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Traffic Engineering Review
for Esposito Enterprises.
[redacted] by Christ

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TRAFFIC ENGINEERING REVIEW

OF SITE PLANS FOR TOWNHOUSES AND FUTURE COMMERCIAL USE

PROPOSED BY ESPOSITO ENTERPRISES

LOCATED ON MOUNTAIN BOULEVARD

WARREN TOWNSHIP, SOMERSET COUNTY, N.J.

PREPARED FOR

TERRENCE O'CONNOR
RICHARDSON & O'CONNOR
ATTORNEYS AT LAW
968 SOMERSET STREET
WATCHUNG, N.J. 07060

by

JOHN E. CHRIST, P.E.
80 ORTON ROAD
WEST CALDWELL, N.J. 07006

MAY 1982

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INTRODUCTION

The Esposito Enterprises site plan shows 181 townhouse units located off the north side of Mountain Boulevard. Plans by Matthew R. Zito, Architect-Planner, were reviewed for site data. Two-car garages are shown for 166 units. The remaining 15 units have single car garages. Driveway parking is shown for 347 cars. The only other parking shown is at the tennis courts.

Two roadways are shown to Mountain Boulevard. The more major roadway is shown as a divided roadway along the westerly side of the property. A proposed one-way entry driveway is shown in a 50 foot right-of-way between the Warren Professional Building and the Queen City Savings Bank. A possible connection to the F & W Associates site is shown. The F & W site is also a townhouse application, east of the subject site.

It should be noted that the Esposito site plan shows 5.3 acres along Mountain Boulevard as part of the subject property for future commercial use.

The undersigned personally conducted peak hour traffic counts at Mountain Boulevard and Bardy Road. These counts included the driveway activity for the Queen City Savings Bank and the Warren Professional Center. In addition, a counting machine was installed at a utility pole on the south side of Mountain Boulevard approximately 550 feet east of Bardy Road. This location is approximately 80 feet west of a Chevron Gasoline Service Station. The machine counted eastbound and total traffic separated by ½ hour periods for a total week. The accuracy of the machine was verified at the beginning, middle, and end of the count by manual counts made by the undersigned. The machine counts axles and then divides by two to get the number of vehicles. Therefore, a 3 axle truck counts as 1½ vehicles, a 4 axle truck counts as 2 vehicles and a 5 axle vehicle as 2½ vehicles. Since these larger vehicles have more of an effect on the

traffic flow and capacity than passenger cars, the results give an accurate picture of passenger car equivalents along Mountain Boulevard.[1]

Observations of traffic conditions were made during the morning and afternoon peak hours at the intersection of Mountain Boulevard and Mt. Bethel Road.

A traffic engineering report by Harlyn Associates, Harvey Yesowitz, P.E., dated June 1981, for the Esposito Enterprises site was reviewed.

Observations were made of sight distances provided at the various driveways. General observations were made of traffic conditions.

Internal traffic review of the site was made. The Esposito Enterprises application is a bifurcated application where site plan review is not being sought. It is appropriate to comment generally on the internal flow now as changes could be made before more detailed plans are drawn.

Some consideration must be given to the future commercial site that is part of the subject property. All improvements needed to Mountain Boulevard for the total development of the subject property should be constructed at one time. Reconstruction of an existing roadway is disruptive to the existing traffic flow. Therefore, it would be ill-advised to construct improvements to Mountain Boulevard now, and then in a few years do further reconstruction. Also note that the commercial site will share the same left turn stacking lane and probably the same driveway.

The following publications were referred to as part of this study:

TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK, Institute of Traffic Engineers, 1976

HIGHWAY CAPACITY MANUAL, Bureau of Public Roads, 1965

TRIP GENERATION, Institute of Transportation Engineers, 1975, as revised in 1979

[1] See page 5-14 for a description of the traffic count format.

INTERNAL TRAFFIC FLOW - ESPOSITO ENTERPRISES

A detailed roadway plan is not shown on the plan set. However, the schematic shown on Sheet 1 of 7 does warrant some comment.

The intersection along the main driveway approximately 720 feet from Mountain Boulevard is too wide open. Drivers approaching this intersection on all approaches would feel they have the right-of-way. Note that a STOP sign on the north approach would be unsuccessful in stopping southbound visitor traffic. The real danger would be for a possible head-on collision involving a southbound through vehicle and a northbound left turning vehicle. The solution is to bend the east-west roadway, the west approach, so that it intersects the north-south roadway as close to a right angle as possible. Then the curb lines would be joined with radii of from 25 to 35 feet. With this change the intersection right-of-way would be evident to all drivers.

The right-of-way would be questionable to drivers at the intersection of the east-west roadway and the short roadway joining it. The solution would be to join the north curb line of the straight-away sections of the east-west roadway with a simple curve with a minimum radius of 350 feet. The radius point (center of curve) would be north of the roadway. The curb lines of the north-south roadway would be extended and joined to the east-west roadway with 25 to 35 foot radii. Then proper traffic control could be afforded.

The total amount of parking spaces is adequate. However, no provision is made for visitor parking when several guests may visit a particular unit. Consideration should be given to providing visitor parking.

Islands are shown within the turn-arounds on the plan. Care should be exercised to insure that trucks and buses can make the U-turns without backing.

The traffic volume generation in the Harlyn report has been very conservatively derived. It is likely that the actual traffic volumes will be lower than those derived.

The auxiliary roadway would become one-way facing possible exiting traffic approximately 200 feet from the east-west roadway. This condition would be difficult to sign effectively for visiting traffic.

