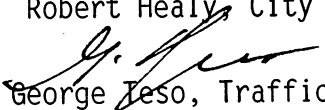




CITY OF CAMBRIDGE
INTEROFFICE CORRESPONDENCE

To Robert Healy, City Manager

Date Feb. 26, 1990

From  George Teso, Traffic Director

Reference

Subject Follow Up On Intersection Study for Broadway and Trowbridge Street

Enclosed are copies of the intersection analysis of Broadway and Trowbridge Street. I will take the necessary first steps in improving the safety at this intersection.

RECEIVED
90 FEB 26 AM 9:22
OFFICE OF THE CITY MANAGER

BROADWAY AND TROWBRIDGE STREET
INTERSECTION ANALYSIS

PREPARED BY
CITY OF CAMBRIDGE
TRAFFIC AND PARKING DEPARTMENT
FEBRUARY 1990

BROADWAY AND TROWBRIDGE STREET
INTERSECTION ANALYSIS

A. PURPOSE

The purpose of this study is to collect and analyze data to determine the need to improve traffic and pedestrian safety and the need of any traffic control devices that would improve the safety of the intersection. The method used was to conduct various studies such as traffic volume, turning movement counts, pedestrian counts, speed and accident studies, to analyze this information and make a determination of what the problems are and what measures can be taken to solve them.

This process requires extensive counting by mechanical equipment as well as manual counting of all vehicles and pedestrians using this intersection. The accident reports must be read and analyzed to determine causes whenever possible and speed checks made on all the approaches to the intersection.

This process usually takes from 4 to 6 weeks from the time we start to the time we make a decision. Also weather conditions cause delays due to snow or ice on our streets.

B. EXISTING CONDITIONS

The Broadway and Trowbridge Street intersection currently operates with free flowing traffic on Broadway and stop sign controlled traffic on Trowbridge Street as shown on the existing condition plan. Broadway is 44' wide from curb to curb with one lane of traffic in each direction and parking on both sides. Trowbridge Street is 26' wide curb to curb, with parking allowed on one side of the southern leg and no parking allowed on both sides of the northern leg. The intersection is located between a heavily populated residential area to the south and the Cambridge Public Library and High School to the north. With the open campus policy at the high school we have a high volume of pedestrians crossing Broadway.

C. BASE TRAFFIC VOLUMES

Mechanical counters were used to obtain average daily traffic counts (ADT) and sample manual counts were made to check the accuracy of the mechanical devices. The following ADT volumes as well as the peak hour volumes were produced.

<u>STREET</u>	<u>DIRECTION</u>	<u>ADT</u>	<u>AM PEAK</u>	<u>PM PEAK</u>
Broadway	East Bd.	7996	729	618
Broadway	West Bd.	7304	598	806
Trowbridge St.	North Bd.	2221	184	229
Trowbridge St.	South Bd.	180	42	12

Manual turning movement counts as well as pedestrian counts were conducted during the hours when students were arriving and leaving the school. These counts are as follows:

<u>7:45 AM to 8:45 AM</u>							
<u>STREET</u>	<u>DIRECTION</u>	<u>LEFT TURN</u>	<u>THRU</u>	<u>RIGHT TURN</u>	<u>TRUCKS</u>	<u>BUSES</u>	<u>PEDESTRIANS CROSSING</u>
Broadway	East Bd.	2	525	0	10	2	104
Broadway	West. Bd.	0	290	4	8	8	15
Trowbridge St.	North Bd.	72	4	86	4	0	50
Trowbridge St.	South Bd.	<u>0</u>	<u>0</u>	<u>1</u>	<u>0</u>	<u>0</u>	<u>112</u>
	Totals	74	819	91	22	10	281

<u>2:00 PM to 3:00 PM</u>							
<u>STREET</u>	<u>DIRECTION</u>	<u>LEFT TURN</u>	<u>THRU</u>	<u>RIGHT TURN</u>	<u>TRUCKS</u>	<u>BUSES</u>	<u>PEDESTRIANS CROSSING</u>
Broadway	East Bd.	10	312	0	14	5	70
Broadway	West Bd.	0	405	24	12	6	51
Trowbridge St.	North Bd.	83	3	82	6	3	45
Trowbridge St.	South Bd.	<u>21</u>	<u>0</u>	<u>21</u>	<u>0</u>	<u>0</u>	<u>88</u>
	Totals	114	720	127	32	14	254

D. SPEED STUDIES

Radar speed checks were made by checking 100 vehicles at random on all three major approaches the following speeds were recorded.

