CITY OF DOVER
TRANSPORTATION COMPONENT - MASTER PLAN

FINAL REPORT
TECHNICAL MEMORANDUM NO. 1
PROBLEM INTERSECTION LOCATIONS

Prepared for:

THE CITY OF DOVER, N.H.
DEPARTMENT OF PLANNING
AND COMMUNITY DEVELOPMENT

JULY, 1988

by:

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in association with:

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PROFESSIONAL ENGINEERS AND
LAND SURVEYORS

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I. Introduction

A. Background

In January, 1988, the City of Dover retained the consulting firms of Storch Associates of Manchester, New Hampshire and Fredette Associates, Inc. of Salem, New Hampshire to provide technical input into the Transportation Component of the 1988 Master Plan. This technical input may be expressed in the following task objectives:

Task 1. Identify existing conditions and recommend improvements for twelve problem intersection locations.

Task 2. Investigate options for improving traffic flow in the downtown Central Avenue Corridor, including land widening, one-way circulation pattern, or new bypass roadway.

Task 3. Identify long range highway improvement needs for the Route 9 Corridor in the City of Dover per major industrial rezoning proposed in the Master Plan.

This Technical Memorandum No. 1 - Problem Intersection Locations documents the results of Task 1 of the Transportation Component.

B. Methodology

Technical Memorandum No.1 - Problem Intersection Locations, generally consists of an inventory of existing conditions at twelve problem intersections identified by the City Planning Department for inclusion in the City's short-term capital improvement program. These intersections are identified in Maps 1 and 2 and are based in part on a recent survey by the Dover Police Department identifying twelve potentially hazardous intersections within the City. Included is the identification of existing physical problems, traffic count data, accident history, and intersection capacity for the purpose of identifying and ranking intersection improvements.

Also reported herein are recommendations for roadway and/or traffic control improvements intended to mitigate the identified intersection problems. These improvements are proposed within the context of providing the City of Dover with an outline of cost effective, near-term (through 1993) funding requirements to both alleviate existing problems and provide for anticipated traffic growth needs at these locations.

The preliminary findings and recommendations of this study task were presented to the City of Dover Transportation Committee on March 28, 1988. This Final Report reflects the input provided by the Committee at that time.

C. Other Studies

This study has made use of traffic data from the following sources:

- Automatic Traffic Recorder Counts by the New Hampshire Department of Transportation at various times from 1979 through 1987.

- Traffic Accident Summaries by the New Hampshire Department of Transportation from 1984 to 1987.

- Peak hour traffic counts conducted by the City of Dover and Strafford Regional Planning Commission between 1987 and 1988.

- "An Analysis of the N.H. Route 108 Corridor in Dover, New Hampshire", by Strafford Regional Planning Commission, December 1987.

- "Traffic Impact Analysis for the Mast Road Development Consortium, Dover, New Hampshire", by Holden Engineering and Surveying, Inc. April 1987.

D. Acknowledgements

We would like to acknowledge the advice and assistance provided by the following departments and organizations:

- City of Dover Department of Planning and Community Development.

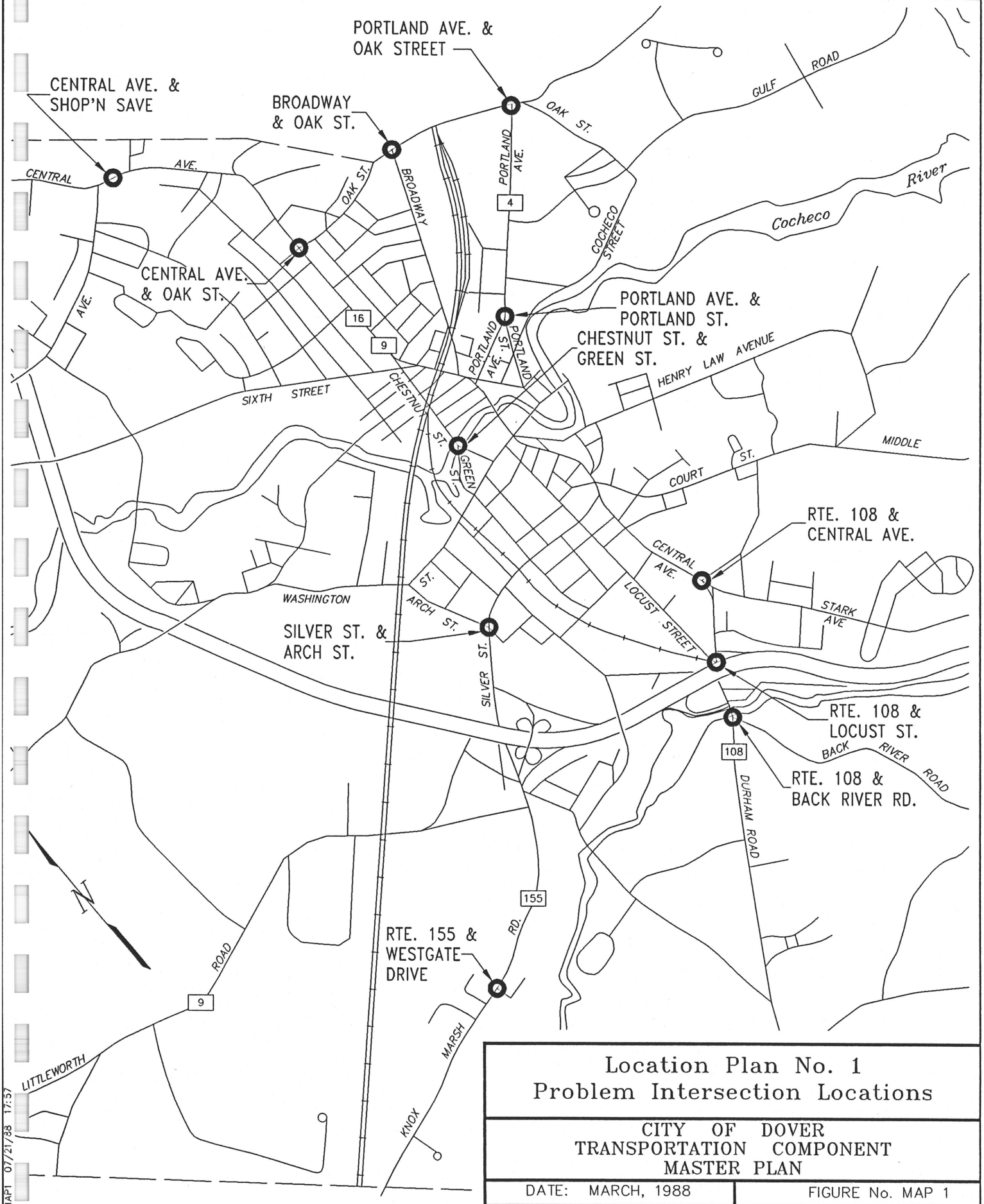
- City of Dover Department of Public Works.

- City of Dover Department of Public Safety.

- City of Dover Transportation Committee and involved citizens.

- Strafford Regional Planning Commission.

- New Hampshire Department of Transportation, Bureau of Transportation Planning.



APPROXIMATE SCALE: 1"= 2000'

Location Plan No. 1
Problem Intersection Locations

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. MAP 1

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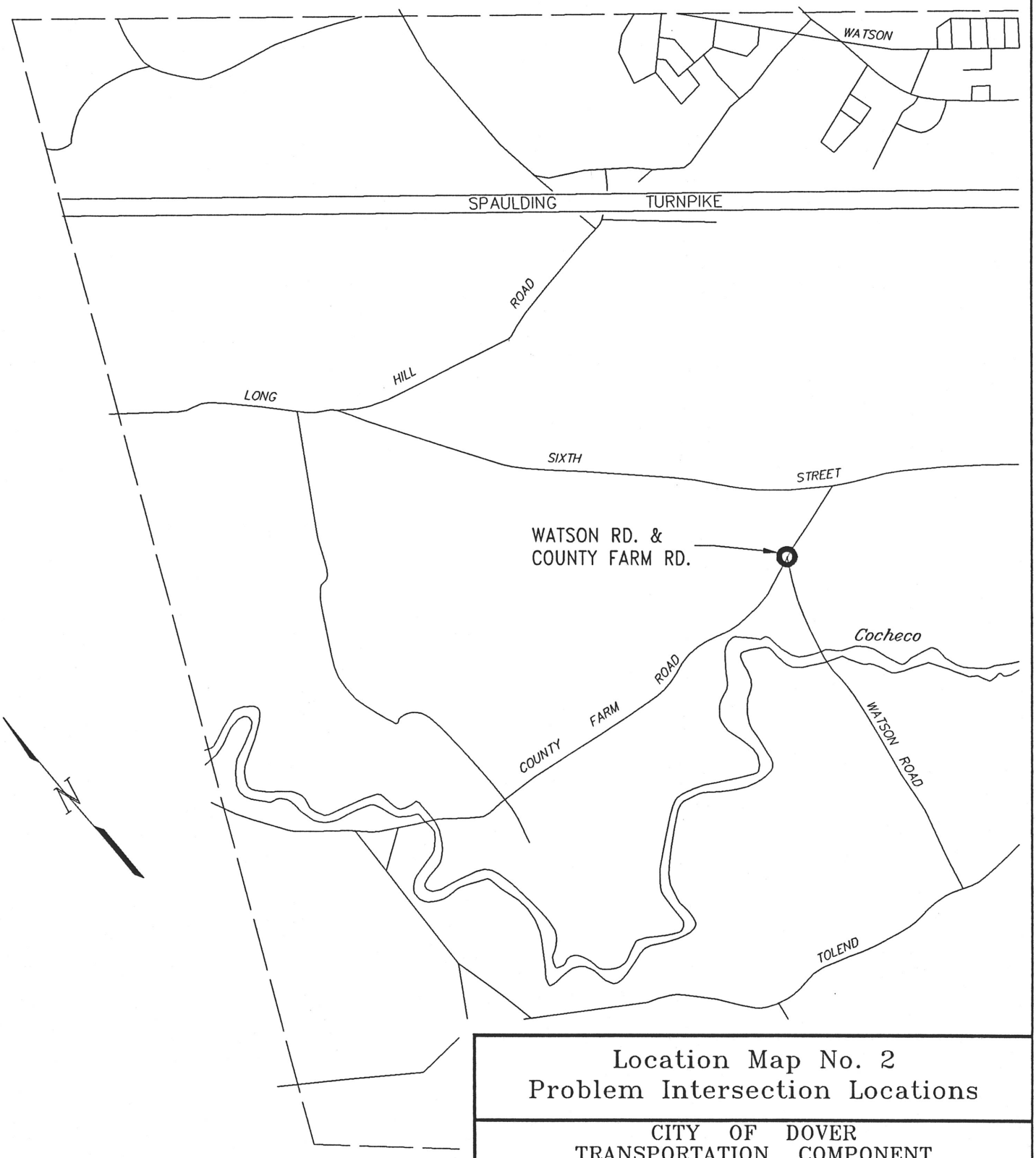

Location Map No. 2
Problem Intersection Locations

CITY OF DOVER
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MASTER PLAN

DATE: MARCH, 1988

FIGURE No. MAP 2

APPROXIMATE SCALE: 1"= 2000'

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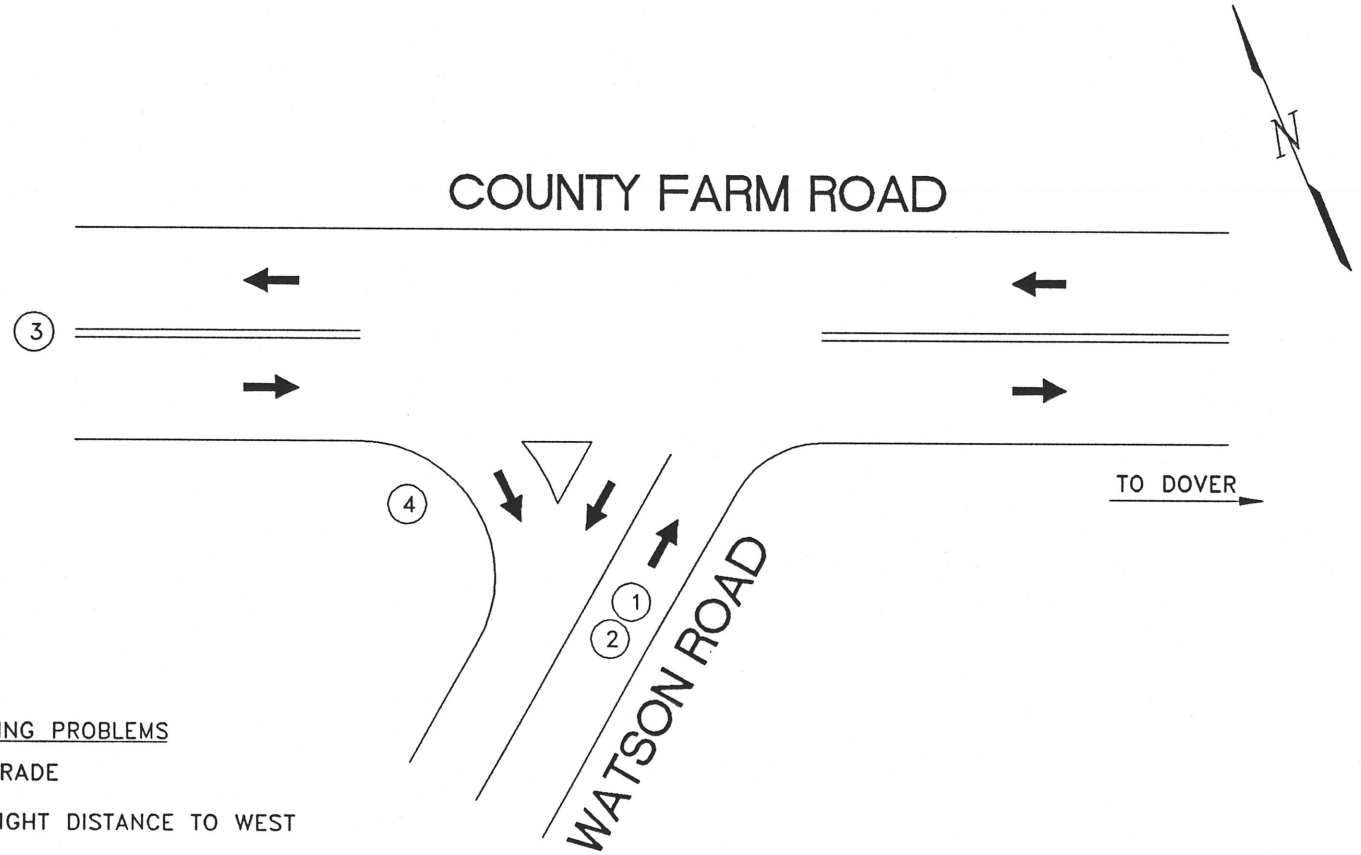
II. Problem Intersection Identification

A. Summary of 1988 Existing Conditions

The 1988 existing conditions for each of the 12 problem intersections have been summarized graphically on the 1988 Existing Conditions Plans. In addition to this, each plan identifies the key problem areas in terms of deficiencies related to physical roadway layout and traffic operations.

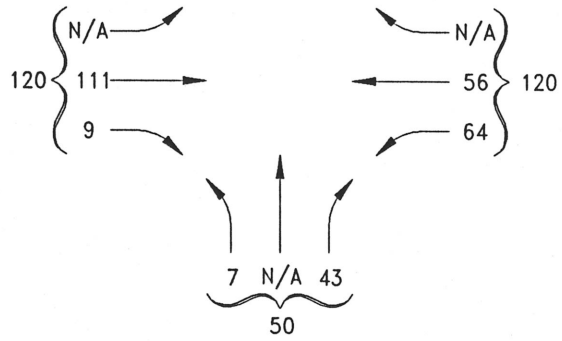
The Existing Conditions Plans for each problem intersection have been arranged in order on the following Figures 1 to 12. The following sections of this report will describe in more detail the items summarized on these figures.



EXISTING PROBLEMS

1. GRADE
2. SIGHT DISTANCE TO WEST
3. CREST OF VERTICAL CURVE
4. ROADSIDE VEGETATION

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 290

MINOR STREET
LEVEL OF SERVICE: A

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 2
PERSONAL INJURY ACCIDENTS: 2

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.577

INTERSECTION
NUMBER
1

EXISTING CONDITIONS
Watson Road at County Farm Road

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FIGURE No. 1

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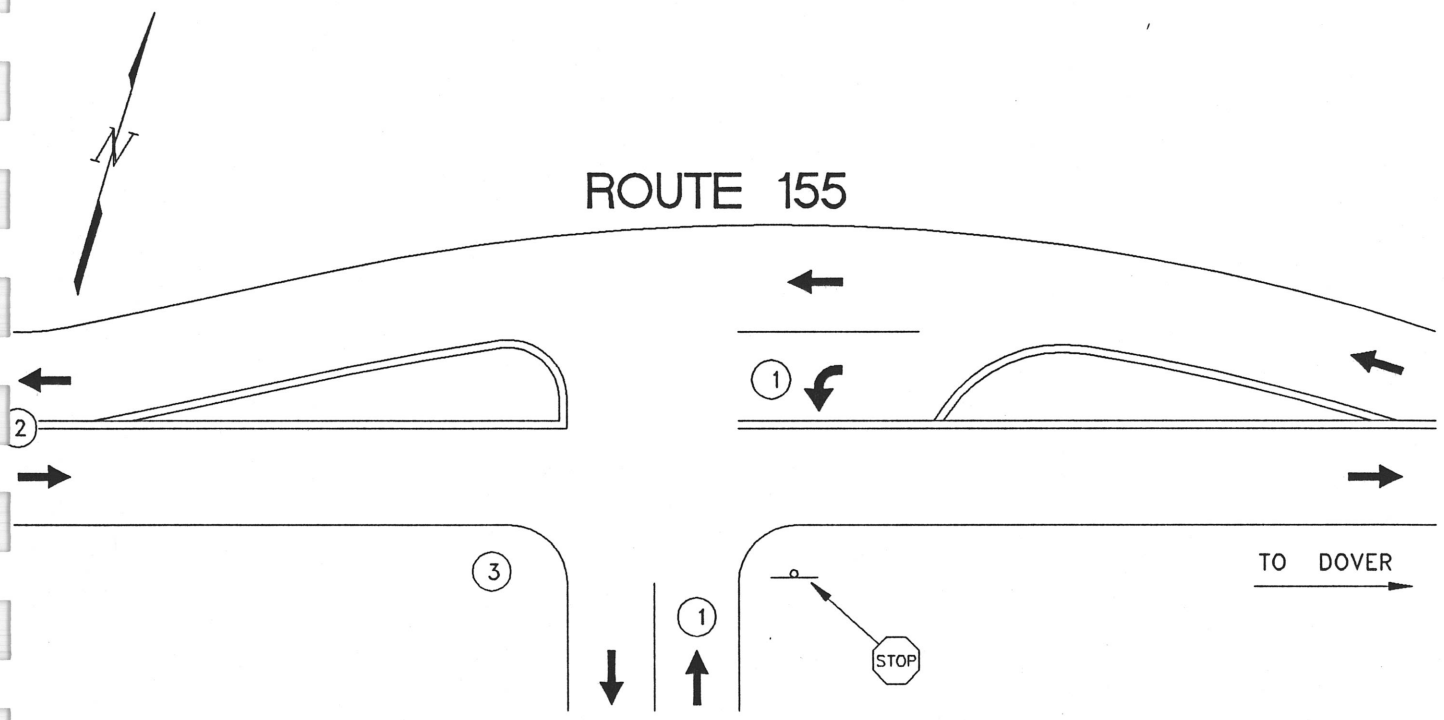
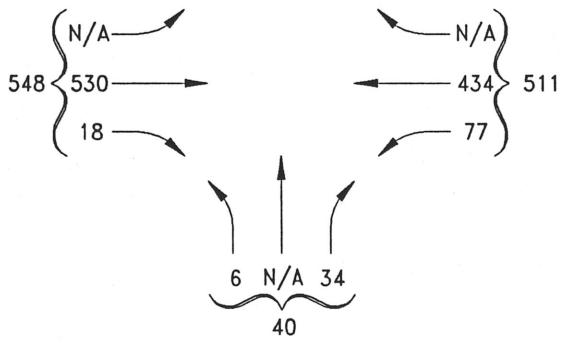


EXISTING PROBLEMS

(1) SIGHT DISTANCE TO WEST
(2) CREST OF VERTICAL CURVE
(3) RAISED FILL AREA BEHIND CURB

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1099

MINOR STREET
LEVEL OF SERVICE: D

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 5
PERSONAL INJURY ACCIDENTS: 3

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.381

INTERSECTION
NUMBER
2

EXISTING CONDITIONS
Route 155 at Westgate Apartments

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 2

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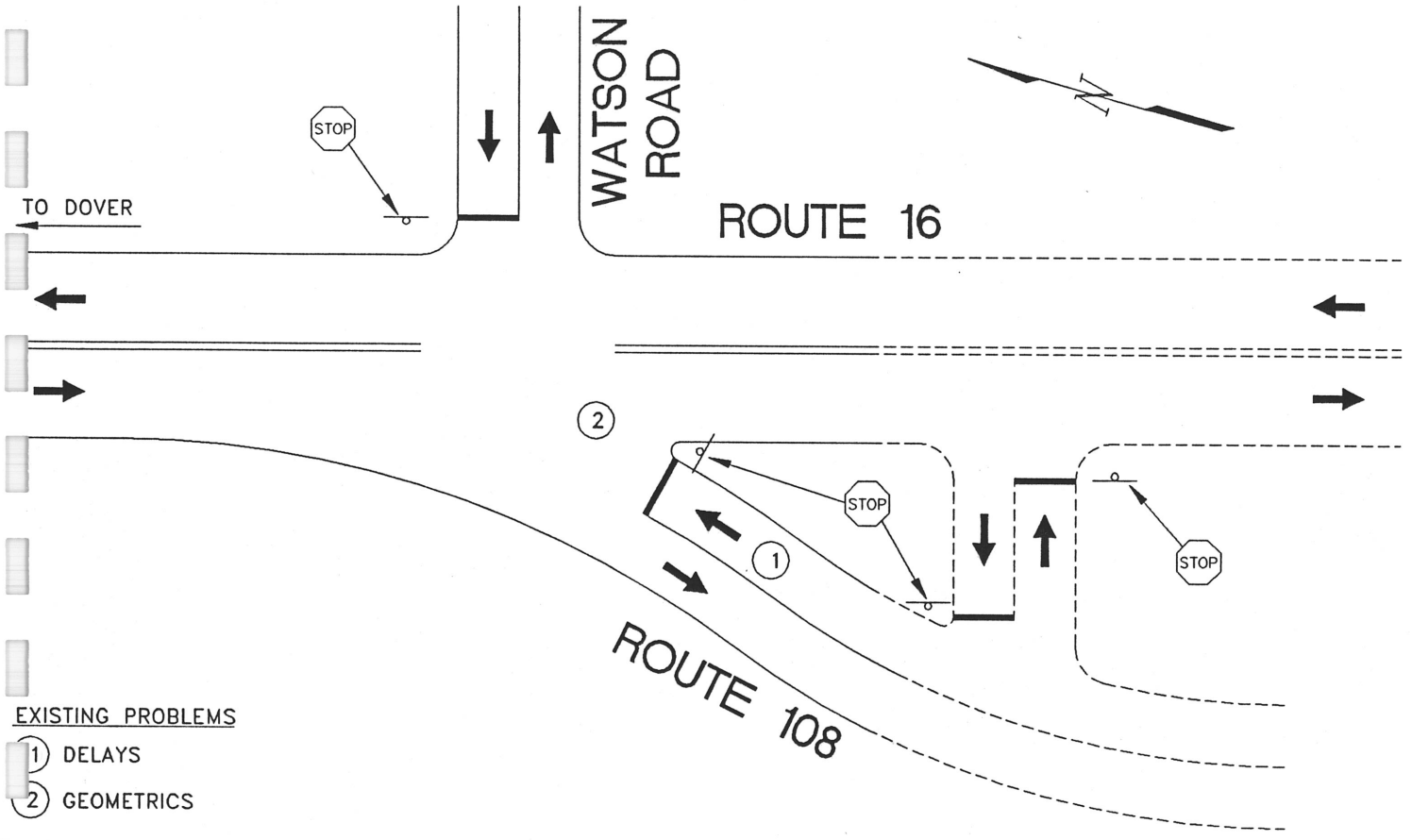
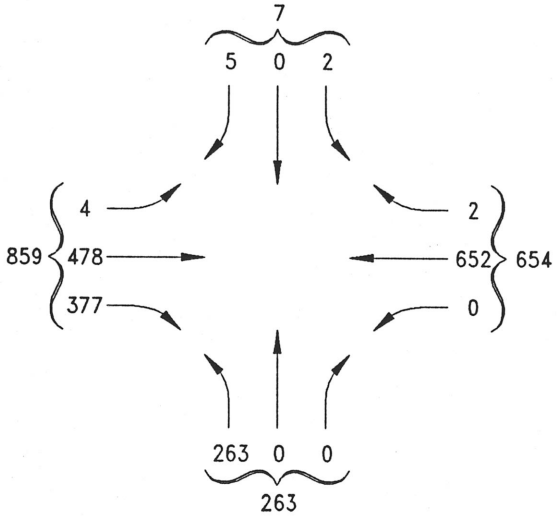


EXISTING PROBLEMS

(1) DELAYS

(2) GEOMETRICS

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1783

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 23
PERSONAL INJURY ACCIDENTS: 3

