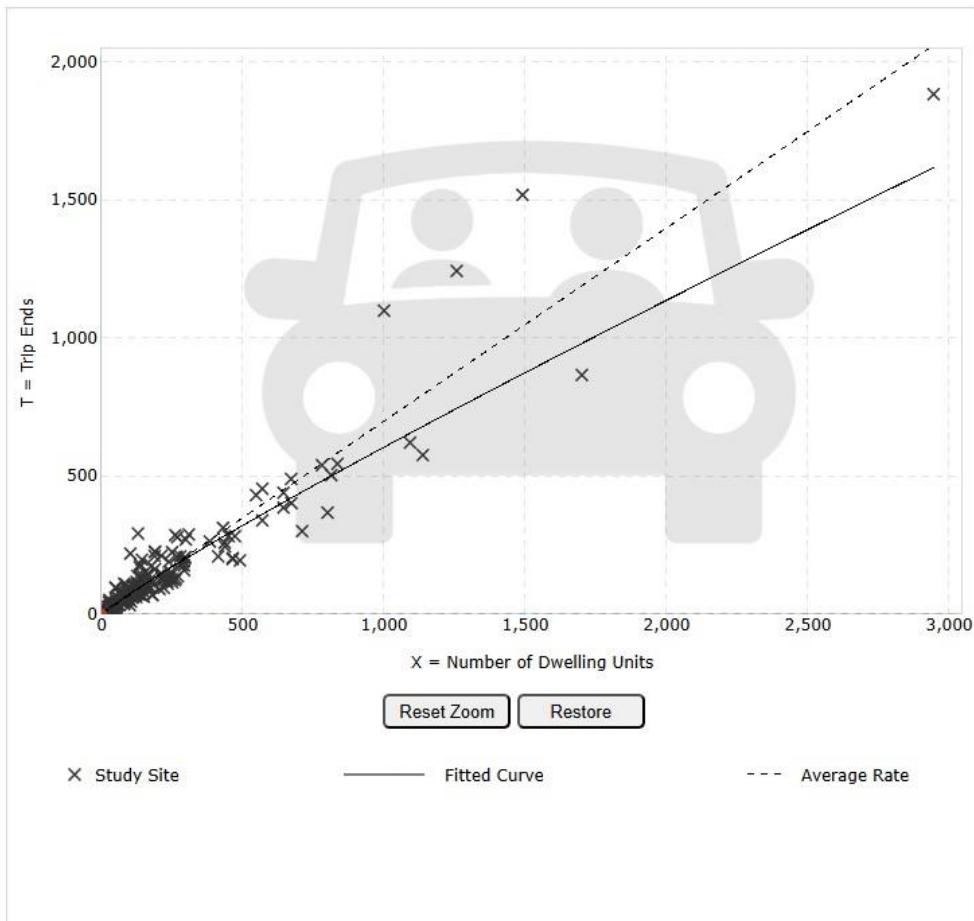
50% entering, 50% exiting

Calculated Trip Ends:

Average Rate: 9 (Total), 5 (Entry), 4 (Exit)

Fitted Curve: 15 (Total), 7 (Entry), 8 (Exit)

Data Plot and Equation



DATA STATISTICS

Land Use:

Single-Family Detached Housing (210) [Click for Description and Data Plots](#)

Independent Variable:

Dwelling Units

Time Period:

Weekday
Peak Hour of Adjacent Street Traffic
One Hour Between 7 and 9 a.m.

Setting/Location:

General Urban/Suburban

Trip Type:

Vehicle

Number of Studies:

192

Avg. Num. of Dwelling Units:

226

Average Rate:

0.70

Range of Rates:

0.27 - 2.27

Standard Deviation:

0.24

Fitted Curve Equation:

$\ln(T) = 0.91 \ln(X) + 0.12$

R²:

0.90

Directional Distribution:

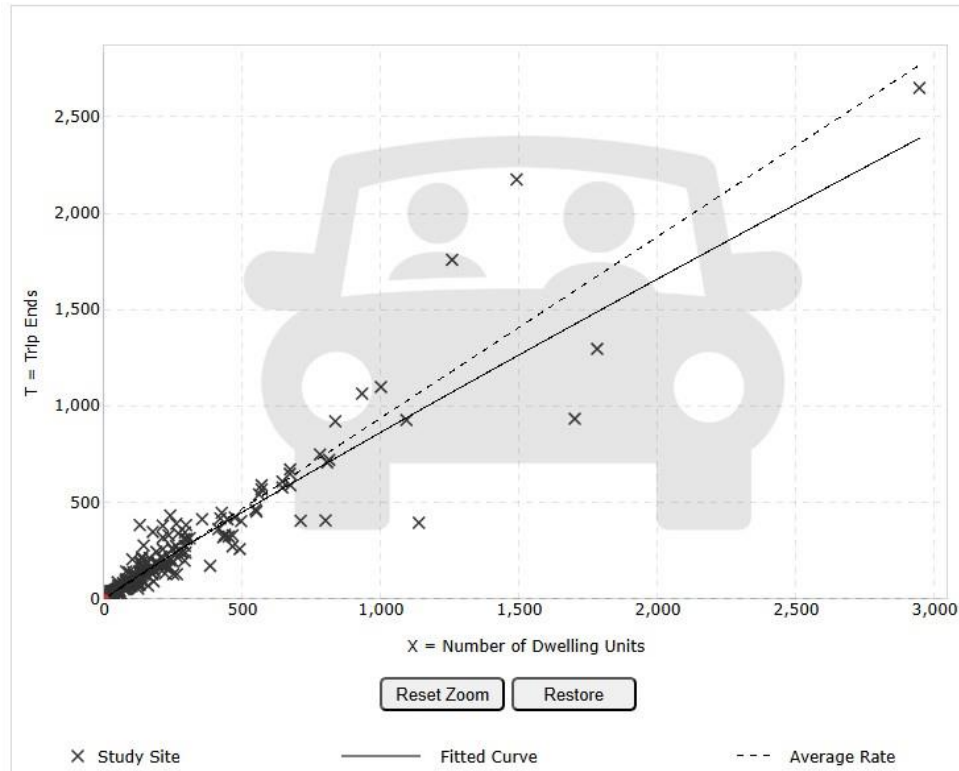
25% entering, 75% exiting

Calculated Trip Ends:

Average Rate: 1 (Total), 0 (Entry), 1 (Exit)

Fitted Curve: 1 (Total), 0 (Entry), 1 (Exit)