<u>STREET</u>	<u>AVE. SPEED</u>	<u>85% SPEED</u>
Broadway E.Bd.	31.5 MPH	36 MPH
Broadway W.Bd.	31.0 MPH	35 MPH
Trowbridge St. N.Bd	23.0 MPH	27 MPH

The speed checks revealed that the average speed is within the 30 MPH legal range on all approaches and that 15% of all the drivers are exceeding the speed limit. This is a normal pattern of speed checks.

E. ACCIDENT STUDY

An accident study was conducted by the Traffic Department with cooperation from the Police Department and as shown on the enclosed collision diagram there were a total of eight (8) accidents reported in 1989 and none so far in 1990. Of the total 8 accidents reported all involved property damage and no personal injuries were reported. Also 5 of the 8 accidents involved vehicles making a left turn onto Broadway from Trowbridge Street.

F. CONCLUSIONS AND RECOMMENDATIONS

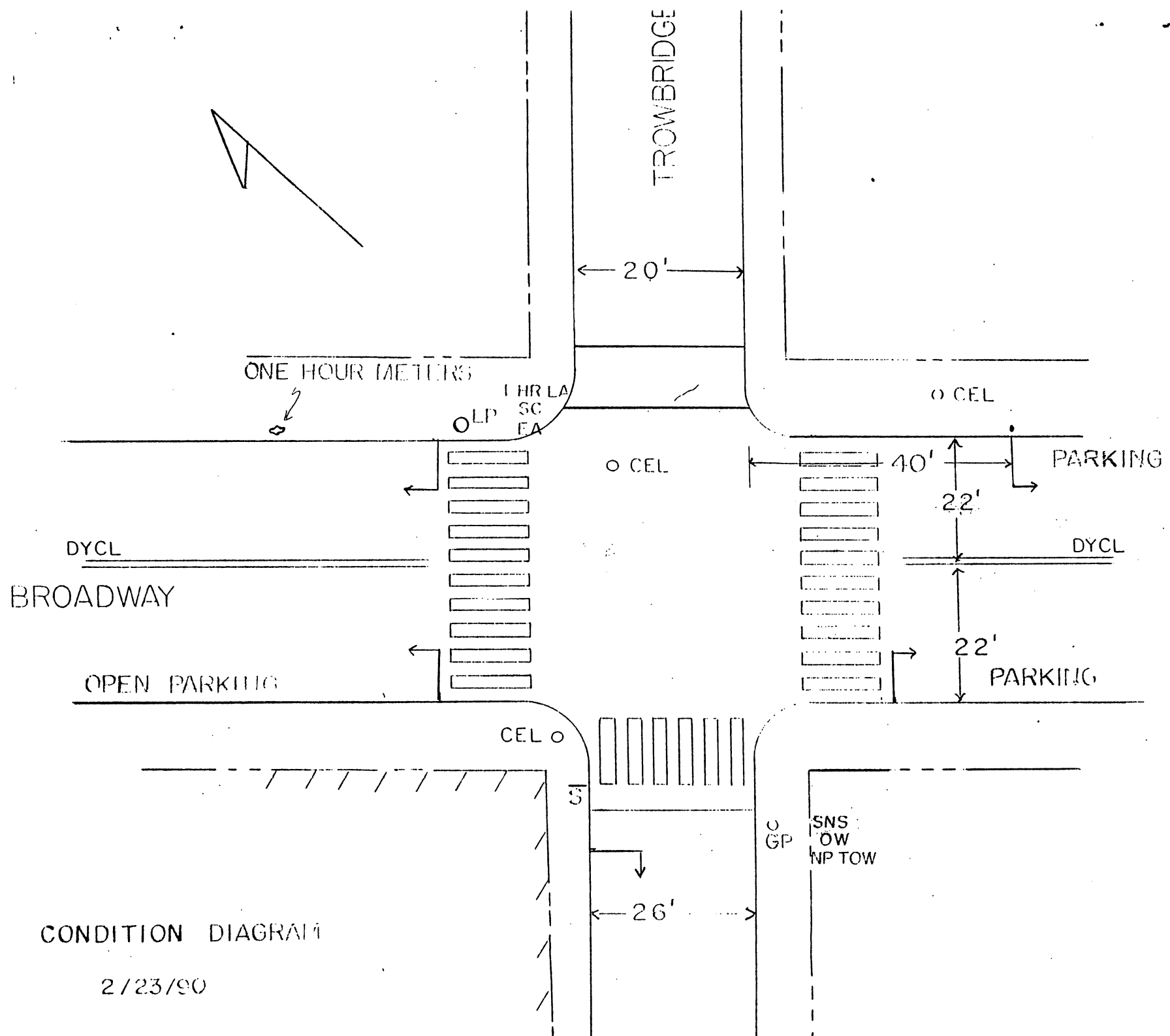
In analyzing the data collected and what our visual observations revealed, it was determined that a problem existed with the left turn from Trowbridge Street into Broadway. Using the speed data collected a safe stopping distance for vehicles traveling eastbound on Broadway was calculated. It revealed that traffic traveling at an 85 percentile speed of 36 MPH Eastbound on Broadway could not see the vehicle entering the intersection from Trowbridge Street in time to stop thereby creating a serious accident potential.

