Transportation
Land Development
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Services

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Technical Memorandum

To: Downtown Traffic Circulation Steering Committee Peterborough, NH

Date: April 14, 2003

Project No.: 51386

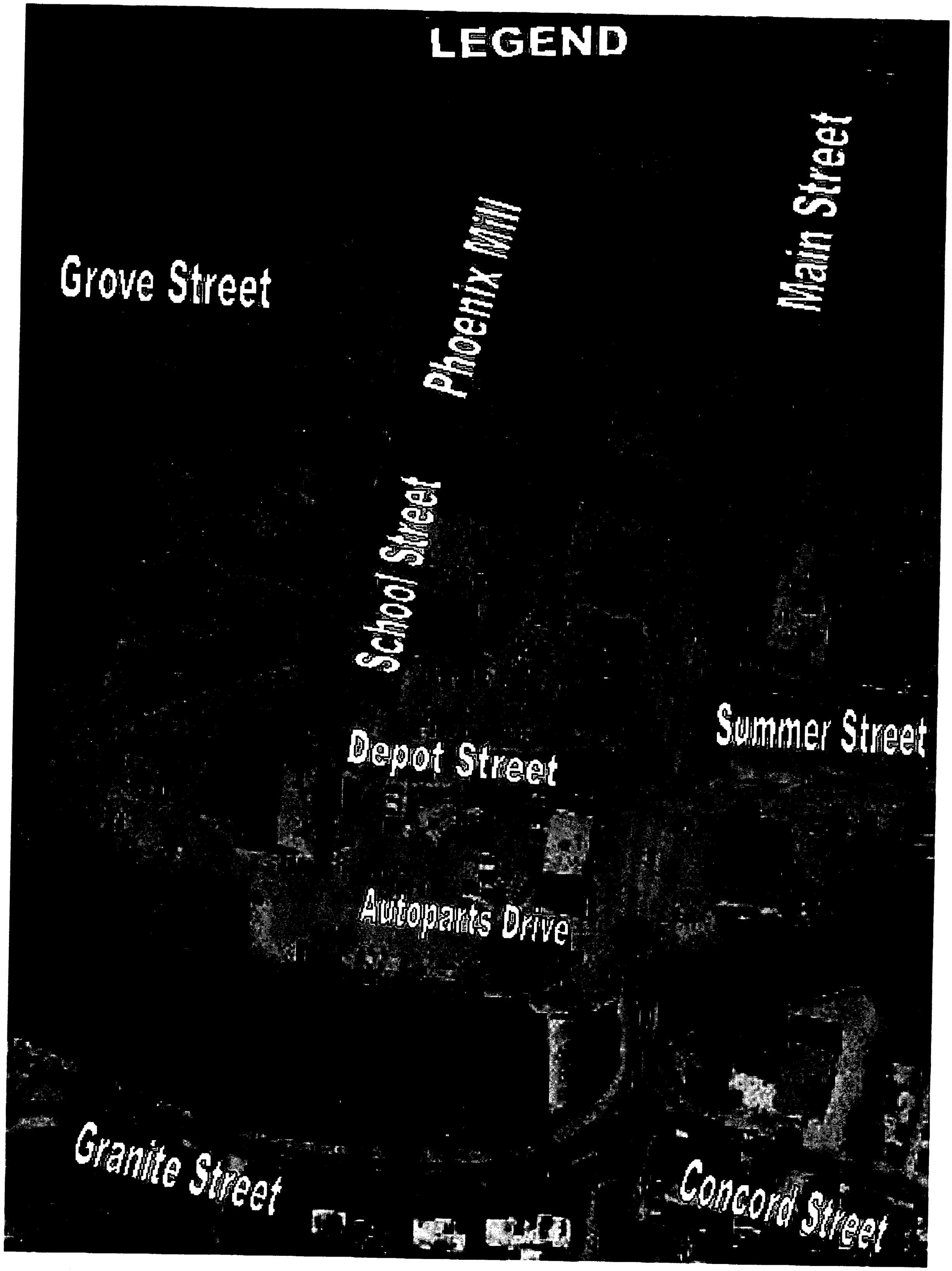
From: Christopher M. Bobay, P.E., PTOE

Re: Microsimulation Results of Downtown Traffic Circulation

The Town of Peterborough has retained Vanasse Hangen Brustlin, Inc. to assist a jointly formed municipal and citizen committee created by the Peterborough Board of Selectman to evaluate, study and identify opportunities to improve the efficiency and safety of traffic circulation and pedestrian access within the downtown area. A traffic evaluation was initiated in September 2002 to assess traffic operations under current and future conditions within the downtown area with specific emphasis on six unsignalized intersections. Table 1 lists the study area intersections and identifies the type and location of the existing traffic control. Figure 1 illustrates the location of these intersections in relation to the surrounding roadway network.

TABLE 1
STUDY AREA INTERSECTIONS

Location	Type and Location of Traffic Control
Main Street at Concord/Granite Street (US202)	Main Street Eastbound STOP
Main Street at Autoparts Drive/Rite-Aide Driveway	Autoparts Drive Northbound STOP
Main Street at Depot Street/Summer Street	Depot Street Northbound and Summer Street Southbound STOP
Main Street at Grove Street/Bank Driveway	Main Street. Eastbound / Grove Street Northbound Bank Drive Southbound STOP
Grove Street at School Street / Phoenix Mill Lane	Phoenix Mill Eastbound and School Street Westbound STOP
Grove Street at Post Office Exit-Only Driveway	Post Office Exit Southbound STOP



Approx. Scale 1" = 200'

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Figure 1

Study Area Intersections

EXISTING CONDITIONS

To determine the traffic volume demands and flow patterns within the downtown area and more specifically at the six study area intersections, VHB obtained daily and peak hour traffic volumes through a data collection program conducted in September 2002.

Daily Traffic Volumes

Daily traffic volume data along the primary roadways within the downtown area were obtained from automatic traffic recorder (ATR) counts collected over a one-week period during the last week of September 2002. Table 2 summarizes the results of the average daily traffic (ADT) volumes recorded along each roadway. Copies of the traffic data have been provided in a separate document entitled "Data Collection Program for Microsimulation of Downtown Traffic Circulation", which was submitted to the Town of Peterborough on November 11, 2002.

TABLE 2
DAILY TRAFFIC VOLUME SUMMARY

		Daily Traffic Volumes (vehicles per day)		
Roadway	Location	Weekday	Saturday	Sunday
Main Street	West of Grove Street	5,800	5,200	3,850
Main Street	At the Contoocook River Bridge	11,000	10,500	9,000
Grove Street	At the Nubanusit River Bridge	8,500	8,350	5,550
Summer Street	North of Main Street	1,250	1,050	900
Depot Street	South of Main Street	2,400	2,500	1,650
School Street	East of Grove Street	2,200	2,250	1,300
Autoparts Driveway	South of Main Street	1,100	900	600
Granite Street (US202)	South of Main Street	15,000	14,000	12,000

Note: Daily traffic volumes have been rounded up to the nearest 50 vehicles.

A review of daily and hourly variations in traffic from the ATR's data clearly show distinctive peak periods in traffic volumes during the weekday midday (11AM-1PM) and evening (3PM-6PM) periods. Based on this evaluation, more detailed information was gathered at the six study area intersections during these time periods using manual turning movement counts.

Manual Turning Movement Counts

Manual vehicle turning movement counts (TMC's) were conducted to supplement the 24-hour ATR's. The TMC's were conducted on September 25, 2002 during the weekday midday and evening peak hours at the six study area intersections identified in Table 1. The turning movement counts included vehicle classification (car/truck/bus) and pedestrian activity within the vicinity of each intersection.

In addition to the six study area intersections, one person was stationed at the intersection of School Street and Depot Street to record the number of vehicles using School Street and Depot Street as a "cut through" to bypass the Main Street and Grove Street intersection. This individual also recorded origin and destination information on vehicles entering and exiting the parking lots east and west of Depot Street to assist in the identification of quantity of vehicles originating and destined for downtown Peterborough.

Copies of the traffic data have been provided in the separate document entitled "Data Collection Program for Microsimulation of Downtown Traffic Circulation".

Seasonal Variation Adjustments

Monthly traffic data from the NH101 NHDOT permanent traffic recorder station located at the Peterborough/Dublin town line was reviewed to determine the seasonal traffic variations within the study area. The traffic data indicates that June typically represents peak month conditions. Overall, a seasonal adjustment of 8% for the September weekday volumes was determined to be reasonable and appropriate to represent peak month conditions. Calculations to support the seasonal adjustment factors that were applied are provided in the separate document entitled "Data Collection Program for Microsimulation of Downtown Traffic Circulation".

2002 Peak Hour Traffic Volume Networks

Year 2002 existing conditions traffic volume networks were developed by applying the 8% seasonal adjustment factor to the weekday midday and evening peak hour data obtained from the data collection program. The resulting traffic volume networks to be used for traffic analysis are illustrated in Figures 2 and 3.

Micosimulation Model for Operational Analyses

In February 2002, the Town of Peterborough hired an outside consultant to develop weekday evening (PM) peak hour traffic simulation model as part of a study that evaluated traffic operations at 15 intersections within the Town limits. The consultant chose to model these intersections using the SYNCHRO/SimTraffic package of which the Town of Peterborough has a users license. The Town recommended, with VHB's concurrence, that the model be used to assess traffic circulation within the downtown area. One unique opportunity in using the microsimulation model is it allows for traffic operations analysis of the 3-way STOP intersection of Main Street and Grove Street/Bank Driveway that would not be able to be analyzed using standard capacity analysis techniques due to the intersections unique stop control configuration. While the intersections of Grove Street with Phoenix Mill/School Street and Main Street with Summer/Depot Street and Granite/Concord Street were included in the existing traffic simulation model, it was apparent through an initial evaluation that the model would need to be refined to include more detailed street, pedestrian and intersection information as well street interconnections (i.e., School and Depot Streets) to effectively evaluate existing conditions and potential traffic circulation modifications.

VHB obtained the existing microsimulation model in October 2002 and made the necessary modifications to accurately portray the physical infrastructure of the downtown traffic circulation system. Figure 4 graphically illustrates differences between the existing and revised microsimulation models.

Traffic Operations Analysis of Existing Conditions

Each of the six study area intersections were analyzed under 2002 existing conditions using the updated SYNCHRO/SimTraffic microsimulation model. The results from the microsimulation model follow methodologies and measures of effectiveness listed in the 2000 Highway Capacity Manual (HCM).[1]

Six levels of service (LOS) are defined in the HCM. They are given letter designations ranging from LOS A to LOS F, with LOS A representing the best operation conditions and LOS F representing the worst. For this study, LOS A, B and C are "desirable", LOS D is "good", LOS E is "acceptable" and LOS F conditions are "substandard" and identify an operational deficiency.

The results of the capacity analyses are summarized in Table 3. Copies of the analyses have been provided in the Appendix.

[1] Highway Capacity Manual, Special Report 209, published by the Transportation Research Board, Washington, D.C., 2000.