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 1.079

INTERSECTION NUMBER 3

EXISTING CONDITIONS
Route 108 at Route 16

CITY OF DOVER
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FIGURE No. 3

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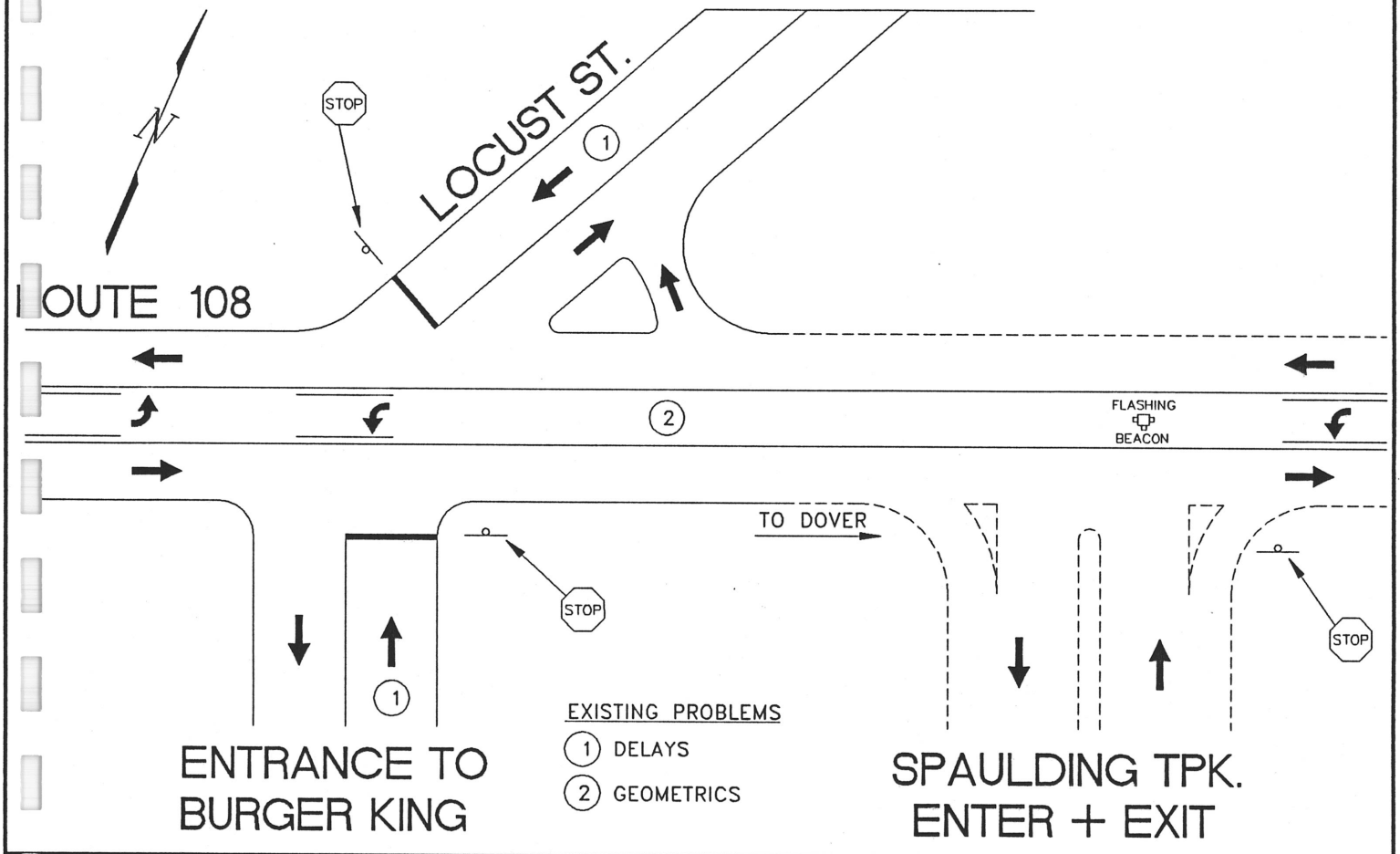
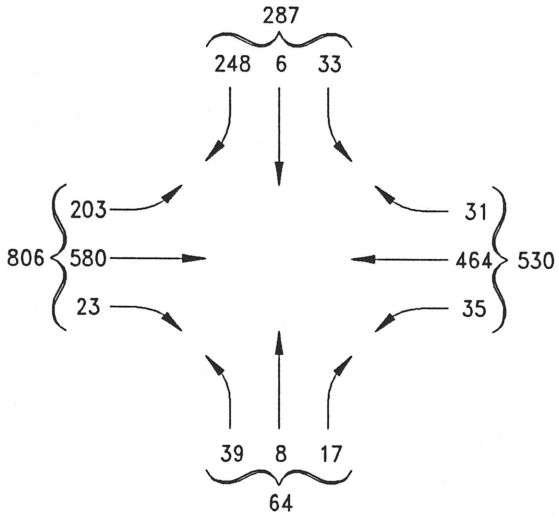


1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1687

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 11
PERSONAL INJURY ACCIDENTS: 2

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.545

INTERSECTION
NUMBER
4

EXISTING CONDITIONS
Route 108 at Locust Street

CITY OF DOVER
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DATE: MARCH, 1988

FIGURE No. 4

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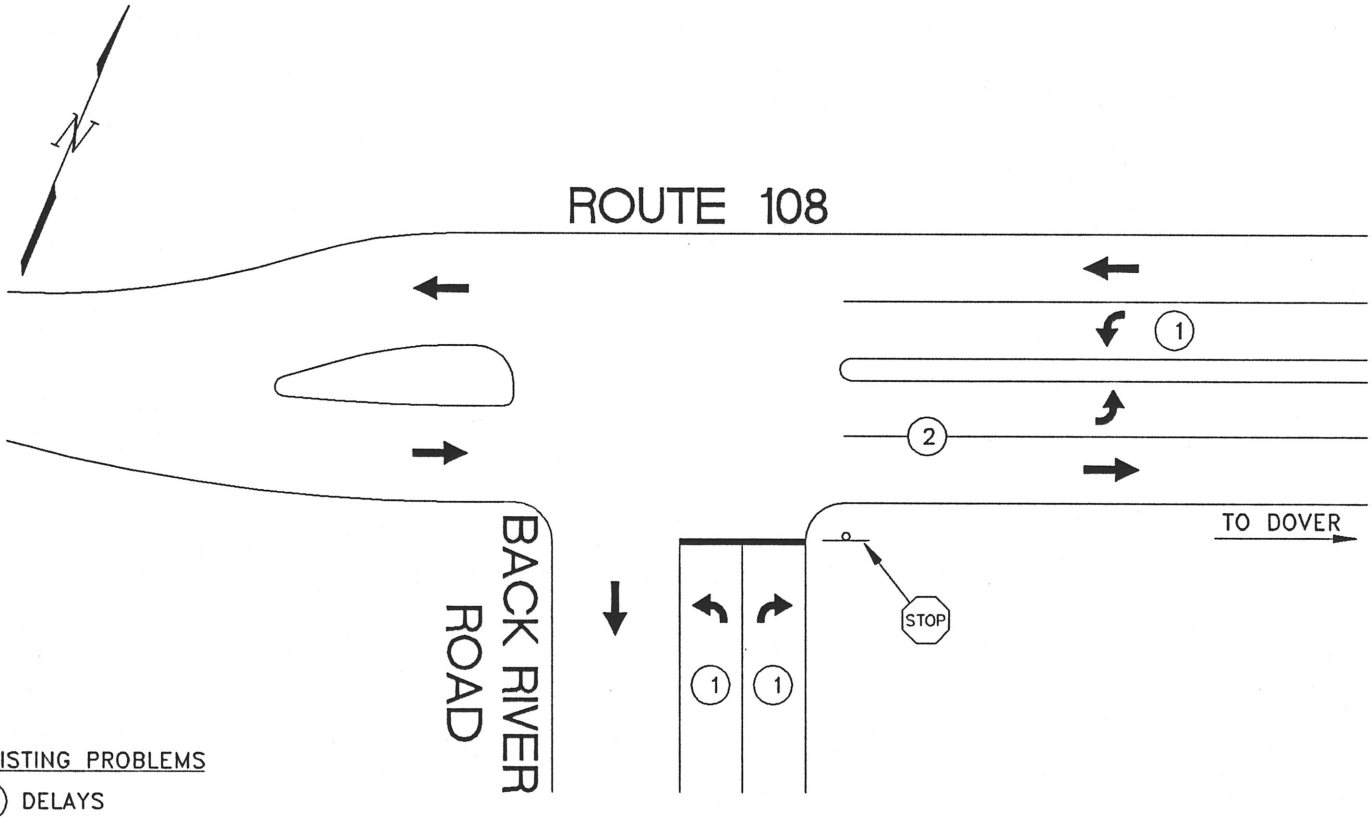
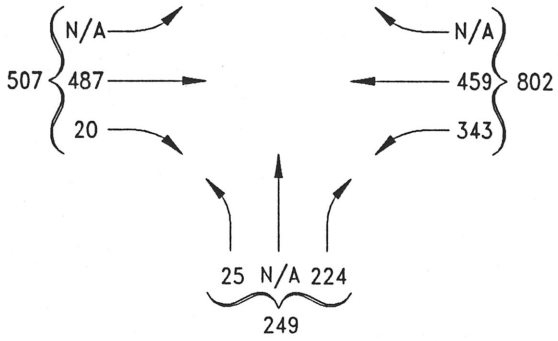


XISTING PROBLEMS

(1) DELAYS

(2) QUEUEING FROM TRAFFIC SIGNAL AT MILL STREET

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1558

MINOR STREET
LEVEL OF SERVICE: E

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 18
PERSONAL INJURY ACCIDENTS: 2

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.966

INTERSECTION NUMBER
5

EXISTING CONDITIONS
Route 108 at Back River Road

CITY OF DOVER
TRANSPORTATION COMPONENT
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FIGURE No. 5

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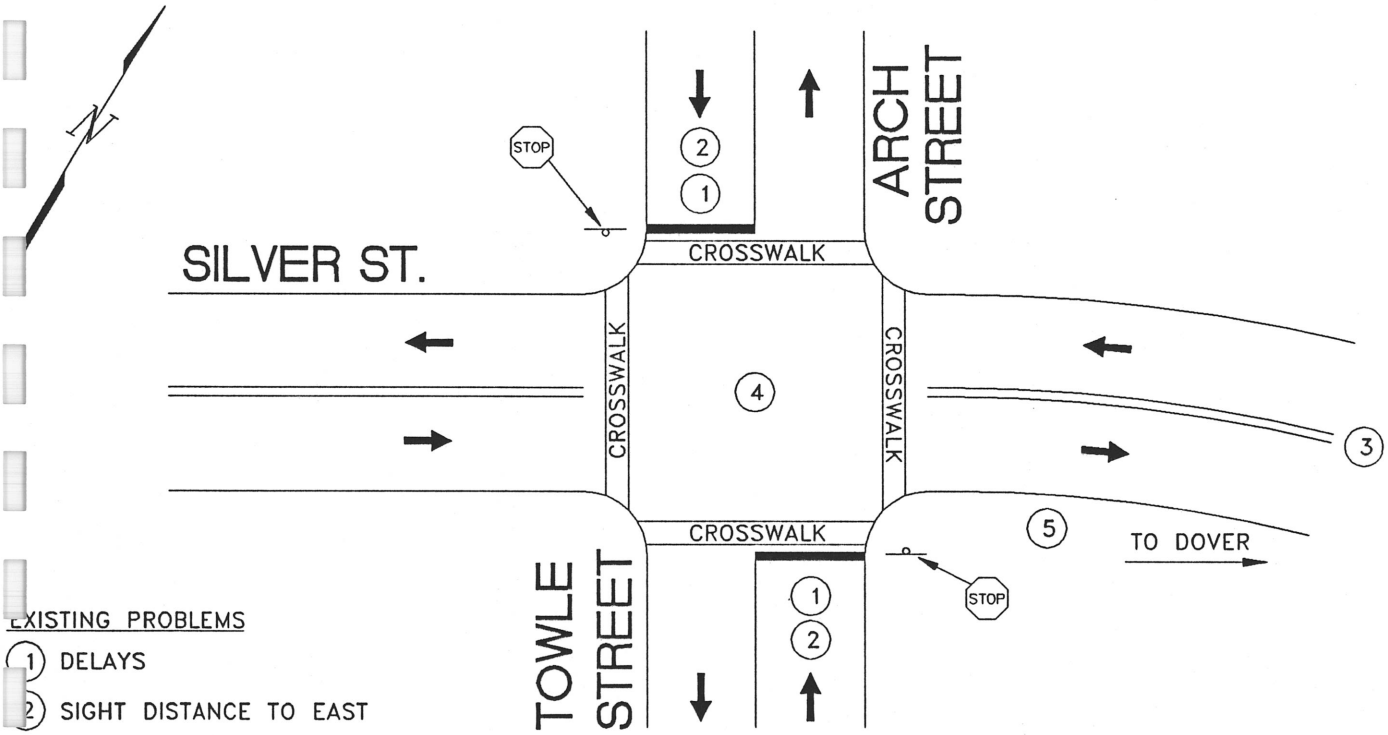
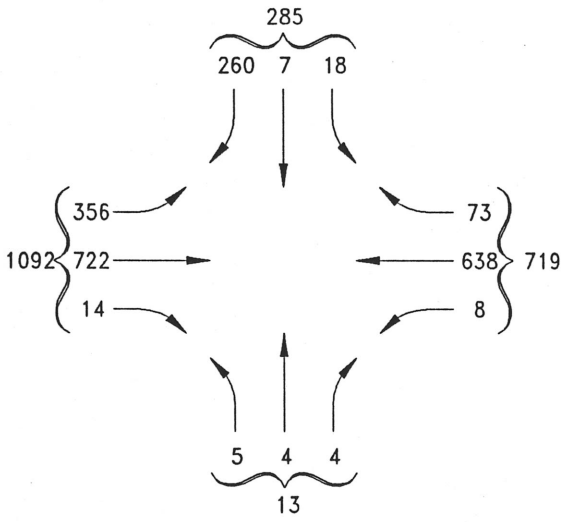


EXISTING PROBLEMS

1. DELAYS
2. SIGHT DISTANCE TO EAST
3. CREST OF VERTICAL CURVE
4. SCHOOL CROSSING
5. TREES

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2109

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 11
PERSONAL INJURY ACCIDENTS: 4

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.436

INTERSECTION NUMBER 6

EXISTING CONDITIONS
Silver Street at Arch Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 6

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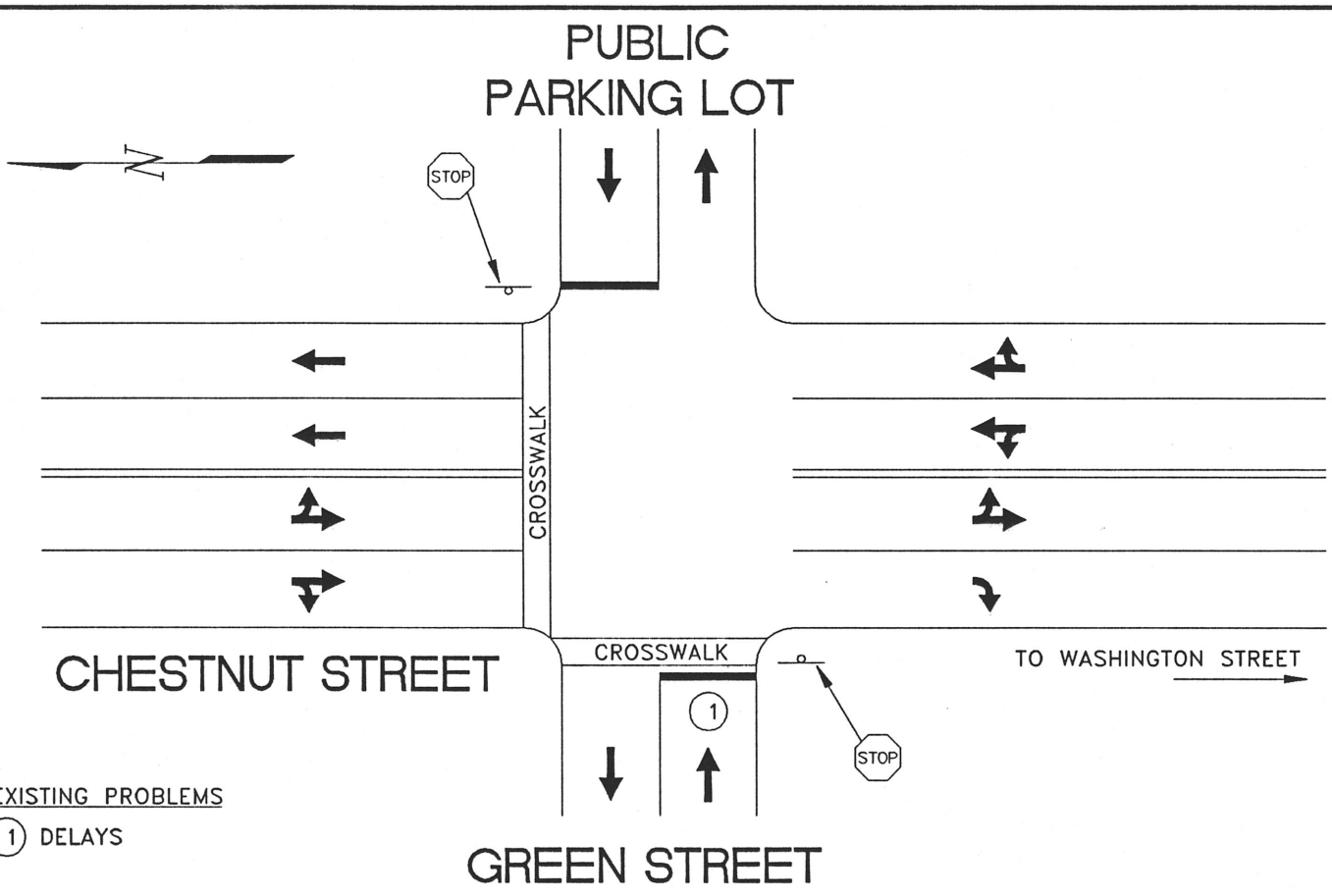
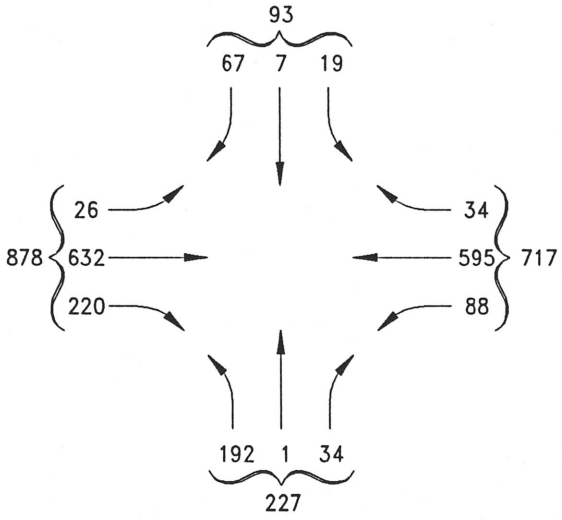


1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1915

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 12
PERSONAL INJURY ACCIDENTS: 2

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.524

INTERSECTION
NUMBER
7

EXISTING CONDITIONS
Chestnut Street at Green Street

CITY OF DOVER
TRANSPORTATION COMPONENT
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DATE: MARCH, 1988

FIGURE No. 7

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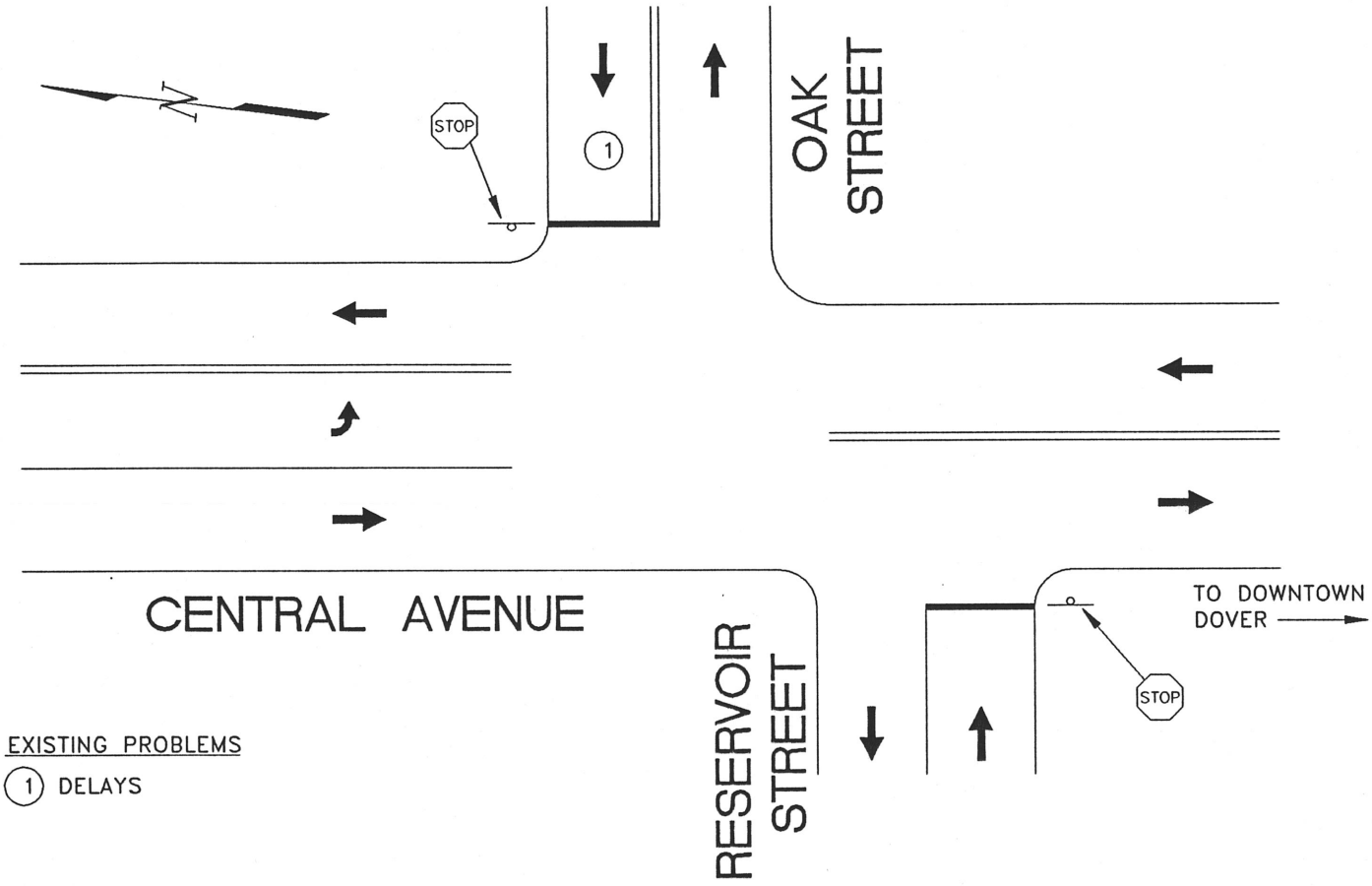
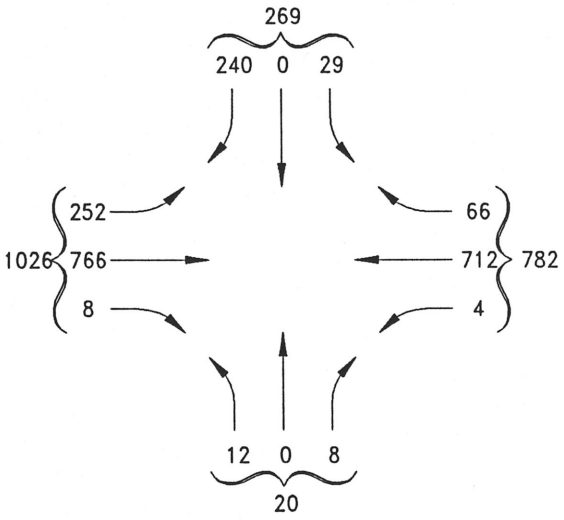


EXISTING PROBLEMS

(1) DELAYS

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2097

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 22
PERSONAL INJURY ACCIDENTS: 7

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.878

INTERSECTION NUMBER 8

EXISTING CONDITIONS
Central Avenue at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
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FIGURE No. 8

