March 7, 2017

Ms. Grissel,
Deputy Director of Public Works
City of Signal Hill
2175 Cherry Avenue
Signal Hill, CA 90755

Subject: Redondo Avenue and East 20th Street Traffic Signal Warrant Analysis Memo

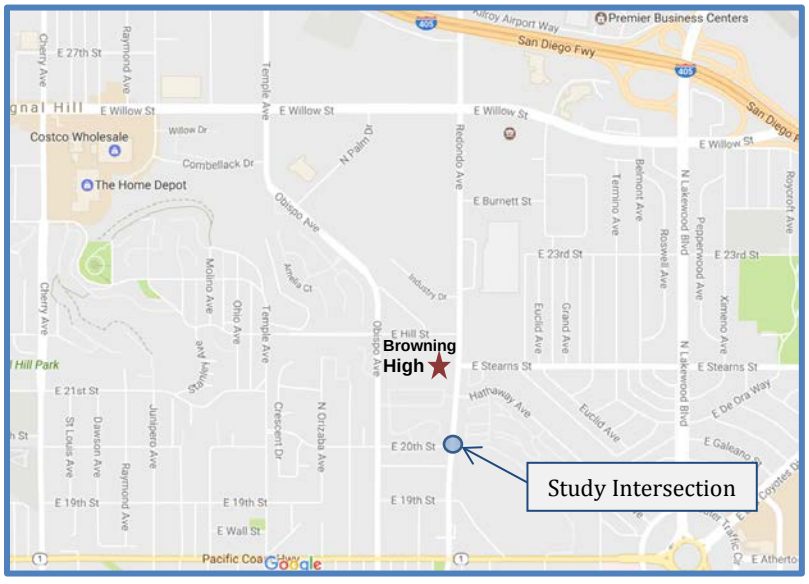
Dear Ms. Grissel:

W.G. Zimmerman Engineering, Inc. has performed a traffic signal warrant analysis for the Redondo Avenue and East 20th Street intersection. Our results from this analysis are presented in this Letter Report. The traffic analysis was performed at the request of the City of Signal Hill to evaluate the need for a traffic signal at this intersection. The study was based upon the recent edition of the California Manual of Traffic Control Devices (CA-MUTCD), Chapter 4C – Traffic Signal Needs Studies. This section defines nine warrants which are based upon traffic conditions such as traffic volumes, traffic flow gaps, pedestrian characteristics, and physical conditions to determine whether a traffic signal is justified at this location. One or more of these traffic signal warrants (if applicable) must be satisfied to consider the installation of a traffic signal at the Redondo Avenue and East 20th Street intersection.

Project Description

The Redondo Avenue and East 20th Street intersection is located in the City of Signal Hill. Figure 1 shows the project location map. The area south of East 20th Street consists of a combination of industrial and commercial developments. The area north of East 20th Street consists of residential developments, Browning High School and U.S. Army facilities.

Figure 1: Project Location Map



W.G. Zimmerman Engineering, Inc.
17011 Beach Boulevard, Suite 1240
Huntington Beach, CA 92647
(714) 799 -1700 / (714) 333 -4712 Fax

Figure 2: Study Location Arieal

Existing Conditions

Redondo Avenue and East 20th Street is a one way STOP sign controlled T-intersection. Redondo Avenue is four lane arterial road oriented in the north-south direction. There is no parking allowed along Redondo Avenue near the intersection. East 20th Street is a two lane local street oriented in the east-west direction. There is no parking allowed along East 20th Street near the intersection.

Speed Survey

The posted speed limit is 40 miles per hour along Redondo Avenue. The speed limit along East 20th Street is 25 miles per hour. A radar speed survey was conducted in September, 2016 to determine the vehicle travel speeds. Based upon the radar speed survey, the 85th-percentile vehicle speed on Redondo Avenue is 42 miles per hour in the northbound direction. The 85th-percentile vehicle speed on Redondo Avenue is 41 miles per hour in the southbound direction. The radar speed survey worksheet is included in Appendix A.

Existing Traffic Volumes

Traffic and pedestrian counts at Redondo Avenue and East 20th Street intersection were conducted by Traffic Counts Unlimited in February, 2017. Vehicle and pedestrian count worksheets are included in Appendix B.

Future Traffic Volumes

Future traffic volumes are based on a 1% per annum growth rate for traffic in the region in addition to approved development projects within the study area. The opening of Browning High School in the fall of 2017 will create additional trips within the project area. The year 2020 is used for future trip projections because fall 2020 will mark the first school year that all grade levels will have enrolled students.

Future Trip Generation

The Institute of Transportation Engineers (ITE), "*Trip Generation" Report, 8th Edition*, was used to develop the traffic generated by the Browning High school site based on the type of land use. ITE code 530, "High School", was used to determine the number of peak period trips generated by the site. The ITE rates are based upon field studies of similar sized high schools and consider a typical level of bus and walking trips.

Table 1 summarizes the daily, morning, and afternoon peak hourly trips that the project could be expected to generate – based upon the ITE rates.

Table 1 –Browning High School Future Trip Generation (Fall 2020)

			A.M. Peak Hour*			P.M. Peak Hour**			P.M. Peak Hour Generator		
	Units	Daily	In	Out	Total	In	Out	Total	In	Out	Total
Trip Generation Rates	Students	1.71	0.28	.14	0.42	0.06	0.07	0.13	0.096	.194	0.29
Vehicle Trips	860	1471	241	121	362	52	60	112	83	167	250
Note: *High school A.M. peak hour typically coincides with peak hour of adjacent street traffic. **P.M. peak hour is peak hour of adjacent street traffic (4 P.M. - 6 P.M.).											