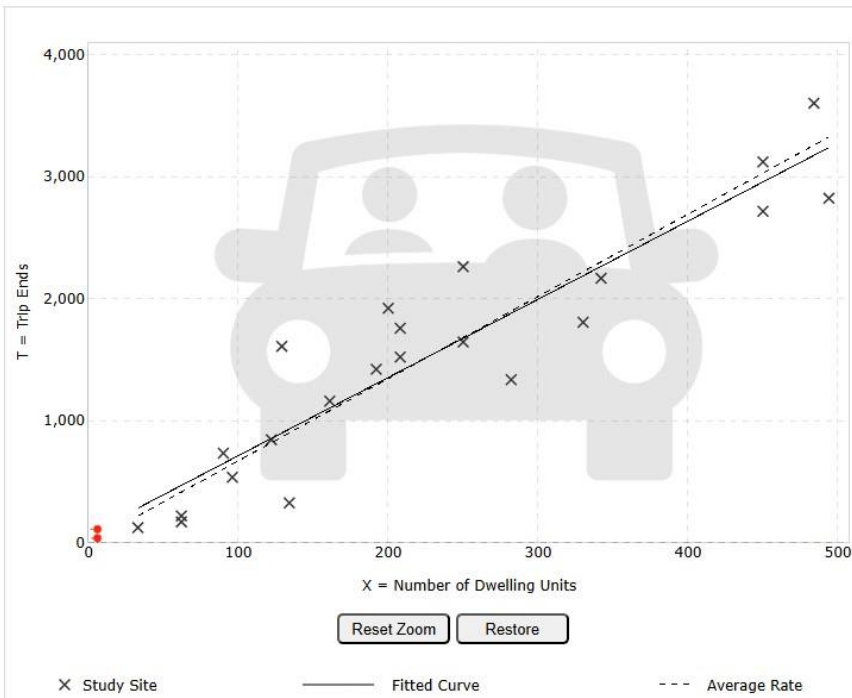
Data Plot and Equation



DATA STATISTICS

Land Use:	Single-Family Detached Housing (210) Click for Description and Data Plots
Independent Variable:	Dwelling Units
Time Period:	Weekday Peak Hour of Adjacent Street Traffic One Hour Between 4 and 6 p.m.
Setting/Location:	General Urban/Suburban
Trip Type:	Vehicle
Number of Studies:	208
Avg. Num. of Dwelling Units:	248
Average Rate:	0.94
Range of Rates:	0.35 - 2.98
Standard Deviation:	0.31
Fitted Curve Equation:	$\ln(T) = 0.94 \ln(X) + 0.27$
R²:	0.92
Directional Distribution:	63% entering, 37% exiting
Calculated Trip Ends:	Average Rate: 1 (Total), 1 (Entry), 0 (Exit) Fitted Curve: 1 (Total), 1 (Entry), 0 (Exit)

Data Plot and Equation



DATA STATISTICS

Land Use:
Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) [Click for Description and Data Plots](#)

Independent Variable:
Dwelling Units

Time Period:
Weekday

Setting/Location:
General Urban/Suburban

Trip Type:
Vehicle

Number of Studies:
22

Avg. Num. of Dwelling Units:
229

Average Rate:
6.74

Range of Rates:
2.46 - 12.50

Standard Deviation:
1.79

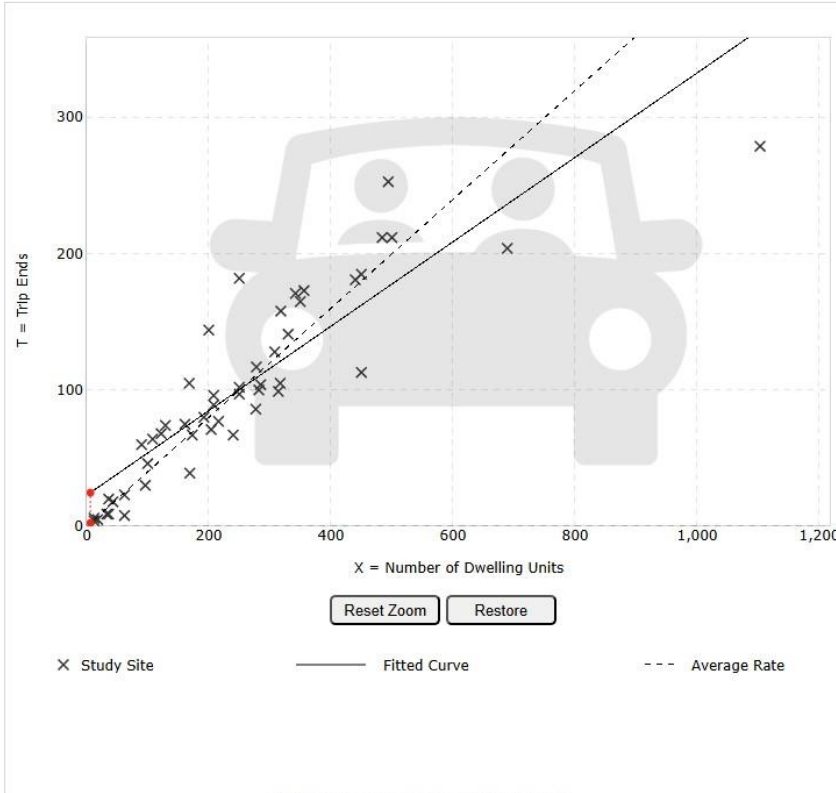
Fitted Curve Equation:
 $T = 6.41(X) + 75.31$

R²:
0.86

Directional Distribution:
50% entering, 50% exiting

Calculated Trip Ends:
Average Rate: 40 (Total), 20 (Entry), 20 (Exit)
Fitted Curve: 114 (Total), 57 (Entry), 57 (Exit)

