SIGNAL SYSTEM STUDY
for the
CENTRAL BUSINESS DISTRICT

Burlington, Iowa

George L. Crawford and Associates, Inc.
St. Louis, Missouri

George L. Crawford and Associates inc.
Traffic Engineers
P.O. Box 1240 Maryland Heights, Missouri 63043
314·567·4870

February 20, 1976

Mr. Mike Rukgaber
City Engineer
City of Burlington, Iowa
Burlington, Iowa 52601

Dear Mr. Rukgaber:

We are pleased to submit herewith our report of the Signal System Study of the Central Business District recently completed for the City of Burlington. This work was performed under the supervision of the Iowa State Highway Commission and was funded, in part, with Federal Highway Safety funds.

The major objective of this project was to analyze the signal system in the Central Business District to determine necessary measures for improving traffic circulation. The recommendations developed in this study should be of significant help in improving traffic safety within the study area.

We wish to express our appreciation to various members of the City's staff, particularly yourself, for their assistance in carrying out this project. We look forward to being of further service to you in the future.

Sincerely,

George L. Crawford, P.E.
President

GLC:jcm

SIGNAL SYSTEM STUDY
FOR THE
CENTRAL BUSINESS DISTRICT

Burlington, Iowa

February 3, 1976

This report was prepared through a Grant provided by the United States Department of Transportation, Federal Highway Administration, pursuant to the provisions of Section 402 of Title I of the Highway Safety Act of 1966.

PREPARED BY

George L. Crawford and Associates Inc.
Traffic Engineers
P. O. Box 1240
Maryland Heights, Missouri 63043

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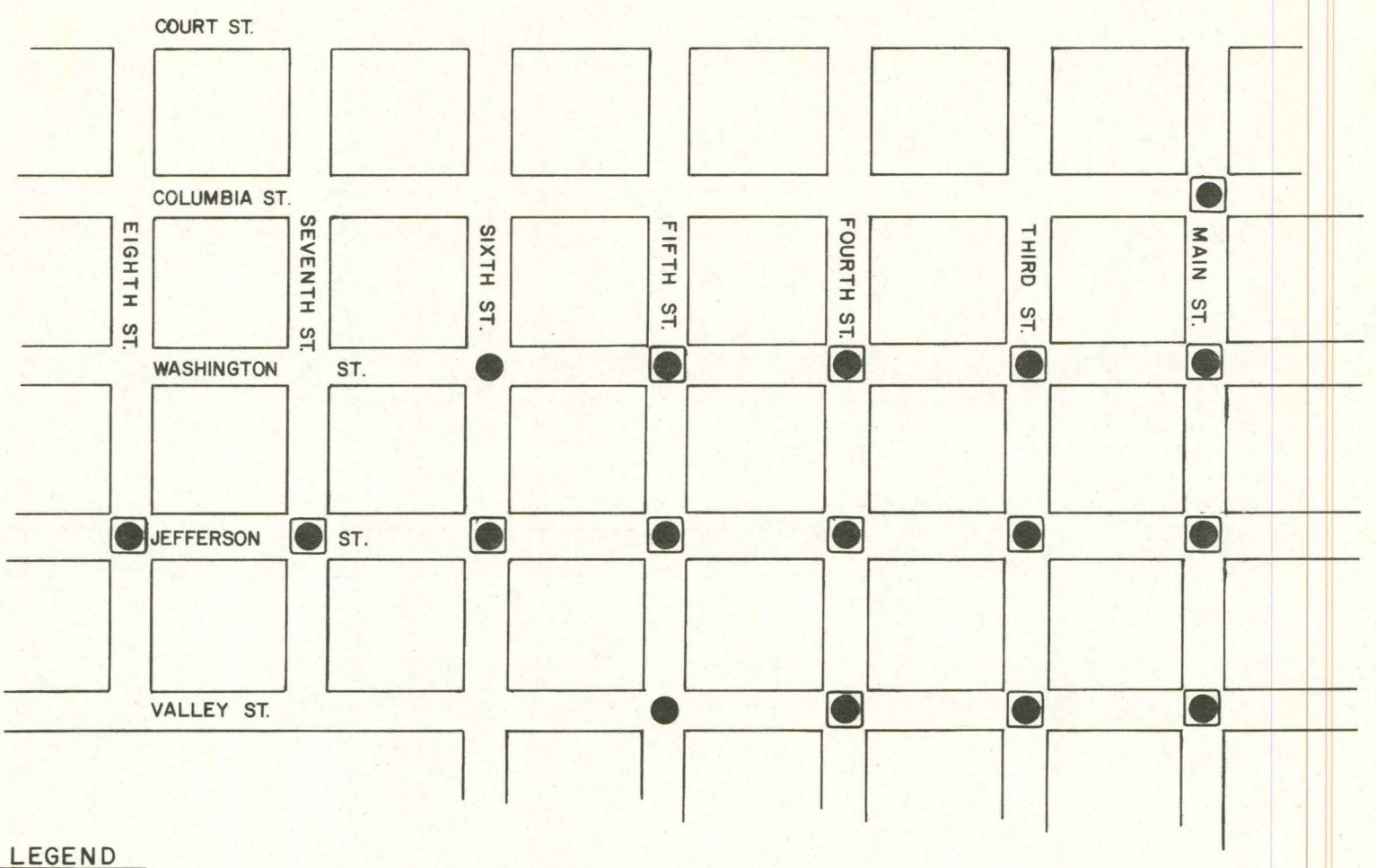
INTRODUCTION