TRAFFIC FLOW ON MOUNTAIN BOULEVARD

The Esposito townhouse development will add approximately 150 vehicles in the evening peak hour to Mountain Boulevard as a two-way flow right at the site. If the directional characteristics are evenly split, this would mean 75 vehicles east of the site and 75 vehicles west of the site. The potential increase in volumes from the 5.3 acres commercial site should be approximately 250 vehicles entering and 250 vehicles exiting the site in the evening peak hour.

The Esposito site plan shows an entry roadway between the Warren Professional Building and the Queen City Savings Bank. A left turn should not be allowed from Mountain Boulevard into this proposed roadway. It is in an area already complicated by eastbound left turns into the Professional Center and more importantly the Bank. Following traffic could not get around a vehicle waiting to turn left at this point. Moreover, this roadway would have a near-right far-left offset with Bardy Road. This type offset could lead to a lock-up condition when vehicles in opposite directions desire to turn left into Bardy Road and left into the proposd roadway at the same time. This would have a deleterious effect on both capacity and safety. Therefore, the roadway should be a one way exit only limited to right turns. The only real benefit as an entrance would be for vehicles exiting the bank to reach the Esposito site. A driveway could be constructed from the bank parking lot to the proposed roadway allowing two-way movement north of that driveway.

Mountain Boulevard appears to operate at what is defined as Level of Service C, generally regarded as an adequate level. Capacity is a difficult thing to calculate by numbers as there are many intangibles involved. These include presence of school buses, mail delivery vehicles, garbage trucks; frequency of and location of left turns, as well as the standard factors. Not considering the intersection movements at the proposed site roadways, the addition of the traffic generated by the 181 units of townhouses would cause the

Level of Service along Mountain Boulevard to drop to a low C. Considering the turning movements into and out of the proposed site, the Level of Service could be expected to drop well into the D range if Mountain Boulevard remains as a two-lane roadway in front of the site. Addition of the future commercial traffic on this site would further decrease the Level of Service.[1]

Left turn stacking lanes should be provided in the center of Mountain Boulevard to reduce the negative effect of the added traffic. The developed pavement width for this stacking lane should be continuous and include the roadways to the Esposito townhouse site as well as the future office and commercial sites. A transition section for westbound traffic beginning east of the site with a maximum rate of one foot lateral to sixty feet longitudinally should be used if all of the widening occurs on the north side of Mountain Boulevard. At the west end, the widening should join with the already widened section in the developed commercial area. The minimum width of pavement that should be considered for this improved section should be 36 feet. A width of 40 feet would be more desirable. Side benefits would be the use of the developed width for left turn stacking out of the through lane in either direction for left turns into the Municipal Building driveway, Bardy Road, and for the Queen City Savings Bank driveway. The increase in capacity from these side benefits would help to offset the decrease in Level of Service caused by the townhouse site traffic.

Sight distance was checked and found possible to be adequate at the driveway locations. Sight distance easements or similar means will be needed to insure safety at these locations.

Traffic volumes at the intersection of Mountain Avenue and Mt. Bethel Rd. would be increased approximately 3% in the AM peak hour and 5% in the PM peak hour. An acceptable Level of Service C or better should be retained at this signalized intersection.[2]

[1] See page 5-12 of the Appendix for a description of each Level of Service.

[2] See page 5-13 of the Appendix for a description of Level of Service at a signalized intersection.

The peak hours of traffic flow are of the most interest to a traffic engineer. The attached machine-made traffic counts show that for the week beginning on Sunday, October 18, 1981, the peak one hour of Mountain Boulevard was 1389 passenger car equivalents. This peak hour occurred on Thursday, October 22, 1982,from 4:30 to 5:30 PM. On that date, the 24 hour traffic flow on Mountain Boulevard was 12,694 passenger car equivalents. The fluctuations in the hourly traffic flows can be seen by referring to the attached traffic counts. The hourly fluctuations in a townhouse development's traffic would be expected to be similar to the pattern shown for Mountain Boulevard.

According to the ITE's TRIP GENERATION, the Average Weekday Vehicle Trip Ends is 5.1 per Occupied Townhouse Unit. A Trip End is one end of a trip. When a vehicle arrives at the site, it is one Trip End. When it leaves the site,it is another Trip End. Then 5.1 Trip Ends per 24 hour day per unit means that 2.55 round trips are expected. The average 181 unit townhouse development would be expected to generate 460 vehicles arriving at the site and 460 vehicles exiting the site on a 24 hour weekday.

A single family detached residence has approximately the same peak hour traffic generation per unit as a townhouse unit. The single family home has a greater trip generation factor over the period of a 24 hour day. The average 24 hour Trip Ends factor for detached single family homes is shown in the ITE's TRIP GENERATION as 10.0 per dwelling unit. Assuming that 20 single family detached homes could be built on the 35.7 acre tract, the peak hour vehicle trips generated would be approximately 11% of that of the 181 townhouses proposed by Esposito Enterprises. Over the period of a 24 hour weekday, the 20 single family detached homes would be expected to generate 100 trips arriving at the site and 100 trips departing the site. The 24 hour weekday vehicle trips for 20 single family detached homes would be approximately 22% of that generated by 181 townhouses.

The potential traffic generated by the commercial site over the period of a business day would vary by the day of the week. On Thursday or Friday, most retail uses would generate more traffic than on a Tuesday. On the busy day of the week, the commercial site

would have the potential to draw between 1500 and 2000 vehicles entering the site and the same number exiting the site. The hourly fluctuations for the commercial site would not be expected to follow the fluctuation of the roadway traffic flow. The commercial site traffic generation could be fairly even from 10 AM to 8 PM. There would be very little traffic generated during the morning roadway traffic peak hour.