Future Trip Distribution

Directional distribution percentages of the Browning High School trips were developed for the study intersection. These estimates, as shown in Table 2, are based upon assumptions involving the local geographical residency of the student population, roadway network pathways, and existing local travel patterns.

Future Trip Assignment

The morning and afternoon Browning High School peak hour trips were assigned to the study intersection based upon the trip distribution assumptions. Table 2 illustrates the A.M. and P.M. peak hour trip assignments.

Table 2 – Browning High School Future Trip Table (Fall 2020)

	Peak Hour Distribution			Peak Hour Trip Assignment		
Traffic Movement	A.M.	P.M.*	P.M. Generator	A.M.	P.M.*	P.M. Generator
NBL (In)	5%	5%	5%	13	3	5
SBR (In)	5%	5%	5%	13	3	5
EBR (Out)	9%	9%	9%	11	6	16
*P.M. peak hour is peak hour of adjacent street traffic (4 P.M. - 6 P.M.).						

Accident Data Analysis

Accident data has been obtained from the Statewide Integrated Traffic Records System (SWITRS) database for the City of Signal Hill from January 1, 2013 through December 31, 2015. This three (3) year data set has been sorted to refine the data for only accidents that occurred at the Redondo Avenue and East 20th Street intersection. In these three (3) years, there have been no reported accidents at the study intersection.

Traffic Signal Warrant Analysis

The need for a traffic signal under fall 2020 conditions at the Redondo Avenue and East 20th Street Intersection has been reviewed with respect to the following CA-MUTCD warrants:

- **Warrant 1, Eight-Hour Vehicular Volume**
- **Warrant 2, Four-Hour Vehicular Volume**
- **Warrant 3, Peak Hour**
- **Warrant 4, Pedestrian Volume**
- **Warrant 5, School Crossing**
- **Warrant 6, Coordinated Signal System**
- **Warrant 7, Crash Experience**
- **Warrant 8, Roadway Network**
- **Warrant 9, Intersection Near a Grade Crossing**

Traffic signal Warrants 4 through 9 are not applicable to the Redondo Avenue and East 20th Street intersection.

The 85th-percentile speed on the study intersection's major street, Redondo Avenue, exceeds 40 miles per hour. In addition, there is only one outlet for the isolated community along East 20th Street which is provided by the Redondo Avenue and East 20th Street intersection. These qualifications warrant the 70 percent factor or "urban" classification to be utilized for the traffic signal warrant analysis. Based on the analysis, the criteria of traffic signal Warrants 1 and 3 are not met at the Redondo Avenue and East 20th Street. However the study intersection meets the traffic signal warrant under Warrant 2 criteria (see Appendix C).

Conclusions and Recommendations

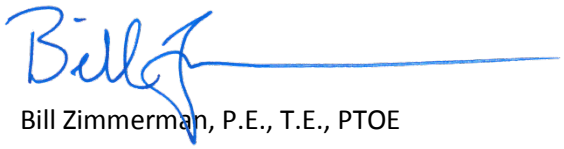
East 20th Street and Redondo Avenue serves as a main gateway to the residential housing communities along East 20th Street. The west leg of the study intersection is a conflict area between pedestrians crossing East 20th street and vehicles turning from Redondo Avenue onto East 20th Street. A significant number of the students who will attend Browning High live on the east and west sides of Redondo Avenue. The vehicle and pedestrian conflicts at the study intersection may be resolved through signal installation. A traffic signal at Redondo Avenue and East 20th will help regulate the traffic flow at the intersection and provide adequate gaps for pedestrians to cross safely. The installation of a traffic signal and upgrading the ADA ramps will directly impact this accident risk by providing a safe environment to safely cross East 20th Street. Utilizing a controlled intersection approach will provide visual information to students showing the how much time available to cross the street with the use of countdown pedestrian heads located on each leg of Redondo Avenue.

Based upon the State and Federal criteria detailed in the CA-MUTCD, traffic signal Warrant 2 is satisfied at the intersection of Redondo Avenue and East 20th Street, therefore it is recommended to install a traffic signal at this location.

Should you have any questions regarding this Letter Report, please do not hesitate to contact me directly at (714) 799-1700 ext. 11 or email at wgzimmerman@wgze.com.

W.G. Zimmerman engineering, Inc.,

Respectfully,



Bill Zimmerman, P.E., T.E., PTOE

President

APPENDIX A

Radar Speed Survey Worksheet

W.G. Zimmerman Engineering, Inc.
17011 Beach Boulevard, Suite 1240
Huntington Beach, CA 92647
(714) 799 -1700 / (714) 333 -4712 Fax

City of Signal Hill

Radar Speed Survey

Speed	E/B	W/B	MPH	Vehicles Surveyed — Northbound	Vehicles Surveyed — Southbound	TOT. VEH.		
65	0	0	65			0		
64	0	0	64			0		
63	0	0	63			0		
62	0	0	62			0		
61	0	0	61			0		
60	0	0	60			0		
59	0	0	59			0		
58	0	0	58			0		
57	0	0	57			0		
56	0	0	56			0		
55	0	0	55			0		
54	0	0	54			0		
53	0	0	53			0		
52	0	0	52			0		
51	0	0	51			0		
50	0	0	50			0		
49	0	1	49		X	1		
48	0	0	48			0		
47	0	0	47			0		
46	0	0	46			0		
45	0	2	45		X X	2		
44	0	0	44			0		
43	0	2	43		X X	2	*	
42	0	2	42		X X	2	*	
41	0	4	41		X X X X	4	*	
40	0	7	40		X X X X X X X	7	P	
39	0	9	39		X X X X X X X X X	9	A	
38	0	8	38		X X X X X X X X	8	C	
37	0	3	37		X X X	3	E	
36	0	3	36		X X X	3	*	
35	0	4	35		X X X X	4	*	
34	0	3	34		X X X	3	*	
33	0	0	33			0		
32	0	1	32		X	1		
31	0	0	31			0		
30	0	1	30		X	1		
29	0	0	29			0		
28	0	0	28			0		
27	0	0	27			0		
26	0	0	26			0		
25	0	0	25			0		
24	0	0	24			0		
23	0	0	23			0		
22	0	0	22			0		
21	0	0	21			0		
20	0	0	20			0		
19	0	0	19			0		
18	0	0	18			0		
17	0	0	17			0		
16	0	0	16			0		
15	0	0	15			0		
					GRAND TOTALS	50		