As can be seen on the collision diagram there were 8 accidents reported in 1989 and none so far in 1990. Five of the 8 accidents involved left turns out of Trowbridge Street and eastbound traffic substantiating our speed study that visibility is the major problem.

An intersection analysis was calculated using the ITE Highway Capacity Manual Circular 212 and this study revealed that the intersection is operating on a level of service A on three approaches which means little or no delay and that the Trowbridge Street northbound traffic was operating at a level of service D during peak hours which means long delays. The overall operation of the intersection can be improved with minor modifications.

It is our opinion that removing the parking on the south side of Broadway for a distance of 40' from Trowbridge Street will allow for a better view of traffic eastbound on Broadway and traffic entering the intersection from Trowbridge Street.

We will also continue to monitor this intersection and evaluate the improvements we will make which will also include new warning signs with a view towards pedestrian and motor vehicle safety.



CONDITION DIAGRAM

2/23/90

CIRCULAR 212 WORKSHEET: UNSIGNALIZED - 4 APPROACHES

BROADWAY AND TROWBRIDGE ST. INTERSECTION ANALYSIS 7:45 AM to 8:45 AM

GENERAL CHARACTERISTICS

CONTROLS: STOP

PREVAILING SPEED: 30 MPH

MAIN STREET # OF LANES: 2 LANES

MINOR STREET LANES

APPROACH: C: TROWBRIDGE ST.

EXCLUSIVE LEFT TURN LANES: N

EXCLUSIVE RIGHT TURN LANES: N

APPROACH: D: TROWBRIDGE ST.

EXCLUSIVE LEFT TURN LANES: N

EXCLUSIVE RIGHT TURN LANES: N

APPROACH	A: BROADWAY E.			B: BROADWAY W.			C: TROWBRIDGE			D: TROWBRIDGE		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
VOLUME	2	525	0	0	290	4	72	4	86	0	0	1
PERCENT GRADE	0.00			0.00			0.00					
PERCENT CYCLES	0.00			0.00			0.00			0.00		
PASSENGER CARS	97.00			97.00			98.00			100.00		
PERCENT LT TRU	0.00			0.00			0.00			0.00		
PERCENT HV TRU	3.00			3.00			2.00			0.00		
PASS CAR/HR	2			0			73	4	88	0	0	1

STEP 1 RIGHT TURNS FROM	C: TROWBRIDGE ST.		D: TROWBRIDGE ST.	
CONFLICTING FLOWS	525		292	
CRITICAL GAPS	6.0		6.0	
CAPACITY	533		704	
DEMAND	88		1	
CAPACITY USED	16		0	
IMPEDANCE FACTOR	0.89		1.00	
SHARED LANE	Y		Y	

STEP 2 LEFT TURNS FROM	B: BROADWAY W. BD.		A: BROADWAY E. BD.	
CONFLICTING FLOWS	525		294	
CRITICAL GAPS	5.0		5.0	
CAPACITY	710		894	
DEMAND	0		2	
CAPACITY USED	0		0	
IMPEDANCE FACTOR	1.00		1.00	
AVAILABLE RESERVE	710		892	
DELAY	Little or no delay		Little or no delay	
LOS	A		A	

BROADWAY AND TROWBRIDGE ST. INTERSECTION ANALYSIS 7:45 AM to 8:45 AM

STEP 3 THRU MOVES FROM	C:TROWBRIDGE ST.	D:TROWBRIDGE ST.
CONFLICTING FLOWS	821	819
CRITICAL GAPS	7.0	7.0
CAPACITY	272	272
ADJUST FOR IMP	271	272
DEMAND	4	0
CAPACITY USED	2	0
IMPEDANCE FACTOR	0.99	1.00
SHARED LANE LEFT	Y	Y
SHARED LANE RIGHT	Y	Y

STEP 4 LEFT TURNS FROM	C:TROWBRIDGE ST.	D:TROWBRIDGE ST.
CONFLICTING FLOWS	822	909
CRITICAL GAPS	7.5	7.5
CAPACITY	233	205
ADJUST FOR IMP	233	181
SHARED LANE THRU	Y	Y
SHARED LANE RIGHT	Y	Y
SHARED LN DEMAND	165	1
CAPACITY OF SHARED LN	334	704
AVAILABLE RESERVE	169	703
DELAY	Long traffic delay	Little or no delay
LOS	D	A

CIRCULAR 212 WORKSHEET: UNSIGNALIZED - 4 APPROACHES

BROADWAY AND TROWBRIDGE ST. INTERSECTION ANALYSIS 2:00 PM to 3:00PM

GENERAL CHARACTERISTICS

CONTROLS: STOP

PREVAILING SPEED: 30 MPH

MAIN STREET # OF LANES: 2 LANES

MINOR STREET LANES

APPROACH: C: TROWBRIDGE ST.