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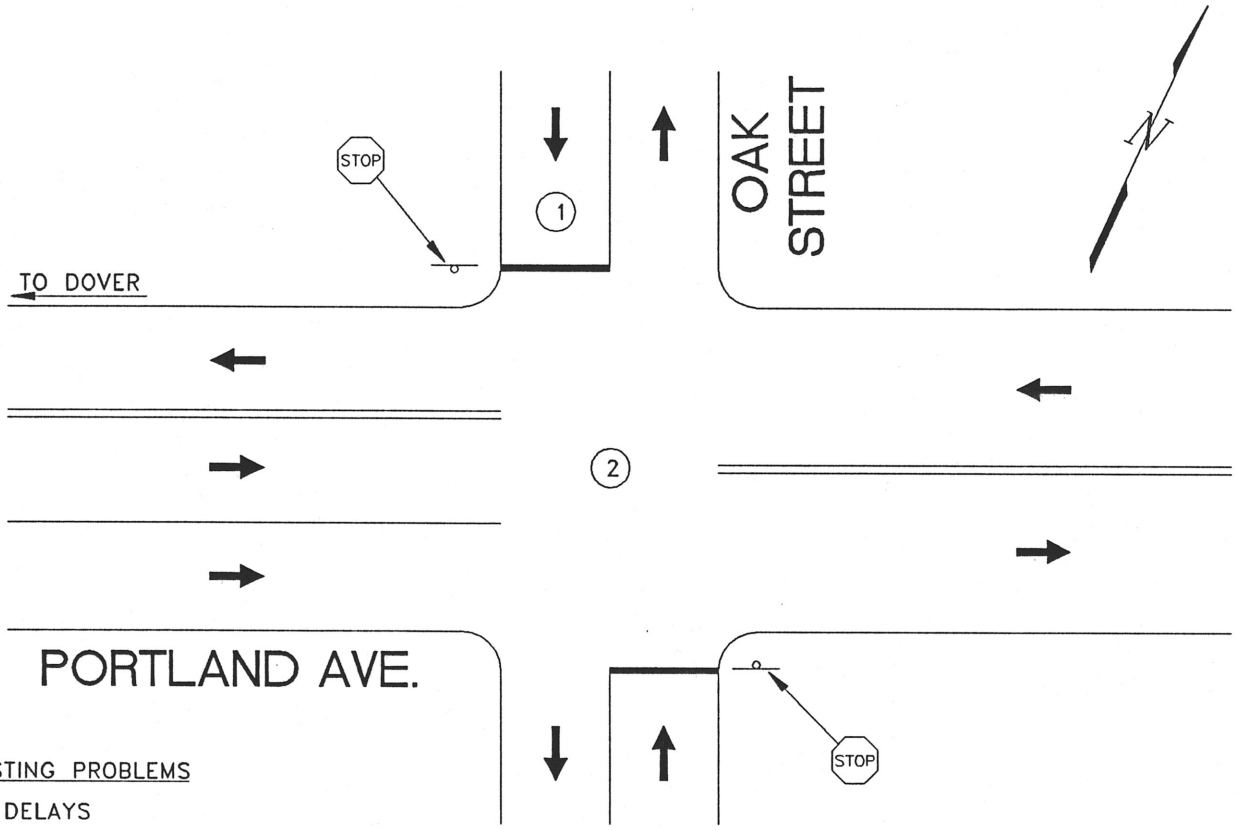
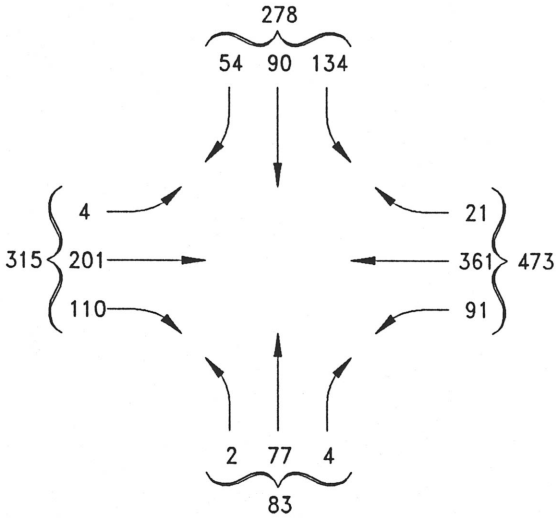


EXISTING PROBLEMS

(1) DELAYS

(2) HIGH SPEEDS

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1149

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS:	19
PERSONAL INJURY ACCIDENTS:	6
FATAL ACCIDENTS:	1

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 1.383

INTERSECTION NUMBER 9

EXISTING CONDITIONS
Portland Avenue at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 9

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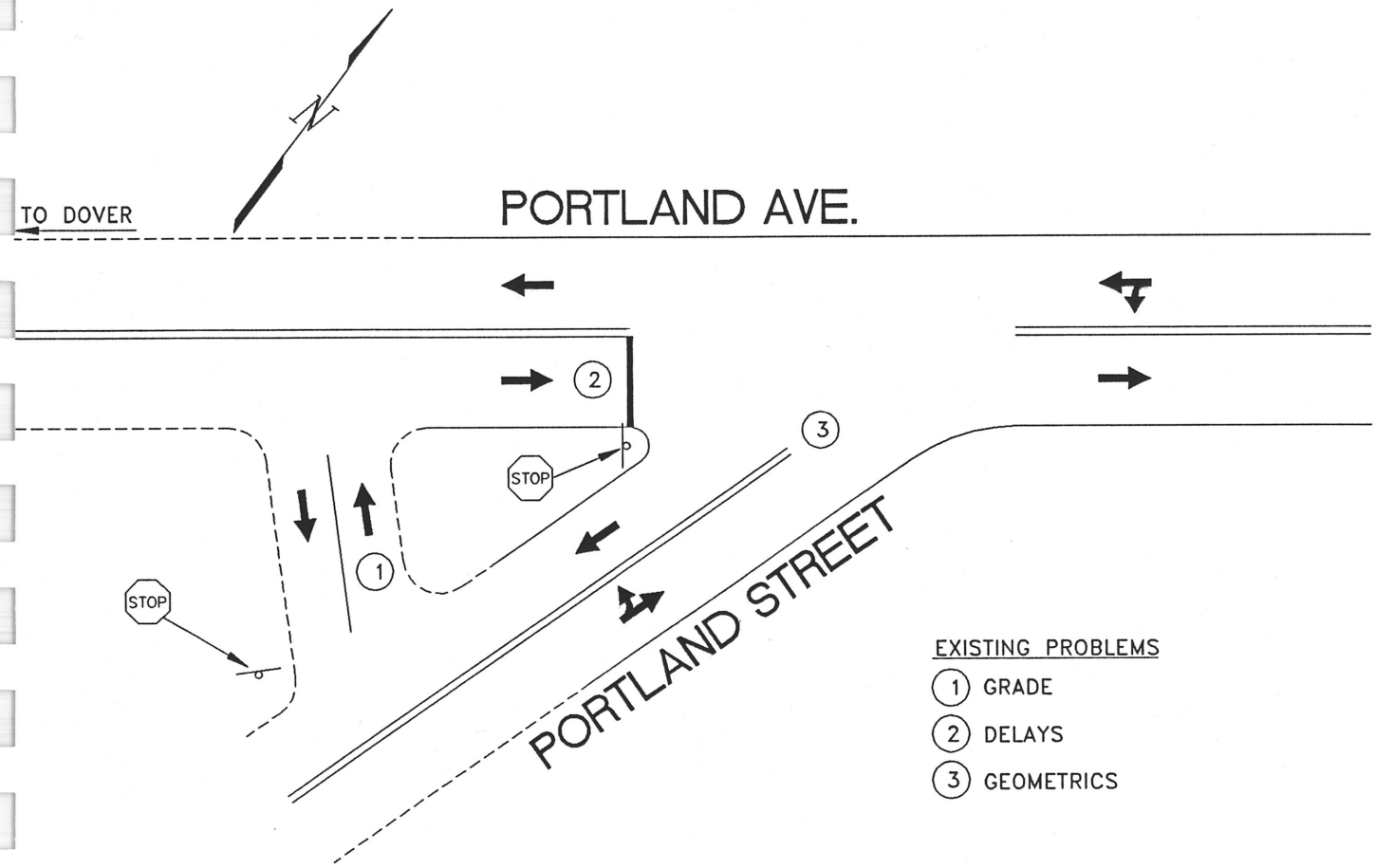
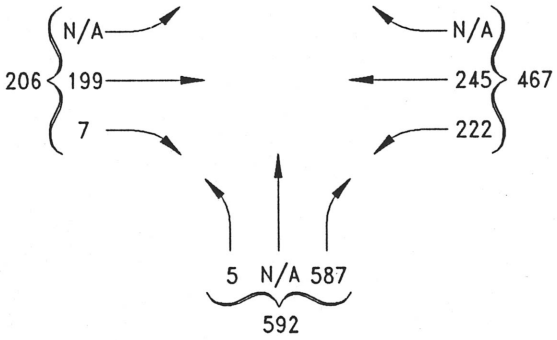


1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1265

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 3
PERSONAL INJURY ACCIDENTS: 0

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.198

INTERSECTION
NUMBER
10

EXISTING CONDITIONS
Portland Avenue at Portland Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 10

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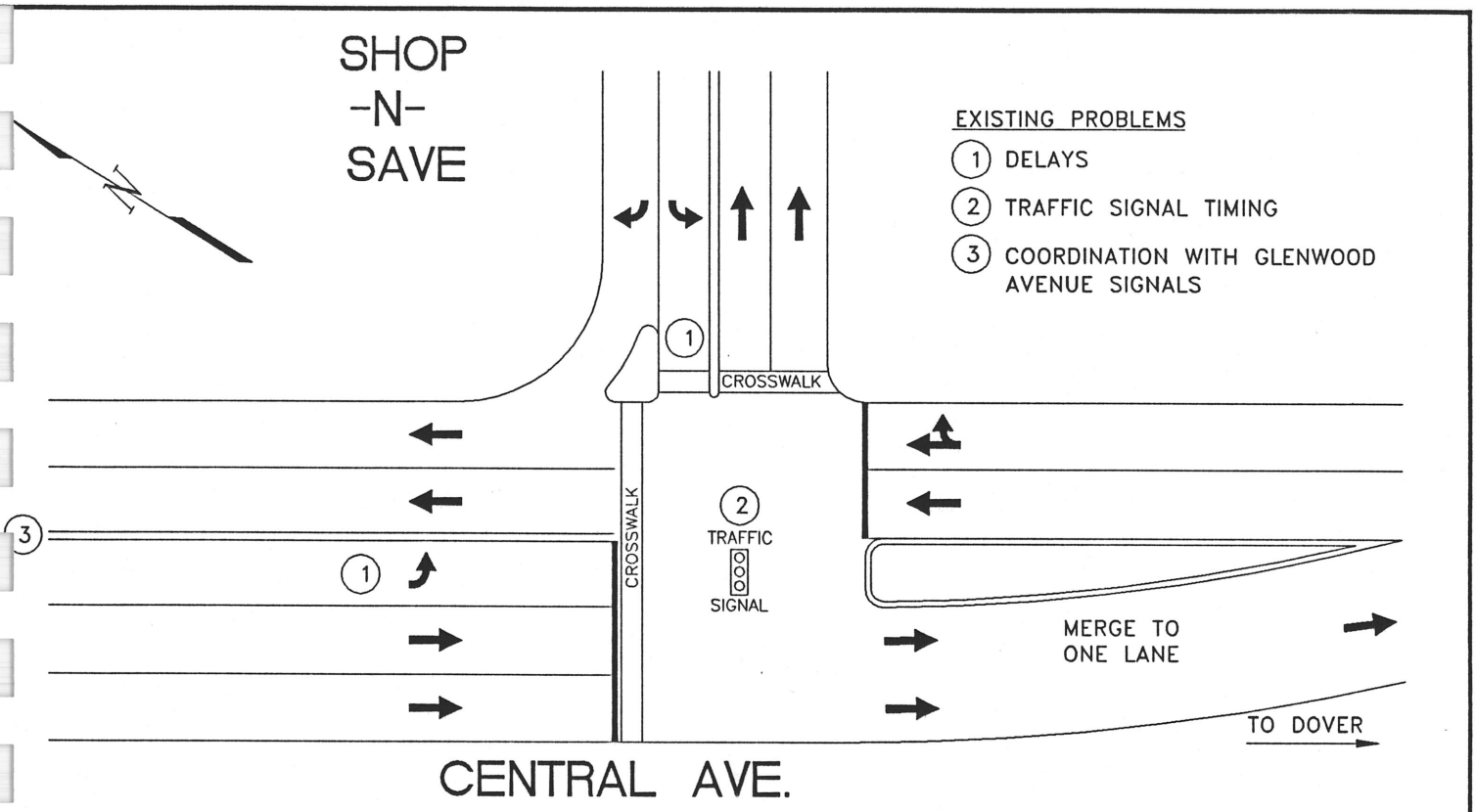
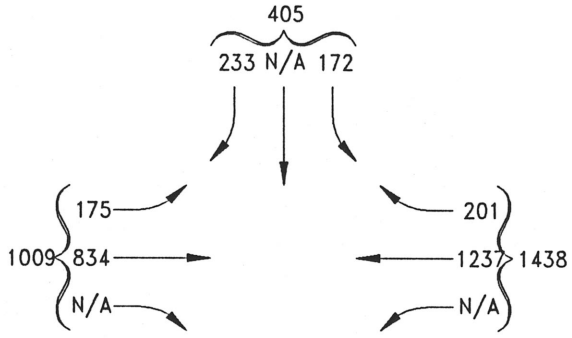


1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2852

MINOR STREET
LEVEL OF SERVICE: B

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 4
PERSONAL INJURY ACCIDENTS: 1

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 0.117

INTERSECTION
NUMBER
11

EXISTING CONDITIONS
Central Avenue at Shop'n Save

CITY OF DOVER
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FIGURE No. 11

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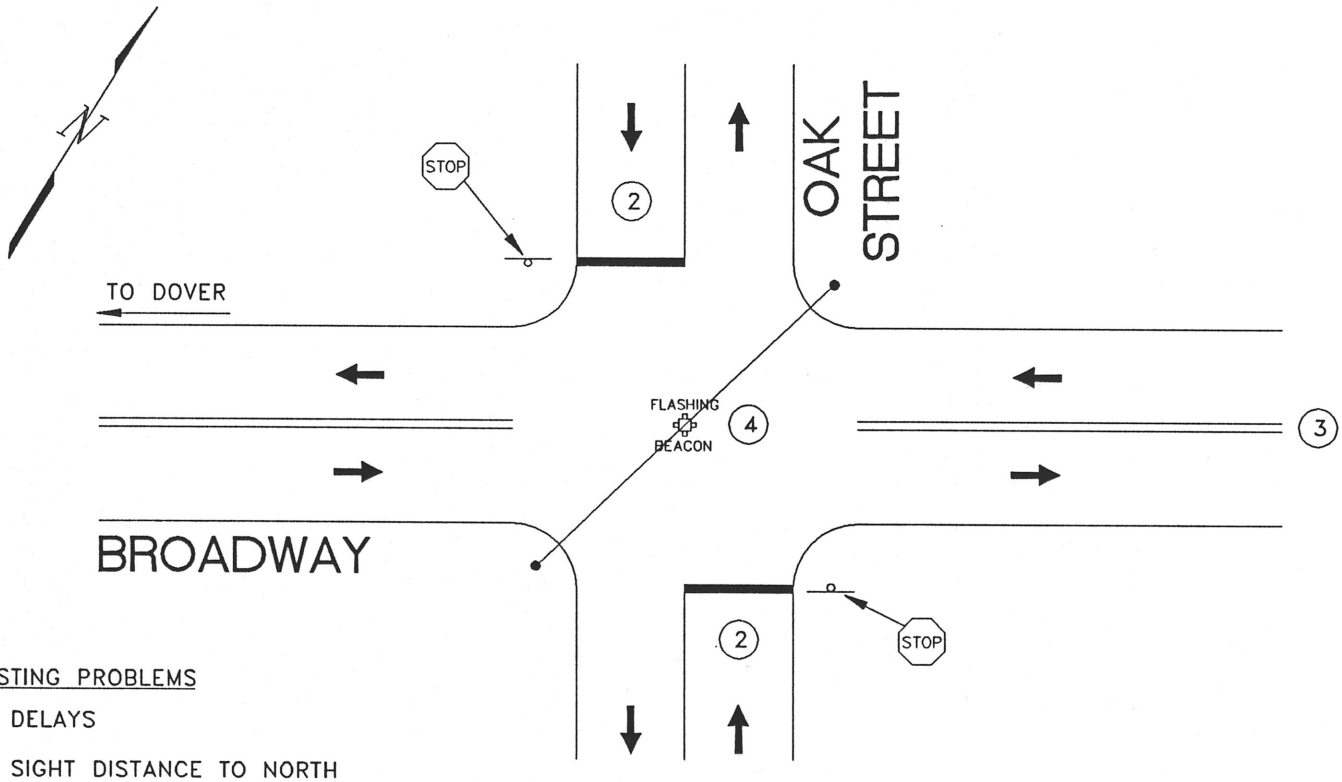


EXISTING PROBLEMS

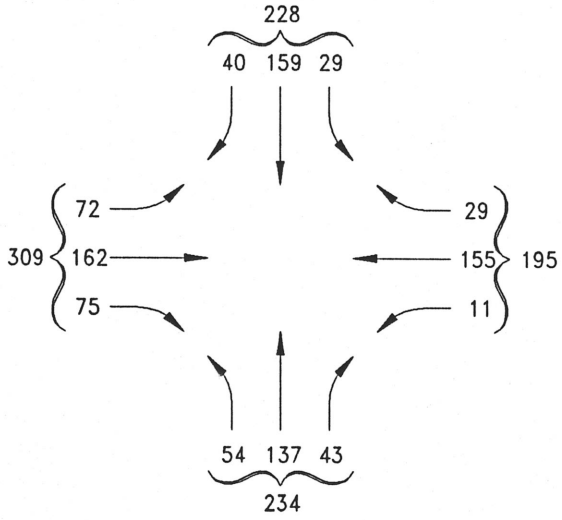
(1) DELAYS

(2) SIGHT DISTANCE TO NORTH

(3) CREST OF VERTICAL CURVE

(4) ACCCIDENTS

1988 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 966

MINOR STREET
LEVEL OF SERVICE: F

1984–1986 ACCIDENT HISTORY

PROPERTY DAMAGE ACCIDENTS: 30
PERSONAL INJURY ACCIDENTS: 6

ACCIDENT RATE PER
MILLION ENTERING VEHICLES: 2.598

INTERSECTION NUMBER
12

EXISTING CONDITIONS
Broadway at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 12

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B. Observations of Roadway Conditions

1. County Farm Road At Watson Road

County Farm Road is a rural two-lane roadway that extends from 6th Street to points east in the City of Dover. Its pavement width is approximately 22 feet with 1-2 foot shoulders. Pavement markings in the vicinity of its intersection with Watson Road consist of a double yellow centerline. No posted speed limits were noted along County Farm Road. Due to its general curvelinear alignment, design speeds are estimated to be 40 mph.

Watson Road is a rural two-lane roadway with a pavement width of approximately 20 feet. No pavement markings or stop control was noted at its "T" intersection with County Farm Road.

Watson Road intersects County Farm Road at a skew angle of approximately 60 degrees with a steep approach up-grade for a short distance along Watson Road. East bound right turn movements along County Farm Road utilize a channelized right turn opening of approximately 12 feet in width to negotiate the skewed - angle corner.

Corner sight distance at the intersection is restricted to the west of Watson Road, generally limited by the vertical grade along County Farm Road. Unobstructed views appear to be approximately 300 feet. This view is also partially obscured by roadside vegetation and trees located on the south-west corner of the intersection.

The physical layout of the intersection is illustrated on Figure 13.

2. Route 155 at West Gate Apartment Drive

Route 155 is a two-lane highway providing primary connection to the Spaulding Turnpike and the downtown area to the east. In the vicinity of its intersection with West Gate Apartment Drive the posted speed limit is 50 mph. Pavement markings consist of a double yellow centerline with a designated westbound left turn lane and solid white lines defining the outer edge of the travelled lanes.

West Gate Drive is the main access driveway to the West Gate Apartments residential development. The pavement width is approximately 30 feet with posted stop control at its intersection with Route 155. No pavement markings are provided.

West Gate Drive intersects Route 155 forming a "T" intersection at a 90 degree angle. Corner sight distance views are partially obstructed to the west due to the vertical grade along Route 155. These views along with views for westbound traffic negotiating left turns into the driveway do not clearly observe eastbound approaching vehicles at distances between 250 to 500 feet. Turning movements from West Gate Apartment Drive may also have views affected by the raised curb and fill area located on the southwest corner of the intersection that further contribute to eastbound vehicles being temporarily "hidden" from the view of vehicles wishing to access the highway.

The physical layout of the intersection is illustrated on Figure 14.

3. Route 108 at Route 16

A problem observed at this intersection is the extreme skew of the Route 108 northbound approach to Route 16. This skew complicates a driver's sight distance, and coupled with heavy flows of peak period traffic, creates a difficult intersection approach to negotiate.

The existing roadway facilities for this intersection are further detailed on Pages 30 and 31 in the N.H. Route 108 Corridor Study prepared by the Strafford Regional Planning Commission, December 30, 1987.

The physical layout of the intersection is illustrated on Figure 15.

4. Route 108 at Locust Street

A problem observed at this intersection is the skewed Locust Street approach to Route 108, coupled with the near proximity of the Burger King entrance and the ramps to the Spaulding Turnpike. Multiple uncontrolled traffic movements to and from Route 108 occur with the 100 to 200 foot segment bounded by these two intersections.

The existing roadway facilities for this intersection are further detailed on Pages 27 to 29 in the N.H. Route 108 Corridor Study prepared by the Strafford Regional Planning Commission, December 30, 1987.

The physical layout of the intersection is illustrated on Figure 16.

5. Route 108 at Back River Road

A problem observed at this intersection is the difficulty in Back River Road traffic entering Route 108 during peak traffic periods. The near proximity at the Mill Street/Spaulding Turnpike Ramps, with its signalized operation, results in queueing of northbound Route 108 traffic across the Back River Road approach, thereby blocking Back River Road traffic movement.

The existing roadway facilities for this intersection are further detailed on Pages 23 and 24 in the N.H. Route 108 Corridor Study prepared by The Strafford Regional Planning Commission, December 30, 1987.

The physical layout of the intersection is illustrated on Figure 17.

6. Silver Street at Arch Street

Silver Street is a two-lane urban arterial providing a primary connection between Central Avenue in downtown Dover to the Spaulding Turnpike. In the vicinity of its intersection with Arch Street and Towle Drive the roadway is marked as a school zone with 20 mph advisory speed limits. General vehicle speeds were observed to be approximately 35 mph. Pavement markings consist of a double yellow centerline and faded school/pedestrian crosswalks. Advance 'Dangerous Intersection' signing is also posted.

Arch Street is a two-lane roadway that extends from Washington Street to Silver Street. Stop control is provided at its intersection with Silver Street with posted sign and painted stop line. Corner sight distance at the intersection is restricted to the east of Arch Street, generally limited by the vertical grade along Silver Street. Unobstructed views appear to be approximately 340 feet.

Towle Drive is a local two way residential street that intersects Silver Street directly opposite Arch Street. Posted stop control and painted stop line is provided. Corner sight distance for vehicles entering the intersection from Towle Drive is restricted to the east. In this case the horizontal and vertical alignment of Silver Street combined with a raised yard and tree located on private residential property at the south-east corner restrict views to approximately 270 feet.

The physical layout of the intersection is illustrated in Figure 18.

7. Chestnut Street at Green Street

Chestnut Street is a downtown collector arterial route that extends from Central Avenue north of 6th Street to Washington Street. In the vicinity of its intersection with Green Street the roadway is approximately 44 feet wide providing for two thru lanes in each direction. General vehicle speeds were observed to be 30-35 mph. Pavement markings consist of a double yellow centerline, broken white lane lines and solid white lines outlying the outer edge of the travelled lanes.

Green Street is a two-lane local street 32 feet in width street, that connects to Washington Street to the south and Chestnut Street to the east. Stop sign control is posted at its intersection with Chestnut Street (stop sign is slightly obstructed by "No Parking" sign) and supplemented with a painted stop line (faded).

Corner sight distance at the intersection is restricted to the north of Green Street, generally limited by the horizontal and vertical alignment along Chestnut Street. Unobstructed views appear to be approximately 350 feet.

A 28 foot wide, two way parking lot driveway intersects with Chestnut Street directly opposite Green Street. Posted stop control and painted stop line (faded) is provided. Corner sight distance for vehicles entering the intersection from the parking lot is similarly restricted to the north with a clear view of approximately 350 feet.

Faded pavement markings were noted for two pedestrian crosswalks, one on the north leg and one on the west leg of the intersection.

The Post Office is located in the southwest quadrant of this intersection, with a one-way customer parking lot entrance from Green Street approximately 70 feet west of Chestnut Street.

The physical layout is illustrated on Figure 19.

8. Central Avenue at Oak Street

Central Avenue (N.H. Route 16) is the primary north-south arterial route through downtown Dover. In the vicinity of its intersection with Oak Street the roadway is marked for two lanes of thru traffic with an additional southbound left turn lane. The roadway pavement is approximately 50 feet wide. The speed limit is posted at 30 mph. A slight up-grade for the northbound direction exists south of the Oak Street intersection, changing to a moderate up-grade north of the intersection.

Oak Street is a two-lane residential collector roadway that extends from Central Avenue to east of Portland Avenue connecting to Cocheco Street and Elliot Bridge Road. The posted speed limit along Oak Street is 25 mph with double yellow center line pavement markings. Posted stop control is provided at its intersection with Central Avenue. Corner sight distance was observed to be greater than 350 feet.

Reservoir Street is a local 22 foot wide two-way street that intersects with Central Avenue approximately 35 feet to the south opposite Oak Street. Posted stop control is provided. Corner sight distance was observed to be greater than 350 feet.

The physical layout at the intersection is illustrated on Figure 20.

9. Portland Avenue at Oak Street

Portland Avenue (N.H. Route 4) is a two-lane highway providing connection from points east of Dover to the downtown area. In the vicinity of its intersection with Oak Street the posted speed limit is 55 mph to the east and 35 mph to the west. General speeds were observed to be 50 mph. Pavement markings consist of a double yellow centerline and solid white lines marking the outer edge of the travel lanes. An additional lane is provided for the eastbound approach to the intersection. This lane generally functions as a truck climbing lane for traffic negotiating the eastbound upgrade on Portland Avenue extending approximately 1/4 mile to the west of the Oak Street intersection.

Oak Street is a two-lane residential collector roadway that extends from Central Avenue to east of Portland Avenue, connecting to Cocheco Street at Elliot Bridge Road. The posted speed limit along Oak Street is 25 mph with double yellow center line pavement markings. Stop control is provided at its intersection with Portland Avenue with posted sign and painted stop lines for each approach.

Corner sight distance at the intersection is restricted to the west of Oak Street, generally limited by the vertical grade along Portland Avenue. Unobstructed views appear to be approximately 600 feet. Vehicles entering or crossing Portland Avenue from southbound Oak Street may also have views affected by roadside vegetation and trees located on the north-west corner of the intersection.

The physical layout of the intersection is illustrated on Figure 21.