Location: Redondo Avenue

Between: 20th Street - Pacific Coast Highway

Weather: Clear

Date: 1/20/16

Time From: 1:15

Time To: 3:25

Existing Speed Limit: 40 M. P. H.

% Over Pace:	6%
% In Pace:	90%
% Under Pace:	4%
Average Speed:	39 M.P.H.
Pace Speed:	34 - 43 M.P.H.

15th Percentile / Critical Speed:	**34 MPH**
50th Percentile / Critical Speed:	**38 MPH**
85th Percentile / Critical Speed:	**41 MPH**

Radar Survey Conducted By:

Counts Unlimited, Inc.

PO Box 1178

Corona, CA 92880

T 951-268-6268 F 951-268-6267

City of Signal Hill

Radar Speed Survey

Speed	E/B	W/B	MPH	Vehicles Surveyed — Northbound / Southbound	TOT. VEH.
65	0	0	65		0
64	0	0	64		0
63	0	0	63		0
62	0	0	62		0
61	0	0	61		0
60	0	0	60		0
59	0	0	59		0
58	0	0	58		0
57	0	0	57		0
56	0	0	56		0
55	0	0	55		0
54	0	0	54		0
53	0	0	53		0
52	0	0	52		0
51	0	0	51		0
50	1	0	50	X	1
49	0	0	49		0
48	1	0	48	X	1
47	0	0	47		0
46	0	0	46		0
45	1	0	45	X	1
44	1	0	44	X	1
43	6	0	43	X X X X X X	6
42	3	0	42	X X X	3
41	3	0	41	X X X	3
40	8	0	40	X X X X X X X X	8
39	5	0	39	X X X X X	5
38	8	0	38	X X X X X X X X	8
37	8	0	37	X X X X X X X X	8
36	1	0	36	X	1
35	3	0	35	X X X	3
34	0	0	34		0
33	0	0	33		0
32	1	0	32	X	1
31	0	0	31		0
30	0	0	30		0
29	0	0	29		0
28	0	0	28		0
27	0	0	27		0
26	0	0	26		0
25	0	0	25		0
24	0	0	24		0
23	0	0	23		0
22	0	0	22		0
21	0	0	21		0
20	0	0	20		0
19	0	0	19		0
18	0	0	18		0
17	0	0	17		0
16	0	0	16		0
15	0	0	15		0
				GRAND TOTALS	50

* * * PACE * * *

Location: Redondo Avenue

Between: 20th Street - Pacific Coast Highway

Weather: Clear

Date: 1/20/16

Time From: 1:15

Time To: 3:25

Existing Speed Limit: 40 M. P. H.

% Over Pace:	6%
% In Pace:	92%
% Under Pace:	2%
Average Speed:	40 M.P.H.
Pace Speed:	35 - 44 M.P.H.

15th Percentile / Critical Speed:	**36 MPH**
50th Percentile / Critical Speed:	**38 MPH**
85th Percentile / Critical Speed:	**42 MPH**

Radar Survey Conducted By:

Counts Unlimited, Inc.

PO Box 1178

Corona, CA 92880

T 951-268-6268 F 951-268-6267

APPENDIX B

Traffic and Pedestrian Counts Worksheets

W.G. Zimmerman Engineering, Inc.
17011 Beach Boulevard, Suite 1240
Huntington Beach, CA 92647
(714) 799 -1700 / (714) 333 -4712 Fax