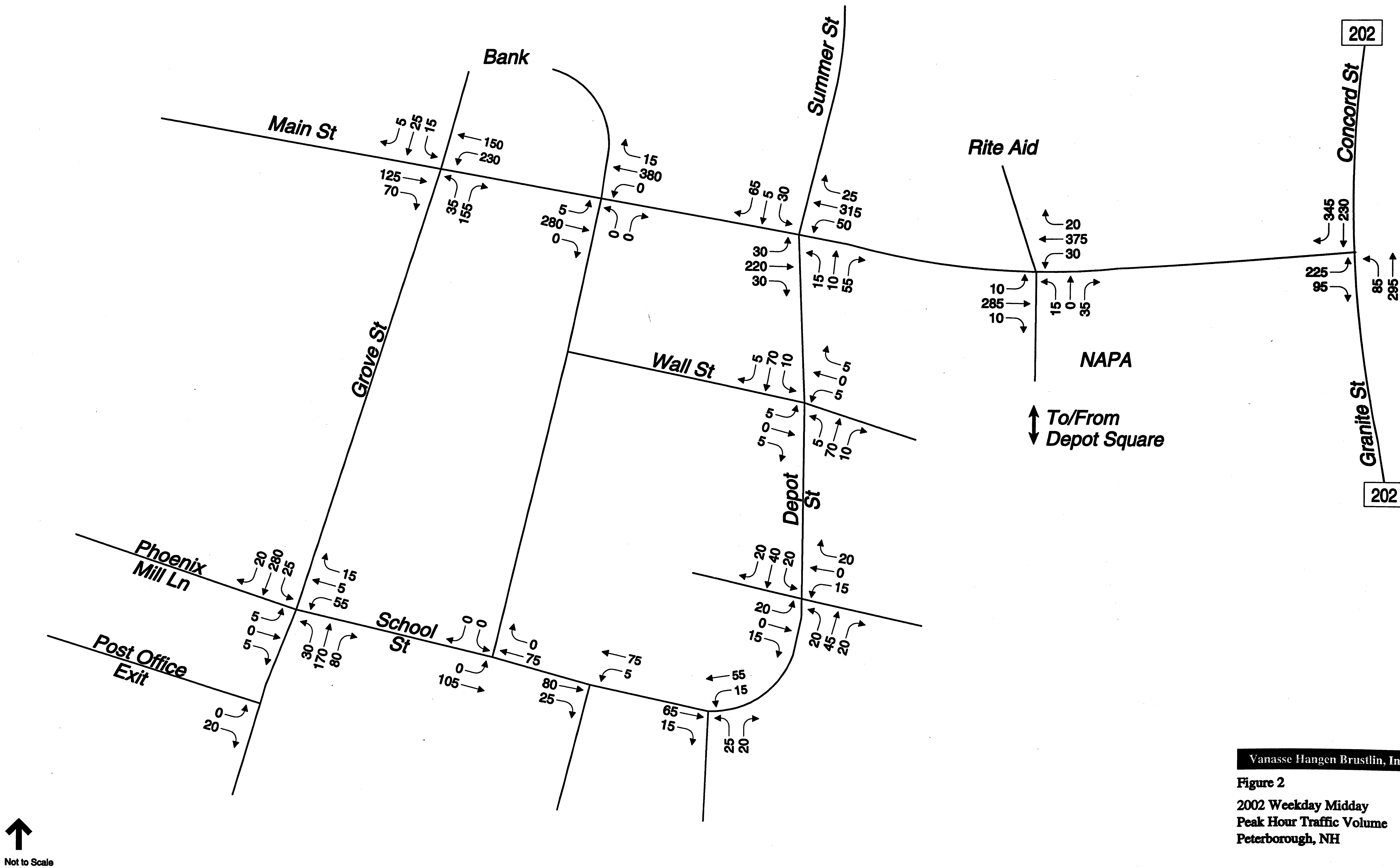

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Figure 2

2002 Weekday Midday
Peak Hour Traffic Volume
Peterborough, NH

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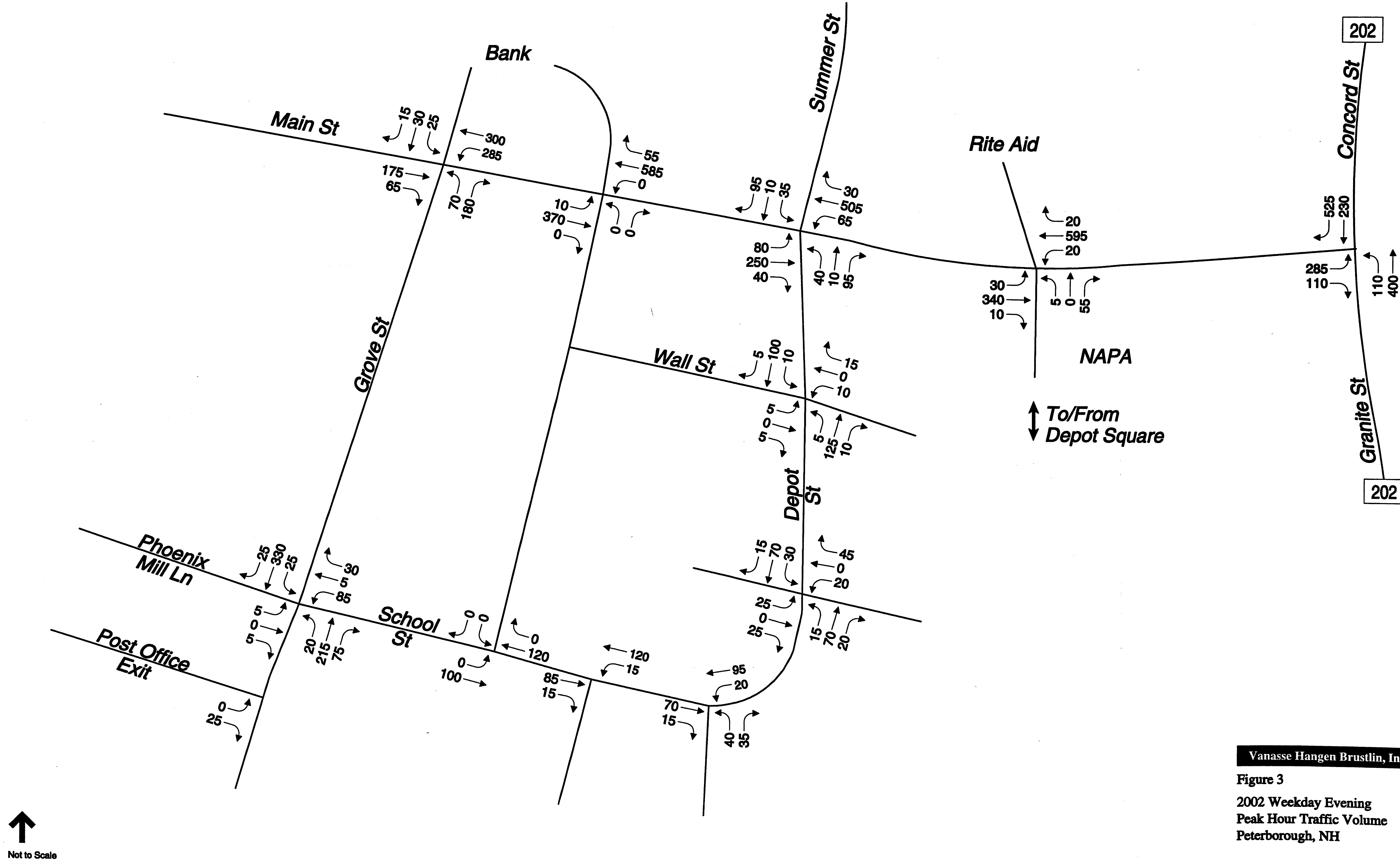

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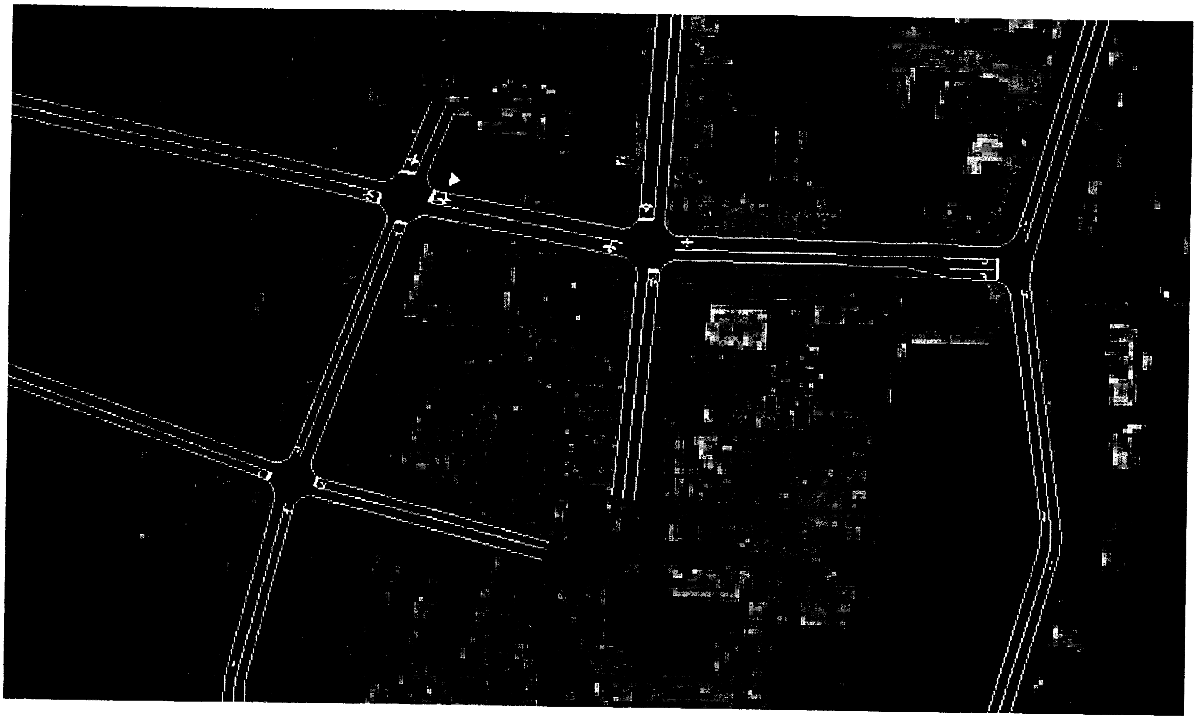
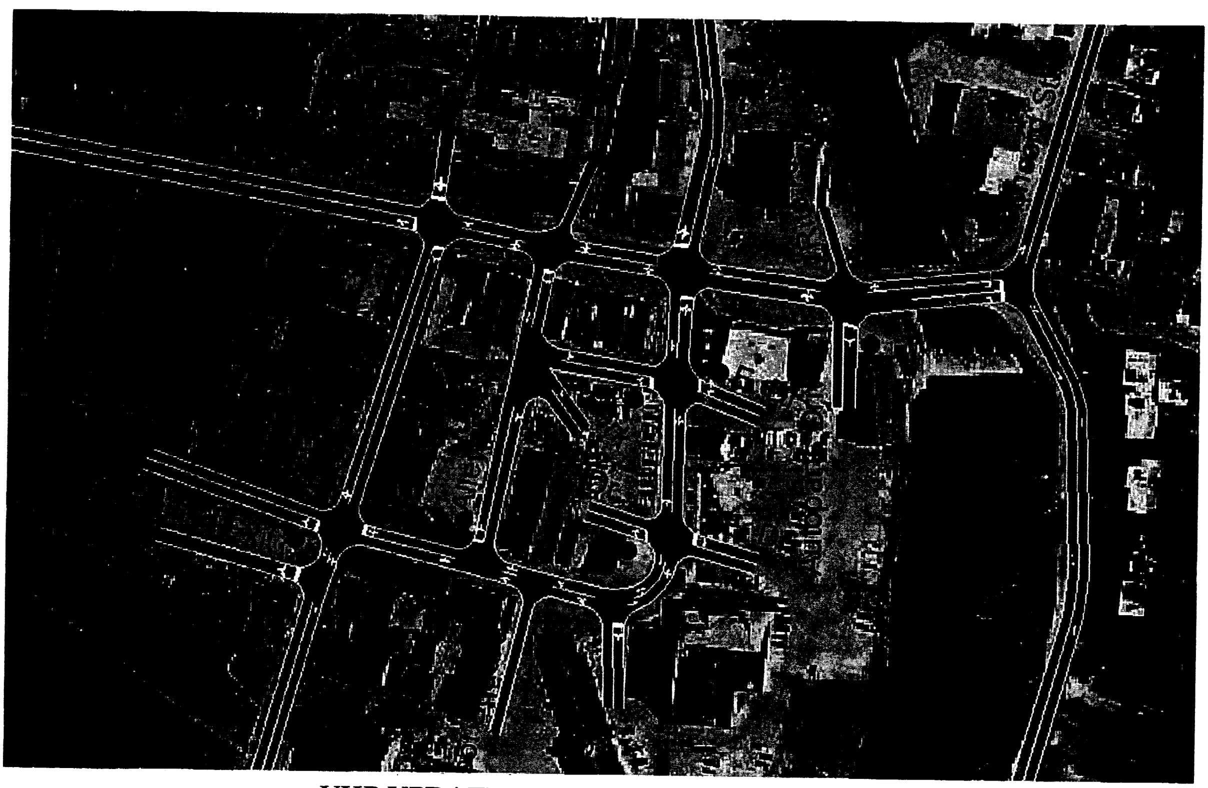
Figure 3