EXCLUSIVE LEFT TURN LANES: N

EXCLUSIVE RIGHT TURN LANES: N

APPROACH: D: TROWBRIDGE ST.

EXCLUSIVE LEFT TURN LANES: N

EXCLUSIVE RIGHT TURN LANES: N

APPROACH	A: BROADWAY E.			B: BROADWAY W.			C: TROWBRIDGE			D: TROWBRIDGE		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
VOLUME	10	312	0	0	405	24	83	3	82	21	0	21
PERCENT GRADE	0.00			0.00			0.00					
PERCENT CYCLES	0.00			0.00			0.00			0.00		
PASSENGER CARS	96.00			97.00			97.00			97.00		
PERCENT LT TRU	0.00			0.00			0.00			0.00		
PERCENT HV TRU	4.00			3.00			3.00			3.00		
PASS CAR/HR	10			0			85	3	84	22	0	22

STEP 1 RIGHT TURNS FROM	C: TROWBRIDGE ST.	D: TROWBRIDGE ST.
CONFLICTING FLOWS	312	417
CRITICAL GAPS	6.0	6.0
CAPACITY	688	606
DEMAND	84	22
CAPACITY USED	12	4
IMPEDANCE FACTOR	0.92	0.98
SHARED LANE	Y	Y

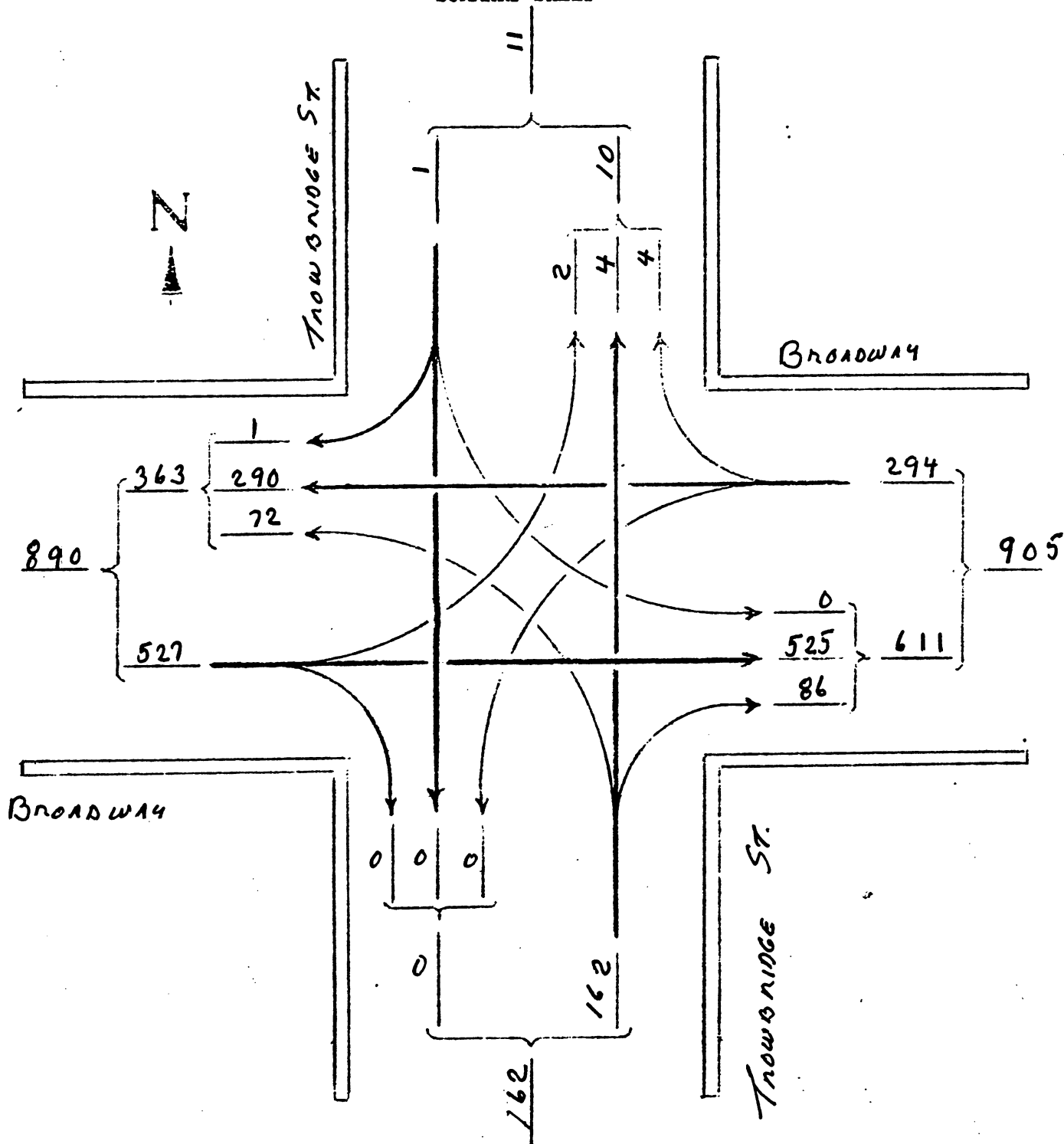
STEP 2 LEFT TURNS FROM	B: BROADWAY W. BD.	A: BROADWAY E. BD.
CONFLICTING FLOWS	312	429
CRITICAL GAPS	5.0	5.0
CAPACITY	878	781
DEMAND	0	10
CAPACITY USED	0	1
IMPEDANCE FACTOR	1.00	0.99
AVAILABLE RESERVE	878	771
DELAY	Little or no delay	Little or no delay
LOS	A	A