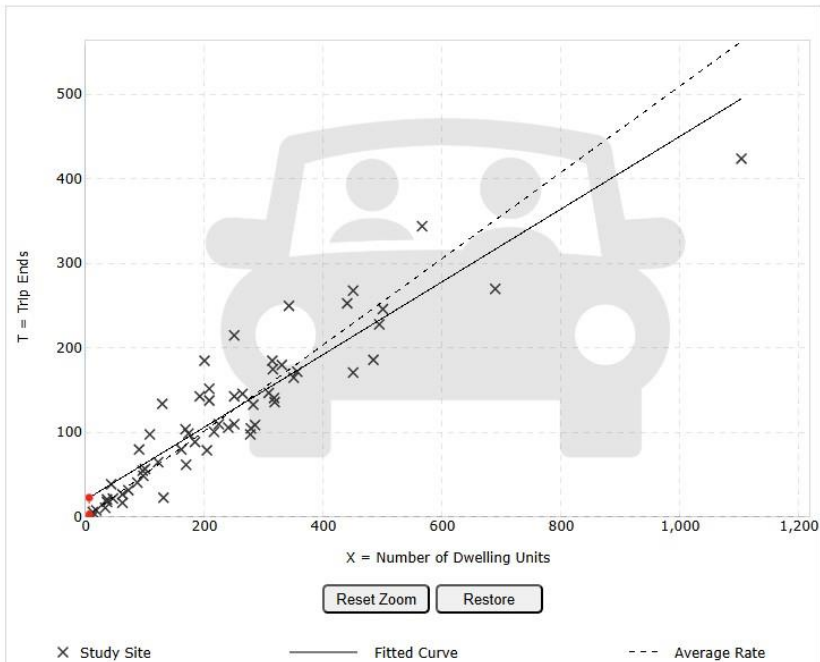
Data Plot and Equation



DATA STATISTICS

Land Use:	Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) Click for Description and Data Plots
Independent Variable:	Dwelling Units
Time Period:	Weekday Peak Hour of Adjacent Street Traffic One Hour Between 7 and 9 a.m.
Setting/Location:	General Urban/Suburban
Trip Type:	Vehicle
Number of Studies:	49
Avg. Num. of Dwelling Units:	249
Average Rate:	0.40
Range of Rates:	0.13 - 0.73
Standard Deviation:	0.12
Fitted Curve Equation:	$T = 0.31(X) + 22.85$
R²:	0.79
Directional Distribution:	24% entering, 76% exiting
Calculated Trip Ends:	Average Rate: 2 (Total), 1 (Entry), 1 (Exit) Fitted Curve: 25 (Total), 6 (Entry), 19 (Exit)

Data Plot and Equation



DATA STATISTICS

Land Use:	Multifamily Housing (Low-Rise) - Not Close to Rail Transit (220) Click for Description and Data Plots
Independent Variable:	Dwelling Units
Time Period:	Weekday Peak Hour of Adjacent Street Traffic One Hour Between 4 and 6 p.m.
Setting/Location:	General Urban/Suburban
Trip Type:	Vehicle
Number of Studies:	59
Avg. Num. of Dwelling Units:	241
Average Rate:	0.51
Range of Rates:	0.08 - 1.04
Standard Deviation:	0.15
Fitted Curve Equation:	$T = 0.43(X) + 20.55$
R²:	0.84
Directional Distribution:	63% entering, 37% exiting
Calculated Trip Ends:	Average Rate: 3 (Total), 2 (Entry), 1 (Exit) Fitted Curve: 23 (Total), 15 (Entry), 8 (Exit)

ATTACHMENT C
Cardinal Distribution Data Base

DIRECTIONAL TRIP DISTRIBUTION REPORT

PREPARED BY:
Gannett Fleming Inc.

PREPARED FOR:



Miami-Dade Transportation
Planning Organization (TPO)