One of the potential uses of the commercial area with the greatest traffic generation would be a large supermarket with agressive marketing along with satellite stores. The resulting traffic volume in the evening peak one hour could be 1400 vehicles through traffic, 150 vehicles for the Esposito Townhouse site, and 500 vehicles for the commercial site, for a total of approximately 2000 vehicles. The three lane arrangement on Mountain Boulevard that would be adequate for just the Townhouse development would be inadequate when considering the potential use of the commercial site. Then a four-lane roadway with an English style flow,where left turns entering the site and left turns exiting the site do not cross each other on Mountain Boulevard, would be needed. An alternative would be to widen Mountain Boulevard to five lanes with the center lane being a left turn stacking lane. It should be noted that a traffic signal usually has a significant negative effect on a close-by adjacent intersection. Therefore, if there is to be a future traffic signal,it would have to accommodate, or control, both the Townhouse and commercial area traffic.

CONCLUSIONS

It can be concluded that:

1. If development of the townhouses by Esposito Enterprises as shown on Matthew R. Zito site plans occurs, a Level of Service D on Mountain Boulevard would result.

2. To prevent an undesirable Level of Service D from occurring, a left turn stacking lane area should be constructed in Mountain Boulevard. A transition section with a minimum rate of 1 foot lateral to 60 feet longitudinal should be provided east of the site for westbound traffic. The widened section on the north side should be extended continuously to join with the already improved section of Mountain Boulevard west of the site.

3. The Level of Service of Mountain Boulevard east of the site should remain within Level of Service C with the townhouse development if no other development occurs in the area.

4. An acceptable Level of Service C or better should be retained at the intersection of Mountain Boulevard and Mt. Bethel Road when the traffic from the proposed 181 townhouses is added to the existing traffic flows.

5. The roadway from the Esposito site to Mountain Boulevard between the Warren Professional Building and the Queen City Savings Bank should be a one-way exit only (southbound) restricted to right turns only. A connector driveway from the Bank parking lot with two-way traffic north thereof would be acceptable.

6. Sight distance at the site roadways intersections with Mountain Boulevard will be adequate as long as sight distance triangles are kept clear of brush, shrubbery, walls, fences, embankments and similar obstructions.

7. Improvements are needed to internal roadway intersections shown schematically on the plans. Refer to the text of this report for specific comments that refer to site plan review.

8. Note should be given to the future commercial area at the front of the site that potentially could generate a greater volume of traffic in the PM peak hour than the townhouses. The Mountain Boulevard improvements and driveway designs should be compatible for both the townhouse use and the future commercial use.

The above is a true representation of my findings.

Respectfully submitted,

John E. Christ

John E. Christ, P.E.
N.J. License 13883

MACHINE COUNT - MOUNTAIN BLVD - WARREN TWP

	SUN 10-18-81			MON 10-19-81		
	EB	WB	TOT	EB	WB	TOT
	56		122	30		48
	55		107	6		20
12:00-1:00 AM	111	118	229	36	32	68
	55		107	5		15
	77		110	4		8
1:00-2:00 AM	132	85	217	9	14	23
	37		58	4		9
	18		35	4		6
2:00-3:00 AM	55	38	93	8	7	15
	17		29	0		5
	7		31	2		2
3:00-4:00 AM	24	36	60	2	5	7
	4		9	2		4
	3		6	9		13
4:00-5:00 AM	7	8	15	11	6	17
	4		8	11		17
	5		10	13		26
5:00-6:00 AM	9	9	18	24	19	43
	4		9	51		92
	11		21	144		216
6:00-7:00 AM	15	15	30	195	113	308
	22		49	317		450
	22		67	337		603
7:00-8:00 AM	44	72	116	654	399	1053
	36		94	272		479
	62		133	218		384
8:00-9:00 AM	98	139	237	490	373	863
7:30-8:30 AM	58	103	161	609	473	1082

MACHINE COUNT — MOUNTAIN BLVD - WARREN TWP

	TUES. 10-20-81			WED 10-21-81			THUR. 10-22-81		
	EB	WB	TOT	EB	WB	TOT	EB	WB	TOT
	15		32	14		36	25		49
	8		22	8		32	12		43
12:00-1:00 AM	23	31	54	22	46	68	37	55	92
	24		34	27		40	27		33
	5		12	9		15	12		17
1:00-2:00 AM	29	17	46	36	19	55	39	11	50
	0		9	5		11	4		15
	4		5	4		11	1		8
2:00-3:00 AM	4	10	14	9	13	22	5	18	23
	2		7	3		7	3		5
	1		4	4		5	4		5
3:00-4:00 AM	3	8	11	7	5	12	7	3	10
	7		10	4		7	9		12
	6		13	5		11	5		10
4:00-5:00 AM	13	10	23	9	9	18	14	8	22
	9		14	11		14	14		18
	25		43	20		33	22		33
5:00-6:00 AM	34	23	57	31	16	47	36	15	51
	55		89	56		92	41		79
	129		208	139		204	142		213
6:00-7:00 AM	184	113	297	195	101	296	183	109	292
	276		392	300		430	310		442
	353		610	322		594	329		590
7:00-8:00 AM	629	373	1002	622	402	1024	639	393	1032
	271		461	246		419	276		491
	189		405	204		389	212		405
8:00-9:00 AM	460	406	866	450	358	808	488	408	896
7:30-8:30 AM	624	447	1071	568	445	1013	605	476	1081