Counts Unlimited
PO Box 1178
Corona, CA 92878
(951) 268-6268

City of Long Beach
N/S: Redondo Avenue
E/W: East 20th Street
Weather: Clear

File Name : LBCRE20 12hr
Site Code :
Start Date : 2/22/2017

Groups Printed- Total Volume

	Redondo Avenue Southbound				East 20th Street Westbound				Redondo Avenue Northbound				East 20th Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
06:00 AM	0	41	1	42	0	0	0	0	2	166	0	168	0	0	0	0	210
06:15 AM	0	58	0	58	0	0	0	0	2	148	0	150	1	0	4	5	213
06:30 AM	0	88	9	97	0	0	0	0	3	188	0	191	0	0	9	9	297
06:45 AM	0	85	2	87	0	0	0	0	3	214	0	217	0	0	6	6	310
Total	0	272	12	284	0	0	0	0	10	716	0	726	1	0	19	20	1030
07:00 AM	0	104	4	108	0	0	0	0	5	274	0	279	0	0	4	4	391
07:15 AM	0	157	6	163	0	0	0	0	11	249	0	260	1	0	8	9	432
07:30 AM	0	155	10	165	0	0	0	0	1	280	0	281	2	0	17	19	465
07:45 AM	0	172	8	180	0	0	0	0	9	301	0	310	1	0	11	12	502
Total	0	588	28	616	0	0	0	0	26	1104	0	1130	4	0	40	44	1790
08:00 AM	0	192	7	199	0	0	0	0	6	268	0	274	1	0	6	7	480
08:15 AM	0	167	7	174	0	0	0	0	7	240	0	247	0	0	13	13	434
08:30 AM	0	167	5	172	0	0	0	0	9	265	0	274	0	0	10	10	456
08:45 AM	0	158	8	166	0	0	0	0	5	276	0	281	0	0	9	9	456
Total	0	684	27	711	0	0	0	0	27	1049	0	1076	1	0	38	39	1826
09:00 AM	0	171	9	180	0	0	0	0	8	262	0	270	0	0	8	8	458
09:15 AM	0	150	6	156	0	0	0	0	1	250	0	251	0	0	12	12	419
09:30 AM	0	139	6	145	0	0	0	0	2	232	0	234	0	0	3	3	382
09:45 AM	0	151	11	162	0	0	0	0	3	205	0	208	0	1	10	11	381
Total	0	611	32	643	0	0	0	0	14	949	0	963	0	1	33	34	1640
10:00 AM	0	126	3	129	0	0	0	0	1	198	0	199	0	0	11	11	339
10:15 AM	0	116	10	126	0	0	0	0	4	220	0	224	2	0	7	9	359
10:30 AM	0	159	5	164	0	0	0	0	1	213	0	214	0	0	3	3	381
10:45 AM	0	141	2	143	0	0	0	0	3	189	0	192	1	0	2	3	338
Total	0	542	20	562	0	0	0	0	9	820	0	829	3	0	23	26	1417
11:00 AM	0	151	7	158	0	0	0	0	1	221	0	222	1	0	5	6	386
11:15 AM	0	158	7	165	0	0	0	0	5	217	0	222	1	0	8	9	396
11:30 AM	0	176	3	179	0	0	0	0	2	175	0	177	1	0	11	12	368
11:45 AM	0	83	0	83	0	0	0	0	2	229	0	231	0	0	10	10	324
Total	0	568	17	585	0	0	0	0	10	842	0	852	3	0	34	37	1474
12:00 PM	0	3	0	3	0	0	0	0	7	206	0	213	0	0	15	15	231
12:15 PM	1	166	4	171	0	0	0	0	2	192	0	194	0	0	4	4	369
12:30 PM	0	149	4	153	0	0	0	0	5	205	0	210	1	0	16	17	380
12:45 PM	0	68	3	71	0	0	0	0	2	220	1	223	1	0	14	15	309
Total	1	386	11	398	0	0	0	0	16	823	1	840	2	0	49	51	1289
01:00 PM	0	9	2	11	0	0	0	0	4	224	0	228	2	0	23	25	264
01:15 PM	0	187	5	192	1	0	0	1	7	253	0	260	0	0	10	10	463
01:30 PM	0	158	7	165	0	0	0	0	7	206	0	213	0	0	10	10	388
01:45 PM	0	153	7	160	0	0	0	0	4	237	0	241	0	0	6	6	407
Total	0	507	21	528	1	0	0	1	22	920	0	942	2	0	49	51	1522
02:00 PM	0	173	8	181	0	0	0	0	5	214	0	219	0	0	8	8	408
02:15 PM	0	210	9	219	0	0	0	0	4	250	0	254	1	0	10	11	484
02:30 PM	1	200	6	207	0	0	0	0	3	219	0	222	2	0	15	17	446
02:45 PM	1	186	13	200	0	0	0	0	8	276	0	284	0	0	10	10	494
Total	2	769	36	807	0	0	0	0	20	959	0	979	3	0	43	46	1832
03:00 PM	0	221	20	241	0	0	0	0	6	257	0	263	0	0	14	14	518
03:15 PM	0	217	9	226	0	0	0	0	8	255	0	263	0	0	10	10	499
03:30 PM	0	258	9	267	0	0	0	0	9	240	0	249	0	0	15	15	531
03:45 PM	2	243	21	266	0	0	0	0	4	252	0	256	0	0	12	12	534
Total	2	939	59	1000	0	0	0	0	27	1004	0	1031	0	0	51	51	2082