September 2019



DIRECTIONAL TRIP DISTRIBUTION REPORT

Miami-Dade 2015 Base Year Direction Trip Distribution Summary											
TAZ of Origin		Trips / Percent	Cardinal Directions								Total Trips
County TAZ	Regional TAZ		NNE	ENE	ESE	SSE	SSW	WSW	WNW	NNW	
599	3499	Trips	591	34	0	13	16	316	294	397	1,717
599	3499	Percent	35.6	2.0	0.0	0.8	1.0	19.0	17.7	23.9	
600	3500	Trips	1,964	258	20	47	84	1,205	1,079	998	5,795
600	3500	Percent	34.7	4.6	0.4	0.8	1.5	21.3	19.1	17.7	
601	3501	Trips	70	-	-	28	277	290	175	257	1,104
601	3501	Percent	6.4	-	-	2.5	25.3	26.4	15.9	23.5	
602	3502	Trips	67	17	-	103	540	455	472	464	2,181
602	3502	Percent	3.2	0.8	-	4.9	25.5	21.5	22.3	21.9	
603	3503	Trips	27	-	-	3	177	160	92	111	570
603	3503	Percent	4.8	-	-	0.5	31.0	28.1	16.2	19.5	
604	3504	Trips	45	-	-	6	506	334	458	381	1,779
604	3504	Percent	2.6	-	-	0.4	29.3	19.3	26.5	22.0	
605	3505	Trips	136	16	-	144	498	321	433	386	1,958
605	3505	Percent	7.0	0.8	-	7.4	25.7	16.6	22.4	20.0	
606	3506	Trips	830	-	-	845	1,407	1,998	1,040	2,384	9,052
606	3506	Percent	9.8	-	-	9.9	16.5	23.5	12.2	28.0	
607	3507	Trips	197	83	-	165	848	498	671	627	3,154
607	3507	Percent	6.4	2.7	-	5.4	27.5	16.1	21.7	20.3	
608	3508	Trips	109	-	-	17	655	545	562	535	2,497
608	3508	Percent	4.5	-	-	0.7	27.0	22.5	23.2	22.1	
609	3509	Trips	80	-	-	30	482	700	242	744	2,414
609	3509	Percent	3.5	-	-	1.3	21.2	30.7	10.6	32.7	
610	3510	Trips	576	187	-	313	1,639	1,859	1,152	2,527	9,381
610	3510	Percent	7.0	2.3	-	3.8	19.9	22.5	14.0	30.6	
611	3511	Trips	344	38	-	107	861	847	782	1,269	4,444
611	3511	Percent	8.1	0.9	-	2.5	20.3	20.0	18.4	29.9	
612	3512	Trips	102	-	-	38	497	479	354	809	2,324
612	3512	Percent	4.5	-	-	1.7	21.8	21.0	15.5	35.5	
613	3513	Trips	50	-	-	45	147	146	130	221	738
613	3513	Percent	6.8	-	-	6.1	19.9	19.8	17.6	30.0	
614	3514	Trips	107	-	-	231	720	908	522	868	3,436
614	3514	Percent	3.2	-	-	6.9	21.5	27.1	15.6	25.9	
615	3515	Trips	748	321	-	855	1,825	1,774	1,120	2,278	9,551
615	3515	Percent	8.4	3.6	-	9.6	20.5	19.9	12.6	25.5	
616	3516	Trips	631	418	-	1,214	1,619	1,428	921	1,966	9,585
616	3516	Percent	7.7	5.1	-	14.8	19.8	17.4	11.2	24.0	
617	3517	Trips	18	4	17	9	11	16	6	43	125
617	3517	Percent	14.3	3.3	13.7	7.4	9.0	13.1	4.7	34.7	
618	3518	Trips	243	105	-	241	640	556	295	599	2,736
618	3518	Percent	9.1	3.9	-	9.0	23.9	20.8	11.0	22.4	
619	3519	Trips	114	-	-	442	1,579	1,258	675	2,112	6,703
619	3519	Percent	1.8	-	-	7.2	25.6	20.4	10.9	34.2	
620	3520	Trips	85	-	-	385	1,902	1,775	809	2,132	7,584
620	3520	Percent	1.2	-	-	5.4	26.8	25.1	11.4	30.1	
621	3521	Trips	411	-	112	336	917	877	409	774	3,916
621	3521	Percent	10.7	-	2.9	8.8	23.9	22.9	10.7	20.2	
622	3522	Trips	725	-	-	733	1,372	1,695	887	1,623	7,653
622	3522	Percent	10.3	-	-	10.4	19.5	24.1	12.6	23.1	
623	3523	Trips	394	243	139	749	727	1,431	755	921	5,657
623	3523	Percent	7.4	4.5	2.6	14.0	13.6	26.7	14.1	17.2	
624	3524	Trips	1,100	613	112	625	1,542	2,663	1,706	1,821	11,072
624	3524	Percent	10.8	6.0	1.1	6.1	15.2	26.2	16.8	17.9	