BROADWAY AND TROWBRIDGE ST.INTERSECTION ANALYSIS 2:00 PM to 3:00PM

STEP 3 THRU MOVES FROM	C:TROWBRIDGE ST.	D:TROWBRIDGE ST.
CONFLICTING FLOWS	751	739
CRITICAL GAPS	7.0	7.0
CAPACITY	300	305
ADJUST FOR IMP	298	303
DEMAND	3	0
CAPACITY USED	1	0
IMPEDANCE FACTOR	1.00	1.00
SHARED LANE LEFT	Y	Y
SHARED LANE RIGHT	Y	Y

STEP 4 LEFT TURNS FROM	C:TROWBRIDGE ST.	D:TROWBRIDGE ST.
CONFLICTING FLOWS	772	824
CRITICAL GAPS	7.5	7.5
CAPACITY	251	232
ADJUST FOR IMP	246	212
SHARED LANE THRU	Y	Y
SHARED LANE RIGHT	Y	Y
SHARED LN DEMAND	173	43
CAPACITY OF SHARED LN	359	314
AVAILABLE RESERVE	186	271
DELAY	Long traffic delay	Average traffic de
LOS	D	C

INTERSECTION COUNT OF VEHICULAR TRAFFIC
SUMMARY SHEET

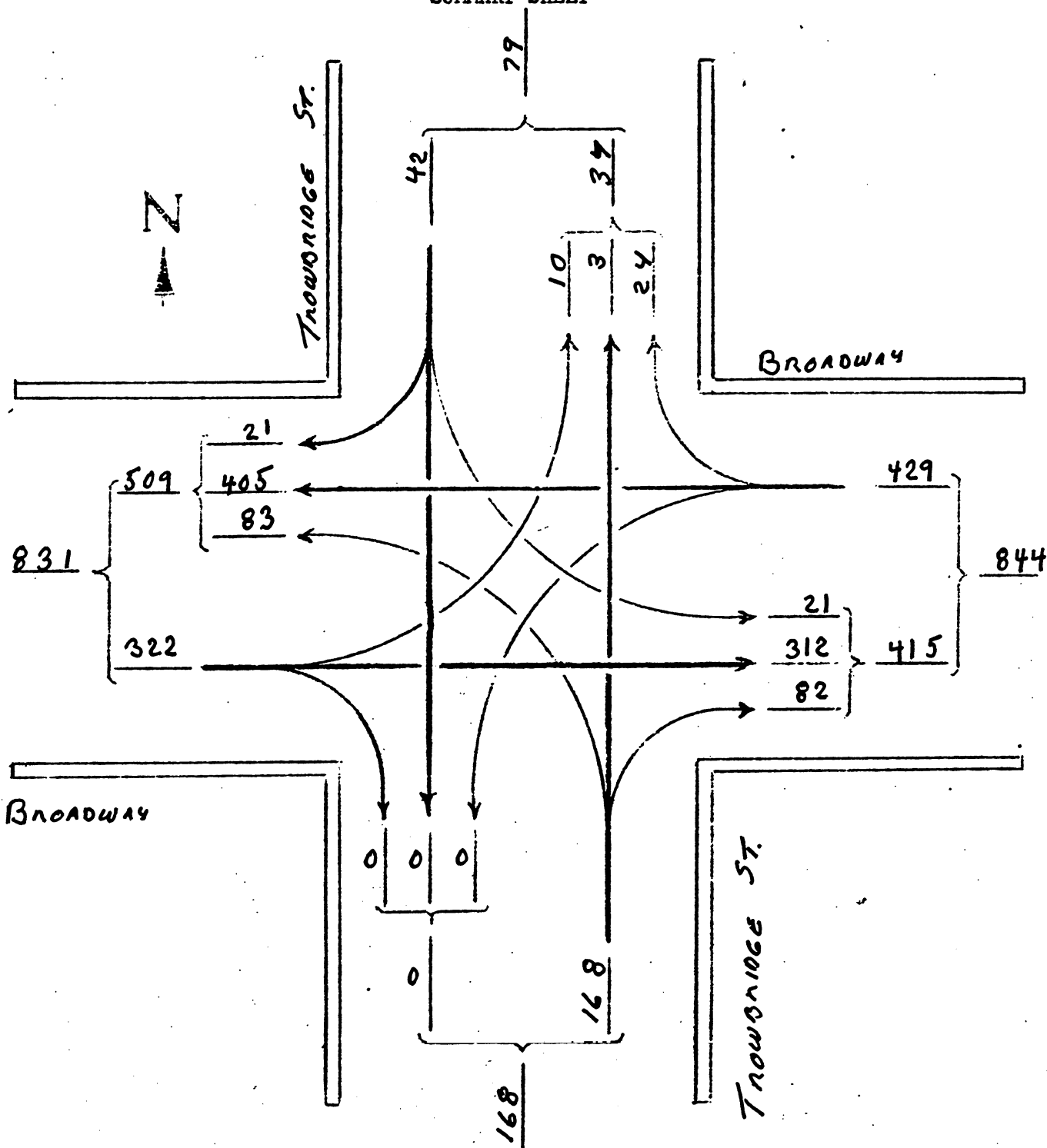


WEATHER RAIN

SHEET 1 OF 1 SHEETS

COMPILED BY J.K.

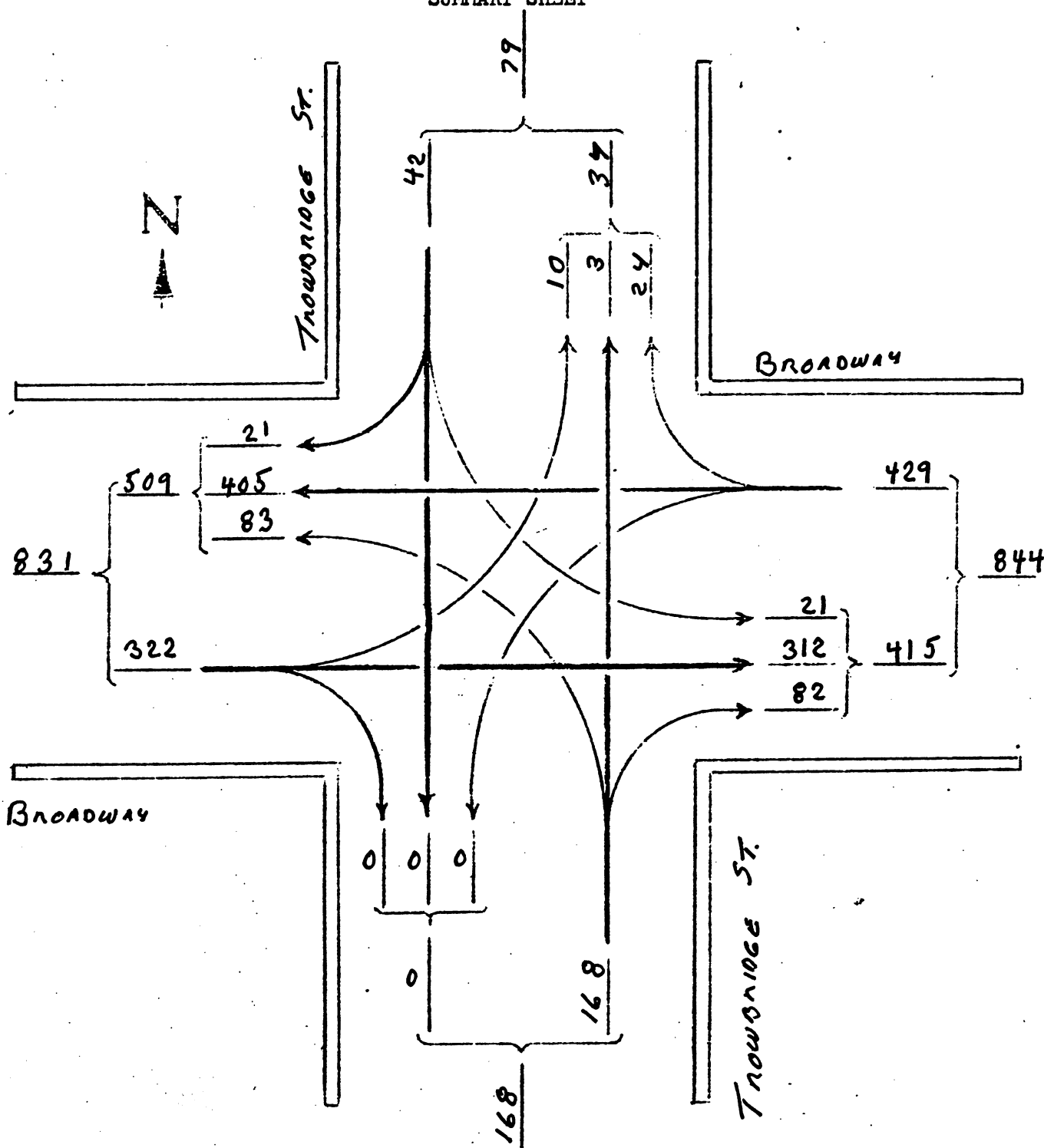
INTERSECTION COUNT OF VEHICULAR TRAFFIC
SUMMARY SHEET