Counts Unlimited
PO Box 1178
Corona, CA 92878
(951) 268-6268

City of Long Beach
N/S: Redondo Avenue
E/W: East 20th Street
Weather: Clear

File Name : LBCRE20 12hr
Site Code :
Start Date : 2/22/2017

Groups Printed- Total Volume

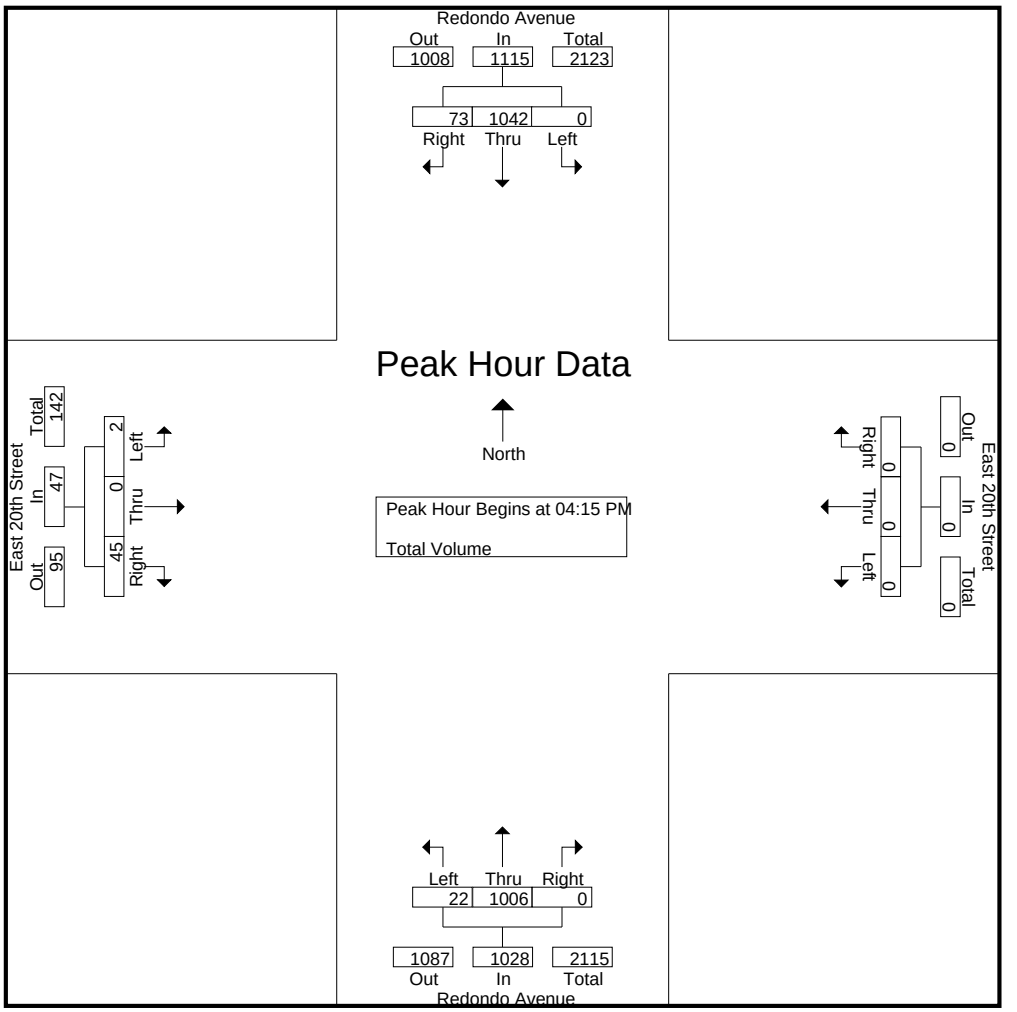
	Redondo Avenue Southbound				East 20th Street Westbound				Redondo Avenue Northbound				East 20th Street Eastbound				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	0	242	13	255	0	0	0	0	6	231	0	237	0	0	8	8	500
04:15 PM	0	259	22	281	0	0	0	0	9	248	0	257	0	0	17	17	555
04:30 PM	0	244	20	264	0	0	0	0	7	278	0	285	1	0	10	11	560
04:45 PM	0	244	15	259	0	0	0	0	4	256	0	260	0	0	10	10	529
Total	0	989	70	1059	0	0	0	0	26	1013	0	1039	1	0	45	46	2144
05:00 PM	0	295	16	311	0	0	0	0	2	224	0	226	1	0	8	9	546
05:15 PM	1	258	16	275	0	0	0	0	7	244	0	251	0	0	11	11	537
05:30 PM	1	275	15	291	0	0	0	0	7	226	0	233	2	0	9	11	535
05:45 PM	0	244	19	263	0	0	0	0	6	268	0	274	0	0	18	18	555
Total	2	1072	66	1140	0	0	0	0	22	962	0	984	3	0	46	49	2173
Grand Total	7	7927	399	8333	1	0	0	1	229	11161	1	11391	23	1	470	494	20219
Apprch %	0.1	95.1	4.8		100	0	0		2	98	0		4.7	0.2	95.1		
Total %	0	39.2	2	41.2	0	0	0	0	1.1	55.2	0	56.3	0.1	0	2.3	2.4	

	Redondo Avenue Southbound				East 20th Street Westbound				Redondo Avenue Northbound				East 20th Street Eastbound				
Start Time	Left	Thru	Right	App. Total				App. Total				App. Total				App. Total	Int. Total
Peak Hour Analysis From 06:00 AM to 05:45 PM - Peak 1 of 1																	
Peak Hour for Entire Intersection Begins at 04:15 PM																	
04:15 PM	0	259	**22**	281	0	0	0	0	**9**	248	0	257	0	0	**17**	**17**	555
04:30 PM	0	244	20	264	0	0	0	0	7	**278**	0	**285**	**1**	0	10	11	**560**
04:45 PM	0	244	15	259	0	0	0	0	4	256	0	260	0	0	10	10	529
05:00 PM	0	**295**	16	**311**	0	0	0	0	2	224	0	226	1	0	8	9	546
Total Volume	0	1042	73	1115	0	0	0	0	22	1006	0	1028	2	0	45	47	2190
% App. Total	0	93.5	6.5		0	0	0		2.1	97.9	0		4.3	0	95.7		
PHF	.000	.883	.830	.896	.000	.000	.000	.000	.611	.905	.000	.902	.500	.000	.662	.691	.978

Counts Unlimited
PO Box 1178
Corona, CA 92878
(951) 268-6268

City of Long Beach
N/S: Redondo Avenue
E/W: East 20th Street
Weather: Clear

File Name : LBCRE20 12hr
Site Code :
Start Date : 2/22/2017
Page No : 3



Peak Hour Analysis From 06:00 AM to 05:45 PM - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	05:00 PM				12:30 PM				07:00 AM				12:30 PM			
+0 mins.	0	**295**	16	**311**	0	0	0	0	5	274	0	279	1	0	16	17
+15 mins.	**1**	258	16	275	0	0	0	0	**11**	249	0	260	1	0	14	15
+30 mins.	1	275	15	291	0	0	0	0	1	280	0	281	**2**	0	**23**	**25**
+45 mins.	0	244	**19**	263	**1**	0	0	**1**	9	**301**	0	**310**	0	0	10	10
Total Volume	2	1072	66	1140	1	0	0	1	26	1104	0	1130	4	0	63	67
% App. Total	0.2	94	5.8		100	0	0		2.3	97.7	0		6	0	94	
PHF	.500	.908	.868	.916	.250	.000	.000	.250	.591	.917	.000	.911	.500	.000	.685	.670