DIRECTIONAL TRIP DISTRIBUTION REPORT

Miami-Dade 2045 Cost Feasible Plan Direction Trip Distribution Summary												
TAZ of Origin		Trips / Percent	Cardinal Directions								Total Trips	
County TAZ	Regional TAZ		NNE	ENE	ESE	SSE	SSW	WSW	WNW	NNW		
599	3499	Trips	392	108	7	13	41	341	344	485	1,765	
599	3499	Percent	22.6	6.2	0.4	0.8	2.4	19.7	19.9	28.0		
600	3500	Trips	1,603	330	17	42	94	1,157	1,332	1,506	6,163	
600	3500	Percent	26.4	5.4	0.3	0.7	1.6	19.0	21.9	24.8		
601	3501	Trips	73	-	-	36	470	342	267	332	1,552	
601	3501	Percent	4.8	-	-	2.4	30.9	22.5	17.5	21.8		
602	3502	Trips	62	6	-	148	713	574	523	476	2,566	
602	3502	Percent	2.5	0.3	-	5.9	28.5	22.9	20.9	19.0		
603	3503	Trips	14	-	-	1	337	258	161	172	980	
603	3503	Percent	1.5	-	-	0.1	35.7	27.4	17.1	18.3		
604	3504	Trips	64	-	-	41	951	737	707	668	3,445	
604	3504	Percent	2.0	-	-	1.3	30.0	23.3	22.3	21.1		
605	3505	Trips	99	36	-	135	670	549	585	509	2,652	
605	3505	Percent	3.8	1.4	-	5.2	25.9	21.2	22.7	19.7		
606	3506	Trips	643	-	-	754	1,891	2,383	1,151	2,389	9,786	
606	3506	Percent	7.0	-	-	8.2	20.5	25.9	12.5	25.9		
607	3507	Trips	188	140	-	182	1,171	780	868	741	4,188	
607	3507	Percent	4.6	3.4	-	4.5	28.8	19.2	21.3	18.2		
608	3508	Trips	110	-	-	48	1,108	1,101	706	785	3,985	
608	3508	Percent	2.9	-	-	1.2	28.7	28.5	18.3	20.4		
609	3509	Trips	86	-	-	37	718	953	371	839	3,169	
609	3509	Percent	2.9	-	-	1.2	23.9	31.7	12.3	27.9		
610	3510	Trips	681	182	-	382	2,239	2,515	1,391	2,792	12,047	
610	3510	Percent	6.7	1.8	-	3.8	22.0	24.7	13.7	27.4		
611	3511	Trips	449	13	-	118	1,000	1,197	848	1,206	5,036	
611	3511	Percent	9.3	0.3	-	2.4	20.7	24.8	17.6	25.0		
612	3512	Trips	74	-	-	56	640	617	408	906	2,773	
612	3512	Percent	2.8	-	-	2.1	23.7	22.9	15.1	33.6		
613	3513	Trips	42	-	-	27	203	188	128	185	774	
613	3513	Percent	5.5	-	-	3.5	26.3	24.2	16.5	24.0		
614	3514	Trips	160	-	-	231	1,441	1,400	1,004	1,429	5,961	
614	3514	Percent	2.8	-	-	4.1	25.4	24.7	17.7	25.2		
615	3515	Trips	657	228	-	698	1,586	1,570	1,040	1,804	7,950	
615	3515	Percent	8.7	3.0	-	9.2	20.9	20.7	13.7	23.8		
616	3516	Trips	663	430	-	1,243	2,224	2,161	1,427	2,581	12,275	
616	3516	Percent	6.2	4.0	-	11.6	20.7	20.1	13.3	24.1		
617	3517	Trips	13	10	12	23	29	51	31	41	219	
617	3517	Percent	6.4	4.8	5.8	10.9	13.8	24.0	14.9	19.5		
618	3518	Trips	155	54	-	218	768	639	484	831	3,208	
618	3518	Percent	4.9	1.7	-	6.9	24.4	20.3	15.4	26.4		
619	3519	Trips	148	-	-	378	1,965	1,591	822	2,087	7,426	
619	3519	Percent	2.1	-	-	5.4	28.1	22.8	11.8	29.9		
620	3520	Trips	101	-	-	236	1,860	2,343	1,013	2,177	8,233	
620	3520	Percent	1.3	-	-	3.1	24.1	30.3	13.1	28.2		
621	3521	Trips	349	-	81	272	1,070	1,011	417	959	4,287	
621	3521	Percent	8.4	-	1.9	6.6	25.7	24.3	10.0	23.1		
622	3522	Trips	552	-	-	687	1,638	2,319	1,127	2,032	8,893	
622	3522	Percent	6.6	-	-	8.2	19.6	27.8	13.5	24.3		
623	3523	Trips	475	123	70	728	1,143	1,694	801	1,023	6,274	
623	3523	Percent	7.8	2.0	1.2	12.0	18.9	28.0	13.2	16.9		
624	3524	Trips	1,356	409	98	912	2,505	3,276	2,354	2,063	13,940	
624	3524	Percent	10.5	3.2	0.8	7.0	19.3	25.3	18.1	15.9		