WEATHER CLEAR & COLD SHEET 1 OF 1 SHEETS

COMPILED BY - J.K.

INTERSECTION COUNT OF VEHICULAR TRAFFIC
SUMMARY SHEET



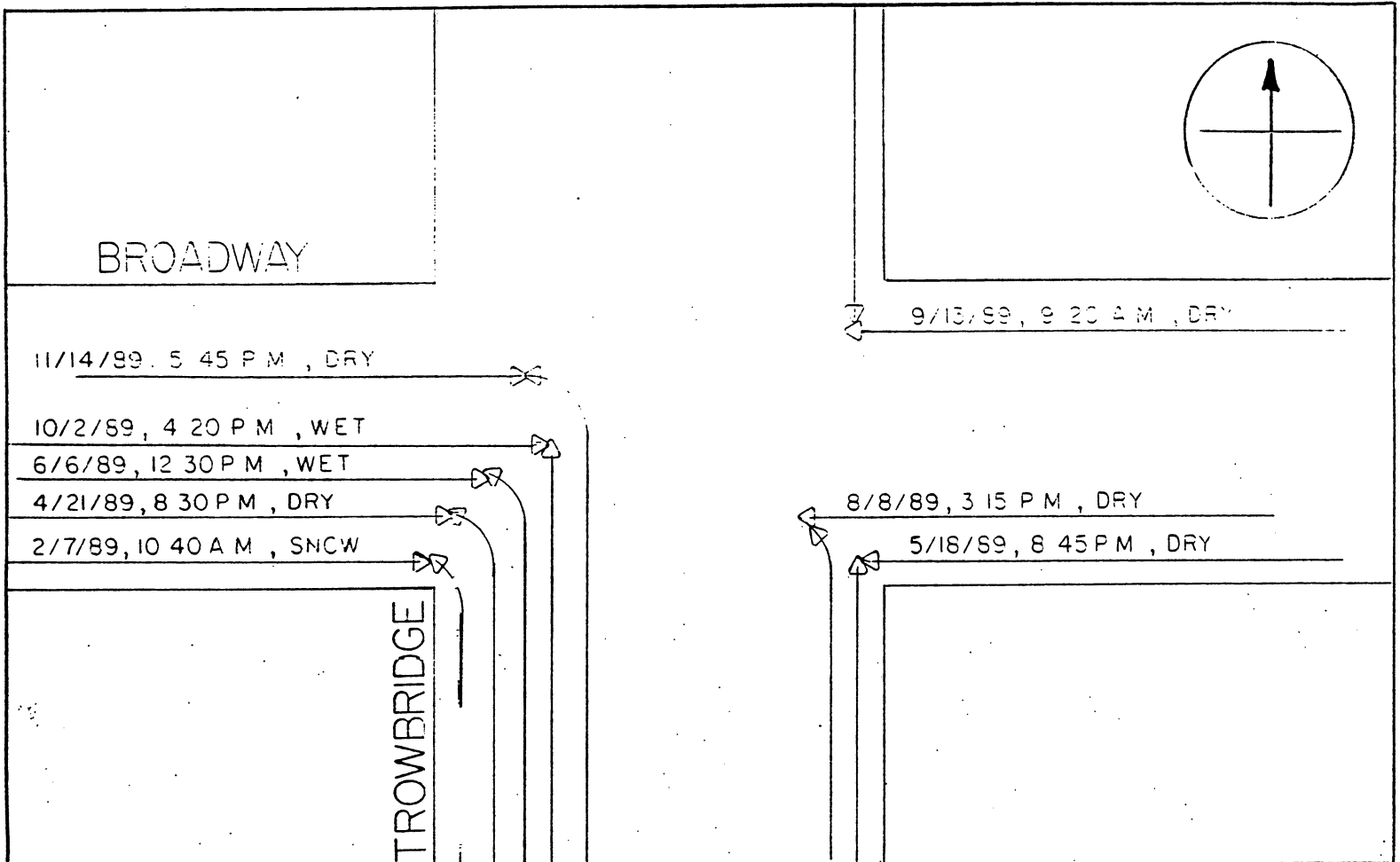
WEATHER CLEAR & COLD SHEET 1 OF 1 SHEETS