MACHINE COUNT - MOUNTAIN BLVD - WARREN TWP

	FRI 10-23-81			SAT. 10-24-81			SUN 10-25-81		
	EB	WB	TOT	EB	WB	TOT	EB	WB	TOT
	33		59	61		96	45		112
	21		47	34		69	62		110
12:00-1:00 AM	54	52	106	95	70	165	107	115	222
	34		49	54		85	43		83
	17		25	34		62	53		96
1:00-2:00 AM	51	23	74	88	59	147	96	83	179
	7		17	51		79	51		87
	9		17	18		30	21		37
2:00-3:00 AM	16	18	34	69	40	109	72	52	124
	10		20	15		22	8		20
	2		2	10		20	6		16
3:00-4:00 AM	12	10	22	25	17	42	14	22	36
	6		7	10		20	13		22
	9		14	8		16	9		16
4:00-5:00 AM	15	6	21	18	18	36	22	16	38
	11		22	7		12	3		8
	17		36	13		21	2		4
5:00-6:00 AM	28	30	58	20	13	33	5	7	12
	56		83	10		37	9		11
	131		205	40		76	2		9
6:00-7:00 AM	187	101	288	50	63	113	11	9	20
	287		424	57		103	17		24
	330		597	71		131	18		38
7:00-8:00 AM	617	404	1021	128	106	234	35	27	62
	227		465	89		156	29		61
	221		420	128		268	43		99
8:00-9:00 AM	448	437	885	217	207	424	72	88	160
7:30-8:30 AM	557	505	1062	160	127	287	47	52	99

MACHINE COUNT – MOUNTAIN BLVD. – WARREN TWP

	SAT 10-17-81			SUN 10-18-81			MON 10-19-81		
	EB	WB	TOT.	EB	WB	TOT	EB	WB	TOT
				74		173	167		309
				105		223	135		282
9:00–10:00 AM				179	217	396	302	289	591
				147		279	143		274
				131		288	162		322
10:00–11:00 AM				278	289	567	305	291	596
				184		357	172		319
				215		399	162		311
11:00–12:00 NOON				399	357	756	334	296	630
				220		422	198		378
				196		371	187		346
12:00–1:00 PM				416	377	793	385	339	724
				202		376	150		316
				201		362	168		346
1:00–2:00 PM				403	335	738	318	344	662
	223		453	218		398	164		345
	213		455	183		361	199		371
2:00–3:00 PM	436	472	908	401	358	759	363	353	716
	229		424	200		363	151		328
	223		455	174		324	205		448
3:00–4:00 PM	452	427	879	374	313	687	356	420	776
	231		439	171		311	222		499
	218		399	176		318	323		632
4:00–5:00 PM	449	389	838	347	282	629	545	586	1131
	261		457	133		246	305		655
	213		379	123		225	247		553
5:00–6:00 PM	474	362	836	256	215	471	552	656	1208
4:30–5:30 PM	479	377	856	309	255	564	628	659	1287

MACHINE COUNT - MOUNTAIN BLVD - WARREN TWP.

	TUES. 10-20-81			WED 10-21-81			THUR. 10-22-81		
	EB	WB	TOT	EB	WB	TOT	EB	WB	TOT
	177		340	169		305	173		324
	156		317	136		297	157		317
9:00-10:00 AM	333	324	657	305	297	602	330	311	641
	155		296	154		264	147		304
	170		307	164		302	161		313
10:00-11:00 AM	325	278	603	318	248	566	308	309	617
	160		275	147		284	147		271
	158		297	171		312	174		323
11:00-12:00 NOON	318	254	572	318	278	596	321	273	594
	211		383	182		336	185		338
	170		327	188		327	161		323
12:00-1:00 PM	381	329	710	370	293	663	346	315	661
	186		367	153		309	182		349
	178		352	141		296	184		366
1:00-2:00 PM	364	355	719	294	311	605	366	349	715
	191		357	172		343	183		367
	185		362	174		323	167		331
2:00-300 PM	376	343	719	346	320	666	350	348	698
	196		411	218		400	224		453
	218		449	213		424	242		495
3:00-4:00 PM	414	446	860	431	393	824	466	482	948
	233		528	227		511	213		471
	303		605	329		638	350		660
4:00-5:00 PM	536	597	1133	556	593	1149	563	568	1131
	335		709	303		646	347		729
	282		622	265		571	288		632
5:00-6:00 PM	617	714	1331	568	649	1217	635	726	1361
4:30-5:30 PM	638	676	1314	632	652	1284	697	692	1389

MACHINE COUNT - MOUNTAIN BLVD - WARREN TWP

	FRI 10-23-81			SAT 10-24-81			SUN 10-25-81		
	EB	WB	TOT	EB	WB	TOT	EB	WB	TOT
	191		319	168		319	46		113
	150		292	182		353	83		211
9:00-10:00 AM	341	270	611	350	322	672	129	195	324
	174		340	230		433	105		192
	159		319	262		500	138		274
10:00-11:00 AM	333	326	659	492	441	933	243	223	466
	165		359	258		491	154		313
	197		345	307		526	157		314
11:00-12:00 Noon	362	342	704	565	452	1017	311	316	627
	224		427	268		478	174		329
	190		374	235		439	215		383
12:00-1:00 PM	414	387	801	503	414	917	389	323	712
	173		351	236		475	206		399
	159		345	230		411	208		411
1:00-2:00 PM	332	364	696	466	420	886	414	396	810
	174		349	240		493	195		368
	171		326	233		465	239		447
2:00-3:00 PM	345	330	675	473	485	958	434	381	815
	208		426	257		486	196		377
	199		439	239		499	218		399
3:00-4:00 PM	407	458	865	496	489	985	414	362	776
	200		530	251		496	227		384
	309		610	216		408	168		334
4:00-5:00 PM	509	631	1140	467	437	904	395	323	718
	306		624	192		359			
	261		594	201		351			
5:00-6:00 PM	567	651	1218	393	317	710			
4:30-5:30 PM	615	619	1234	408	359	767			

MACHINE COUNT – MOUNTAIN BLVD. — WARREN TWP.