10. Portland Avenue at Portland Street

Portland Avenue (N.H. Route 4) is a two-lane roadway providing primary connection from points east of Dover to the downtown area. In the vicinity of its intersection with Portland Street the pavement width varies from 28-30 feet with pavement markings consisting of a double yellow centerline. The posted speed limit is 30 mph.

Portland Street is a two-lane bidirectional roadway that provides connection from Portland Avenue to Main Street. Its pavement width is approximately 28 feet with double yellow centerline pavement markings. Portland Street intersects Portland Avenue on an approximate 45 skew angle with a steep approach up-grade for an extended distance in the eastbound direction.

Thru movements are directed through the intersection via the westbound Portland Avenue approach and eastbound Portland Street. Stop control is posted for the eastbound Portland Street approach. Eastbound right turn movements along Portland Avenue utilize a channelized right turn opening on the southwest corner that varies in width from 28-14 feet and has a severe down grade.

Eastbound approach traffic along Portland Street negotiates a steep up-grade to pass through the intersection. Left turn movements must maneuver through the skewed angle intersection or alternately climb a severe grade utilizing the channelized ramp on the south-west corner.

Clear sight distance is generally provided for turning movements at the intersection although the steep grades and unusual intersection configuration tends to inhibit driver decisions.

The physical layout at the intersection is illustrated on Figure 22.

11. Central Avenue at Shop 'n Save

Central Avenue (N.H. Route 16) is the primary north-south arterial route through downtown Dover. In the vicinity of its intersection with the Shop 'n Save Driveway the roadway provides for two 12 foot through lanes in each direction with an additional 10 foot wide southbound left turn lane.

The Shop 'n Save Drive intersects Central Avenue forming a 'T' intersection at a 90 degree angle. The driveway is divided and provides one left turn lane and one channelized right turn lane at Central Avenue.

The intersection is controlled by a fully actuated traffic signal that provides protected phasing for southbound left hand turn movements along Central Avenue into the Shop 'n Save Driveway and left hand turn movements exiting the Shop 'n Save Drive and travelling south along Central Avenue. This intersection is coordinated with the signal at Glenwood Avenue to provide traffic progression along Central Avenue.

Observations of existing operations show extended periods of green time for thru traffic movements along Central Avenue. This creates unnecessary delays and queuing for southbound left turning traffic along Central Avenue and westbound left turning traffic along the Shop'n Save Driveway that must wait for the following signal phases.

The road layout at the intersection is illustrated on Figure 23.

12. Broadway and Oak Street

Broadway is a two-lane roadway that provides arterial connection between Central Avenue in downtown Dover to rural areas north in Rollinsford and Somersworth. In the vicinity of its intersection with Oak Street, the roadway width varies from 30 to 36 feet. Pavement markings consist of a double yellow centerline with a speed limit posted at 30 mph. General speeds were observed to be 35-40 mph. A moderate up-grade for the northbound Broadway direction extends through the intersection. An overhead flashing beacon is located at the intersection and flashes advisory yellow for Broadway traffic and red for Oak Street traffic.

Oak Street is a two-lane residential collector roadway that extends from Central Avenue to east of Portland Avenue connecting to Cocheco Street at Elliot Bridge Road. The posted Speed Limit along Oak Street is 25 mph with double yellow center line pavement markings. Stop control is provided at its intersection with Broadway Street with posted sign and painted stop line (faded) for each approach supplemented by the overhead flashing red Beacon.

Corner sight distance at the intersection is restricted to the north of Oak Street, generally limited by the vertical grade along Broadway Street. Unobstructed views appear to be approximately 350 feet. Turning movements from Oak Street eastbound may also have views affected by utility poles and occasional obstructions located on the asphalt lot at the north-west corner of the intersection.

The roadway layout at the intersection is illustrated on Figure 24.

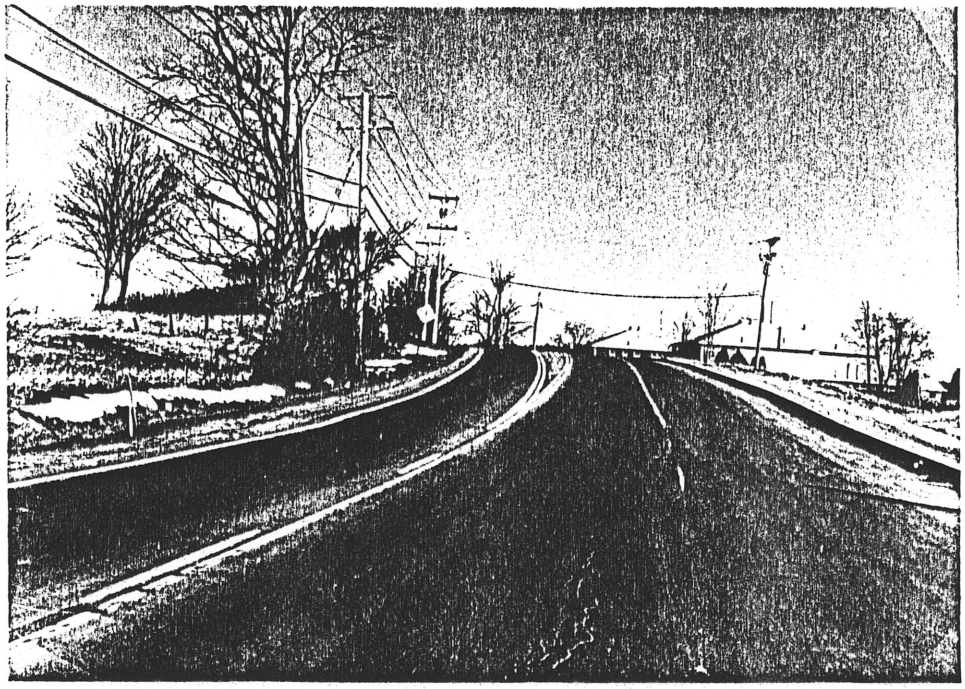
INTERSECTION 1: COUNTY FARM ROAD/WATSON ROAD

Watson Road Northbound Approach To Intersection

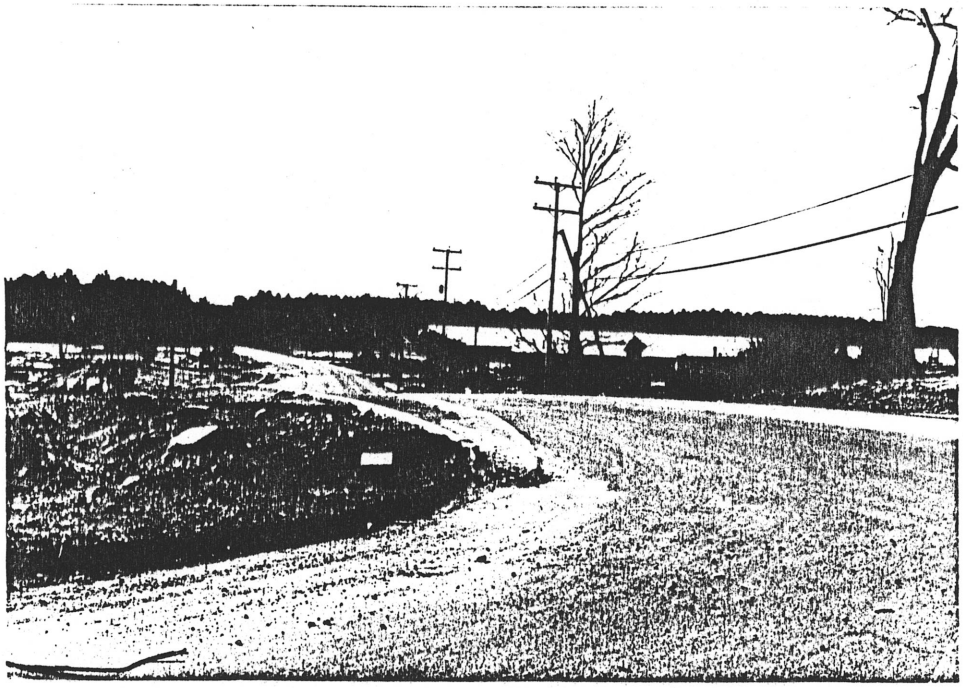
Drivers View Looking West Along
County Farm Road At Intersection

FIGURE NO.13

INTERSECTION 2: ROUTE 155/WEST GATE DRIVE



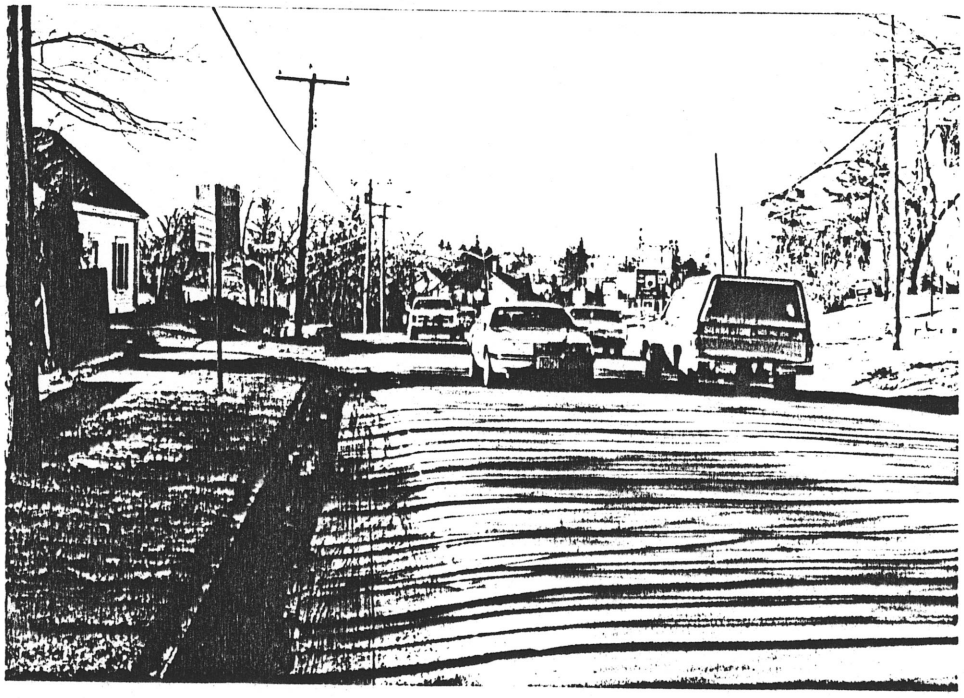
Route 155 Eastbound Approach To Intersection



Drivers View Looking West Along
Route 155 At Intersection

FIGURE NO. 14

INTERSECTION 3: ROUTE 108/ROUTE 16

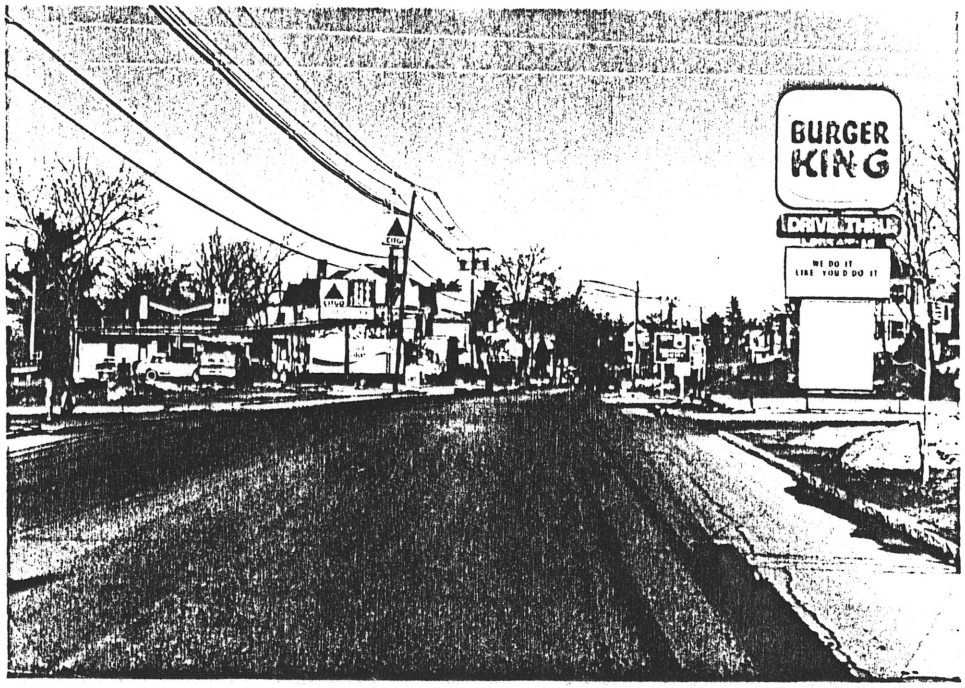


Route 16 Northbound Approach To Intersection

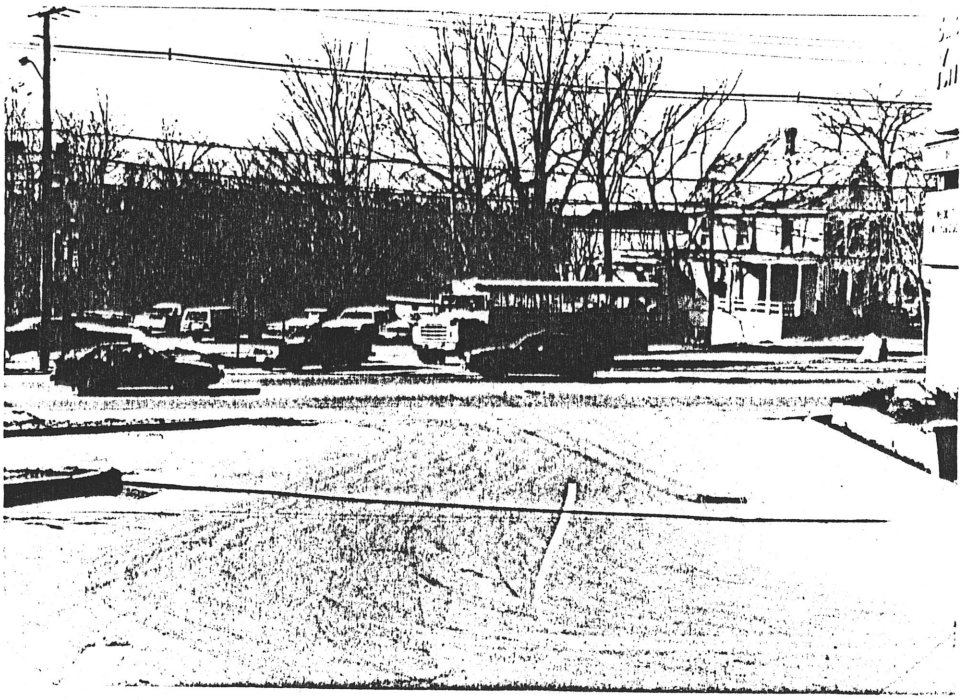
Route 108 Eastbound Approach To Intersection

FIGURE NO. 15

INTERSECTION 4: ROUTE 108/LOCUST STREET



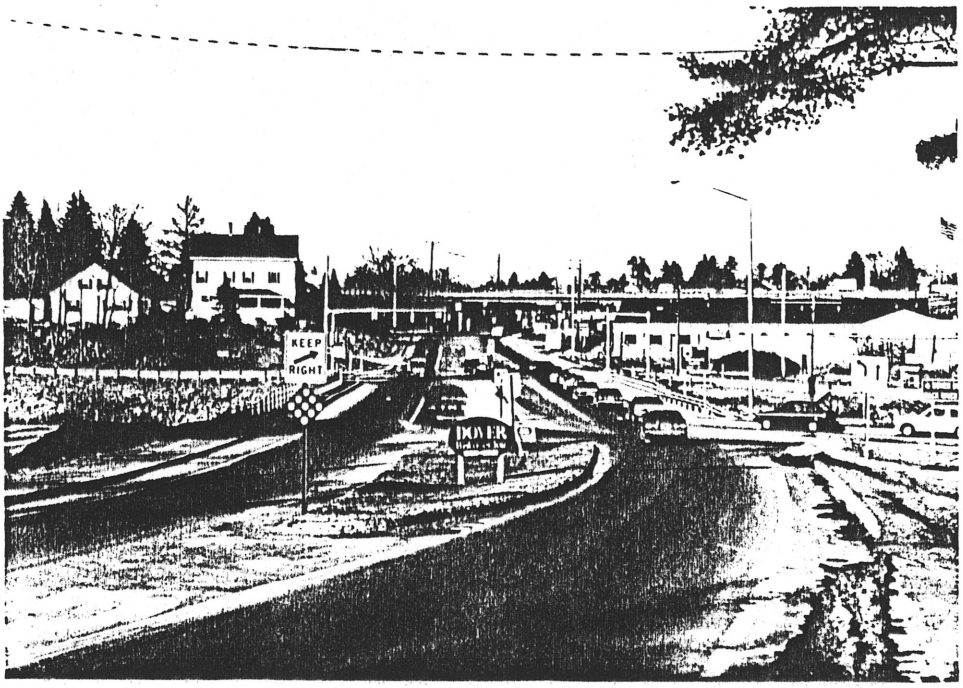
Route 108 Eastbound Approach Through Intersection



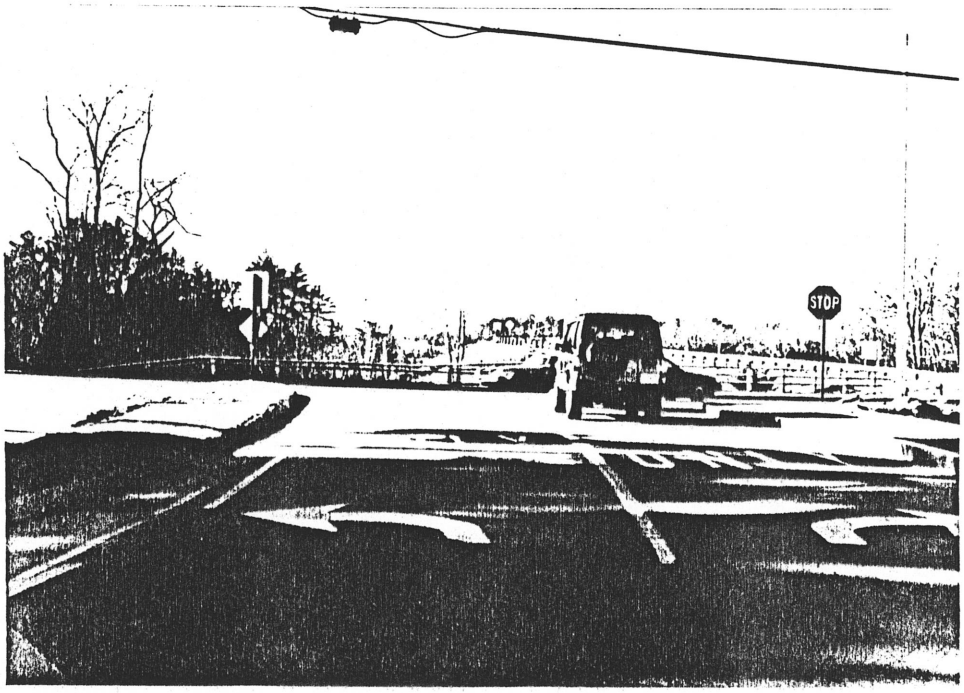
Looking North At Locust Street Intersection
From Burger King Driveway

FIGURE NO. 16

INTERSECTION 5: ROUTE 108/BACK RIVER ROAD



Route 108 Eastbound Approach Through Intersection

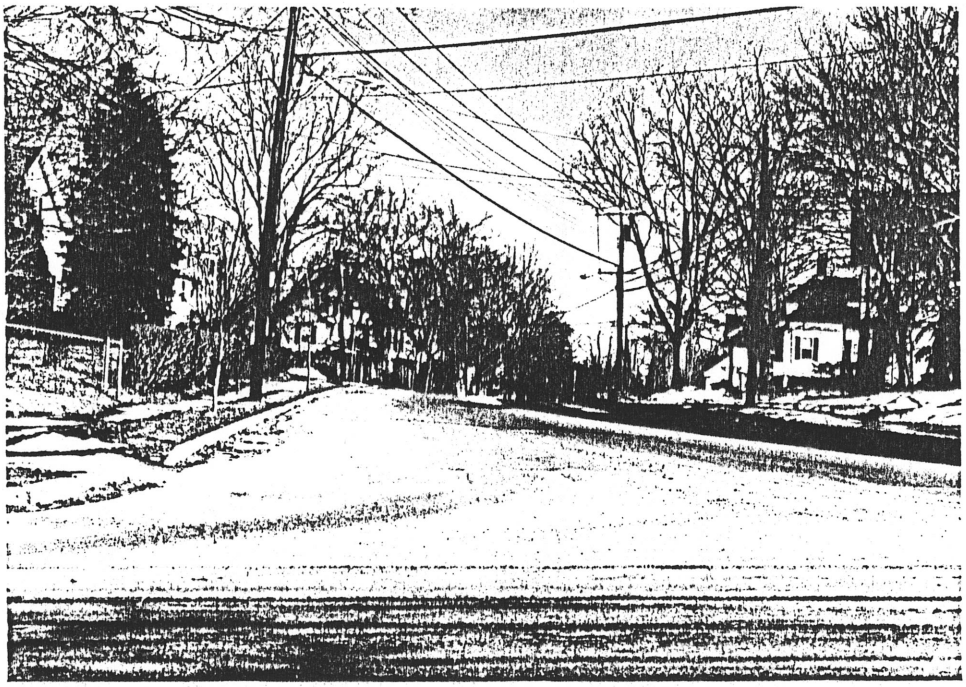


Back River Road Northbound Approach To Intersection

FIGURE NO. 17

INTERSECTION 6: SILVER STREET/ARCH STREET

Silver Street Eastbound Approach To Intersection

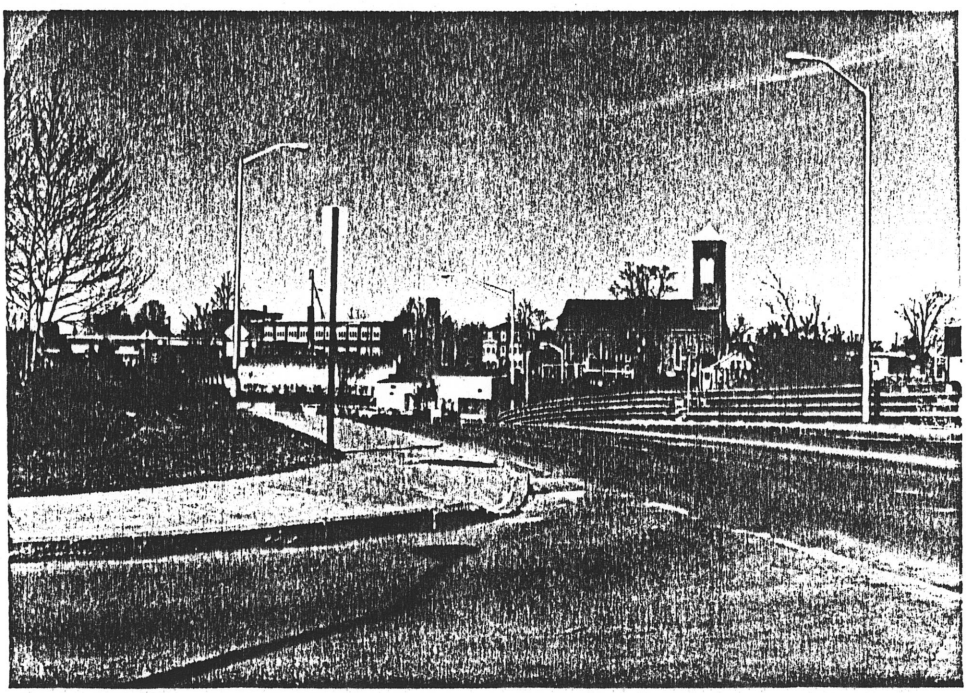


Drivers View Looking East Along
Silver Street At Intersection

FIGURE NO. 18

INTERSECTION 7: CHESNUT STREET/GREEN STREET

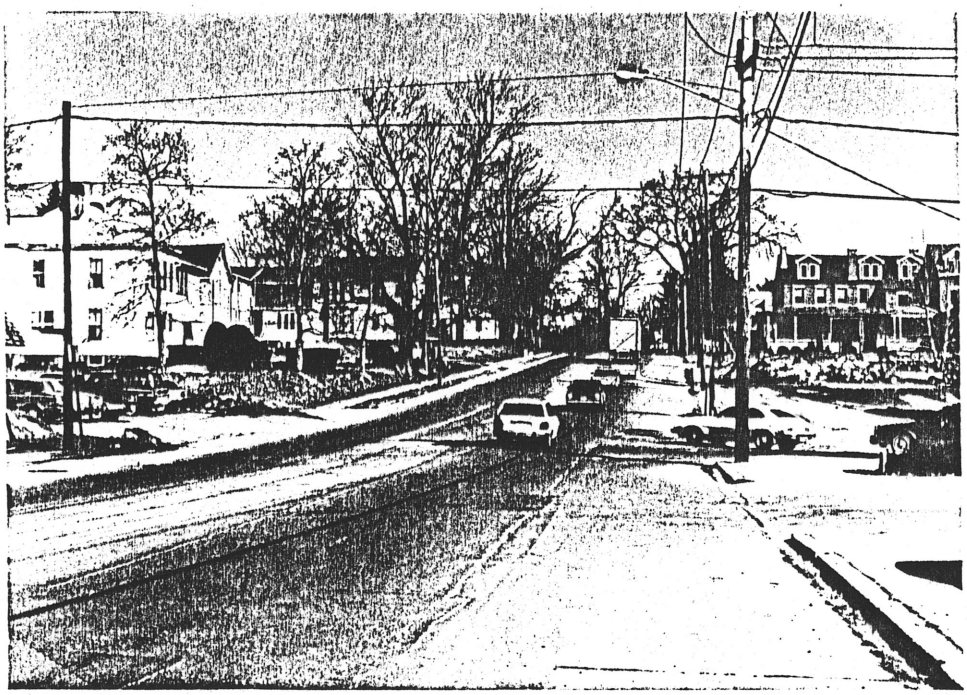
Green Street Approach To Intersection



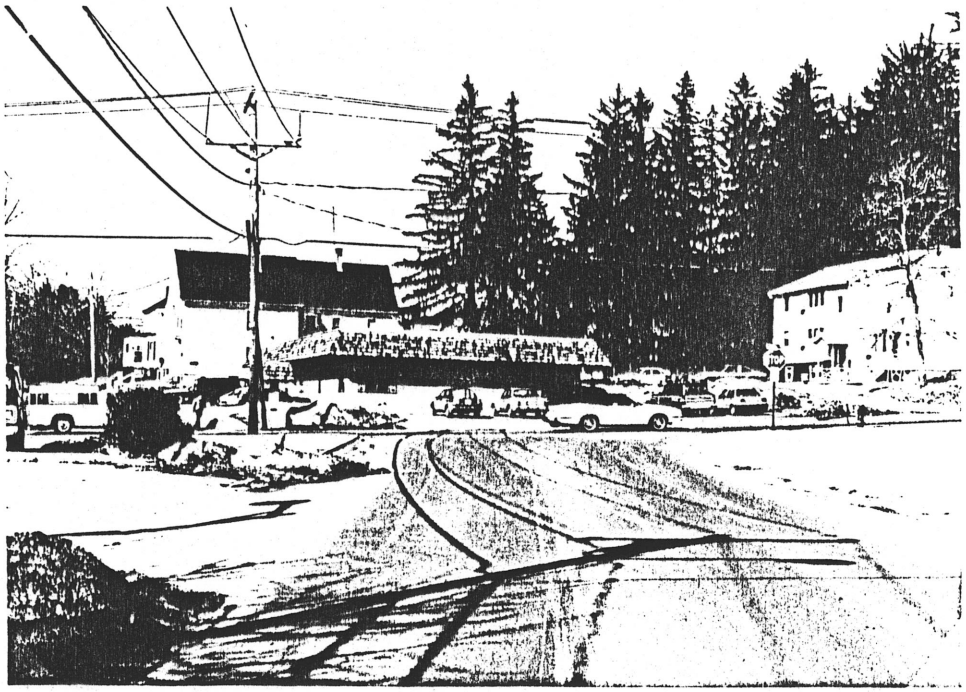
Drivers View Looking North Along
Chesnut Street At Intersection