2002 Weekday Evening Peak Hour Traffic Volume Peterborough, NH



PETERBOROUGH EXISTING MICROSIMUATION MODEL



VHB UPDATED MICROSIMULATION MODEL

Approx. Scale 1" = 200'

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Figure 4

Existing and Updated Microsimulation Models

TABLE 3
2002 EXISTING CONDITIONS
TRAFFIC OPERATIONS SUMMARY TABLE

	2002 Midday Peak Hour			2002 Evening Peak Hour		
Location	Delay*	LOS+	Max. Queue^	Delay	LOS	Max. Queue
Main Street at Concord/Granite Street						
Eastbound Main Street	15	C	175	42	E	375
Northbound Granite Street	2	A	175	5	A	275
Southbound Concord Street	1	A	50	1	A	150
Main Street at Autoparts/Rite-Aide Drive						
Eastbound Main Street	3	A	150	19	B	150
Westbound Main Street	1	A	50	1	A	150
Northbound Autoparts Driveway	4	A	75	10	B	100
Main Street at Depot Street/Summer Street						
Eastbound Main Street	1	A	75	6	A	125
Westbound Main Street	1	A	125	2	A	125
Northbound Depot Street	10	B	75	31	D	250
Southbound Summer Street	12	B	100	40	E	300
Main Street at Grove Street/Bank Driveway						
Eastbound Main Street	7	A	125	10	B	125
Westbound Main Street	0	A	0	0	A	0
Northbound Grove Street	4	A	75	11	B	175
Southbound Bank Driveway	7	A	75	11	B	75
Grove Street at School /Phoenix Mill Lane						
Eastbound Phoenix Mill Lane	5	A	50	13	B	50
Westbound School Street	11	B	125	13	B	150
Northbound Grove Street	1	A	50	1	A	50
Southbound Grove Street	1	A	100	1	A	125
Grove Street at Post Office Exit-Only Drive						
Eastbound Post Office Exit-Only Driveway	5	A	50	4	A	50
Northbound Grove Street	0	A	0	0	A	0
Southbound Grove Street	0	A	0	0	A	0

* Average delay along approach in seconds per vehicle.
\+ Approach level of service.
^ Maximum vehicle queue in feet.

As shown in Table 3, the six downtown study area intersections operate at LOS C or better during the weekday midday peak hour period. These very good operating conditions indicate that the downtown area can accommodate growth in traffic volumes during the midday peak hour period for many years to come. However, two of the six study area intersections operate near deficient levels of service (LOS E) during the weekday evening peak hour period resulting in long (in excess of 300 feet) vehicle queues. Long vehicle queues are of concern because most intersections within the downtown area are spaced nearly 300 feet away from an adjacent intersection. With greater than 300-foot vehicle queues, vehicles for one intersection queue into an adjacent intersection causing deficient operations at that intersection as well. The result is downtown area intersections will not be able to accommodate increased traffic growth during the weekday evening peak hour period.

ALTERNATIVES ANALYSIS

VHB performed a sensitivity analysis of potential improvement alternatives that were formulated by the Downtown Traffic Circulation Committee. Analysis of the alternatives were only performed for the weekday evening peak hour condition as it was identified under the existing conditions analysis as the critical condition for the downtown area.

Alternatives

The Downtown Traffic Circulation Committee identified six alternatives to be tested using the microsimuation model. Each of the alternatives was evaluated with and without signalization of the Main Street and Granite Street / Concord Street intersection. The alternatives are more specifically described as follows:

- Alternative A – existing downtown circulation with All-Way Stops at Main Street and Grove Street and Main Street and Granite/Concord Street. [Alternative A1 with signal]
- Alternative B – existing downtown circulation and traffic control with School Street one-way eastbound from Grove Street to the Depot Square entrance. [Alternative B1 with signal]
- Alternative C – existing downtown circulation and traffic control with School Street one-way westbound from the Depot Square entrance to Grove Street. [Alternative C1 with signal]
- Alternative D – one-way counter-clockwise downtown rotation with School Street one-way eastbound, Depot Street one-way northbound and Grove Street one-way southbound. [Alternative D1 with signal]
- Alternative E – one-way clockwise downtown rotation with Grove Street one-way northbound, Depot Street one-way southbound and School Street one-way westbound. [Alternative E1 with signal]
- Alternative F – Existing downtown circulation and traffic control with 25% diversion of downtown cut-through traffic back to NH101 via US202 through downtown traffic calming measures (see Appendix for samples), signing strategies and signal coordination with an assumed signal installed at the NH101/202 intersection. [Alternative F1 with signal]

Year 2002 traffic volume networks were developed for each alternative for the weekday evening peak hour condition. The resulting traffic volume networks to be used in the traffic analysis are illustrated in Figures 5 through 10.

Traffic Operations Analysis of Alternatives and Projected Future Conditions

The entire downtown study area was analyzed under 2002 traffic conditions for each of the six alternatives using the updated SYNCHRO/SimTraffic microsimulation model. Results of the analysis are shown in Table 4. This table contains both network-wide measures of effectiveness for the entire downtown area and individual intersection measures of effectiveness at the four critical study area intersections (Main at Concord/Granite, Main at Grove, Grove at School and Main at Depot/Summer).

In addition to the 2002 conditions, a sensitivity analysis was performed to determine the life of each alternative. Future year traffic volumes were projected and analyzed to the threshold of LOS e/F operations. A growth rate of 1.5 percent per year was used to estimate future year traffic volumes. Calculations to support the growth rate used in forecasting are provided in the document titled "Data Collection Program for Microsimulation of Downtown Traffic Circulation".