Location: Long Beach
N/S: Redondo Avenue
E/W: East 20th Street

Date: 2/22/2017
Weather: Clear

PEDESTRIANS

Time	North Leg Redondo Avenue	East Leg East 20th Street	South Leg Redondo Avenue	West Leg East 20th Street	TOTAL
6:00 AM	0	0	0	0	0
6:15 AM	0	0	0	0	0
6:30 AM	0	0	0	0	0
6:45 AM	0	1	0	0	1
7:00 AM	0	0	0	1	1
7:15 AM	0	0	0	0	0
7:30 AM	0	1	0	0	1
7:45 AM	0	0	0	0	0
8:00 AM	0	1	0	0	1
8:15 AM	0	0	0	0	0
8:30 AM	0	1	0	0	1
8:45 AM	0	0	1	2	3
9:00 AM	0	0	0	0	0
9:15 AM	0	0	0	1	1
9:30 AM	0	0	0	1	1
9:45 AM	0	3	0	1	4
10:00 AM	0	1	0	2	3
10:15 AM	0	0	0	0	0
10:30 AM	0	0	0	0	0
10:45 AM	0	1	0	0	1
11:00 AM	0	0	0	0	0
11:15 AM	0	0	0	0	0
11:30 AM	0	1	0	2	3
11:45 AM	0	0	0	1	1
12:00 PM	0	2	0	0	2
12:15 PM	0	1	0	0	1
12:30 PM	0	1	1	0	2
12:45 PM	0	0	0	0	0
1:00 PM	0	0	0	0	0
1:15 PM	1	1	0	2	4
1:30 PM	0	0	0	0	0
1:45 PM	0	0	0	2	2
2:00 PM	0	1	0	1	2
2:15 PM	0	4	0	1	5
2:30 PM	0	0	0	2	2
2:45 PM	0	1	1	0	2
3:00 PM	0	0	0	1	1
3:15 PM	0	3	0	2	5
3:30 PM	0	0	0	4	4
3:45 PM	0	0	0	2	2
4:00 PM	0	0	0	3	3
4:15 PM	0	2	0	1	3
4:30 PM	0	1	0	0	1
4:45 PM	0	0	0	4	4
5:00 PM	0	0	0	3	3
5:15 PM	0	0	0	2	2
5:30 PM	0	2	0	1	3
5:45 PM	0	1	0	1	2
TOTAL VOLUMES:	1	30	3	43	77

Counts Unlimited, Inc.
PO Box 1178
Corona, CA 92878
951-268-6268

Location: Long Beach
N/S: Redondo Avenue
E/W: East 20th Street

Date: 2/22/2017
Weather: Clear

BICYCLES

Time	North Leg Redondo Avenue	East Leg East 20th Street	South Leg Redondo Avenue	West Leg East 20th Street	TOTAL
6:00 AM	0	0	0	0	0
6:15 AM	0	0	0	0	0
6:30 AM	1	0	0	0	1
6:45 AM	1	0	1	0	2
7:00 AM	0	0	0	0	0
7:15 AM	0	0	0	0	0
7:30 AM	0	0	3	1	4
7:45 AM	0	0	0	0	0
8:00 AM	0	0	1	0	1
8:15 AM	0	0	0	0	0
8:30 AM	0	0	0	0	0
8:45 AM	1	0	0	0	1
9:00 AM	0	0	1	0	1
9:15 AM	1	0	0	0	1
9:30 AM	0	0	0	0	0
9:45 AM	0	0	0	0	0
10:00 AM	1	0	1	0	2
10:15 AM	0	0	1	0	1
10:30 AM	0	0	0	0	0
10:45 AM	0	0	0	0	0
11:00 AM	0	0	0	0	0
11:15 AM	1	0	0	0	1
11:30 AM	0	0	0	0	0
11:45 AM	0	0	1	0	1
12:00 PM	0	0	0	0	0
12:15 PM	0	0	1	0	1
12:30 PM	0	0	0	0	0
12:45 PM	0	0	0	0	0
1:00 PM	0	0	0	0	0
1:15 PM	0	0	1	0	1
1:30 PM	0	0	0	0	0
1:45 PM	0	0	0	0	0
2:00 PM	0	0	0	0	0
2:15 PM	1	0	0	0	1
2:30 PM	2	0	0	0	2
2:45 PM	0	0	1	0	1
3:00 PM	1	0	1	0	2
3:15 PM	0	0	0	0	0
3:30 PM	0	0	0	0	0
3:45 PM	0	0	0	0	0
4:00 PM	1	0	1	0	2
4:15 PM	0	0	0	0	0
4:30 PM	0	1	0	0	1
4:45 PM	0	0	0	0	0
5:00 PM	0	0	1	0	1
5:15 PM	0	0	0	0	0
5:30 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0
TOTAL VOLUMES:	11	1	15	1	28

Counts Unlimited, Inc.
PO Box 1178
Corona, CA 92878
951-268-6268

APPENDIX C

Traffic Signal Warrants Worksheets

W.G. Zimmerman Engineering, Inc.
17011 Beach Boulevard, Suite 1240
Huntington Beach, CA 92647
(714) 799 -1700 / (714) 333 -4712 Fax

Figure 4C-101 (CA). Traffic Signal Warrants Worksheet (Sheet 1 of 5)

DIST _____ CO _____ RTE _____ PM _____

COUNT DATE February 2020
CALC SO DATE 3/7/2017
CHK KB DATE 3/8/2017

Major St: Redondo Avenue — Critical Approach Speed 41/42 mph
Minor St: East 20th Street — Critical Approach Speed 25 mph