ATTACHMENT D
Queuing Analysis

Queueing Analysis - PM Peak Hour

M= Queue length which is exceeded p percent of the time

$$M = \left[\frac{\ln P(x > M) - \ln Q_M}{\ln \rho} \right] - 1 \quad \text{where} \quad \ln P(x > M) = \ln 0.05$$

N= Number of service channels

Q= Service rate per channel (vph)

ρ = Demand rate/Service rate

$$\rho = \frac{q}{NQ}$$

q = Demand rate on the system (vph)

Q_M = Value obtained from Table 8.11 (refer to next page)

Gate Location- Residents Only	
Q=	300 vph
q =	3 vph
N=	1
ρ =	0.0100
Q_M =	0.0100
M=	-1.34949 \approx 1 vehicle

location, a 5% probability of back-up onto the adjacent street is judged to be acceptable. Demand on the system for design is expected to be 110 vehicles in a 45-minute period. Average service time was expected to be 2.2 minutes. Is the queue storage adequate?

Such problems can be quickly solved using Equation (8-9b) given in Table 8-10 and repeated below for convenience.

$$M = \left[\frac{\ln P(x > M) - \ln Q_M}{\ln \rho} \right] - 1$$

where:

M = queue length which is exceeded p percent of the time

N = number of service channels (drive-in positions)

Q = service rate per channel (vehicles per hour)

$\rho = \frac{\text{demand rate}}{\text{service rate}} = \frac{q}{NQ} = \text{utilization factor}$

q = demand rate on the system (vehicles per hour)

Q_M = tabled values of the relationship between queue length, number of channels, and utilization factor (see Table 8.11)

TABLE 8-11

Table of Q_M Values

	$N = 1$	2	3	4	6	8	10
0.0	0.0000	0.0000	0.0000	0.0000			
0.1	.1000	.0182	.0037	.0008	.0000	0.0000	0.0000
.2	.2000	.0666	.0247	.0096	.0015	.0002	.0000
.3	.3000	.1385	.0700	.0370	.0111	.0036	.0011
.4	.4000	.2286	.1411	.0907	.0400	.0185	.0088
.5	.5000	.3333	.2368	.1739	.0991	.0591	.0360
.6	.6000	.4501	.3548	.2870	.1965	.1395	.1013
.7	.7000	.5766	.4923	.4286	.3359	.2706	.2218
.8	.8000	.7111	.6472	.5964	.5178	.4576	.4093
.9	.9000	.8526	.8172	.7878	.7401	.7014	.6687
1.0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

$$\rho = \frac{q}{NQ} = \frac{\text{arrival rate, total}}{(\text{number of channels})(\text{service rate per channel})}$$

N = number of channels (service positions)

Solution

Step 1: $Q = \frac{60 \text{ min/hr}}{2.2 \text{ min/service}} = 27.3$ services per hour

Step 2: $q = (110 \text{ veh}/45 \text{ min}) \times (60 \text{ min/hr}) = 146.7$ vehicles per hour

Step 3: $\rho = \frac{q}{NQ} = \frac{146.7}{(6)(27.3)} = 0.8956$

Step 4: $Q_M = 0.7303$ by interpolation between 0.8 and 0.9 for $N = 6$ from the table of Q_M values (see Table 8-11).

Step 5: The acceptable probability of the queue, M , being longer than the storage, 18 spaces in this example, was stated to be 5%. $P(x > M) = 0.05$, and:

$$M = \left[\frac{\ln 0.05 - \ln 0.7303}{\ln 0.8956} \right] - 1 = \left[\frac{-2.996 - (-0.314)}{-0.110} \right] - 1$$

$$= 24.38 - 1 = 23.38, \text{ say } 23 \text{ vehicles.}$$