FIGURE NO. 19

INTERSECTION 8: CENTRAL AVENUE/OAK STREET



Central Avenue Northbound Approach Through Intersection



Oak Street Westbound Approach To Intersection

FIGURE NO. 20

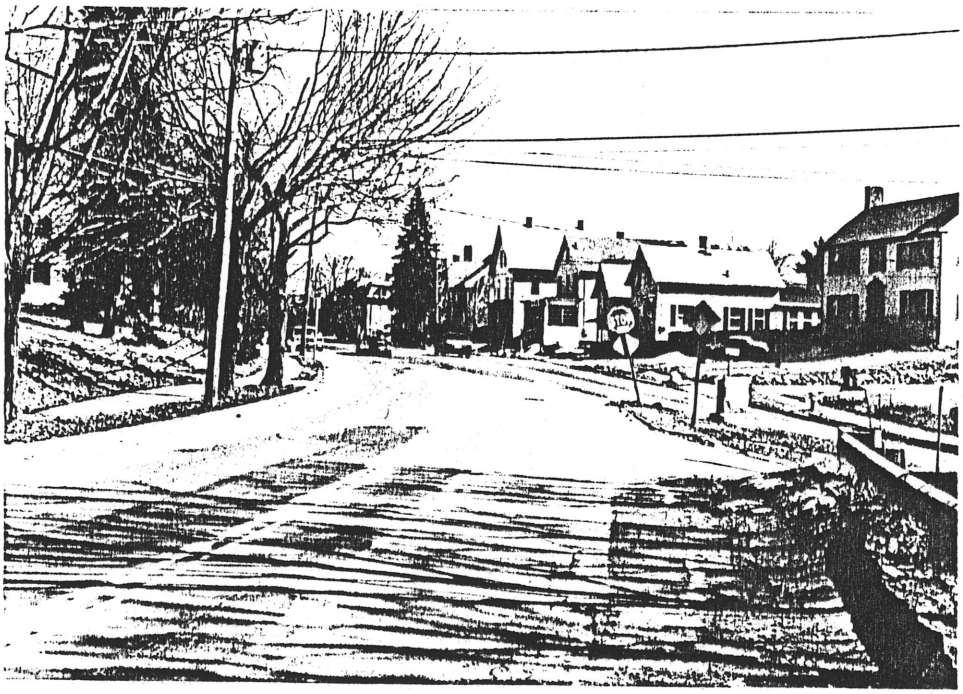
INTERSECTION 9: PORTLAND AVENUE/OAK STREET

Portland Avenue Eastbound Approach Through Intersection

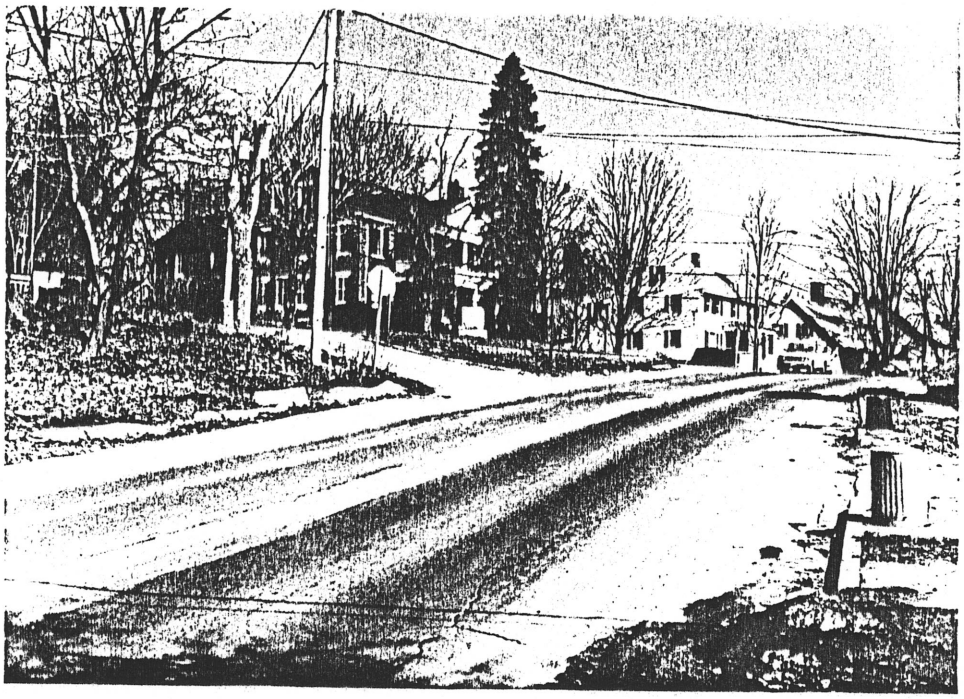
Drivers View Looking West Along
Portland Avenue At Intersection

FIGURE NO. 21

INTERSECTION 10: PORTLAND AVENUE/PORTLAND STREET



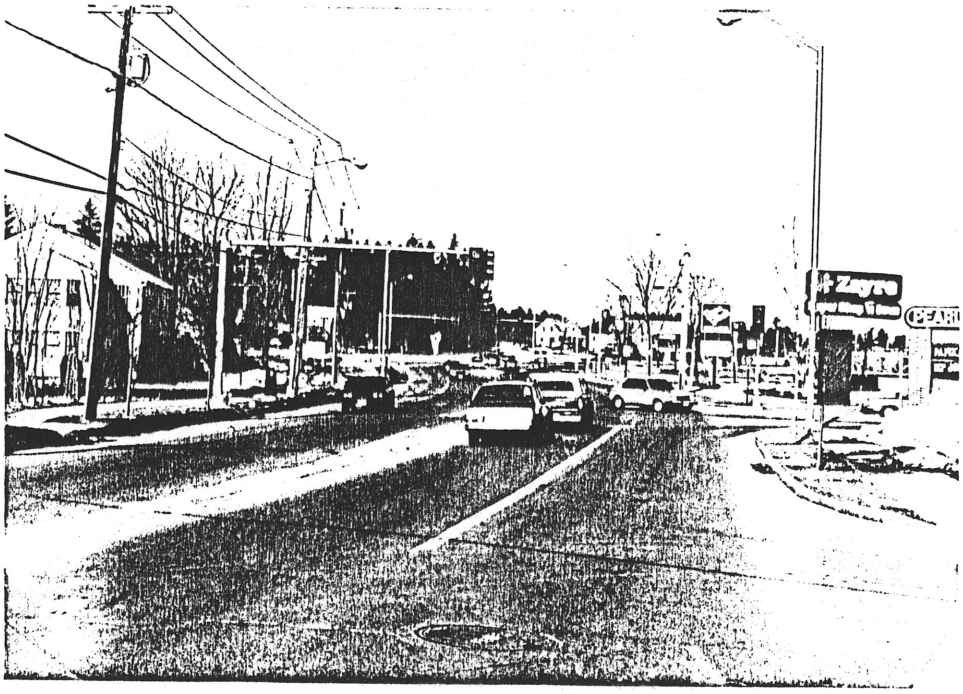
Portland Avenue Eastbound Approach To Intersection



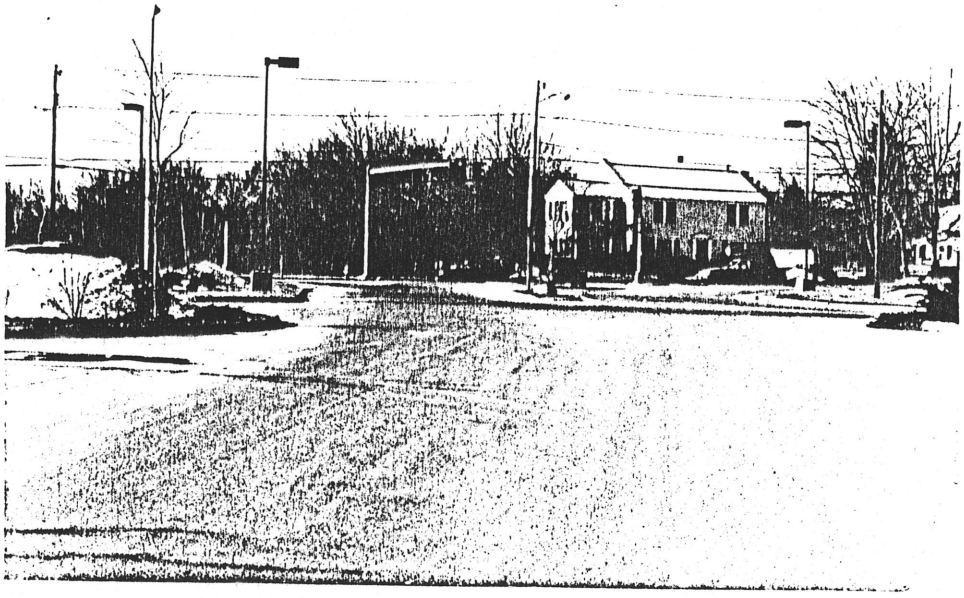
Portland Street Approach To Intersection

FIGURE NO. 22

INTERSECTION 11: CENTRAL AVENUE/SHOP'N'SAVE DRIVE



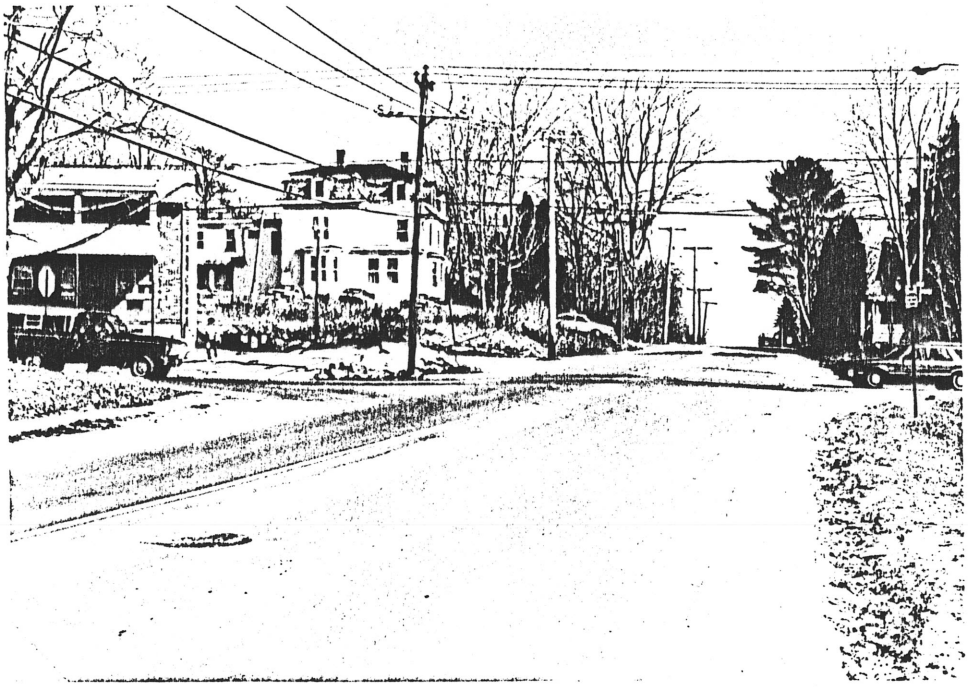
Central Avenue Northbound Approach Through Intersection



Shop 'N' Save Westbound Approach To Intersection

FIGURE NO. 23

INTERSECTION 12: BROADWAY STREET/OAK STREET



Broadway Street Northbound Approach Through Intersection

Oak Street Westbound Approach To Intersection

FIGURE NO. 24

III. Traffic Volumes

A. Traffic Data Sources

A substantial amount of traffic data was available from the Strafford Regional Planning Commission and from recent traffic studies for specific projects, including the Route 108 Corridor Study and the Mast Road Development Consortium.

This data was supplemented and updated by additional traffic data collected by the City of Dover. Table 1 provides a summary of the intersection turning movement counts referenced in this study.

All of these counts were seasonally adjusted to 1988 average weekday conditions utilizing historical traffic growth data described in the next section.

TABLE 1
TRAFFIC DATA SOURCES

Intersection		Source*	Date/Time Period
1.	Watson Rd. at County Farm Rd.	I	2/1/88, 3:30-5:30 PM
2.	Route 155 at West Gate Apart.	IV	1986 PM Peak Hour
3.	Route 108 at Central Ave.	III	1988 PM Peak Hour
4.	Route 108 at Route 16	III	1988 PM Peak Hour
5.	Route 108 at Back River Road	III	1988 PM Peak Hour
6.	Silver Street at Arch Street	I	1/28/88, 3:30-5:30 PM
7.	Chestnut Street at Green St.	I	2/11/88, 3:30-5:30 PM
8.	Central Ave. at Oak Street	II	6/23/86, 3:30-4:30 PM
9.	Portland Ave. at Oak Street	II	10/27-28/87, 4:15-5:15 PM
10.	Portland Ave. at Portland St.	I	2/16/88, 3:30-5:30 PM
11.	Central Ave. at Shop ' Save	I	2/3/88, 3:30-5:30 PM
12.	Broadway at Oak Street	II	6/13/86, 3:30-4:30 PM

*Reference

I. City of Dover (summaries in Appendix A)
II. Strafford Regional Planning Commission (SRPC)
III. Route 108 Corridor Study (SRPC) 1987
IV. Traffic Impact Analysis for the Mast Road Development Consortium (Holden Engineering & Surveying), 1987.

B. Historical Traffic Growth Patterns

Included in Appendix B is a compilation of historical traffic data from the N.H.D.O.T. Continuous Traffic Count Station on N.H. Route 16 (Dover Point Road) south of New Hampshire Route 108. Given are summaries of traffic volume variations on an annual, monthly, weekly and hourly basis. This data was utilized to adjust actual traffic count data to average weekday conditions for the present year (1988).

Based on the annual growth of traffic at this count station since 1979, the average daily traffic has increased at approximately 4.7 percent per year. Growth in the 30th highest hour at each year since 1980 (comparable to a weekday PM peak hour) indicates an annual growth at 3.5 percent. This study assumes this latter annual growth rate for PM peak hour traffic conditions.

Included also in Appendix B is a compilation of short term Average Daily Traffic (ADT) counts conducted and compiled by N.H.D.O.T. at various locations in the City since 1981. This data is presented for information only. Because of the short term nature of the counts (1 week) and the annual adjustment procedure utilized, inferences of actual annual traffic growth from these figures cannot be made with certainty.

C. Design Hour Traffic Volumes

Design of highway facilities are typically based upon the 30th highest hour occurring during the year. It is not considered economical to design highway improvements for the extreme peak hours occurring only a few times per year (in a shopping center area, this is often during the Christmas Season). On the other hand, design for too frequent a condition leads to unacceptable recurring traffic congestion.

In an urban area, the 30th highest hour is likely to be close to the average peak one-hour volume occurring during a typical week day, and typically is 8 to 10% of the AADT. A review of available traffic data indicates that at most locations in the corridor, peak weekly traffic volumes occurred between 4:00 and 5:30 PM.

Thus this study utilizes the weekday PM peak hour as the design hour traffic condition. 1988 design hour traffic volumes at each of the 12 problem intersection locations are illustrated on the applicable existing condition plan (Figures 1 through 12) in Section IIA of this memorandum.

IV. Traffic Levels Of Service

A. Definitions

Level of service (LOS) is a qualitative measure describing driver satisfaction with a number of factors influencing the degree of traffic congestion. These factors include speed and travel time, traffic interruption, freedom to maneuver, safety, driving comfort and convenience, and delays. There are six levels of service describing traffic flow. The highest is LOS A, describing a free-flow condition. The lowest, LOS F, is described as forced flow, and is characterized by traffic volumes at the roadway capacity and extreme congestion.

LOS C, which is normally utilized for design purposes, describes a stable condition of traffic operation. It has a somewhat restricted movement due to higher traffic volumes, but flow conditions are not objectionable for motorists.

LOS D, which is acceptable for traffic operations in urban environments and during peak hours of traffic flow, reflects a more restricted movement for motorists. Queues and delays may occur during short peaks, but lower demands occur often enough to permit clearance of developing queues, thus, preventing excessive backups. LOS E is defined as the actual capacity of the roadway and involves delay to all motorists due to congestion. Levels of Service E and F are generally considered unacceptable.

Level of service is defined separately for both signalized and unsignalized intersections. Level of service for signalized intersections is defined in terms of average delay per vehicle entering the intersection. Delay is considered a measure of driver discomfort, frustration, fuel consumption and travel time. Table 2 summarizes the criteria for signalized intersection level of service.

Level of service for unsignalized intersections is based on the number of acceptable gaps available in a main street traffic flow that may be utilized by minor street vehicles. The criteria shown in Table 3 are based on the available reserve (or unused) capacity (measured in passenger cars per hour) for the minor street movement, and the delay to the minor street traffic.

TABLE 2

LEVEL OF SERVICE CRITERIA FOR
SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	STOPPED DELAY PER VEHICLE (SEC)
A	5.0
B	5.1 to 15.0
C	15.1 to 25.0
D	25.1 to 40.0
E	40.1 to 60.0
F	Greater than 60.0

SOURCE: 1985 Highway Capacity Manual

TABLE 3

LEVEL OF SERVICE CRITERIA FOR
UNSIGNALIZED INTERSECTIONS

RESERVE CAPACITY (pcph)	LEVEL OF SERVICE	EXPECTED DELAY TO MINOR STREET TRAFFIC
400	A	Little or no delay
300 - 399	B	Short traffic delays
200 - 299	C	Average traffic delays
100 - 199	D	Long traffic delays
0 - 99	E	Very long traffic delays
*	F	*

* When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvement to the intersection.

SOURCE: 1985 High Capacity Manual

B. Intersection Levels of Service

In order to determine the present level of service at the problem intersections under the 1988 design hour conditions presented herein, analyses were performed using the Federal Highway Administration's Highway Capacity Software which is based upon the methodology of the 1985 Highway Capacity Manual. Copies of the calculations are contained in Appendix C. 1988 design hour levels of service for the Route 108 intersections at Route 16, Locust Street and Back River Road have been excerpted from the N.H. Route 108 Corridor Study by the Strafford Regional Planning Commission, 1987.

Table 4 contains a summary of present levels of service for the 12 problem intersections. All are unsignalized except for the Central Avenue intersection at Shop n' Save. Calculated levels of service were found to be in general agreement with levels of service observed in the field.

TABLE 4
TRAFFIC LEVEL OF SERVICE

INTERSECTION AND CRITICAL APPROACH(ES)	**1988 PEAK HOUR LOS**
A. Unsignalized Intersections	
1. County Farm @ Watson	
- All turns from Watson	A
2. Route 155 @ Westgate (West)	
- All turns from Westgate	D
3. Route 108 @ Route 16	
- All turns from Route 108	F
- All turns from Watson	C
4. Route 108 @ Locust Street	
- All turns from Locust	F
- All turns from Burger King	F
5. Route 108 @ Back River Road	
- Back River W/B left	E
- Back River W/B right	B*
6. Silver Street @ Arch Street	
- All turns from Arch or Towle	F
- E/B left turn from Silver	E
7. Chestnut Street @ Green Street	
- E/B left turns from Green	F
- N/B left turns from Chestnut	C
8. Central Avenue @ Oak Street	
- All turns from Oak Street	F
- S/B left turns from Central	C
9. Portland Avenue @ Oak Street	
- E/B turns from Oak Street	F
10. Portland Avenue @ Portland Street	
- E/B movement from Portland Avenue	F
12. Broadway @ Oak Street	
- E/B turns from Oak Street	E
- W/B turns from Oak Street	F
B. Signalized Intersections	
11. Central Avenue @ Shop n' Save	
- Overall intersection	B**

* Level of service degrades when blocked by traffic queues on Route 108 N.B.
** Assumes optimized signal timing

V. Accident History

Storch Associates has summarized and reviewed the history of accidents at each of the twelve problem intersections during the years 1984, 1985 and 1986 (partial data included for 1987). Accident statistics were based on reported accidents summarized by the New Hampshire Department of Transportation, Transportation Planning and System Management, Accident Statistics Group (included in Appendix D).

Accident data has been summarized by location, type of collision, and whether property damage, personal injury, or a fatality occurred. Although most traffic accidents result from careless behavior of drivers or pedestrians, a look at the type of collisions that reoccur at particular intersections or roadway segments can help to determine whether improved roadway features or traffic control devices could reduce the accident rate. Examples of such remedies could include the removal of a fixed object that exists too close to the travel way which is often hit or the signalization of an intersection in order to reduce the incidence of angle-type collisions.

In addition to analyzing the types of collisions reoccurring at a particular place, accident rates help to distinguish potentially dangerous intersections. The accident rate of an intersection represents the historical number of accidents occurring per million vehicles which enter the intersection. An intersection with an accident rate of 1.5 or more accidents per MEV (million entering vehicles) may warrant a detailed accident analysis, as suggested in the "Manual of Traffic Engineering Studies" published by the Institute of Transportation Engineers, 1976.

The annual number of accidents at a particular intersection is also used as an indicator for establishing a more restrictive form of traffic control. The Federal Highway Administration's "Manual on Uniform Traffic Control Devices", 1986, considers a reportable intersection accident frequency of 5 or more per year as a basis for further examining warrants for signalization or multiway stop sign control.

Table 5 summarizes the annual number of reported accidents at the problem intersection locations for the years 1984 through October 1987. Those locations indicating greater than 5 accidents in a particular year include:

- Route 108 at Route 16
- Route 108 at Locust Street
- Route 108 at Back River Road
- Chestnut Street at Green Street
- Central Avenue at Oak Street
- Broadway at Oak Street
- Portland Avenue at Oak Street

Table 6 summarizes the total three year intersection accident history from 1984 through 1986, per the number at accidents, type of accidents and computed annual accident rate per million entering vehicles. Broadway at Oak Street was the only study area intersection having an accident rate greater than 1.5 MEV. with a calculated rate of 2.598.

The information gained from the accident history at these twelve problem intersections will be useful in developing recommended improvement plans, as well as in preparing a priority ranking of these intersections with regard to funding implementation. Corrective measures will be sought for those intersections with a high incidence of accidents as part of the recommended improvement plan.

TABLE 5

ANNUAL ACCIDENT SUMMARY
FOR 1984, 1985 AND 1986

	INTERSECTION	YEAR			
		1984	1985	1986	1987
1.	Watson Rd. at County Farm Road	1	0	1	0
2.	Route 155 at West Gate Apartments	3	2	0	0
3.	Route 108 at Route 16	10	4	9	1
4.	Route 108 at Locust Street	5	1	5	8
5.	Route 108 at Back River Road	5	6	7	1
6.	Silver Street at Arch Street	3	4	4	2
7.	Chestnut Street at Green Street	1	4	7	2
8.	Central Avenue at Oak Street	1	7	14	4
9.	Portland Avenue at Oak Street	7	7	5	3
10.	Portland Avenue at Portland Street	2	1	0	0
11.	Central Avenue at Shop n' Save	3	0	1	0
12.	Broadway at Oak Street	12	10	8	8
	TOTALS	53	46	61	29

*January through October 1987

Ref. Total reported accidents by N.H.D.O.T. Accident Statistics Group

Note: These figures represent the minimum number of accidents at each intersection. The actual number may be higher due to reporting deficiencies.