	SAT 10-17-81			SUN 10-18-81			MON 10-19-81		
	EB	WB	TOT.	EB	WB	TOT.	EB	WB	TOT
	181		329	124		237	167		367
	145		278	94		186	148		316
6:00-7:00 PM	326	281	607	218	205	423	315	368	683
	147		270	103		193	112		246
	118		240	90		160	132		251
7:00-8:00 PM	265	245	510	193	160	353	244	253	497
	110		240	68		144	77		171
	90		191	76		137	63		149
8:00 – 9:00 PM	200	231	431	144	137	281	140	180	320
	68		160	58		125	79		157
	80		168	57		111	64		137
9:00 – 10:00 PM	148	180	328	115	121	236	143	151	294
	54		121	38		85	58		119
	49		131	42		80	36		83
10:00 – 11:00 PM	103	149	252	80	85	165	94	108	202
	73		147	43		85	30		62
	63		142	38		69	28		53
11:00 – 12:00 MIDNITE	136	153	289	81	73	154	58	57	115
24 HOUR TOTAL				4379	4044	8423	5883	5659	11,542

MACHINE COUNT - MOUNTAIN BLVD. - WARREN TWP.

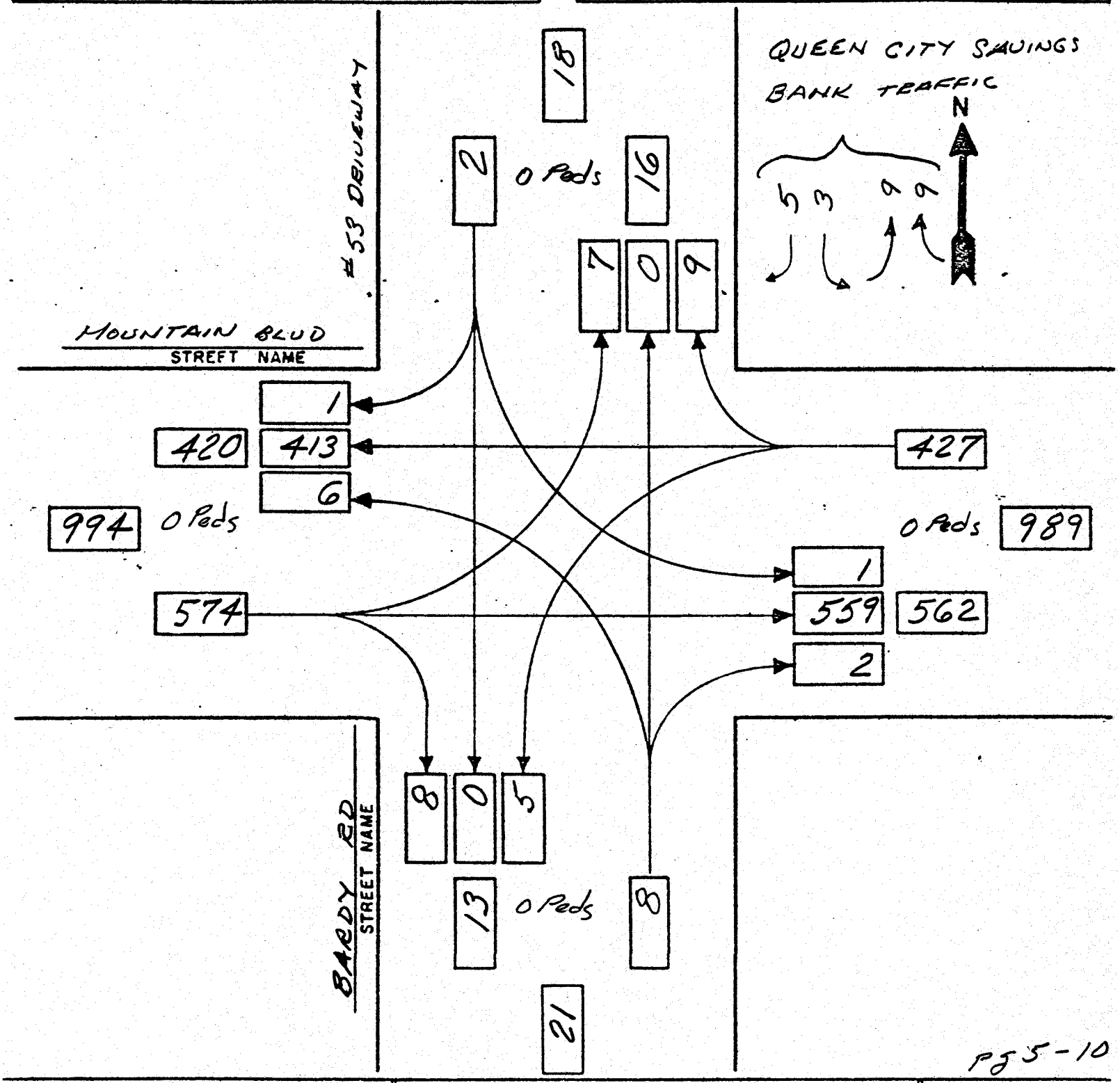
	TUE, 10-20-81			WED. 10-21-81			THUR 10-22-81		
	EB	WB	TOT	EB	WB	TOT	EB	WB	TOT
	204		451	221		447	234		479
	171		356	158		309	188		384
6:00 - 7:00 PM	375	432	807	379	377	756	422	441	863
	147		279	133		268	174		350
	126		267	139		290	154		338
7:00 - 8:00 PM	273	273	546	272	286	558	328	360	688
	115		219	115		244	164		297
	77		159	75		193	89		224
8:00 - 9:00 PM	192	186	378	190	247	437	253	268	521
	78		171	74		170	74		187
	65		145	74		149	89		167
9:00 - 10:00 PM	143	173	316	148	171	319	163	191	354
	41		117	48		115	60		175
	47		85	41		92	55		102
10:00 - 11:00 PM	88	114	202	89	118	207	115	162	277
	47		93	37		97	38		86
	27		63	36		72	33		71
11:00 - 12:00 MIDNITE	74	82	156	73	96	169	71	86	157
24 HOUR TOTAL	6188	5891	12079	6038	5646	11684	6485	6209	12694