COMPILED BY - J.K.

CITY OF CAMBRIDGE

COLLISION DIAGRAM

Location BROADWAY & TROWBRIDGE Number of Accidents 8
 From 1/1/89 To 12/31/89 Date 2/22/90
 Data Obtained From CAMBRIDGE POLICE DEPT By E J



Legend

- ← Moving Motor Vehicle
- Pedestrian
- ☐ Parked Vehicle
- ☐ Fixed Object
- ⊗ Fatal Accident
- ⊙ Personal Injury
- ⊕ Property Damage
- ≡ Trolley
- ⊙ Out of Control
- ← Rear End
- ⊙ Right Angle

Accident Summary

Type	By Types				By Years				
	Fatal	Inj.	Prop. Damage	Total	Year	M.V. M.V.	M.V. Ped.	Other	Total
Head On			1	1	89	8			8
Side Swipe									
M.V. Ped.									
Fixed Object									
Right Angle			7	7					
Others									
Total			7	7		8			8

Date 2/22/90 Compiled By E J

RADAR SPEED CHECK

LOCATION: Broadway AT High School
DATE: 2/21/90 TIME: 9⁴⁰ - 10⁴⁰ WEATHER: sunny cold
CONDITION OF ROAD: new RECORDER: HJK

AMPH	QUAN	PRODUCT
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22	2	44
23	1	23
24	1	24
25	4	100
26	1	26
27	4	108
28	6	168
29	9	261
30	13	390
31	12	372
32	13	416
33	9	297
34	5	170
35	4	140
36	4	144
37	5	185
38	1	38
39	2	78
40	3	120
41	1	41
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		

85 PERCENTILE SPEED = 36

TOTAL	100	3145
AVERAGE		31.5

RADAR SPEED CHECK

LOCATION: Trowbridge AT Broadway
 DATE: 2 TIME: 10:15-11 WEATHER: overcast
 CONDITION OF ROAD: _____ RECORDER: m/j

MPH		QUAN	PRODUCT
10			
11			
12			
13			
14			
15	X	2	30
16	X	2	32
17	X	2	34
18	X	6	108
19	X	10	190
20	X	11	220
21	X	6	126
22	X	7	154
23	X	10	230
24	X	8	192
25	X	12	300
26	X	7	182
27	X	8	216
28	X	3	84
29			
30	X	2	60
31	X	3	93
32	X	1	32
33			
34			
35			
36			
37			
38			
39			
40			
41			
42			
43			
44			
45			
46			
47			
48			
49			
50			
51			
52			
53			
TOTAL		100	2283
AVERAGE			23

85 PERCENTILE SPEED = 27 MPH

5.



CITY OF CAMBRIDGE
CAMBRIDGE, MASSACHUSETTS 02139
TEL. 498-9011

EXECUTIVE DEPARTMENT
ROBERT W. HEALY
City Manager

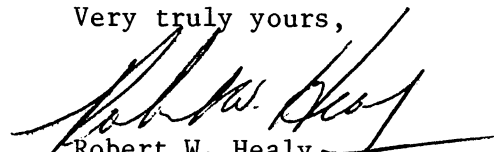
RICHARD C. ROSSI
Deputy City Manager

March 12, 1990

To The Honorable, The City Council:

With regard to Council Order No. 12, dated 1/29/90, relative to the Intersection Analysis for Broadway and Trowbridge Street, attached please find a report from George Teso, Director of Traffic and Parking.

Very truly yours,


Robert W. Healy
City Manager

RWH/mev
enclosure

Agenda # 5

5-253
Response to Council Order #12 of 1/29/90
regarding the Intersection Study for
Broadway and Trowbridge Street.

In City Council,

March 12, 1990

Placed on file