TABLE 6

SUMMARY OF INTERSECTION ACCIDENT DATA
1984 - 1986 (3 YEAR TOTAL)

		Accident Rate per Millon Entering	Total # Accidents	Property Damage Accidents	Personal Injury Accidents	Fatal Accidents	Types of Collison					
							Broadside	Angle	Rear End	Hit Fixed Objects	Other	Unknown
1.	Watson Road @ County Farm Rd.	0.577	2	2	2	-	-	-	-	-	-	2
2.	Route 155 @ West Gate Apartments	0.381	5	5	3	-	-	-	-	1	-	4
3.	Route 108 @ Route 16	1.079	23	23	3	-	-	5	5	1	-	12
4.	Route 108 @ Locust Street	0.545	11	11	2	-	-	3	2	1	-	5
5.	Route 108 @ Back River Road	0.966	18	18	2	-	-	1	4	1	-	12
6.	Silver Street @ Arch Street	0.436	11	11	4	-	-	3	1	-	1	6
7.	Chestnut Street @ Green Street	0.524	12	12	2	-	1	-	-	2	-	9
8.	Central Avenue @ Oak Street	0.878	22	22	7	-	-	1	4	1	1	15
9.	Portland Avenue @ Oak Street	1.383	19	19	6	1	-	1	1	1	2	14
10.	Portland Avenue @ Portland Street	0.198	3	3	-	-	-	1	1	-	-	1
11.	Central Avenue @ Shop n' Save	0.117	4	4	1	-	-	-	2	-	-	2
12.	Broadway at Oak Street	2.598	30	30	6	-	-	10	2	4	-	14

Ref: Total reported accidents by N.H.D.O.T. Accident & Statistics Group

Note: These figures represent the Minimum number of accidents at each intersection.
The actual number may be higher due to reporting deficiences.

VI. Recommended Improvements

A. Introduction

Conceptual improvements for each of the 12 problem intersections are identified in the following section. The improvement concepts take into account the existing conditions and accident analysis, and have been developed to accommodate the 1993 design hour condition, as well as providing for the safe movement of pedestrians, as applicable. The intent of these improvement recommendations is to provide the City with an outline of cost effective, near-term (through 1993) funding requirements for traffic control and roadway improvements necessary to alleviate the existing problems identified.

B. Procedure

Proposed improvements are identified as Low Cost (maintenance related) which can be implemented now with a minimal expenditure of funds; and as Capital Intensive which would require a significant funding allocation to be programmed into the City's capital improvement plan.

Peak hour intersection volumes and traffic growth rates identified in Chapter III of this Memorandum are utilized to develop a 1993 design year condition at each location. Specific growth projections for localized future development reported for Route 108 and Route 155 intersections are derived from SRPC's Route 108 Corridor Study and the Mast Road Development Consortium Study referenced in Chapter 1C of this Memorandum.

In order to estimate whether traffic signal warrants (per the Manual on Uniform Traffic Control Devices, Federal Highway Administration, 1986) are met at applicable problem intersection locations, the eighth highest daily hour volume was estimated proportionally from N.H.D.O.T. historical traffic count data along Route 16 in Dover for an average weekday period. This results in an adjustment factor of 0.66 applied to the design PM peak hour traffic volumes. A minimum twelve hours of vehicle counts during a typical weekday should be undertaken to confirm signal warrants herein estimated at each of the project intersections prior to implementing the improvements.

A revised intersection capacity analysis is included for each intersection where capacity improvements are applicable. Capacity analysis worksheets are included in Appendix E.

An estimate of the cost of designing and constructing the recommended improvements at each location (in 1988 dollars) is also included. Potential right-of-way implications are noted, but associated costs are not estimated.

Traffic signal improvements herein referred to generally assume fully actuated signal control with pedestrian crossings. System interconnection for coordination of adjacent signals is noted as applicable. Estimated costs assume mast arm signal supports and underground electrical service.

C. Recommended Intersection Improvements

Table 7 summarizes the recommended improvements at each intersection and provides a cost estimate in 1988 dollars. Also included is the year of justification of the improvement (based on safety needs, signal warranting volumes, or capacity needs). These improvements are discussed in more detail below.

TABLE 7
SUMMARY OF RECOMMENDED IMPROVEMENTS

Intersection	Low Cost/ Maintenance**	Capital Intensive	Year of Justification	Cost of Capital Intensive Improvements
Watson @ County Farm	Signing, Brush Clearing	Realign Watson	1988	$85,000***
Rt. 155 @ West Gate Apt.	Signing, Regrade Berm	Flashing Beacon	1988	$ 7,000
Rt. 108 @ Rt. 16	----	Signalize, Channelize Minor Widening	1988	$180,000*
Rt. 108 @ Locust	----	Signalize, Channelize	1988	$200,000*
Rt. 108 @ Back River	Signing	Signalize	1988	$120,000*
Silver @ Arch	Repaint Crosswalks	Signalize, Channelize**	1988	$110,000
Chestnut @ Green	Repaint Crosswalks	Close Green at Chestnut	1988	$ 5,000
Central @ Oak	----	Signalize, Realign Oak	1988	$225,000
Portland @ Oak	Brush Clearing, Speed Reduction	Signalize	1988	$ 90,000
Portland Ave@ Portland St	Signing, Left Turn Restriction	----	1988	----
Central @ Shop n' Save	Signal Timing	----	1988	----
Broadway @ Oak	4-Way Stop	----	1988	----

* Recommend construction as one corridor project
** Recommend early implementation
*** Does not include right-of-way acquisition

1. County Farm Road at Watson Road

The existing problems associated with this intersection are:

- Steep up-grade along Watson Road approach;
- Restricted sight distance along County Farm Road west of the intersection.

In order to mitigate both of these problems it is recommended that Watson Road be realigned to the east of its present intersection with County Farm Road. At this new location improved approach grades and corner site distance will be obtained. This will require right-of-way from the parcel on the southeast corner of the intersection.

Regrading of the Watson Road approach does not eliminate the restricted site distance problem while regrading of County Farm Road would require extensive road reconstruction and associated impacts to properties adjacent to the roadway.

A low cost improvement to the existing condition, recommended for early implementation, would be the installation of a stop sign for the Watson Road approach, the clearing of brush on the southwest corner, and the installation of an "Intersection Ahead" advance warning sign along eastbound County Farm Road.

The proposed improvements are conceptually illustrated on Figure 25.

2. Route 155 at West Gate Apartment Drive

The main problem associated with this intersection is the partially obscured sight distance from West Gate Drive along Route 155 to the west of the intersection.

Total elimination of this deficiency by lowering the grade of Route 155 would require extensive reconstruction of Route 155 and is considered cost prohibitive. Traffic signal installation is not recommended since projected traffic volumes for vehicles turning onto Route 155 from the residential development will not meet Traffic Signal Warrants by 1993.

Recommended low cost improvements to the existing condition are installation of an "Intersection Ahead" sign along eastbound Route 155 prior to the intersection and the removal of a raised curb and fill area located on the southwest corner that presently contributes to reduced visibility at the intersection between West Gate Drive and Route 155 to the west.

A recommended capital intensive improvement would be the installation of a flashing beacon to provide additional warning advisory to vehicles approaching the intersection. This improvement is recommended, in part, due to the high speed potential along Route 155.

The proposed improvements are conceptually illustrated on Figure 26.

3. Route 108 at Route 16

The existing problems associated with this intersection are:

- Delays for Route 108 traffic turning onto Route 16 destined to Downtown Dover;
- Skew angle of intersection.

The installation of traffic signals along with channelization of turning movements and associated minor pavement widening is recommended to mitigate the above noted problems. It is estimated that traffic signal warrants are presently exceeded based on the 1988 PM peak hour design volumes.

The recommended improvements are excerpted from the N.H. Route 108 Corridor Study prepared by the Strafford Regional Planning Commission, December 30, 1987, and include the following:

1. Signalization of Route 16/108/Watson intersection and coordination with Route 108 signal system to the west.
2. Channelization and minor roadway widening to include:
   a. Left turn storage lanes on Route 16 at Watson Road and at Jenness Street;
   b. An exclusive right turn lane from Route 16 southbound to Route 108 with channelizing island;
   c. Minor adjustments to the island area bounded by Route 108/16/Jenness Street to allow better alignment between Route 108 and Watson Road
   d. Minor road surface repairs at the southeast corner of Route 108 and Jenness Street.

4. Route 108 at Locust Street

The existing problems associated with both this intersection, and the nearby Spaulding Turnpike Northbound Ramps are:

- Delays for traffic turning onto Route 108 from Locust Street, the
- Burger King Driveway and the Spaulding Turnpike Northbound Ramps.
- Close proximity of the adjacent intersection of the Spaulding Turnpike northbound ramp.
- Skew angle of the Locust Street intersection.

The installation of traffic signals along with improved roadway geometry is recommended to mitigate the above noted problems. It is estimated that traffic signal warrants are presently exceeded along Locust Street based on the 1988 PM peak hour design volumes. It is estimated that traffic signal warrant will be met at the Spaulding Turnpike ramp by 1993.

The recommended improvements are excerpted from the NH Route 108 Corridor Study prepared by the Strafford Regional Planning Commission, December 30, 1987, and include the following:

1. Signalization of the Route 108/Locust/Burger King intersection, together with the Route 108/Spaulding Turnpike Ramp intersection, to operate as one unified intersection. Also include this intersection in a coordinated signal system along Route 108 from Route 16 to Back River Road.
2. Relocate island and monument on Locust Street approach to the northeast, coupled with minor widening on the west side of Locust Street to provide two southbound approach lanes on Locust Street (exclusive right turn lane and thru/left lane).
3. Update striping on Route 108 to provide left turn lanes into Locust Street and Spaulding Turnpike Ramps and new signalized crosswalks.
4. Minor widening and new channelization on the Burger King drive to provide both a left turn and a thru/right turn lane.

The conceptual plan for this major intersection improvement is illustrated on Figure 28. The close proximity of the two jointly signalized intersections will require an additional signal phase for exclusive movements from the Spaulding Turnpike Ramp passing through the Locust Street intersection. This additional phase will result in an anticipated level of service C operation for projected 1993 peak hour conditions.

In addition, existing uncontrolled driveway openings from the Citgo Service Station (on the northeast corner) onto Route 108 will emerge in the immediate vicinity of the intersection and will require more restrictive traffic control in order that the integrity of the proposed signal installation will not be compromised. These considerations will require extensive review during the preliminary design process.

5. Route 108 at Back River Road

The main problem associated with this intersection is the extended queuing of northbound Route 108 traffic stopped at the adjacent Mill Street intersection to the north and subsequent delays to turning movements at Back River Road. Significant residential development planned for the Mast Road area is anticipated to compound this problem by 1993.

The installation of traffic signals and required coordination with the existing signal operation at the Mill Street/Spaulding Turnpike Ramp intersection is recommended to mitigate the above noted problem. Both of these intersections, in turn, should be included in a coordinated signal system along Route 108 from Route 16 to Back River Road. It is estimated that traffic signal warrants at the Route 108/Back River Road intersection are presently exceeded based on the 1988 PM peak hour design volumes.

These improvements are also indicated in the N.H. Route 108 Corridor Study prepared by the Strafford Regional Planning Commission, December 30, 1987.

An immediate, low cost improvement to the existing condition would be posting of a "Do Not Block Intersection" sign for northbound Route 108 traffic so as to help keep the intersection clear of quered vehicles.

The conceptual plan for these intersection improvements is illustrated on Figure No. 29.

The combined operation of both the Back River Road and the Mill Street/Ramp intersection is estimated to operate at level of service D under the indicated signal phasing. A detailed signal system analysis of this intersection under the coordinated operation of all Route 108 signals between Back River Road and Route 16 (recommended during the preliminary design phase of these Route 108 improvements) may indicate a need for additional vehicle clearance or exclusive vehicle intervals which may result in a lower (LOS "E") overall level of service by 1993.

6. Silver Street at Arch Street

The existing problems associated with the operation of this intersection are:

- Delays for traffic turning onto and crossing Silver Street from Arch Street and Towle Street;
- Restricted sight distance east of the intersection along Silver Street;
- Concern for school children crossing busy intersection;

The installation of traffic signals along with channelization of turning movements is recommended to mitigate the above noted problems. It is estimated that Traffic Signal Warrants are presently exceeded based on the 1988 PM peak hour design volumes. The signal installation should include provision for an exclusive pedestrian walk phase. This signal should also be coordinated with the planned signal at Silver/Locust Street. Such coordination can be designed to encourage travel at a specified maximum speed in order to avoid stopping at a second red light.

In addition, realignment of the existing north curb along the westbound Silver Street approach to generally provide a constant roadway width through the intersection will improve the overall lane alignment for vehicular traffic and will reduce the length of crosswalk on the east leg of the intersection.

Painted channelization for exclusive left turn lanes on Silver Street and an exclusive right turn lane on Arch Street can be installed within the present pavement width. Stop bars for the left turn lanes on Silver Street will have to be set back to allow space for encroaching turning traffic movements at the intersection.

The prohibition of all parking along each of the approaches to this intersection should be enforced, particularly along the proposed three-lane sections. An existing mailbox (U.S. Postal Service) on the eastern side of Arch Street should be relocated to preclude traffic from stopping in the vicinity of the intersection.

The conceptual plan for this intersection improvement is illustrated on Figure No. 30.

7. Chestnut Street at Green Street

The main problems associated with the operation of this intersection include:

- Restricted visibility of the painted crosswalk area to vehicles approaching from the north on Chestnut Street due to crest vertical curvature of the roadway at the crosswalk area;
- The 4-lane width of Chestnut Street coupled with the demand for Chestnut Street crossings by residents of nearby senior citizen housing;
- Delays for the high volume of traffic along Green Street wishing to turn left onto Chestnut Street;
- Peak period traffic backups at the Green Street entrance to the Post Office caused by high volumes of postal customers, the above delays on Green Street, and the close proximity of the postal entrance to Chestnut Street.

While traffic signalization would mitigate the above problems, the installation of new signals less than 300 feet from the presently signalized Chestnut/Washington intersection is not desireable with regard to traffic flow along Chestnut Street. Recommended by the Transportation Committee as an alternative would be the closure of Green Street at Chestnut Street. Green Street, between Chestnut Street and Fayette Street would become one-way westbound to direct exiting post office vehicles toward Washington Street. The existing traffic circulation through the post office customer lot would be reversed (Fayette to Green). Needed additional post office parking (at least 10-15 new spaces) can be provided along the closed off segment of Green Street east of Fayette Street.

These recommended improvements are illustrated on Figure 31, and will mitigate the present vehicle delays experienced at the Chestnut/Green intersection. While vehicle-pedestrian sight distance at the Green Street crosswalk is generally adequate for a 35 mph speed, the installation of new crosswalk markings and posted advance signing for the pedestrian crossing on the Chestnut Street southbound approach is recommended as a short term improvement. During heavy traffic periods, potential pedestrian crossing delays may be alleviated by utilizing the presently signalized Chestnut Street crosswalk at Washington Street.

These recommended improvements are illustrated on Figure 31.

8. Central Avenue at Oak Street

The major problem associated with the operation of this intersection is delay for the high volume of traffic along Oak Street wishing to turn onto Central Avenue.

The installation of traffic signals along with the proposed realignment/widening of the Oak Street approach to eliminate the existing offset in alignment with Reservoir Street is recommended to mitigate the above noted problem. Coordination of this signal with adjacent signals at Old Rollinsford Road (planned) and Fourth Street is also recommended. It is estimated that traffic signal warrants are presently exceeded based on the 1988 PM peak hour design volumes.

The proposed improvements are illustrated on Figure 32.

9. Portland Avenue at Oak Street

The main problems associated with the operation of this intersection are:

- Delays for high volumes of traffic turning onto and crossing Portland Avenue from Oak Street;
- High speeds of vehicles traveling along Portland Avenue which compound the delays to Oak Street vehicles turning at the intersection.

The installation of traffic signals along with channelization of left turn movements along Portland Avenue is recommended. It is estimated that Traffic Signal Warrants are presently exceeded based on the 1988 PM peak hour design volumes.

The painting of left turn standby lanes on Portland Avenue can be accomplished within the existing three lane width by utilizing the present eastbound passing lane. Conversion of this passing lane to a two-way left turn lane west of the intersection (within the City of Dover) is also suggested.

As an interim measure to partially mitigate existing problems, a low cost improvement would be an extension of the existing 35 mph speed zone further east along the highway within the jurisdiction of the Town of Rollinsford in order to lower vehicle speeds along each approach to the intersection. Because of the nature of Route 4 at this location, such a speed reduction may only be effective with increased enforcement efforts.

The trimming of tree branches and brush along the westbound shoulder of Portland Avenue just west of Oak Street is also recommended to improve the corner sight distance visibility for Oak Street southbound vehicles.

The recommended improvements are illustrated on Figure 33.

10. Portland Avenue at Portland Street

The existing problems associated with the operation of this intersection are:

- Up-grade along Portland Street approach;
- Skew angle of intersection;
- Delays for eastbound traffic along Portland Avenue that must stop and wait for an adequate gap in the through traffic pattern to proceed east through the intersection.

Review of the physical layout of the intersection did not reveal any feasible, cost effective solution to the geometric deficiencies noted.

A recommended low cost improvement that would reduce potential traffic conflicts at the intersection would be the restriction of left turns from the Portland Street approach as illustrated on Figure 34.

Due to the steep grade along Portland Street, non-stop traffic movements should be maintained for the northbound direction to avoid potential problems with stopping on the upgrade during icy winter conditions. For this reason, the installation of traffic signals is not recommended although present peak hour design volumes indicate that traffic signal warrants are met. Hence, the existing stop sign control along Portland Avenue eastbound should be maintained.

The designation of Portland Street as one-way southbound would alleviate the up-grade problem, however, the resultant increase in northbound traffic volumes along Main Street from Portland Street to Portland Avenue and eastbound along Portland Avenue from Main Street to Portland Street is considered to be unacceptable.

11. Central Avenue at Shop n' Save

The major problem associated with the operation of this presently signalized intersection is the extended period of stopped time for left turn movements into, and all movements out of, the Shop n' Save driveway.

In order to mitigate these unnecessary delays and resultant queuing, it is recommended that the existing signal timing and coordination with the signal at Glenwood Avenue be investigated and adjusted as necessary.

With the implementation of this improvement it is anticipated that an acceptable level of service C condition will be provided for the 1993 PM peak hour design volumes.

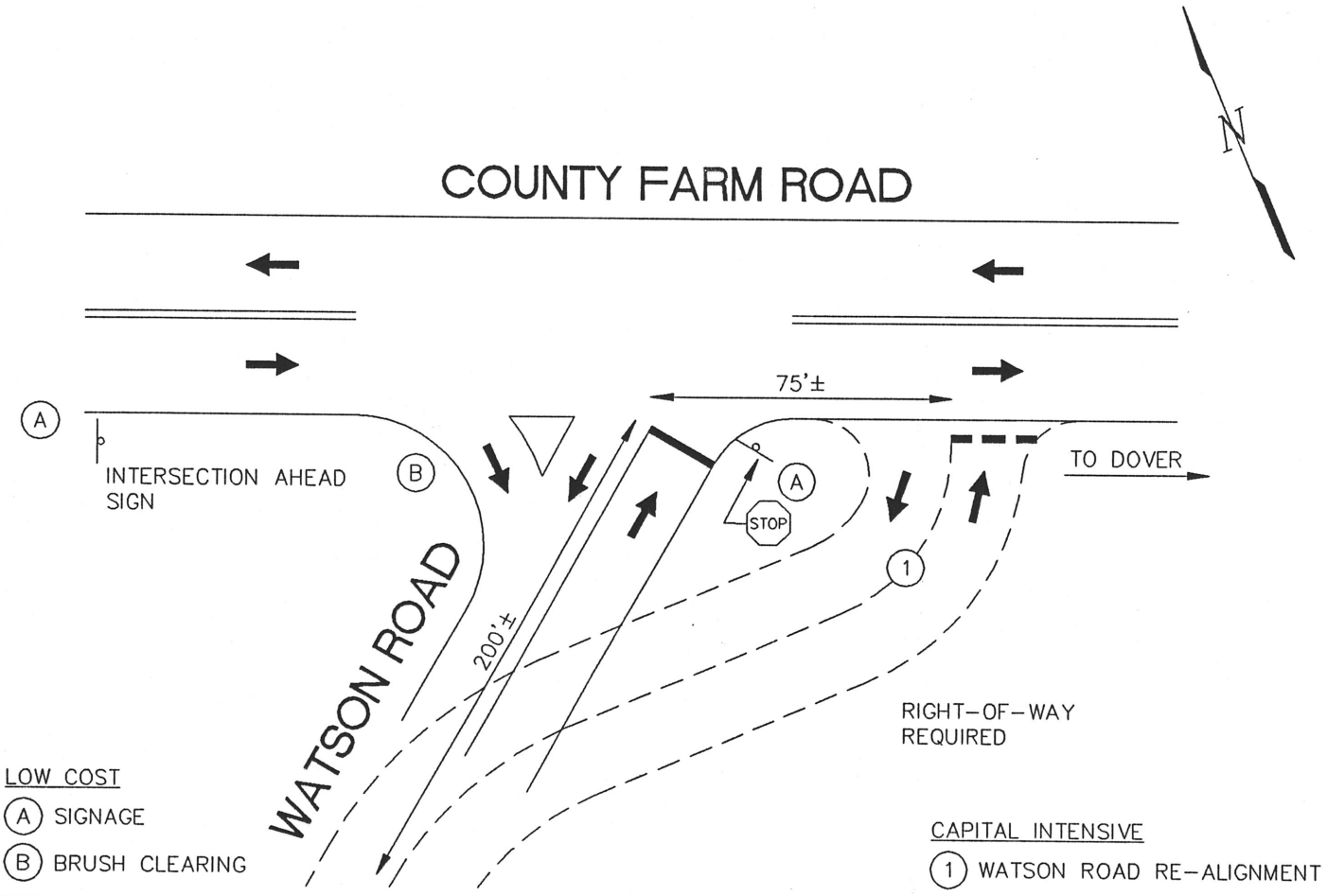
12. Broadway and Oak Street

The existing problems associated with the operation of this intersection are:

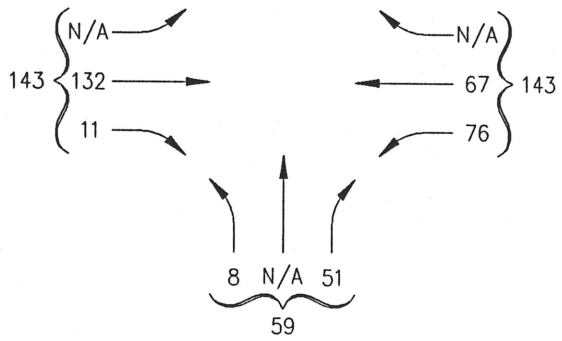
- Delays for vehicles crossing or turning onto Broadway from Oak Street;
- Restricted sight distance along Broadway north of the intersection;
- High number of accidents and accident rate.

In order to mitigate these problems it is recommended that 4-way stop sign control be implemented at the intersection as illustrated conceptually on Figure 36. To supplement this traffic control particularly in regard to the sight distance restriction on Broadway to the north, it is recommended that the present overhead flashing beacon be revised to flash a four-way red indication. A stop ahead sign is also recommended on the Broadway southbound approach to this intersection (in Rollinsford). This low cost improvement is anticipated to provide an acceptable level of service C for the projected 1993 PM peak hour design volumes.

Traffic signal installation is not recommended at this time since traffic volumes utilizing the intersection neither meet Traffic Signal Warrants now, nor in 1993 if the number of accidents are sufficiently reduced under the 4-way stop control. However, at the time of this study, there was preliminary discussion of potential new commercial development along Broadway just south of the intersection. If plans for this development become established, an updated traffic study of the intersection should be prepared and signal warrants reinvestigated.