MACHINE COUNT - MOUNTAIN BLVD - WARREN TWP

	FRI 10-23-81			SAT 10-24-81		
	EB	WB	TOT	EB	WB	TOT
	211		463	158		286
	156		354	134		254
6:00-7:00 PM	367	450	817	292	248	540
	120		304	119		226
	123		291	117		225
7:00-8:00 PM	243	352	595	236	215	451
	116		243	128		234
	76		169	90		188
8:00-9:00 PM	192	220	412	218	204	422
	73		189	79		169
	66		153	60		137
9:00-10:00 PM	139	203	342	139	167	306
	66		138	53		142
	69		135	53		125
10:00-11:00 PM	135	138	273	106	161	267
	54		137	53		123
	49		111	71		167
11:00-12:00 PM	103	145	248	124	166	290
24 HOUR TOTAL	6217	6348	12565	6030	5531	11561

JOHN E. CHRIST, P.E.
80 ORTON ROAD
WEST CALDWELL, N.J. 07006
PHONE 201-226-3609

LOCATION MOUNTAIN BLVD & BARDY RD
53 DRIVEWAY
MUNICIPALITY WARREN
WEATHER LIGHT RAIN - SPRINKLES 61°F
DATE _____ S M T W T F S
TIME: FROM 7:45 A M TO 8:45 A M