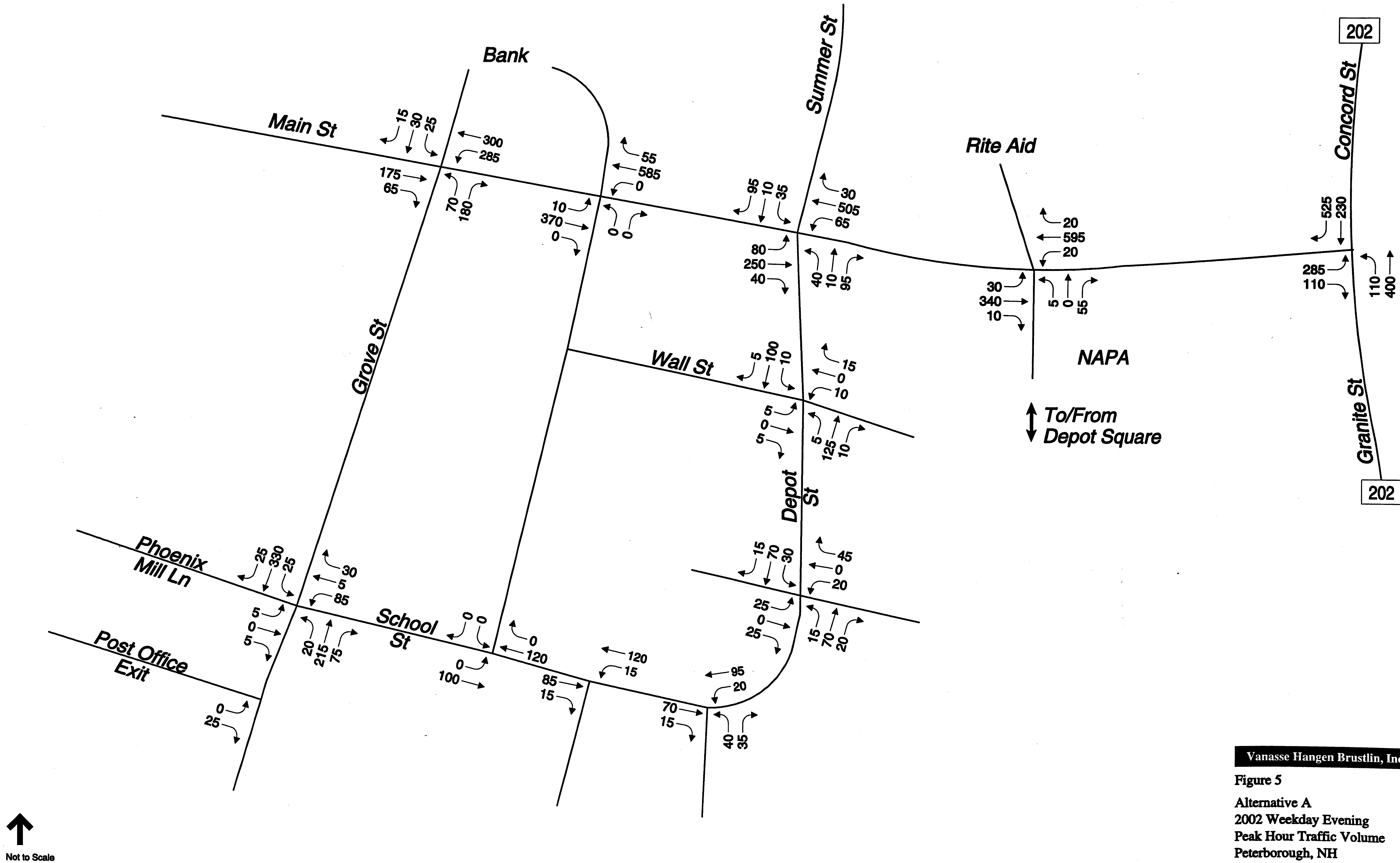

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Figure 5

Alternative A
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

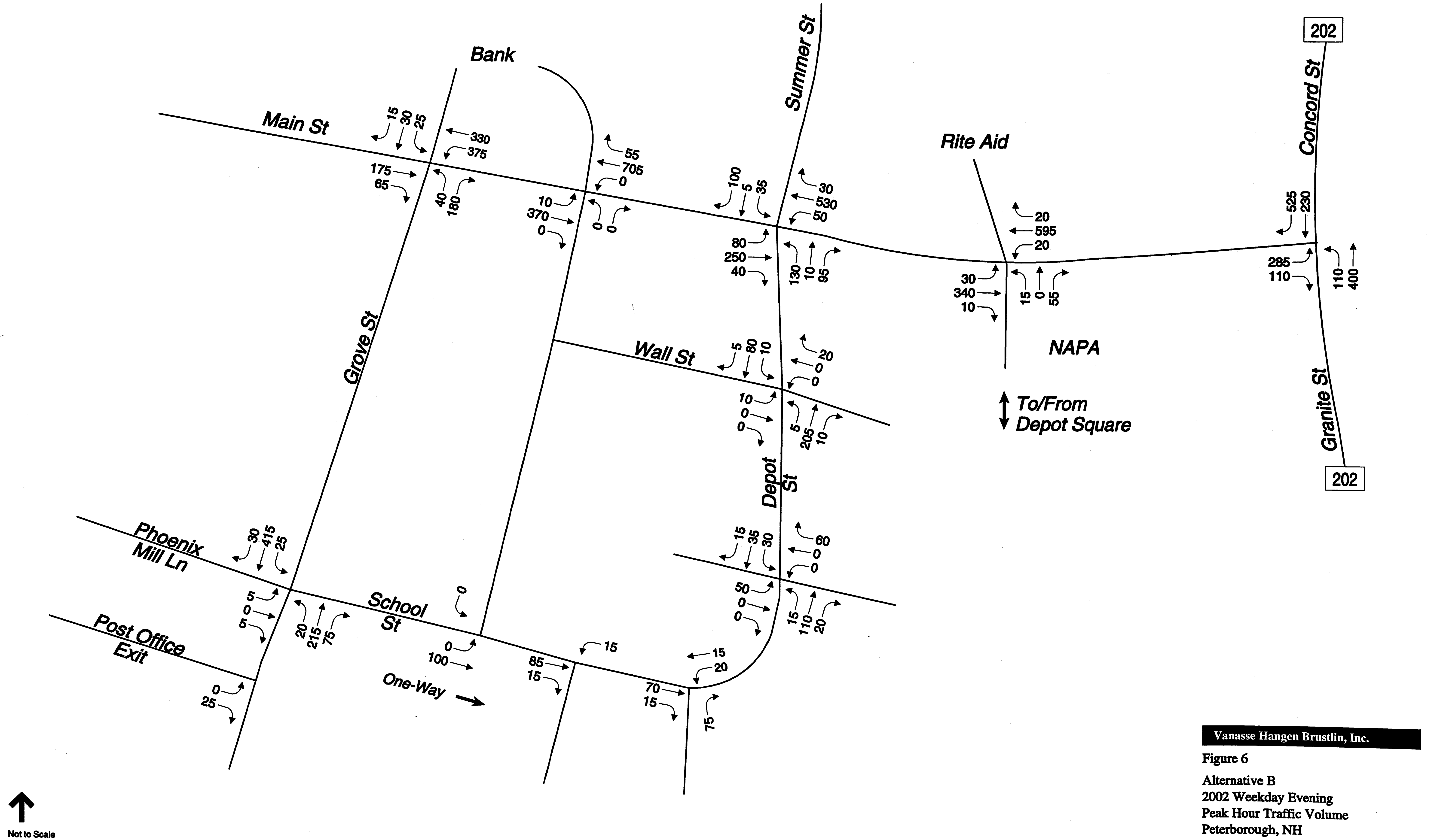

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Figure 6

Alternative B
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

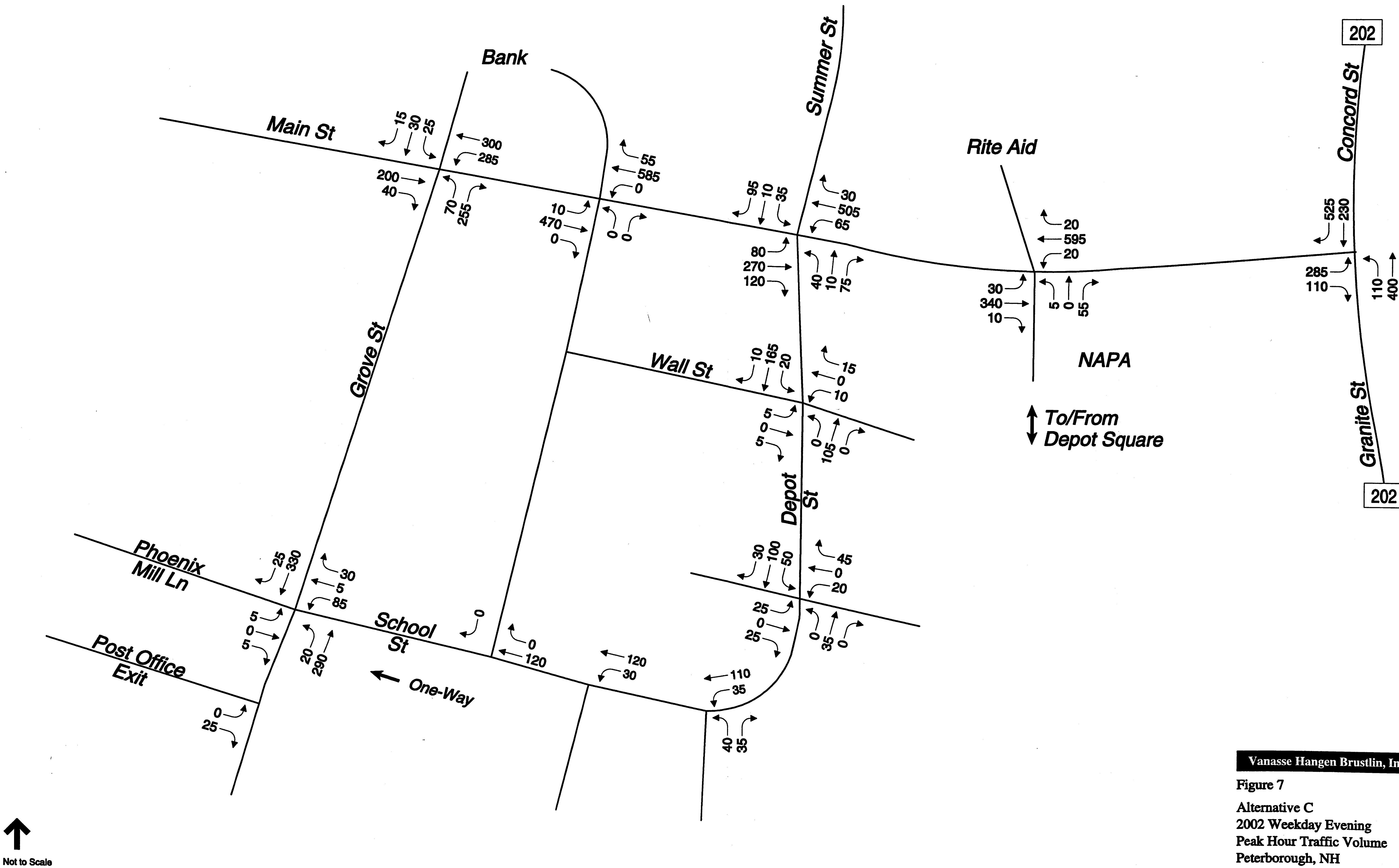

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Figure 7

Alternative C
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

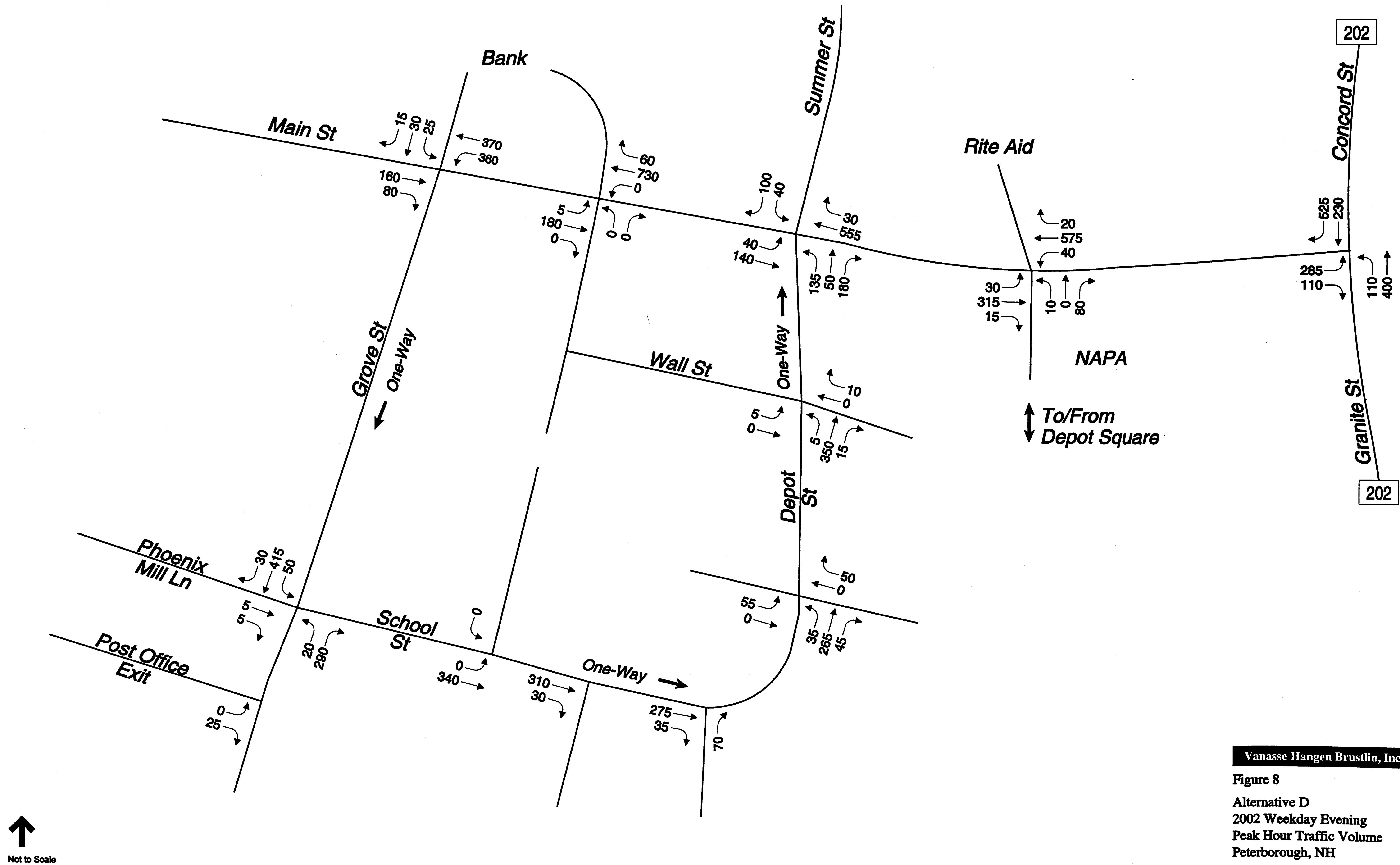

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Figure 8

Alternative D
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

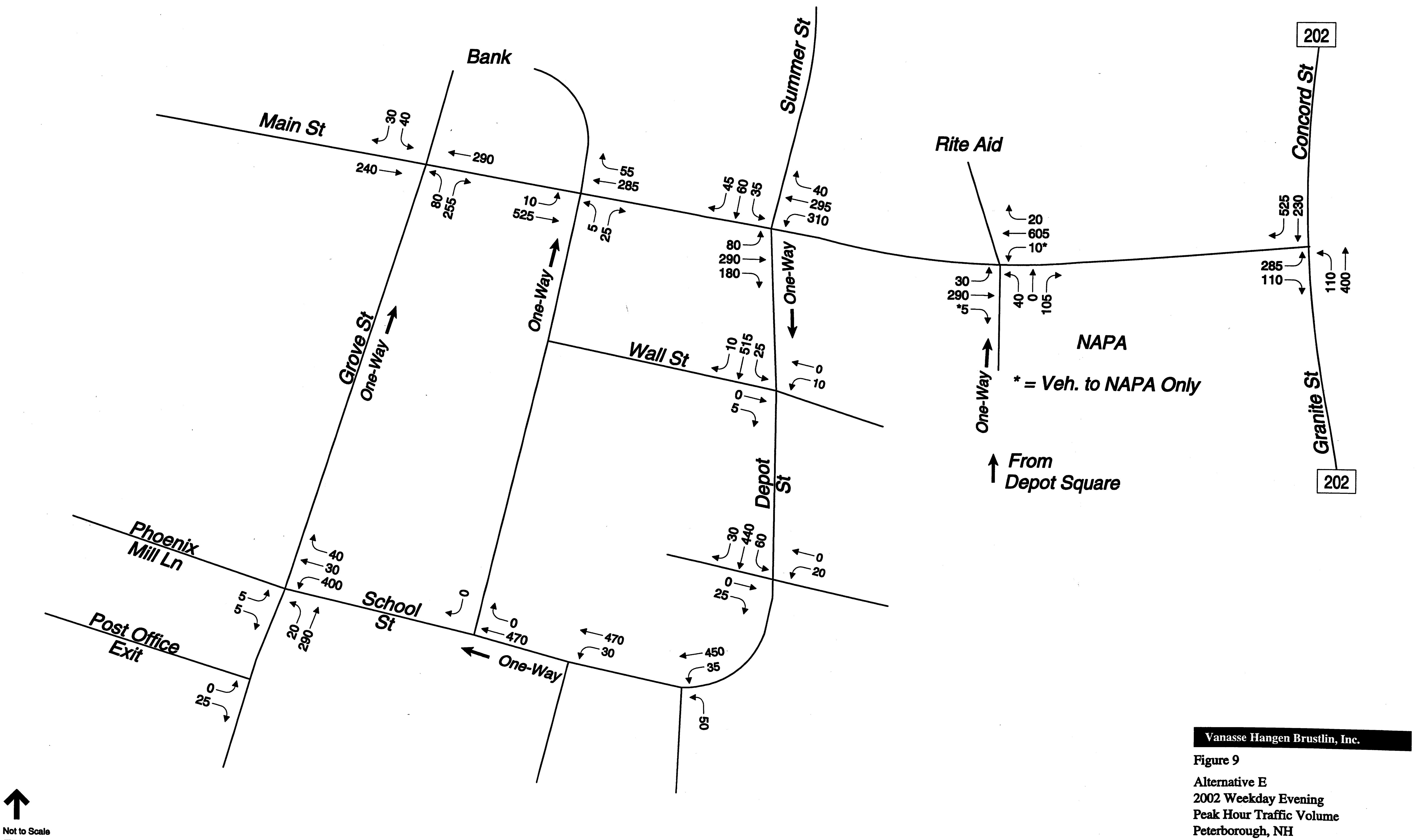

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Figure 9

Alternative E
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

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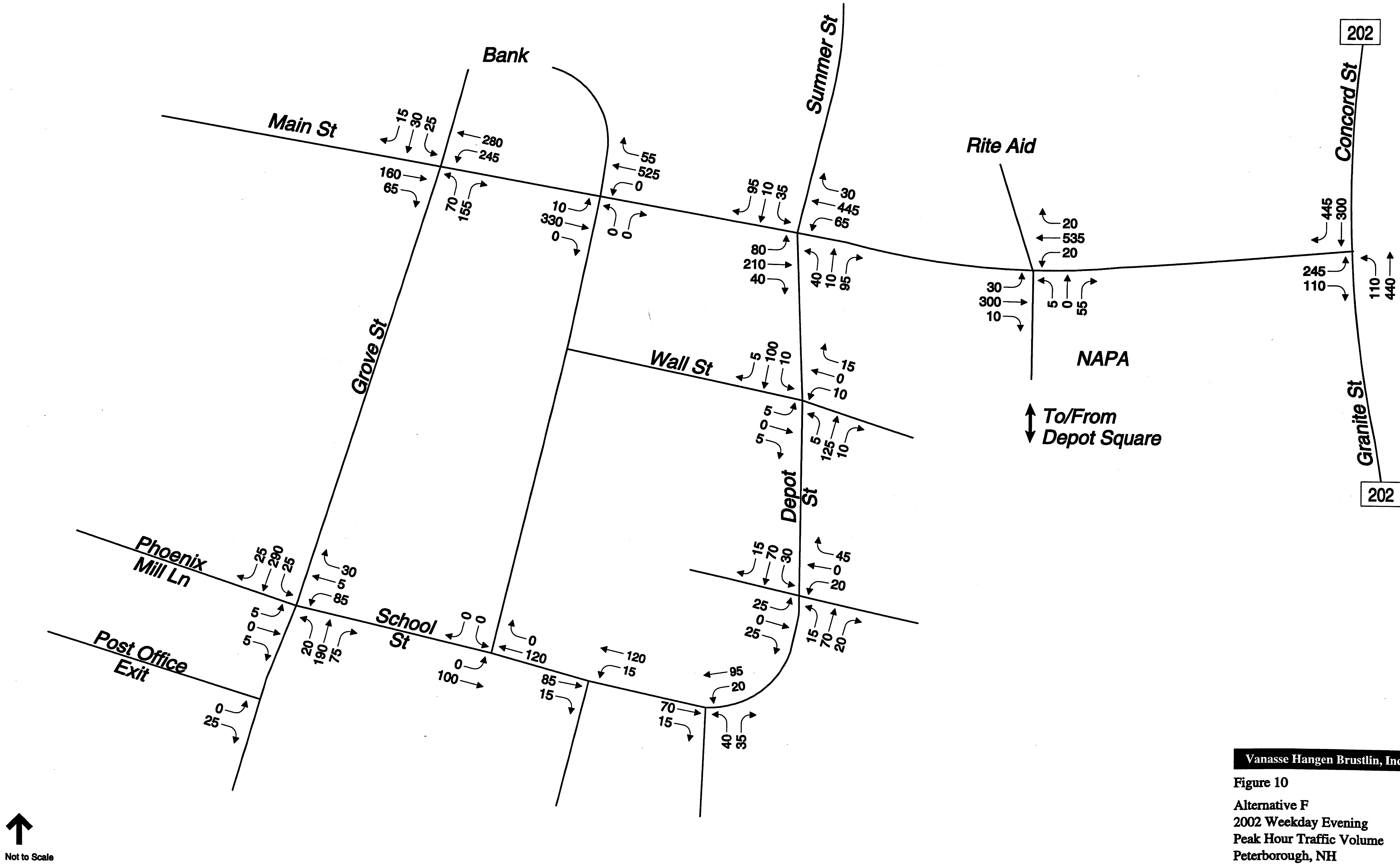

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Figure 10

Alternative F
2002 Weekday Evening
Peak Hour Traffic Volume
Peterborough, NH

TABLE 4
EVENING PEAK HOUR ALTERNATIVES AND FUTURE CONDITIONS
TRAFFIC OPERATIONS SUMMARY TABLE

ANALYSIS CRITERIA DESCRIPTION FROM SIMTRAFFIC	UNITS	2002 EXISTING "NO-BUILD" CONDITIONS	2002 UNSIGNALIZED ALTERNATIVES						2002 SIGNAL ALTERNATIVES					
			A	B	C	D	E	F	A1	B1	C1	D1	E1	F1
NETWORK-WIDE MEASURES OF EFFECTIVENESS														
Total Study Area Travel Time	hours	43.7	136.8	45.2	49.4	48.7	212.0	41.1	42.0	44.3	45.1	42.5	52.3	39.7
Total Study Area Delay	hours	18.5	111.0	20.0	23.8	23.2	189.2	16.3	15.8	17.8	18.8	16.9	26.9	14.2
Total Study Area Stops	no.	2430	4768	2325	2475	2395	3894	2195	2970	2883	2970	2563	3023	2781
INTERSECTION MEASURES OF EFFECTIVENESS														
Main Street at Concord/Granite Street	Worst Approach LOS	**E**	**F**	**E**	**E**	C	**F**	**E**	B	B	B	B	B	B
Eastbound Main St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	42 / E / **375'**[1]	5 / A / 225'	38 / E / **375'**[1]	44 / E / **375'**[1]	18 / C / 300'	43 / E / **675'**[1]	43 / E / 350'	14 / B / 275'	14 / B / 275'	14 / B / 275'	13 / B / 250'	11 / B / 275'	15 / B / 250'
Northbound Granite St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	5 / A / 275'	11 / B / 375'	4 / A / 375'	6 / A / 450'	3 / A / 275'	54 / F / 500'	4 / A / 275'	9 / A / 300'	7 / A / 350'	7 / A / 200'	7 / A / 225'	8 / A / 300'	7 / A / 325'
Southbound Concord St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	1 / A / 150'	206 / F / 650'	1 / A / 225'	1 / A / 150'	1 / A / 0'	78 / F / 625'	1 / A / 100'	10 / B / 625'	8 / A / 300'	7 / A / 450'	5 / A / 425'	7 / A / 425'	9 / A / 600'
Main Street at Grove Street	Worst Approach LOS	B	A	B	C	C	**F**	B	B	B	B	B	B	B
Eastbound Main St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	10 / B / 125'	7 / A / 100'	10 / B / 12\5'	23 / C / 250'	1 / A / 75'	17 / C / **325'**	11 / B / 150'	13 / B / 200'	16 / C / 250'	16 / C / 200'	1 / A / 75'	1 / A / 50'	10 / B / 125'
Westbound Main St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	0 / A / 0'	7 / A / **300'**[1]	0 / A / 0'	0 / A / 0'	1 / A / 225'	n/a	0 / A / 0'	0 / A / 0'	0 / A / 0'	0 / A / 0'	1 / A / 175'	n/a	0 / A / 0'
Northbound Grove St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	11 / B / 175'	8 / A / 150'	10 / B / 125'	25 / D / 325'	n/a	200 / F / **500'**[1]	10 / B / 175'	12 / B / 175'	19 / C / 250'	18 / C / 250'	n/a	10 / B / 225'	10 / B / 175'