1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 345

MINOR STREET
LEVEL OF SERVICE: A

COST OF IMPROVEMENTS

LOW COST: $500

CAPITAL INTENSIVE: $85,000

INTERSECTION NUMBER 1

RECOMMENDED IMPROVEMENTS
Watson Road at County Farm Road

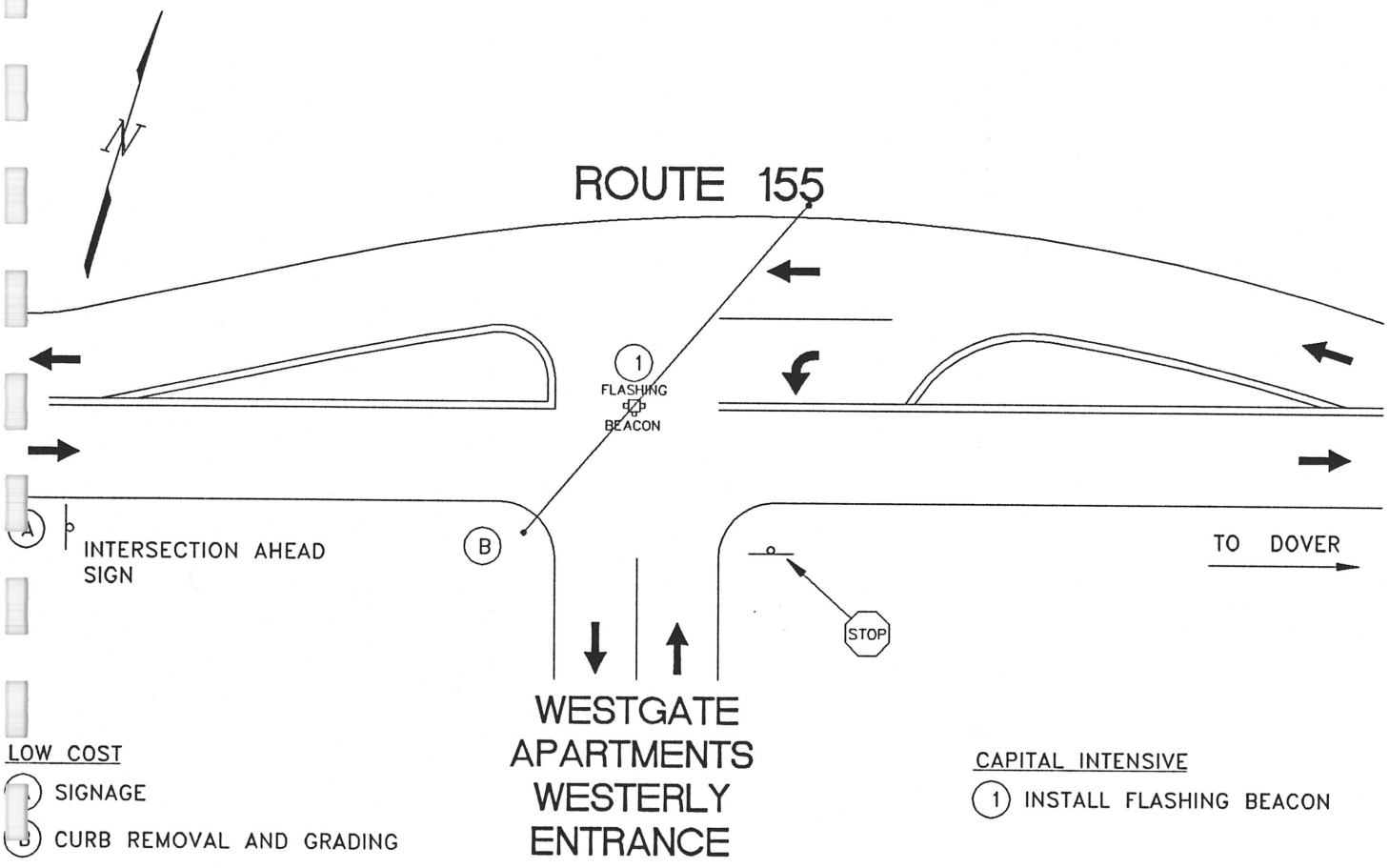
CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 25

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
engineers – surveyors – landscape architects
planners – environmental scientists
994 Candia Road – Manchester, N.H. 03103



LOW COST

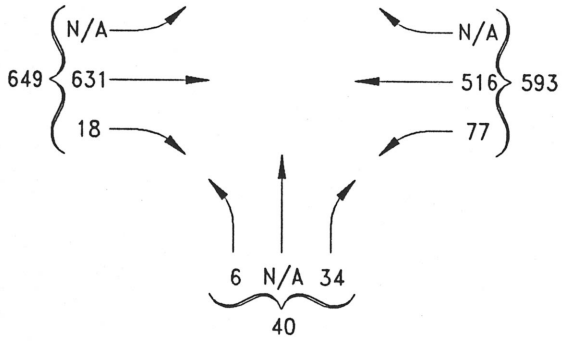
(A) SIGNAGE

(B) CURB REMOVAL AND GRADING

CAPITAL INTENSIVE

(1) INSTALL FLASHING BEACON

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1282

MINOR STREET
LEVEL OF SERVICE: D

COST OF IMPROVEMENTS

LOW COST: $1500

CAPITAL INTENSIVE: $7000

INTERSECTION NUMBER 2

RECOMMENDED IMPROVEMENTS
Route 155 at Westgate Apartments

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 26

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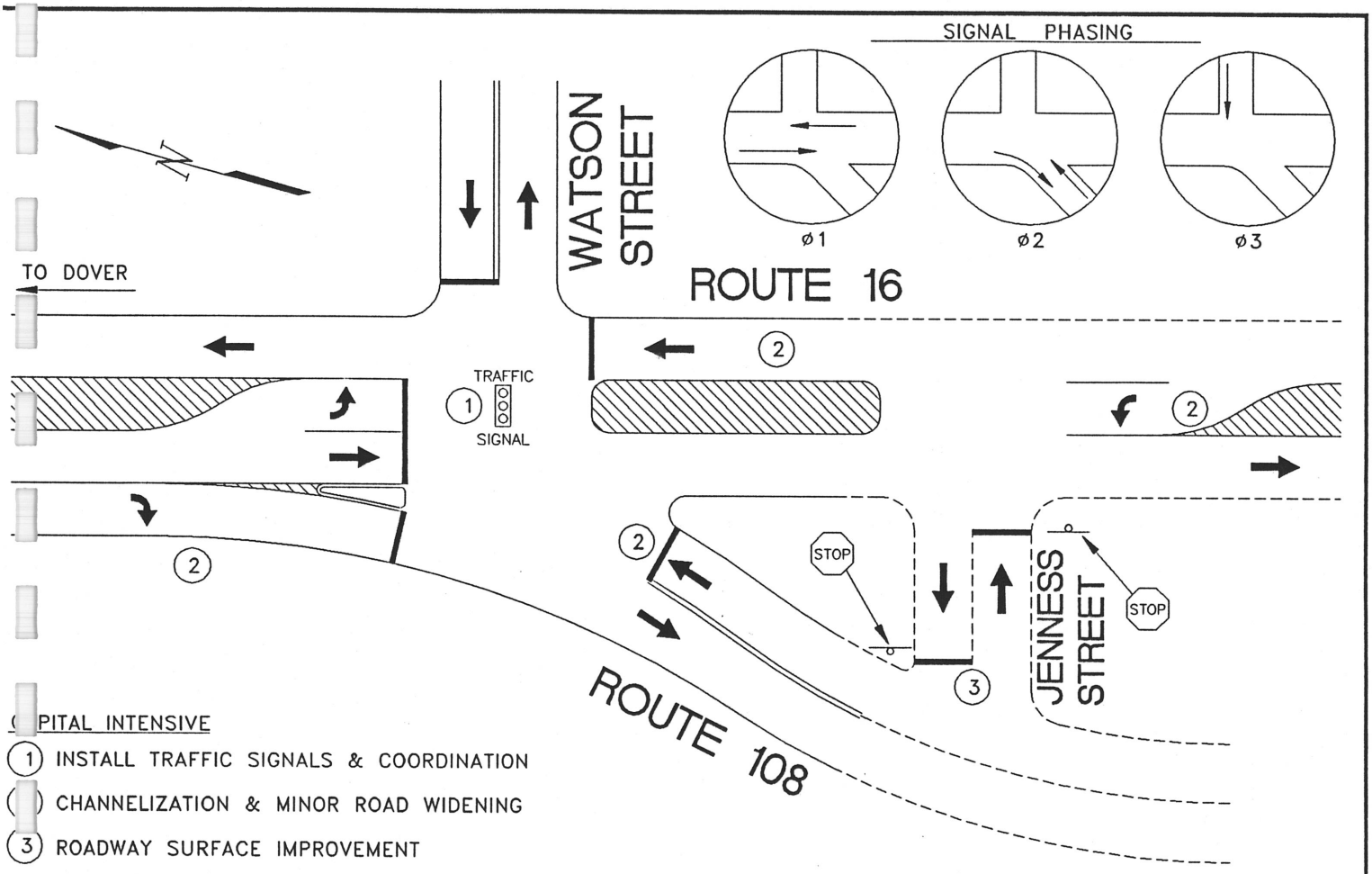
Tel. (603) 893-7497

STORCH ASSOCIATES
engineers – surveyors – landscape architects
planners – environmental scientists
994 Candia Road – Manchester, N.H. 03103



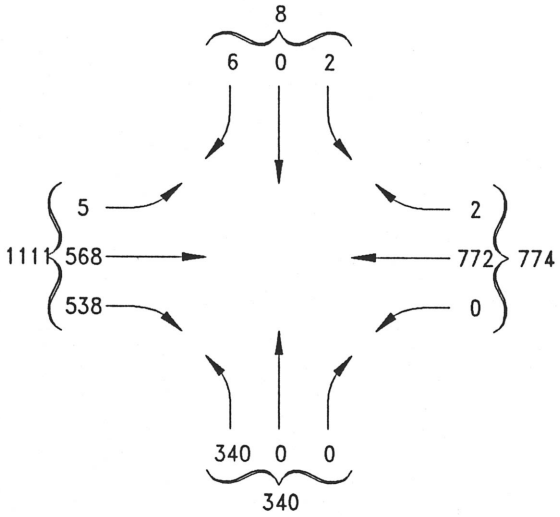
CAPITAL INTENSIVE

(1) INSTALL TRAFFIC SIGNALS & COORDINATION

( ) CHANNELIZATION & MINOR ROAD WIDENING

(3) ROADWAY SURFACE IMPROVEMENT

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2233

OVERALL SIGNALIZED
LEVEL OF SERVICE: B

COST OF IMPROVEMENTS

LOW COST: 0

CAPITAL INTENSIVE: $180,000

INTERSECTION NUMBER

3

RECOMMENDED IMPROVEMENTS
Route 108 at Route 16

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 27

FREDETTE ASSOCIATES, INC.
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Tel. (603) 893-7497

STORCH ASSOCIATES
engineers – surveyors – landscape architects
planners – environmental scientists
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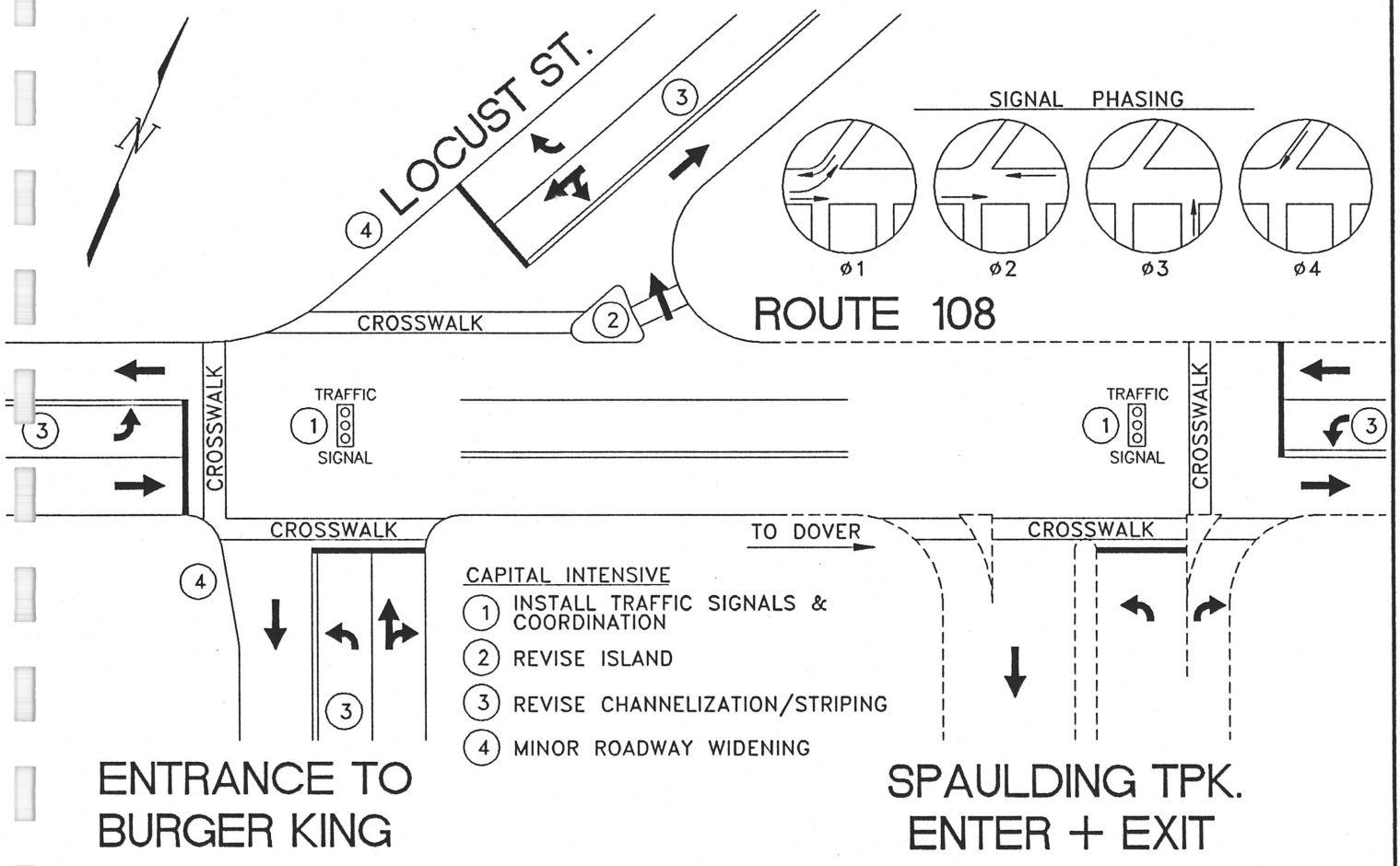
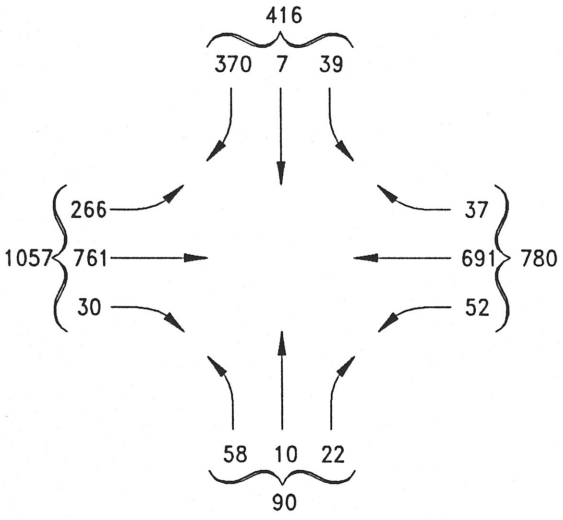


1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2343

OVERALL SIGNALIZED
LEVEL OF SERVICE: C

COST OF IMPROVEMENTS

LOW COST: 0

CAPITAL INTENSIVE: $200,000

INTERSECTION NUMBER 4

RECOMMENDED IMPROVEMENTS
Route 108 at Locust Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 28

FREDETTE ASSOCIATES, INC.
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Tel. (603) 893-7497

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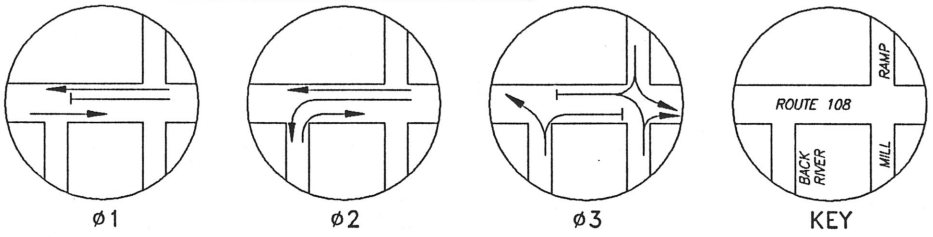
engineers – surveyors – landscape architects
planners – environmental scientists
994 Candia Road – Manchester, N.H. 03103

SIGNAL PHASING



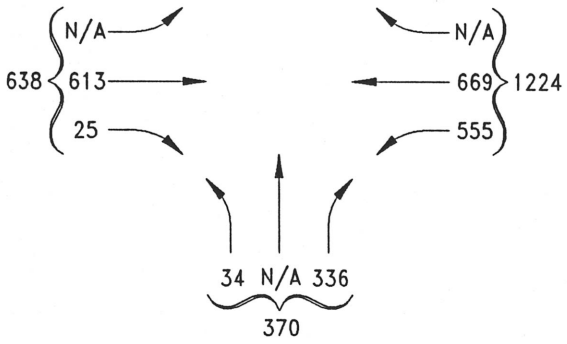
LOW COST

(A) SIGNAGE

CAPITAL INTENSIVE

(1) INSTALL TRAFFIC SIGNALS & COORDINATION WITH MILL STREET/RAMPS.

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2232

OVERALL SIGNALIZED* LEVEL OF SERVICE: B

* – LOS D AT ADJACENT MILL STREET INTERSECTION

COST OF IMPROVEMENTS

LOW COST: $100

CAPITAL INTENSIVE: $120,000

INTERSECTION NUMBER 5

RECOMMENDED IMPROVEMENTS
Route 108 at Back River Road

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 29

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
engineers – surveyors – landscape architects
planners – environmental scientists
994 Candia Road – Manchester, N.H. 03103

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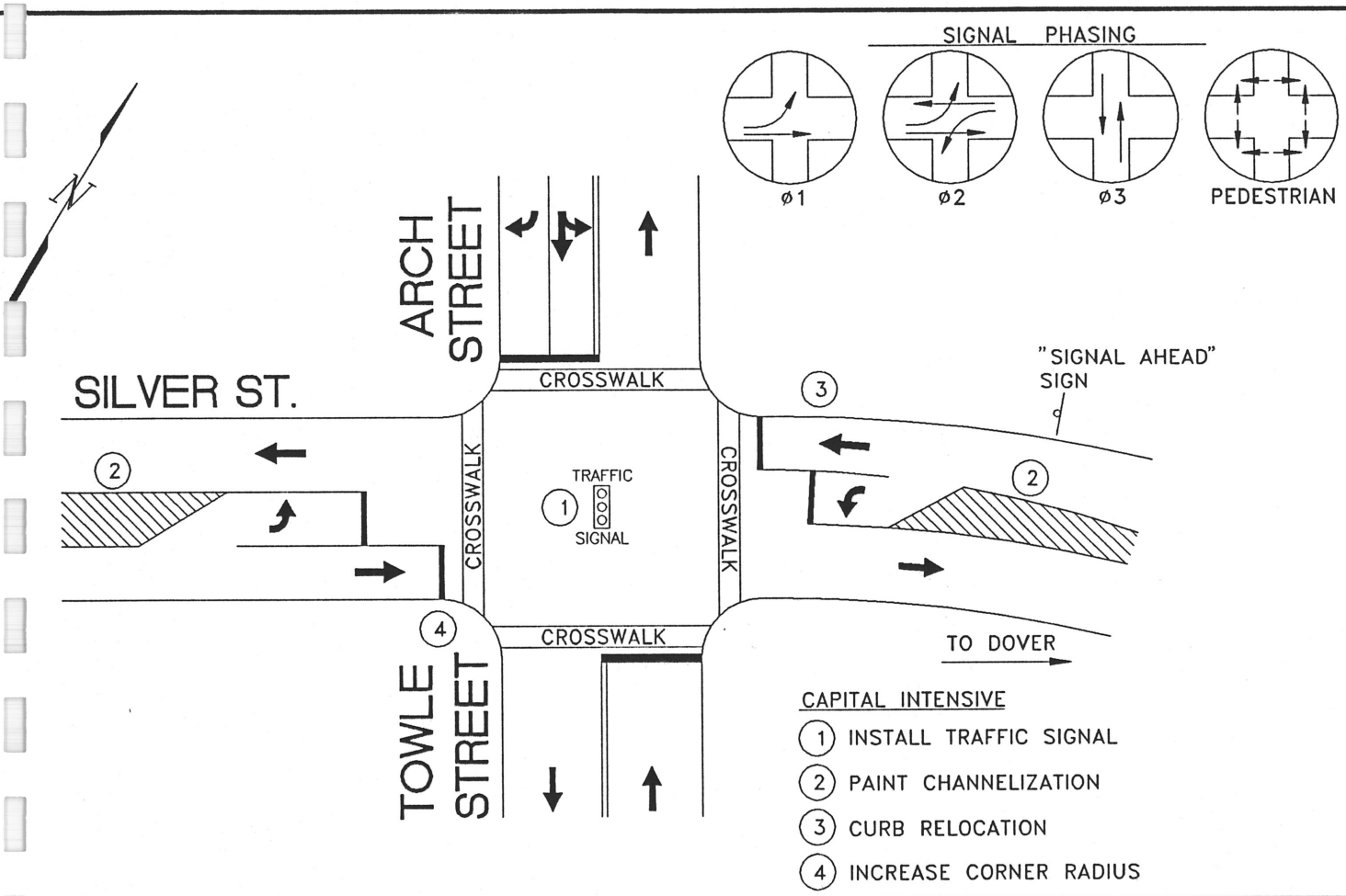
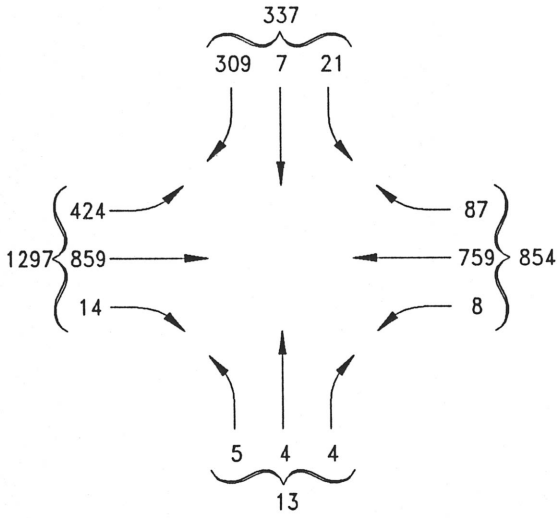


CAPITAL INTENSIVE

1. INSTALL TRAFFIC SIGNAL
2. PAINT CHANNELIZATION
3. CURB RELOCATION
4. INCREASE CORNER RADIUS

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2501

OVERALL SIGNALIZED
LEVEL OF SERVICE: C

COST OF IMPROVEMENTS

LOW COST: 0

CAPITAL INTENSIVE: $110,000

INTERSECTION NUMBER 6

RECOMMENDED IMPROVEMENTS
Silver Street at Arch Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 30

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
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planners – environmental scientists
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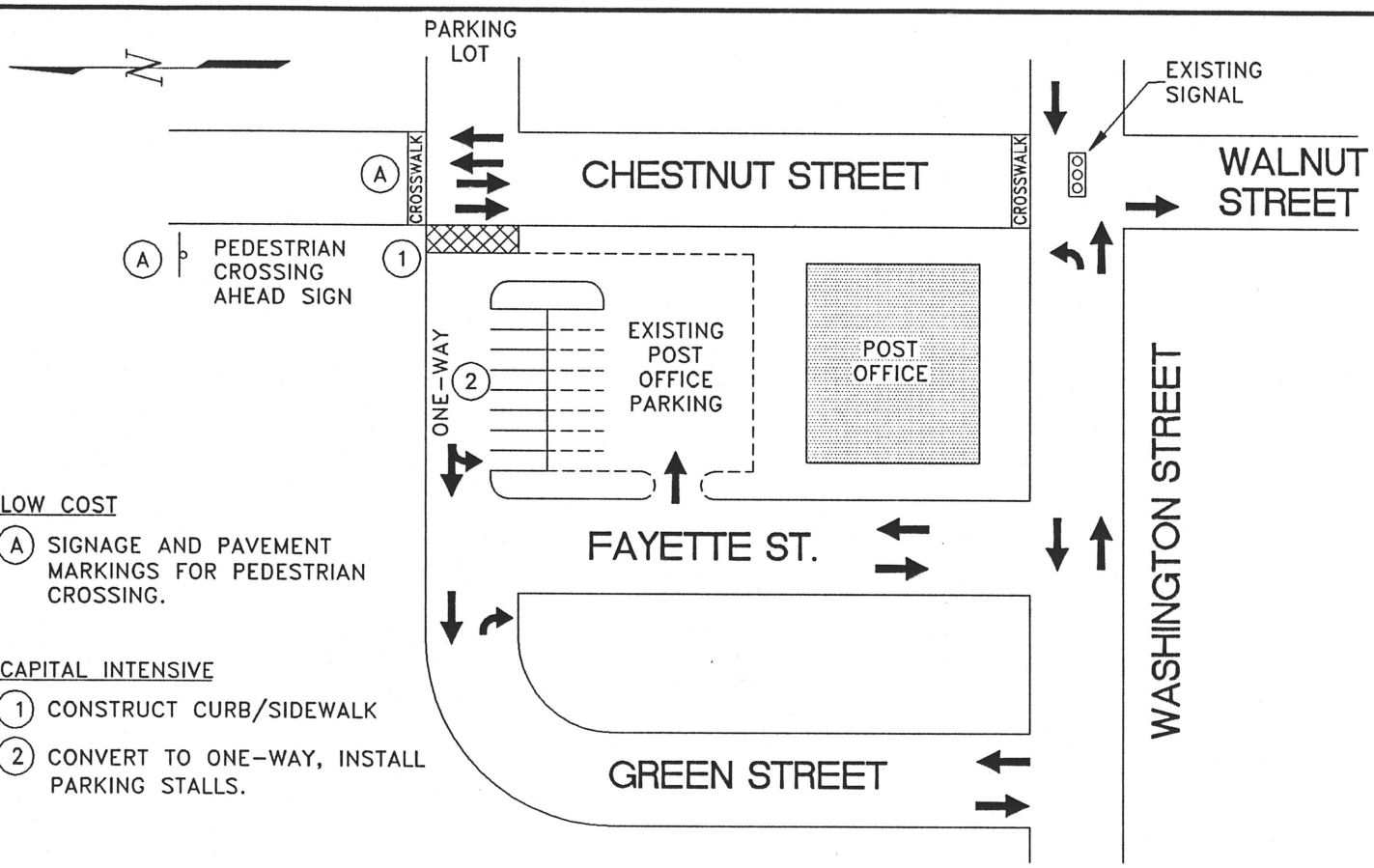


LOW COST

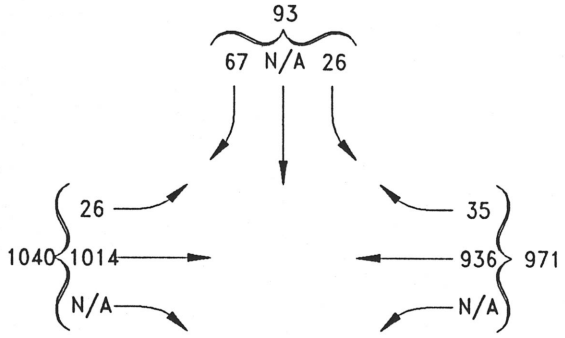
(A) SIGNAGE AND PAVEMENT MARKINGS FOR PEDESTRIAN CROSSING.