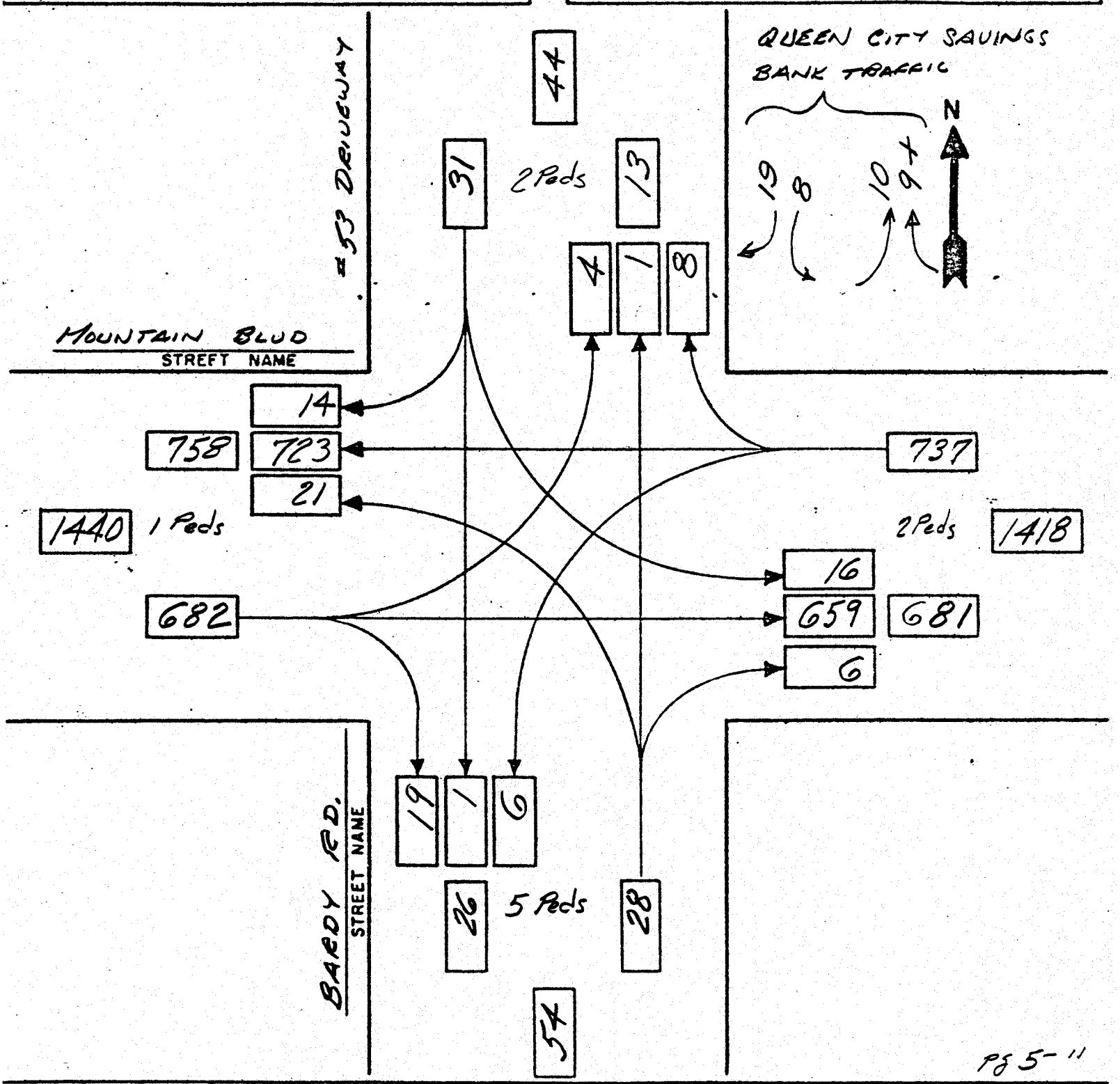


pg 5-10

ENTERING TRAFFIC NAMES OF STREETS	TRAFFIC VOLUMES TOTAL HOURS VEHICLES	AV PER HR	PERCENT	PEAK HOUR VEHICLES	PERCENT	CHECK INBOUND	OUTBOU
TOTAL						1011	1011

JOHN E. CHRIST, P.E.
80 ORTON ROAD
WEST CALDWELL, N.J. 07006
PHONE 201-226-3609

LOCATION MOUNTAIN BLVD & BARDY RD & #53 DRIVEWAY
MUNICIPALITY WARREN
WEATHER FAIR - 66°F
DATE SEPT. 18, 1981 S M T W T (F) S
TIME: FROM 4:30 P.M. TO 5:30 P.M.



Pg 5-11

ENTERING TRAFFIC NAMES OF STREETS	TRAFFIC VOLUMES TOTAL HOURS VEHICLES	AV PER HR	PERCENT	PEAK HOUR VEHICLES	PERCENT	CHECK INBOUND	OUTBOUND
TOTAL						1478	1478

Level of Service Along a Roadway

One of the most concise and easily understood descriptions of Level of Service is contained on page 315 of the TRANSPORTATION AND TRAFFIC ENGINEERING HANDBOOK, published by the Institute of Transportation Engineers in 1976. That description is as follows;

The practice of describing and labeling various service levels greatly facilitates communication both within and outside the profession and has been generally accepted. Its principal hazard lies in the attribution of a precision to the commonly cited boundary points between service levels which is unjustified by either the state of current knowledge or the basic characteristics of the highway traffic flow phenomenon.

The level of service descriptions that follow and the criteria given in later sections should be considered with the above caution in mind.

The definition and measurement of service levels under interrupted flow conditions pose different problems and are discussed in a later section on intersections.

Level of service A is the highest quality of service a particular class of highway can provide. It is a condition of free flow in which there is little or no restriction on speed or maneuverability caused by the presence of other vehicles. As shown in Figure 8.1, operating speed is in the highest range and density is low. On a freeway, lane density is approximately 10 vpm (6 vpk), and the volume/capacity ratio is typically about 1/3. Because speeds are high and volumes low, the occurrence rate of some kinds of accidents may be higher than at other service levels and total economic cost of providing the service may be excessive. Figure 8.3 shows a typical freeway operating at level of service A.

Level of service B is a zone of stable flow. However (as shown in Figure 8.1), operating speed is beginning to be restricted by other traffic. Under freeway conditions, density is under 20 vpm (12 vpk), restriction on maneuver is still negligible, and there is little probability of major reduction in speed or flow rate. This level of service approximates typical design volumes for high type rural highways, including freeways (see Figure 8.4).

Level of service C is still a zone of stable flow but at this volume and density level most drivers are becoming restricted in their freedom to select speed, change lanes, or pass. Operating speeds are still in the range of 2/3 to 3/4 of maximum; density is from 30 to 35 vehicles per lane mile on freeways (19 to 22 vehicles per lane kilometer). This service level is frequently selected as being an appropriate criterion for design purposes, particularly for urban freeways where the cost of providing the higher service levels during peak periods may be prohibitive (see Figure 8.5).

Level of service D approaches unstable flow. Tolerable average operating speeds are maintained but are subject to considerable and sudden variation. Freedom to maneuver and driving comfort are low because lane density has increased to between 45 and 50 vpm (28 and 31 vpk), and the probability of accidents has increased. Most drivers would probably consider this service level unsatisfactory (see Figure 8.6).

The upper limit of level of service E is the capacity of the facility. Operation in this zone is unstable, speeds and flow rates fluctuate, and there is little independence of speed selection or maneuver. Since headways are short and operating speeds subject to rapid fluctuation, driving comfort is low and accident potential high. Although circumstances may make operation of facilities under these conditions necessary, it is clearly undesirable and should be avoided whenever feasible (see Figure 8.7).

Level of service F describes forced flow operations after density has exceeded optimum which is normally in the range of 70 to 75 vpm (43 to 47 vpk) on free flowing facilities. Speed and rate of flow are below the levels attained in zone E and may, for short time periods, drop to zero. Figure 8.8 shows, pictorially, the operating conditions on a typical freeway under service volumes associated with the level of service F.

Level of Service at a Traffic Signal

At a signalized intersection the Level of Service is related to the percentage of traffic signal cycles that are loaded signal cycles. A signal cycle is the time from the beginning of a changing point in the display shown drivers to the next beginning of that same changing point. In other words, the signal cycle could be the time measured from the beginning of the yellow indication to Mountain Boulevard traffic to the next beginning of yellow shown to Mountain Boulevard traffic. A loaded cycle is one which has a green phase that is fully utilized by vehicles. Note that the traffic signal at Mountain Boulevard and Mt. Bethel Road is fully actuated with the time length of green phases fluctuating by the presence of vehicles over signal detectors located in the roadway. Therefore, a green indication could appear fully utilized or "loaded" when in actuality the green indication could have been longer if there were vehicles present in the vehicle detector area. Therefore, a loaded cycle or green indication at Mountain Boulevard and Mt. Bethel Road would be one where all of the green indication has been fully utilized and there is at least one vehicle stopped by the signal change that was immediately behind the last vehicle to continue through the intersection. Then the description of Levels of Service would be as follows:

Level of Service A - There are no loaded signal cycles.