Southbound Bank Dr. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	11 / B / 75'	5 / A / 75'	11 / B / 75'	12 / B / 100'	18 / C / 100'	36 / E / 125'	8 / A / 75'	10 / B / 100'	13 / B / 75'	12 / B / 100'	12 / B / 75'	9 / A / 75'	9 / A / 100'
Grove Street at School Street	Worst Approach LOS	B	C	B	B	D	**F**	B	B	B	B	B	B	B
Eastbound Phoenix Mill Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	13 / B / 50'	6 / A / 50'	10 / B / 50'	8 / A / 50'	34 / D / 75'	121 / F / 75'	9 / A / 50'	8 / A / 50'	15 / B / 50'	8 / A / 50'	13 / B / 50'	10 / B / 75'	11 / B / 50'
Westbound School St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	13 / B / 150'	16 / C / 150'	n/a	12 / B / 175'	n/a	15 / C / 350'	8 / A / 100'	12 / B / 125'	n/a	13 / B / 150'	n/a	11 / B / 200'	10 / B / 125'
Northbound Grove St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	1 / A / 50'	1 / A / 50'	1 / A / 50'	1 / A / 50'	2 / A / 75'	196 / F / 300'	1 / A / 50'	1 / A / 50'	1 / A / 50'	1 / A / 50'	1 / A / 50'	1 / A / 50'	1 / A / 50'
Southbound Grove St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	1 / A / 125'	2 / A / 125'	1 / A / 175'	1 / A / 100'	4 / A / 275'	n/a	1 / A / 100'	1 / A / 100'	1 / A / 125'	0 / A / 0'	2 / A / 175'	n/a	1 / A / 100'
Main Street at Depot Street/Summer Street	Worst Approach LOS	**E**	**F**	**E**	**F**	**E**	**F**	**D**	D	**E**	**F**	D	**F**	C
Eastbound Main St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	6 / A / 125'	6 / A / 125'	8 / A / 125'	8 / A / 125'	5 / A / 100'	12 / B / **325'**[1]	6 / A / 100'	3 / A / 125'	5 / A / 125'	3 / A / 100'	4 / A / 100'	2 / A / 100'	2 / A / 125'
Westbound Main St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	2 / A / 125'	2 / A / 125'	2 / A / 150'	3 / A / 125'	n/a	21 / C / **400'**[1]	1 / A / 150'	2 / A / 150'	2 / A / 150'	4 / A / 150'	n/a	14 / B / **400'**[1]	2 / A / 150'
Northbound Depot St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	31 / D / 250'	108 / F / 400'	47 / E / 400'	45 / E / 350'	35 / E / 350'	n/a	22 / C / 225'	21 / C / 225'	44 / E / 375'	45 / E / 325'	33 / D / 325'	n/a	19 / C / 225'
Southbound Summer St. Delay / LOS / Max Veh Queue	sec per veh / LOS / feet	40 / E / 300'	188 / F / 650'	49 / E / 250'	80 / F / 425'	45 / E / 450'	730 / F / 800'	29 / D / 200'	34 / D / 250'	41 / E / 175'	77 / F / 300'	26 / D / 150'	201 / F / 650'	20 / C / 125'
Approximate Year When Severe Capacity Conditions (LOS F) Create Deficient Traffic Operations Within the Downtown Area[2]	Year	2005	2002[3]	2004	2002[3]	2004	2002[3]	2007	2016	2013	2013	2011	2002[3]	2020

Where:
Alternative A = Existing Downtown Circulation with All-Way Stops at Main & Grove Street and Main & Concord/Granite Street (NH202)
Alternative B = Existing Downtown Circulation and Traffic Control with School Street One-Way Eastbound from Grove Street to Depot Square Entrance
Alternative C = Existing Downtown Circulation and Traffic Control with School Street One-Way Westbound from Grove Street to Depot Square Entrance
Alternative D = One-Way Counter-Clockwise Downtown Rotation; School Street One-Way Eastbound; Depot Street One-Way Northbound; Grove Street One-Way Southbound
Alternative E = One-Way Clockwise Downtown Rotation; Grove Street One-Way Northbound, Depot Street One-Way Southbound; School Street One-Way Westbound
Alternative F = Existing Downtown Circulation and Traffic Control with 25% Diversion of Downtown Cut-Through Traffic Back to NH101 via NH202 Through Downtown Traffic Calming Measures, Signing Strategies and Signal Coordination with assumed signal installed at NH101/NH202.