CAPITAL INTENSIVE

(1) CONSTRUCT CURB/SIDEWALK

(2) CONVERT TO ONE-WAY, INSTALL PARKING STALLS.

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2104

COST OF IMPROVEMENTS

LOW COST: $300

CAPITAL INTENSIVE: $5000

INTERSECTION NUMBER 7

RECOMMENDED IMPROVEMENTS
Chestnut Street at Green Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 31

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
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planners – environmental scientists
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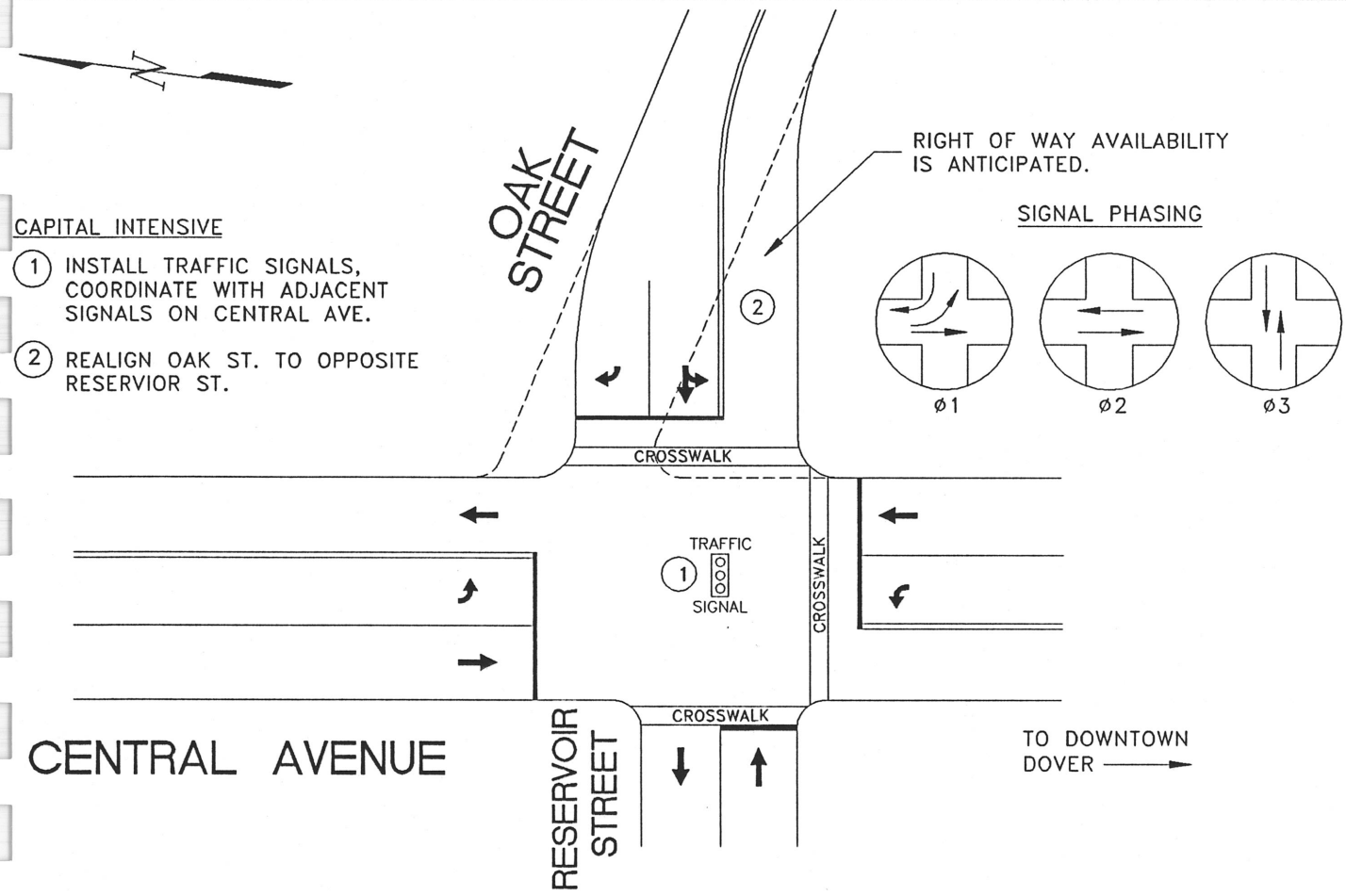
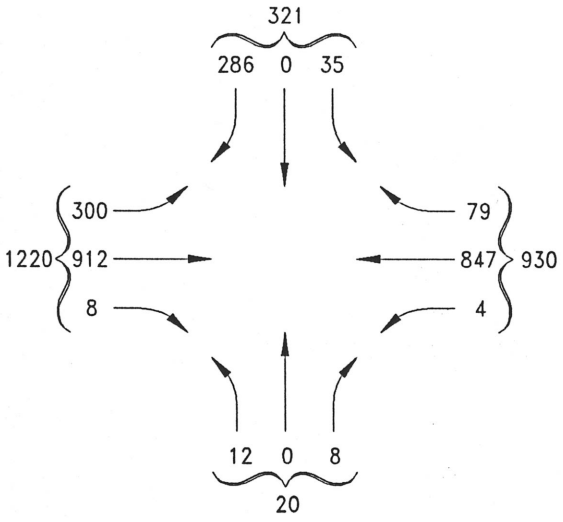


1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 2491

OVERALL SIGNALIZED LEVEL OF SERVICE: C

COST OF IMPROVEMENTS

LOW COST: 0

CAPITAL INTENSIVE: $225,000

INTERSECTION NUMBER 8

RECOMMENDED IMPROVEMENTS
Central Avenue at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 32

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
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Tel. (603) 893-7497

STORCH ASSOCIATES
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planners – environmental scientists
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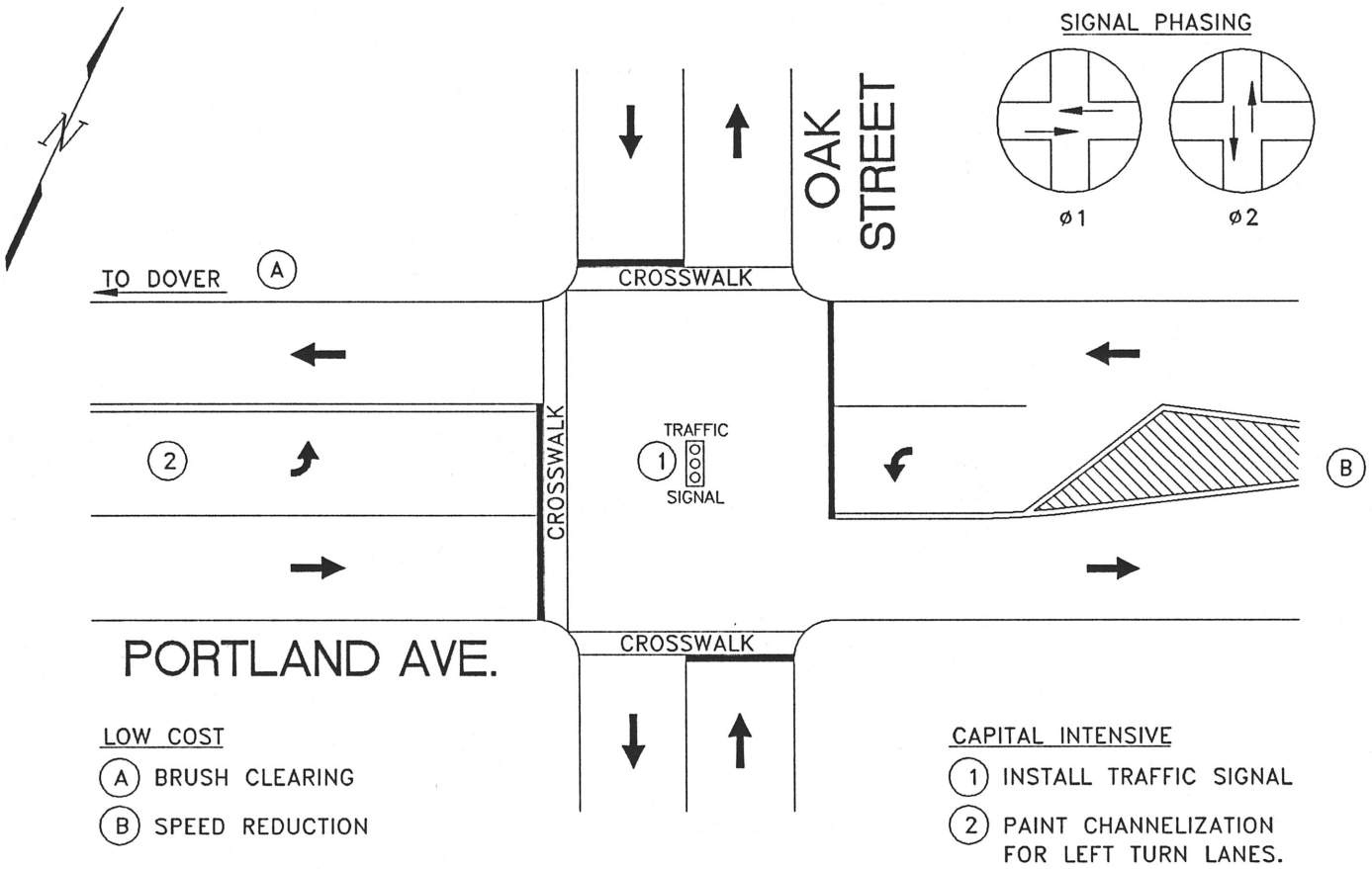
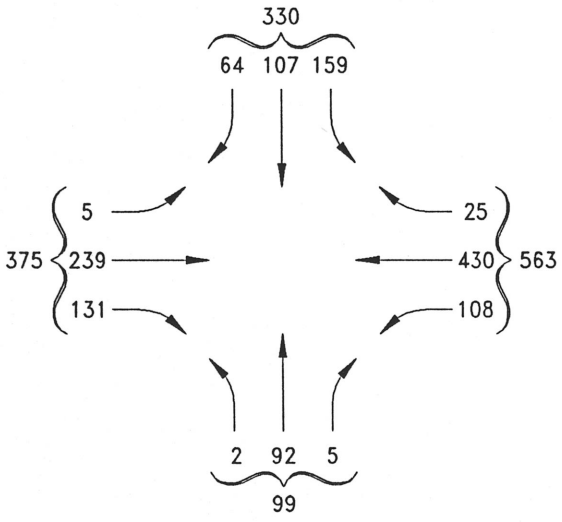


1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1367

MINOR STREET
LEVEL OF SERVICE: B

COST OF IMPROVEMENTS

LOW COST: $300

CAPITAL INTENSIVE: $90,000

INTERSECTION NUMBER 9

RECOMMENDED IMPROVEMENTS
Portland Avenue at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 33

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
engineers – surveyors – landscape architects
planners – environmental scientists
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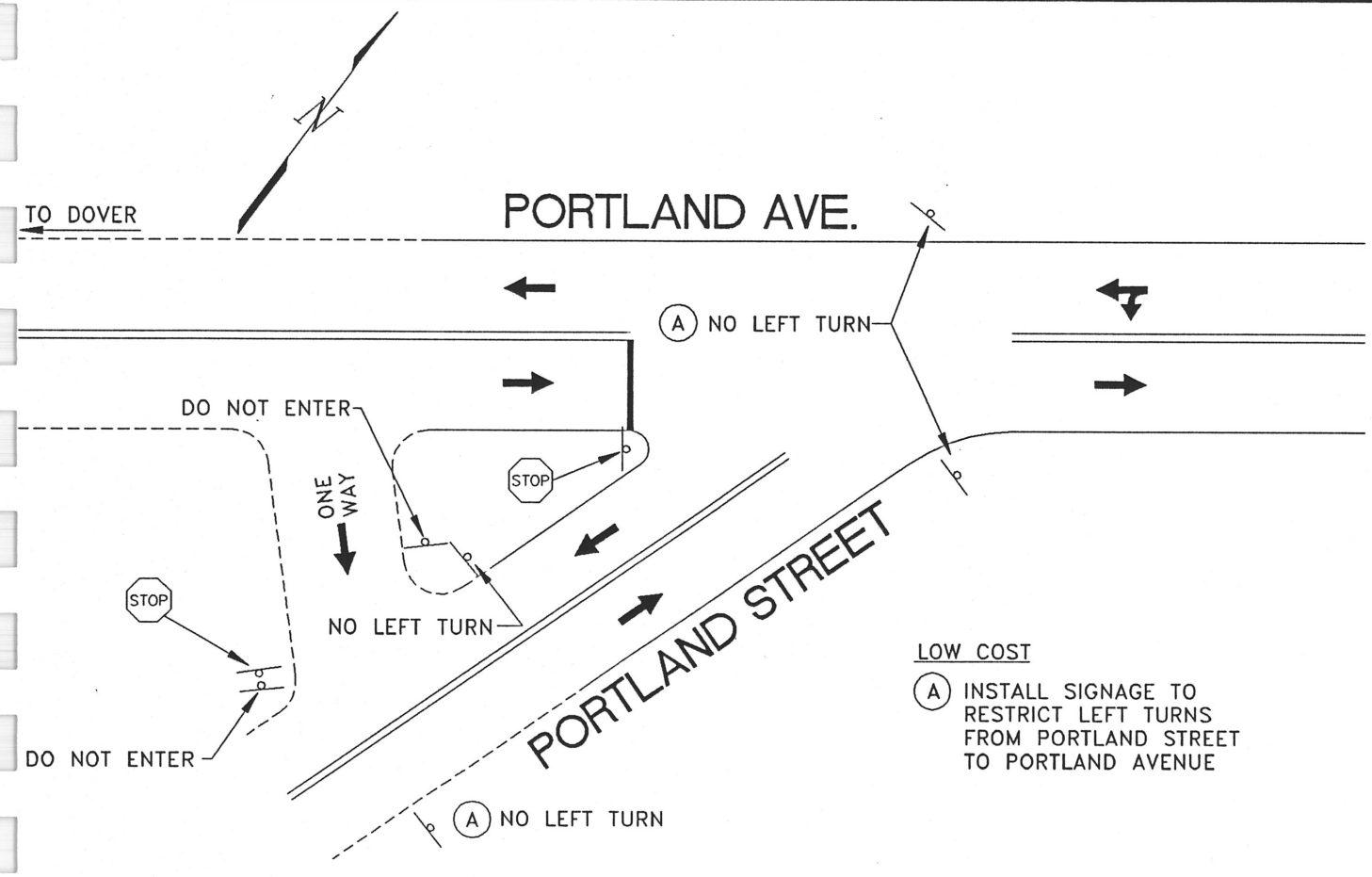
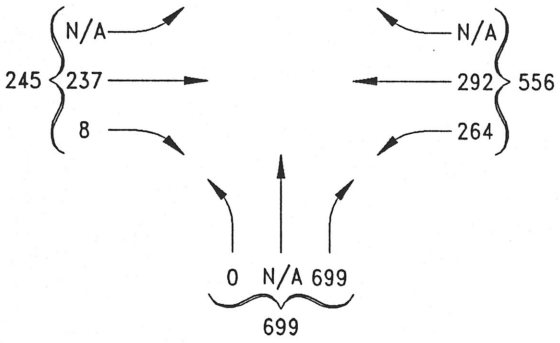


LOW COST

(A) INSTALL SIGNAGE TO RESTRICT LEFT TURNS FROM PORTLAND STREET TO PORTLAND AVENUE

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1500

MINOR STREET
LEVEL OF SERVICE: F

COST OF IMPROVEMENTS

LOW COST: $900

CAPITAL INTENSIVE: 0

INTERSECTION NUMBER 10

RECOMMENDED IMPROVEMENTS
Portland Avenue at Portland Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: JULY, 1988

FIGURE No. 34

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

STORCH ASSOCIATES
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planners – environmental scientists
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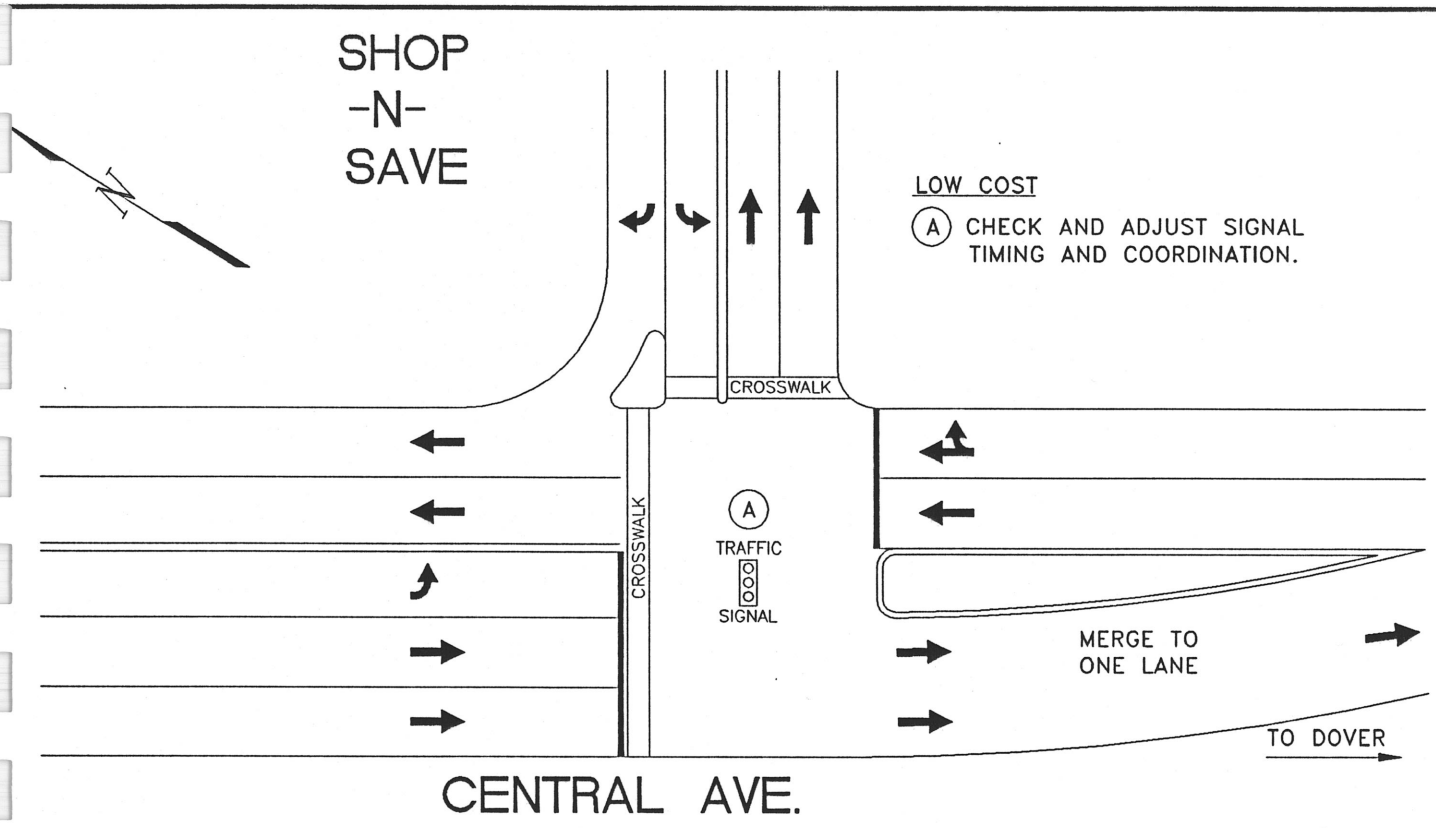
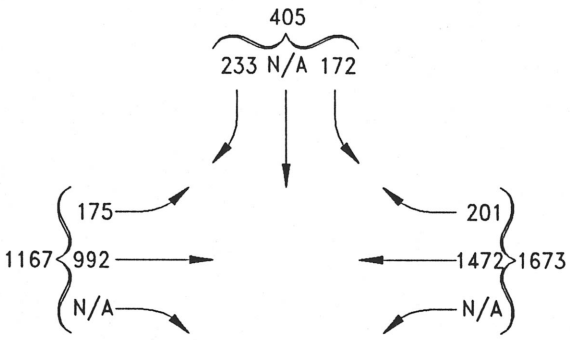


1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 3245

OVERALL
LEVEL OF SERVICE: C

COST OF IMPROVEMENTS

LOW COST: $500

CAPITAL INTENSIVE: 0

INTERSECTION NUMBER
11

RECOMMENDED IMPROVEMENTS
Central Avenue at Shop'n Save

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 35

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
Tel. (603) 893-7497

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planners – environmental scientists
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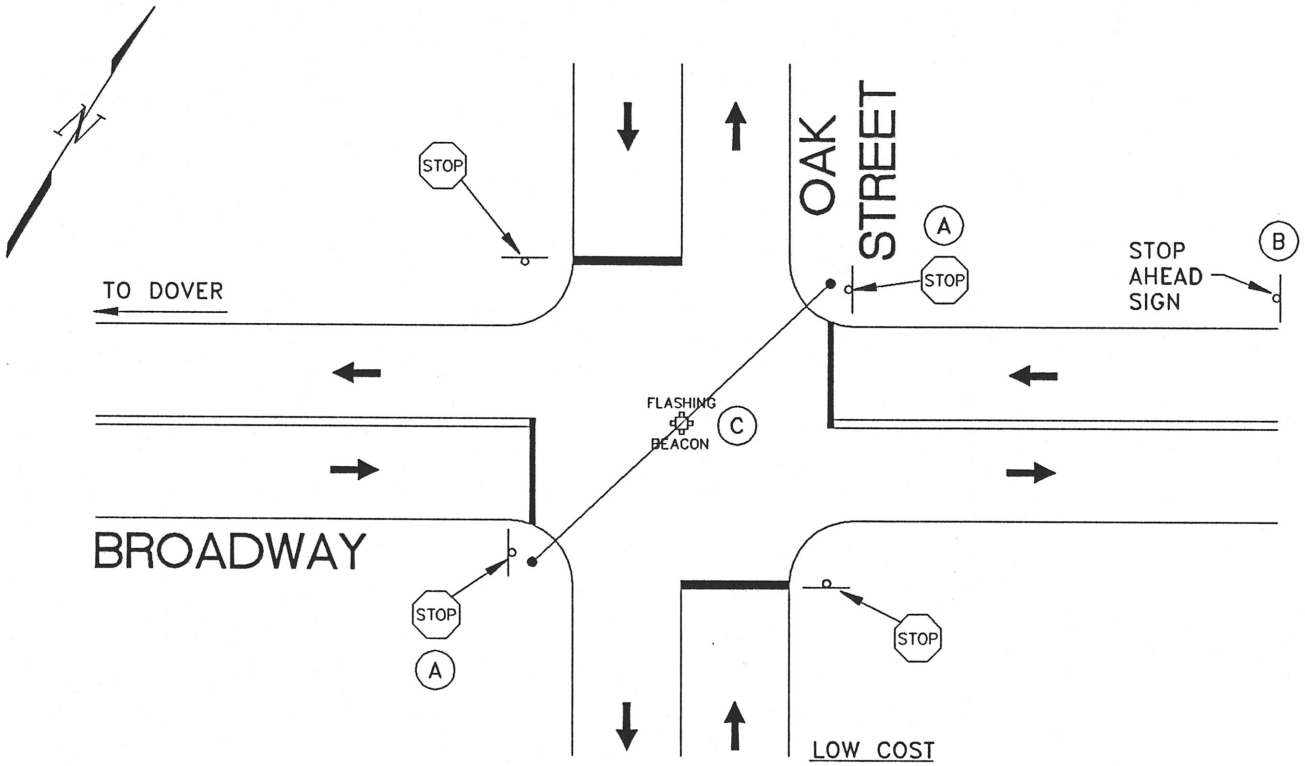


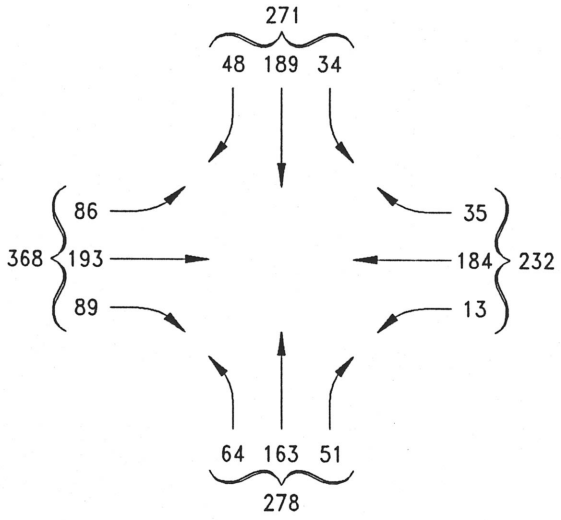
LOW COST

(A) INSTALL 4-WAY STOP SIGN CONTROL

(B) STOP AHEAD SIGNAGE

(C) CONVERT BEACON TO 4-WAY FLASHING RED

1993 DESIGN HOUR VOLUMES



TOTAL ENTERING VOLUME: 1149

OVERALL INTERSECTION
LEVEL OF SERVICE: C

COST OF IMPROVEMENTS

LOW COST: $700

CAPITAL INTENSIVE: 0

INTERSECTION NUMBER 12

RECOMMENDED IMPROVEMENTS
Broadway at Oak Street

CITY OF DOVER
TRANSPORTATION COMPONENT
MASTER PLAN

DATE: MARCH, 1988

FIGURE No. 36

FREDETTE ASSOCIATES, INC.
PROFESSIONAL ENGINEERS AND LAND SURVEYORS
P.O. Box 644, Salem, New Hampshire 03079
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planners – environmental scientists
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