Level of Service B - Up to 10% of the signal cycles may be loaded.

Level of Service C - Up to 30% of the signal cycles may be loaded. This is the Level of Service generally considered acceptable in urban areas.

Level of Service D _ Between 30% and 70% of the signal cycles are loaded. Maximum capacity will occur during this Level of Service. Level of Service D is generally regarded as not acceptable.

Level of Service E - Over 70% of the signal cycles are loaded. The traffic flow is unstable and capacity lowers, leading to significant congestion. Level of Service E is to be avoided.

Description of the Traffic Count Format

MACHINE COUNT – MOUNTAIN BLVD – WARREN TWP

	SUN 10-18-81			MON 10-19-81		
	EB	WB	TOT	EB	WB	TOT
	56		122	30		48
	55		107	6		20
12:00-1:00 AM	111	118	229	36	32	68
	55		107	5		15
	77		110	4		8
1:00-2:00 AM	132	85	217	9	14	23

Above is a reproduction of the first two hours count shown on page 5-1 of this report. The top row of the columns states the day of the week and the date that the count data in the three columns below it was taken. In the next row, the EB represents eastbound traffic, WB westbound traffic, and TOT the total 2-way traffic. Note that the counting machine has two channels. It was set so that the first channel recorded eastbound traffic and the second channel total 2-way traffic.

The top row and the row immediately below the top row are the numbers that were recorded on the counting machine tape. Reading across the top row of numbers gives the machine readout for the time period from 12:00 midnight to 12:30 AM on Sunday 10-18-81 and Monday 10-19-81. One could subtract the 56 eastbound vehicles from the 122 total vehicles and get 66 westbound vehicles for the time period 12:00 AM to 12:30 AM on Sunday, October 18, 1981 if they so desired. The row of numbers immediately below the top row is for the time period 12:30 AM to 1:00 AM as the numbers were read from the machine tape printout. The next row down has horizontal lines drawn above and below it and represents the total in each column for the hour midnight to 1:00 AM. The subtraction to determine the

westbound hourly flow has been worked out and recorded in the hourly totals. The rest of the machine count data is presented in this same format.

The peak traffic flow hours in this area is usually from 7:30 AM to 8:30 AM and from 4:30 PM to 5:30 PM on week days. Therefore, in addition to the hourly totals the totals from 7:30 AM to 8:30 AM and from 4:30 PM to 5:30 PM is also presented. A heavy line is drawn under the peak total 2-way traffic flow number.

The 24 hour totals are shown on pages 5-7, 5-8 and 5-9.

RESUME OF JOHN E. CHRIST, P.E. JUNE 1980

80 Orton Road
West Caldwell, New Jersey 07006 201-226-3609

PROFESSIONAL ENGINEER

Licensed in the State of New Jersey, Certificate #13883

EDUCATION

Bachelor of Science in Civil Engineering, Rutgers University, June 1958
Certificate in Traffic Engineering, Yale University Bureau of Highway Traffic, 1959 (academic year full time graduate school)

EXPERIENCE

Senior Engineer-Traffic, New Jersey Division of Motor Vehicles, Bureau of Engineering and Planning, June 1959 to April 1963: Design of traffic control devices such as traffic signals, speed zone signs, "through streets" channelizations, intersection geometrics, regulatory and warning signs, review of traffic data including volume counts and accident reports.

Principal Engineer-Traffic, Essex County (N.J.) Highways and Bridges Department, April 1963 to December 1965.

Traffic Engineer, Essex County Engineering Division, formerly the Highways and Bridges Dept., December 1965 to present: Determines the need for and the design of traffic control devices such as traffic signals, intersection and roadway geometrics, channelizations, regulatory, warning and guide signs, review of accident data, traffic counts, site plans, subdivisions, TOPICS analysis, describes aspects of traffic to the public, gives expert testimony concerning the County roadway system. Works with other engineers in department on various roadway projects. Responsible to the County Engineer.

Former teacher at Rutgers University, University Extension Division, New Brunswick, N.J., 1968 through 1977:

Traffic Regulations: 3 years, 4 sessions/yr., 2 hours per session
Traffic Signals: 5 years, 13 sessions/yr., 3 hours per session
Intersection Geometrics: 1 year,2 sessions/yr. 3 hours per session
Traffic Signs and Markings: 2 years, 10 sessions/yr, 3 hours per sessi

Lecturer at various traffic seminars given by Rutgers University, Newark College of Engineering, A.A.A., New Jersey State Safety Council and Substitute Lecturer at he Bergen County Police Academy.

Consulting As a Professional Engineer, April 1965 to present: Design of driveways and parking facilities for businesses, design of traffic control signals and one-way roadway report for municipalities, expert testimony before planning boards, variance boards, A.B.C. hearings, magistrates courts, Superior Court, Chancery Division and Law Division of Superior Court, Traffic Court.

ACTIVITIES

Member of the Institute of Transportation Engineers, currently Immediate Past President of the N.Y. and N.J. Metropolitan Section (also past Treasurer, Secretary, and Vice President.

Supporting Member of the Transportation Research Board, National Academy of Sciences.

Past member of committees to review the State Laws on Traffic and the Manual on Uniform Traffic Control Devices for Streets and Highways

Listed in the 1980 edition of Who's Who in Engineering, published by the American Association of Engineering Socities.