Alternative A1 = Existing Downtown Circulation and Traffic Control with a Traffic Signal installed at Main Street & Concord/Granite Street (NH202)
Alternative B1 = Alternative B with a Traffic Signal Installed at Main Street & Concord/Granite Street (NH202)
Alternative C1 = Alternative C with a Traffic Signal Installed at Main Street & Concord/Granite Street (NH202)
Alternative D1 = Alternative D with a Traffic Signal Installed at Main Street & Concord/Granite Street (NH202)
Alternative E1 = Alternative E with a Traffic Signal Installed at Main Street & Concord/Granite Street (NH202)
Alternative F1 = Alternative F with a Traffic Signal Installed at Main Street & Concord/Granite Street (NH202)

1. Vehicle Queue Periodicly Backs Up Through Upstream Unsignalized Intersection Resulting in Deficient Traffic Operations at the Upstream Intersection.
2. Based on 1.5% Per Annum Growth (Calculated From Histrorical Data).
3. Alternative Results in Deficient Operating Conditions Upon Initial Implementation.

As shown in the last column of Table 4, under the existing "No-Build" condition, traffic operations are expected to reach a deficient condition by year 2005. Alternative A does not improve traffic operations when compared to the No-Build condition; however, Alternative A1 (Alternative A with signalization of Main Street and Granite/Concord Street) results in a substantial improvement with LOS D or better operating conditions through the year 2016.

Alternative B results in slightly improved traffic operations (42 seconds to 38 seconds of delay) at Main Street and Concord/Granite Street but results in decreased traffic operations (LOS D/E to LOS E/E) at Main Street and Depot Street/Summer Street when compared to the No-Build condition. Alternative B1 results in an improvement with acceptable operating conditions up to year 2013. However, it is noted that the northbound and southbound approaches to Main Street and Depot Street/Summer Street intersection will continue to operate at LOS E with maximum vehicle queues in excess of 300 feet.

Alternative C does not improve traffic operations when compared to the No-Build condition; however, Alternative C1 results in an improvement with acceptable operating conditions up to year 2013. It is noted that under Alternative C1 the Summer Street approach to the Main Street and Depot Street/Summer Street intersection will operate at deficient (LOS F) levels of service, but maximum queue lengths are manageable at approximately 300 feet.

Alternative D results in improved traffic operations (LOS E to C) at Main Street and Concord/Granite Street but results in decreased traffic operations at Main Street and Depot Street/Summer Street (LOS D to E), Main Street at Grove Street (LOS B to C) and Grove Street and School Street (LOS B to D) when compared to the No-Build condition. Alternative D1 results in an overall improvement with acceptable operating conditions up to year 2011.

Alternative E and Alternative E1 do not improve traffic operations when compared to the No-Build condition. The problem with this alternative is that all southbound Grove Street traffic has to negotiate a left-turn from westbound Main Street onto southbound Depot Street while finding a gap in eastbound Main Street through traffic. The resulting delays for this left-turn movement cause traffic to queue into the closely spaced Main Street and Granite/Concord Street intersection causing potential gridlock conditions. As such, this alternative should be discarded from any further consideration.

Alternative F results in similar or slightly improved traffic operations at every intersection within the downtown study area with acceptable conditions up to the year 2007. Alternative F1 further improves traffic operations with acceptable conditions through the year 2020.

CONCLUSIONS

Without a change in downtown traffic circulation system the Town of Peterborough will begin to experience effects of traffic congestion at several of its key downtown intersections within the next 2 to 3 years. While the congestion will usually be limited to a one-hour period, generally from 4:30PM to 5:30 PM Monday through Friday during the Spring and Summer and Fall months, there are alternate solutions available to increase capacity in the downtown transportation system.

Through microsimulation analysis of existing and future conditions it is apparent that Alternatives B, C, D and F are all viable alternatives; however, Alternative F is the only scenario that shows improvements without signalization of the Main Street and Granite/Concord Street intersection. Alternative F encourages diversion of cut-through traffic back to the principle NH101/US202 arterials through measures including, but not limited to, traffic calming, signing strategies and signal coordination with an assumed signal installed at the NH101/202 intersection. Another benefit to Alternative F is that it can be implemented at a relatively low cost and monitored through ATR's for effectiveness without the Town having to implement costly infrastructure changes or confusing traffic rerouting measures. A final benefit to Alternative F is that it increases pedestrian safety as traffic calming measures generally slow down traffic and reduce pedestrian road crossing lengths with bulb-outs at primary intersections.

TECHNICAL APPENDIX

TRAFFIC CALMING DEFINITIONS, GOALS, OBJECTIVES AND EXAMPLES

Traffic Calming is:

- The use of mainly physical measures to
  - Reduce the negative impacts of motor vehicle use
  - Alter driver behavior
  - Improve conditions for non-motorized street users.

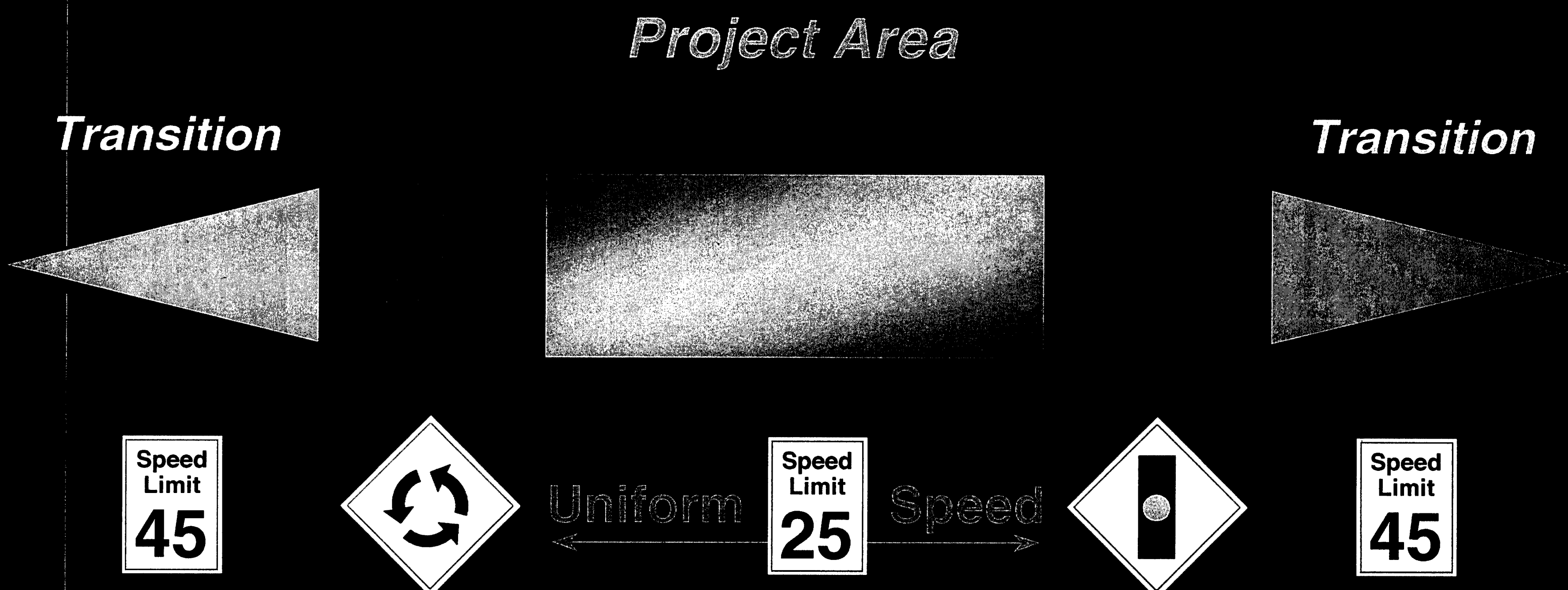
Traffic Calming Goals

- Increase quality of life
- Incorporate preferences of people using the area along the street
- Create safe and attractive streets
- Reduce negative effects of motor vehicles
- Promote pedestrian, cycle and transit use

Traffic Calming Objectives

- Slow speeds
- Reduce frequency and severity of collisions
- Increase safety for non-motorized users of the street
- Reduce need for police enforcement
- Enhance street environment
- Increase access for all modes
- Reduce cut-through motor vehicle travel

Traffic Calming Design Issues

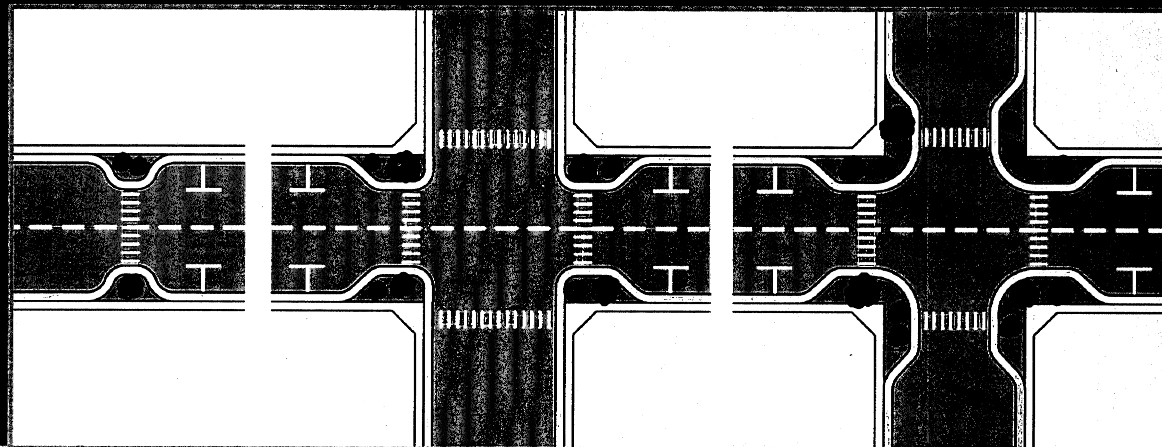


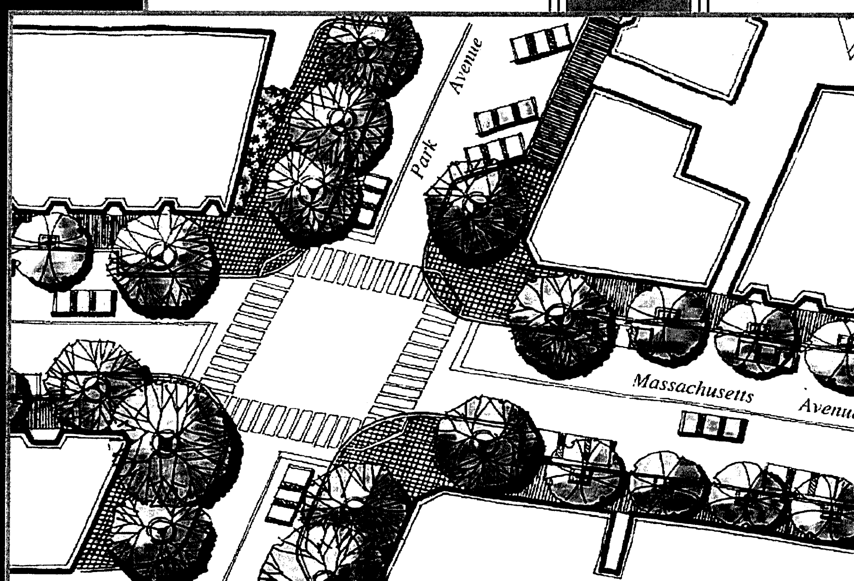
Traffic Calming Toolbox

- Speed Humps
- Raised Intersections
- Raised/Textured Crosswalks
- Median Barriers
- Neckdowns
- Chicanes
- Closures
- Semi & Diagonal Diverters
- Corner Radii