Speed limit or critical speed on major street traffic > 40 mph..... ☐
or
In built up area of isolated community of < 10,000 population..... ☐ **RURAL (R)**

☒ **URBAN (U)**

WARRANT 1 - Eight Hour Vehicular Volume **SATISFIED YES ☐ NO ☒**
(Condition A or Condition B or combination of A and B must be satisfied)

Condition A - Minimum Vehicle Volume **100% SATISFIED YES ☐ NO ☒**
80% SATISFIED YES ☐ NO ☒

	MINIMUM REQUIREMENTS (80% SHOWN IN BRACKETS)											
	U	R	U	R								
APPROACH LANES	1		2 or More		7:30 A.M.	8:30 A.M.	12:00 P.M.	1:00 P.M.	2:00 P.M.	3:00 P.M.	4:00 P.M.	5:00 P.M. Hour
Both Approaches Major Street	500 (400)	350 (280)	600 (480)	420 (336)	1912	1804	1276	1515	1867	2093	2168	2195
Highest Approach Minor Street	150 (120)	105 (84)	200 (160)	140 (112)	64	41	53	53	64	69	54	57

Condition B - Interruption of Continuous Traffic **100% SATISFIED YES ☐ NO ☒**
80% SATISFIED YES ☒ NO ☐

	MINIMUM REQUIREMENTS (80% SHOWN IN BRACKETS)											
	U	R	U	R								
APPROACH LANES	1		2 or More		7:15 A.M.	8:15 A.M.	12:00 P.M.	1:00 P.M.	2:00 P.M.	3:00 P.M.	4:00 P.M.	5:00 P.M. Hour
Both Approaches Major Street	750 (600)	525 (420)	900 (720)	630 (504)	1888	1818	1276	1515	1841	2093	2168	2195
Highest Approach Minor Street	75 (60)	53 (42)	100 (80)	70 (56)	60	42	53	53	64	69	54	57

Combination of Conditions A & B **SATISFIED YES ☐ NO ☒**

REQUIREMENT	CONDITION	✓	FULFILLED
TWO CONDITIONS SATISFIED 80%	A. MINIMUM VEHICULAR VOLUME		Yes ☐ No ☒
	AND, B. INTERRUPTION OF CONTINUOUS TRAFFIC		
AND, AN ADEQUATE TRIAL OF OTHER ALTERNATIVES THAT COULD CAUSE LESS DELAY AND INCONVENIENCE TO TRAFFIC HAS FAILED TO SOLVE THE TRAFFIC PROBLEMS			Yes ☐ No ☒

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

Figure 4C-101 (CA). Traffic Signal Warrants Worksheet (Sheet 2 of 5)

WARRANT 2 - Four Hour Vehicular Volume **SATISFIED* YES ☒ NO ☐**

Record hourly vehicular volumes for any four hours of an average day.

APPROACH LANES	One	2 or More	7:30 A.M.	12:30 P.M.	2:30 P.M.	3:30 P.M.
Both Approaches - Major Street		☒	1912	1389	1974	2142
Higher Approach - Minor Street	☒		64	70	69	60

Hour

*All plotted points fall above the applicable curve in Figure 4C-1. (URBAN AREAS)	Yes ☐	No ☒
OR, All plotted points fall above the applicable curve in Figure 4C-2. (RURAL AREAS)	Yes ☒	No ☐

WARRANT 3 - Peak Hour **SATISFIED YES ☐ NO ☒**
(Part A or Part B must be satisfied)

PART A **SATISFIED YES ☐ NO ☒**

(All parts 1, 2, and 3 below must be satisfied for the same one hour, for any four consecutive 15-minute periods)

1. The total delay experienced by traffic on one minor street approach (one direction only) controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach, or five vehicle-hours for a two-lane approach; AND	Yes ☐	No ☐
2. The volume on the same minor street approach (one direction only) equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND	Yes ☐	No ☒
3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches.	Yes ☒	No ☐

PART B **SATISFIED YES ☐ NO ☒**

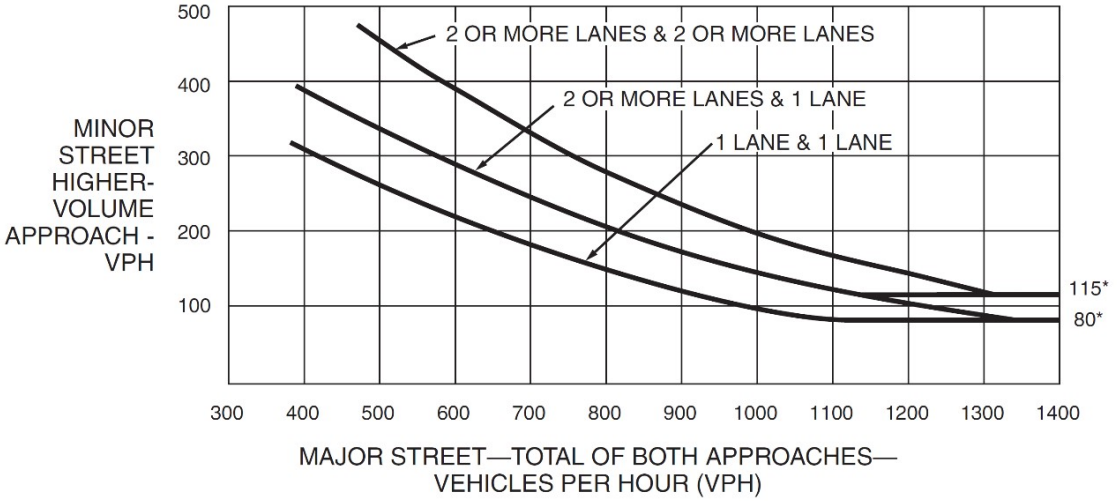
APPROACH LANES	One	2 or More	2:30 P.M.
Both Approaches - Major Street		☒	1974
Higher Approach - Minor Street	☒		69

Hour

The plotted point falls above the applicable curve in Figure 4C-3. (URBAN AREAS)	Yes ☐	No ☒
OR, The plotted point falls above the applicable curve in Figure 4C-4. (RURAL AREAS)	Yes ☐	No ☒

The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.

Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume

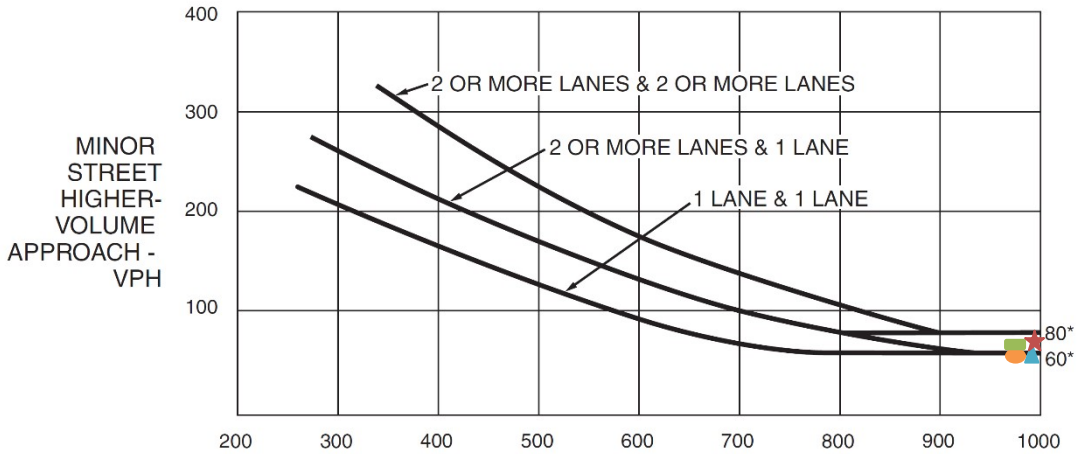


*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

(NOT USED)

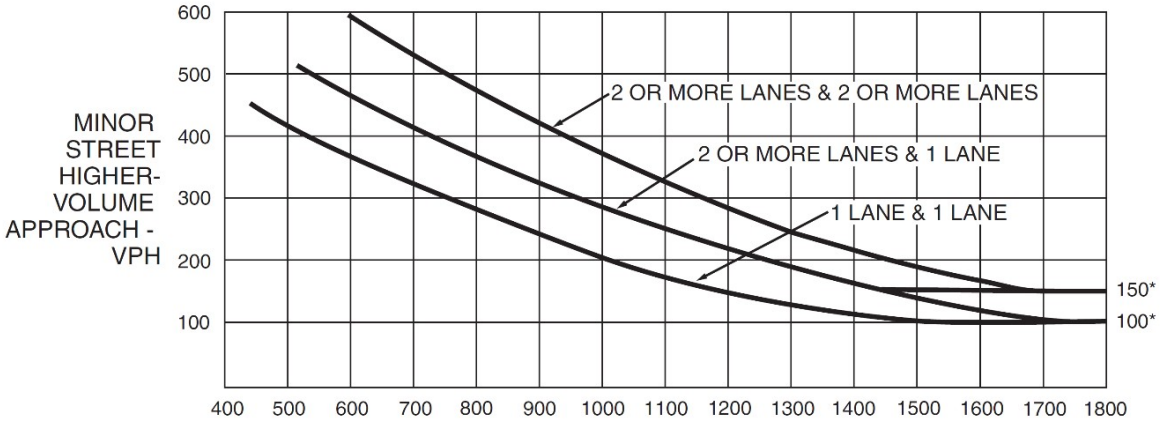
Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-3. Warrant 3, Peak Hour

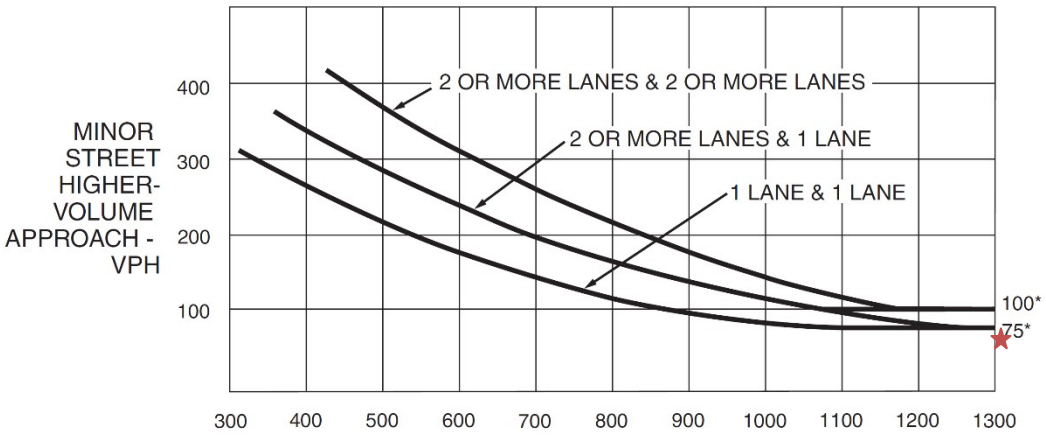


*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

(NOT USED)

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 40 MPH ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.