- Parking
- Roundabouts
- Traffic Circles
- Edge Treatment
- Streetscaping
- Transition Zones
- Land Treatments
- Enforcement

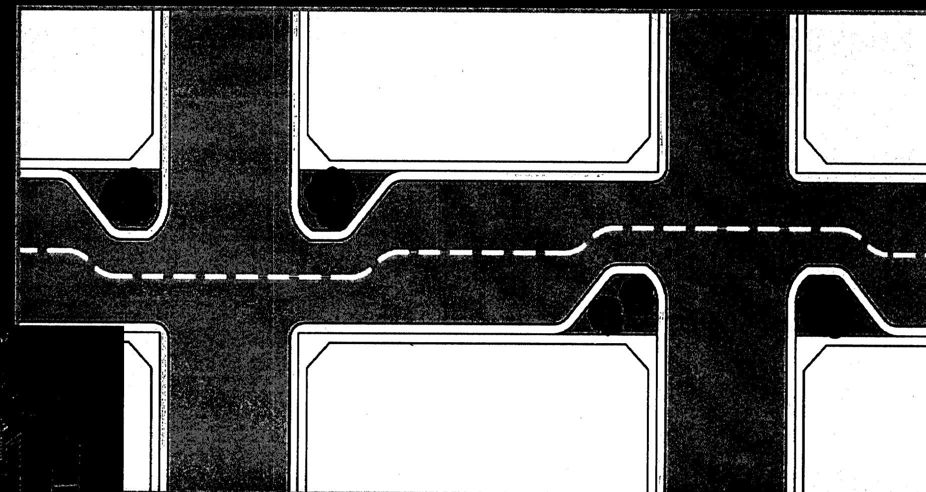
Neckdowns





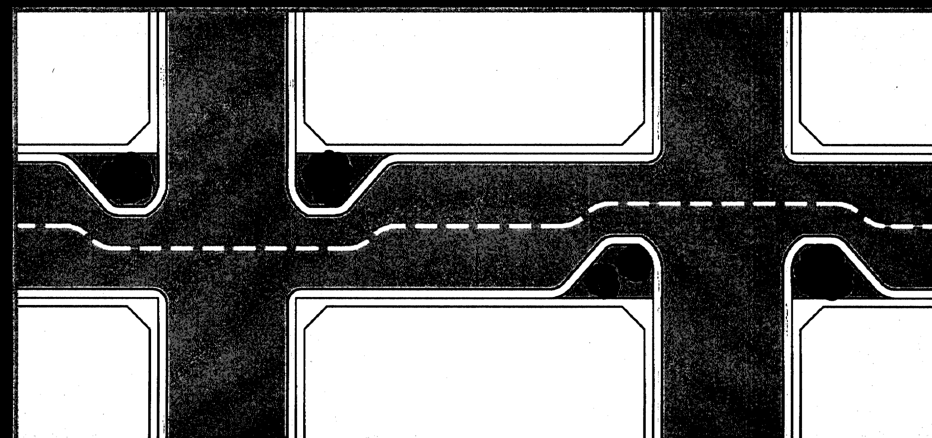
Neckdowns

Chicane

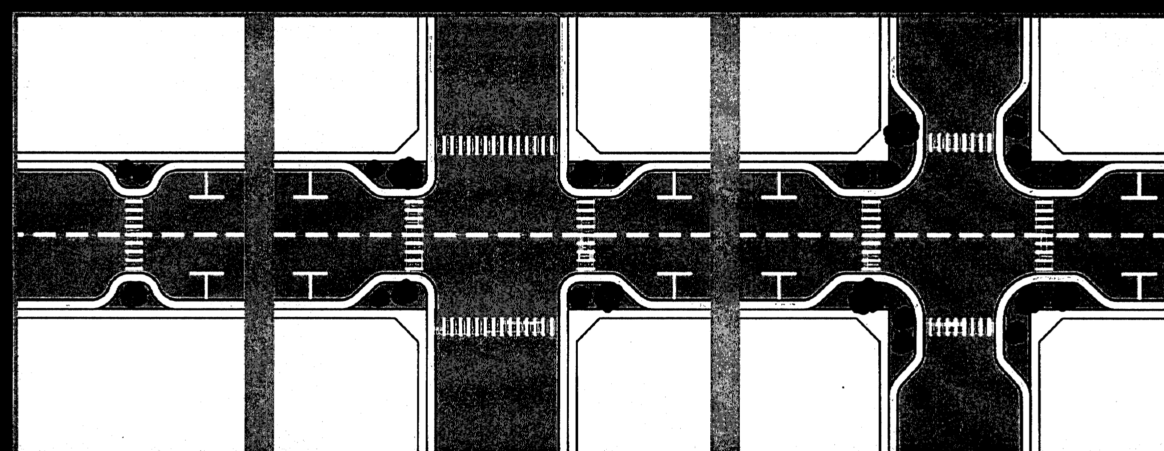


Traffic Calming Techniques

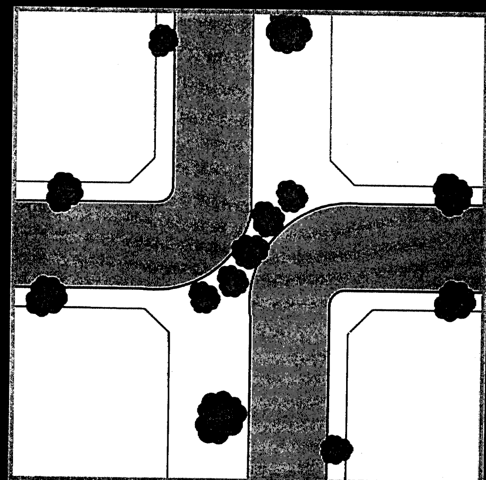
Chicane



Neckdown

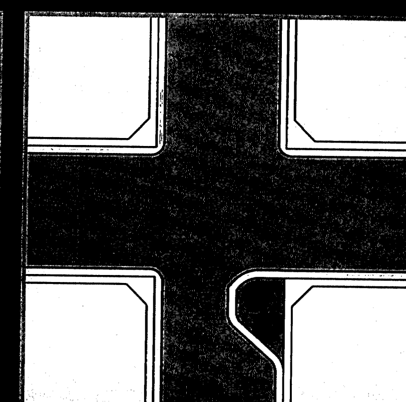


Traffic Calming Techniques

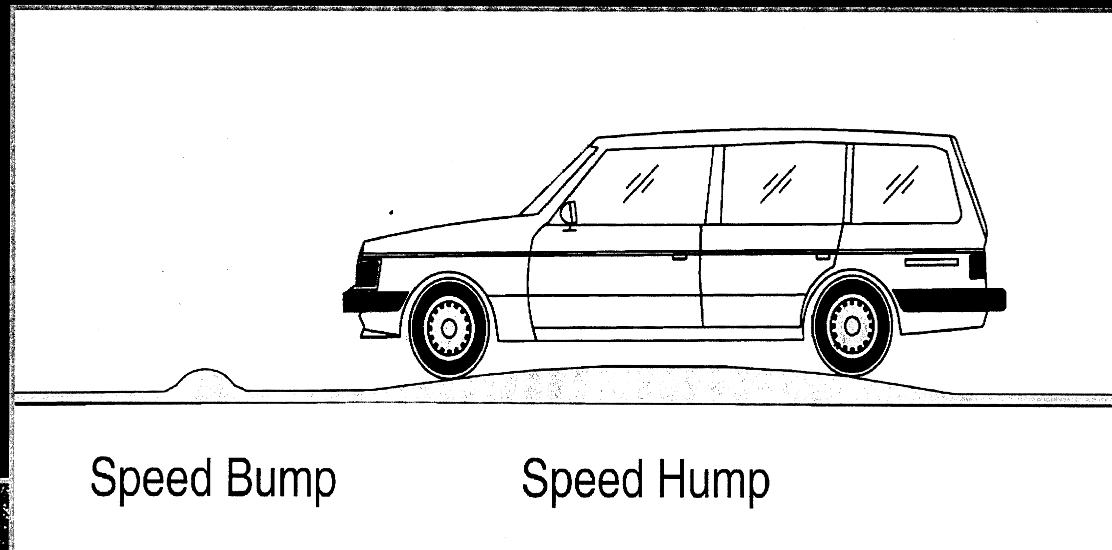


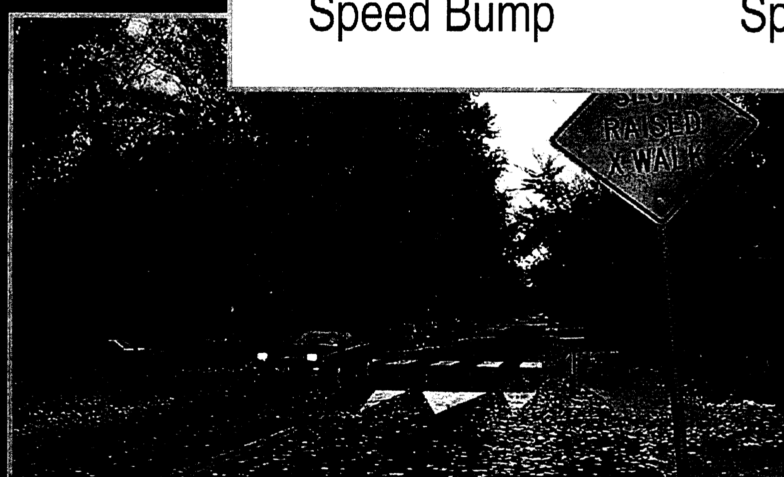
Diagonal Diverter

Semi-Diverter



Speed Hump



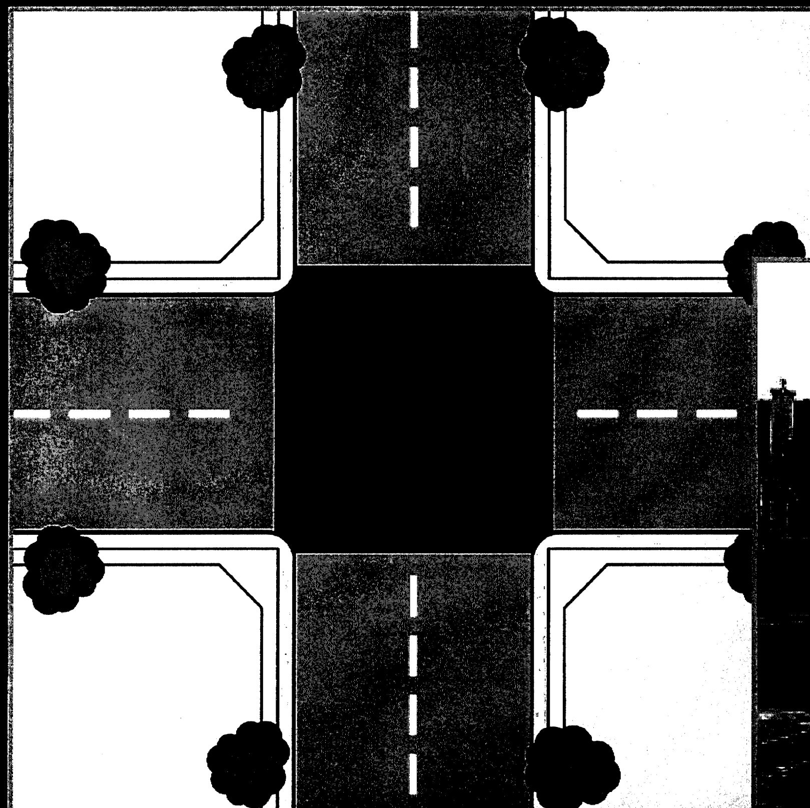


Raised Crosswalk

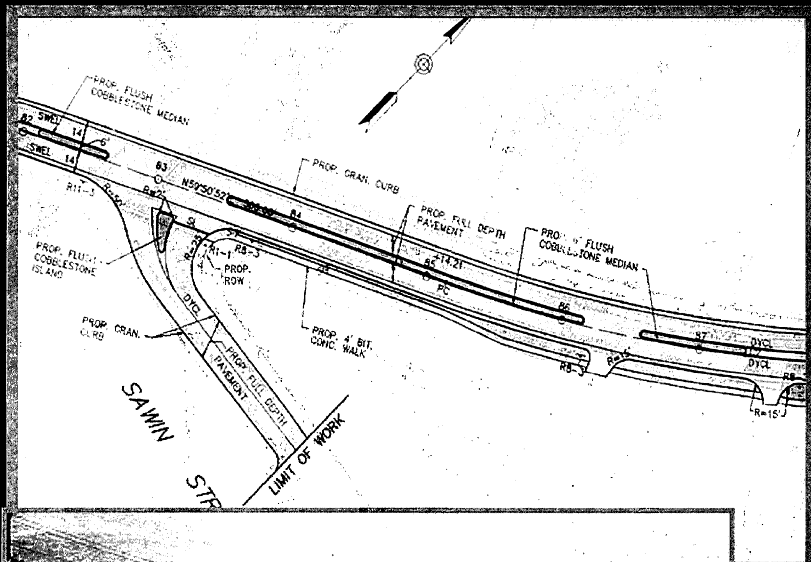
Raised Crosswalk

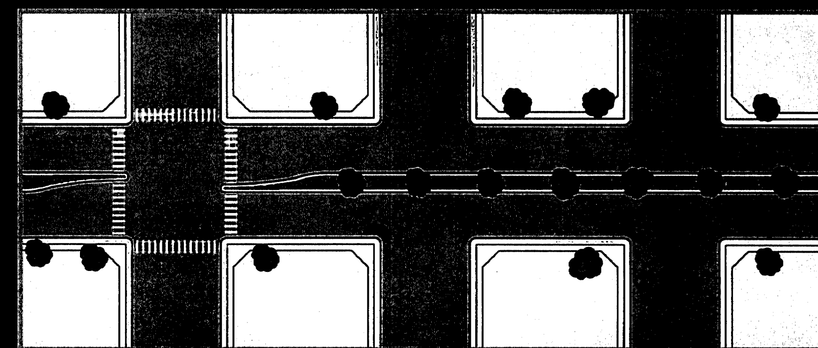
(Driver's Eye View)

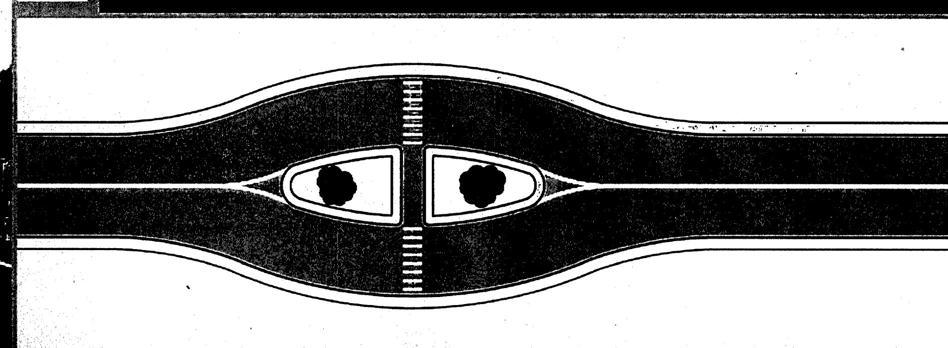
Raised Intersection



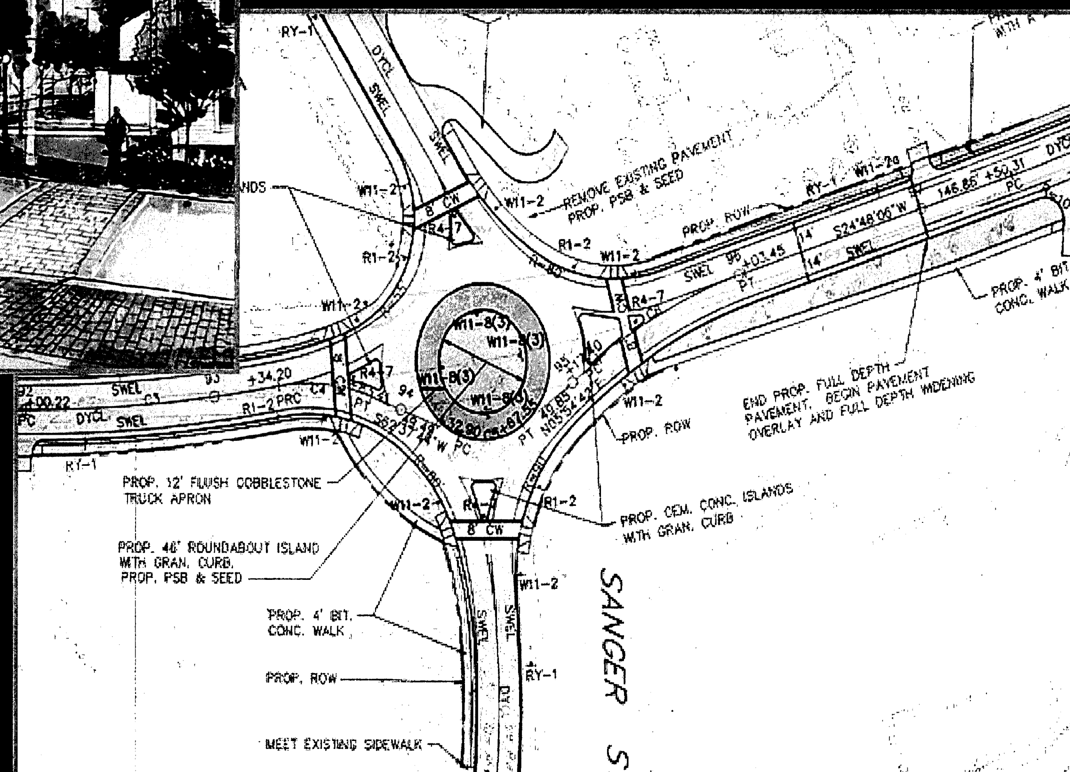
Median Treatment & Traffic Island







Roundabout


REMOVE EXISTING PAVEMENT
PROP. PSB & SEED
PROP. ROW
PROP. 4' BIT. CONC. WALK
END PROP. FULL DEPTH PAVEMENT. BEGIN PAVEMENT OVERLAY AND FULL DEPTH WIDENING
PROP. ROW
PROP. CEM. CONC. ISLANDS WITH GRAN. CURB
SANGER ST
PROP. 12' FLUSH COBBLESTONE TRUCK APRON
PROP. 46' ROUNDABOUT ISLAND WITH GRAN. CURB. PROP. PSB & SEED
PROP. 4' BIT. CONC. WALK
PROP. ROW
MEET EXISTING SIDEWALK

Roundabout/Traffic Circle

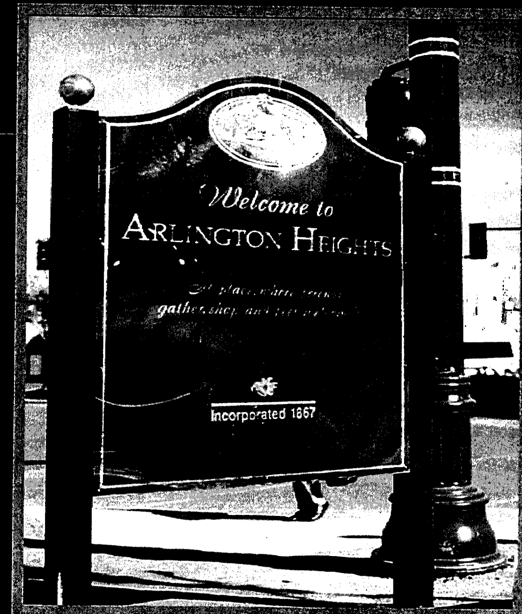
Textured Treatments

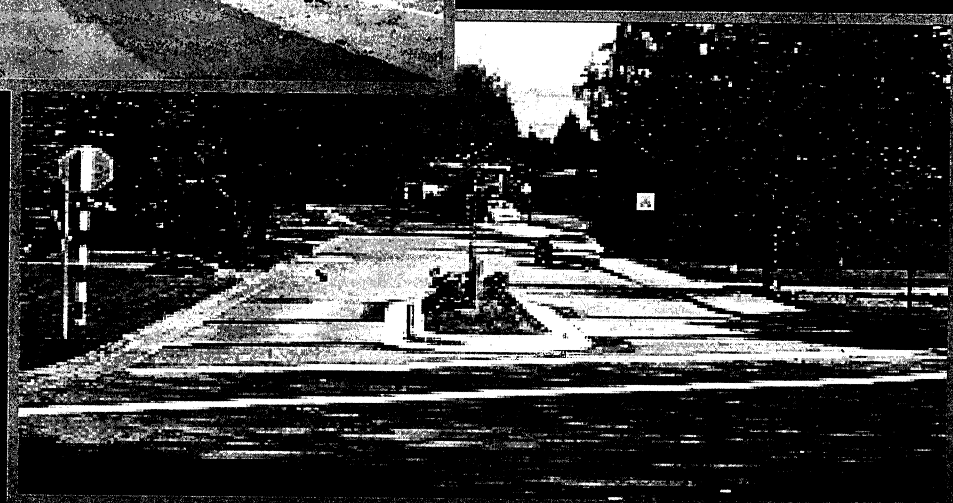
Miami Lakes, Florida

Amesbury, MA (VHB Design)

Enhanced Crosswalk Treatment

Gateways





Lighting

Resources:

- *Traffic Calming, State of the Practice,* ITE, U.S. DOT, FHWA
- *Traffic Calming in Practice,* County Surveyors Society, etc.
- *Traditional Neighborhood Development – Street Design Guidelines,* ITE
- *Take Back Your Streets,* CLF
- *Speed Hump Design Guidelines,* ITE
- *Traffic Calming:Devices, Applications & Program Management,* SWRPA

Resources for Roundabouts:

- *Roundabouts: An Informational Guide*, U.S. DOT, FHWA
- *Roundabout Design Guidelines*, Ourston & Doctors
- *Florida Roundabout Guide*
- *Roundabout Design Guidelines*, State of Maryland
- *Roundabouts, Guide to Engineering Practice*, AUSTROADS