The City of Burlington, Iowa, in conjunction with the traffic engineering firm of George L. Crawford and Associates, Inc., recently completed a comprehensive study of traffic movements in the central business district. The primary objective of this project was to determine measures for improving traffic circulation through a detailed evaluation of the downtown signal system.

Federal Highway Safety Funds, made available through the Iowa State Highway Commission, were used to finance this project. It is anticipated that the recommendations eminet-ing from this study will measurably improve traffic safety.

A considerable amount of data was collected in this project. Manual traffic counts were made at all major intersections. Existing traffic signals were inventoried to determine the condition of their equipment as well as their present operation. Physical characteristics of the streets, such as width, number of lanes, etc., were also measured. Exhibit 1, page 2, illustrates the locations studied.

On the basis of this data, a number of traffic studies were performed. Using information from these studies, recommendations were prepared for improving signal phasing and timing and innerconnecting these signals so as to achieve a progressive movement of traffic.



LEGEND

● STUDY INTERSECTIONS

◉ SIGNALIZED INTERSECTIONS

STUDY AREA
BURLINGTON, IOWA

Exhibit 1

The following sections of the report discuss this study in detail. An estimate of the cost for implementing the recommended improvements has also been prepared and is presented at the conclusion of this report.

DATA COLLECTION AND ANALYSIS

To fully analyze the existing traffic signal operation in the central business district as well as to evaluate future needs, a considerable amount of data was collected. Collection of this information was a joint effort between the City and the Consultant. Following a determination of data needs by the Consultant, City personnel were used to make the actual field studies. The following paragraphs discuss this phase of the study.

Traffic Volume Counts

Traffic volume counts were made at each of the 15 signalized intersections in the downtown area and also at the intersection of 6th and Washington Streets. Vehicular flows were counted manually thereby enabling each movement (throughs, left and right turns) to be counted and summarized separately by 15 minute periods for the various periods of the day. The counts were made between the hours of 7:00 a.m. and 9:00 a.m., 11:00 a.m. and 1:00 p.m., and 4:00 p.m. and 6:00 p.m. Table 1, pages 5, 6, and 7, tabulates this information and shows the average hourly movement for each intersection during the AM and PM peak hours and at midday.

These counts indicate that Main Street is the heaviest traffic carrier averaging nearly 800 vehicles per hour at Jefferson Avenue during the PM peak period. Washington and Valley Streets also handle large volumes of traffic in the

TABLE 1

TABULATION OF VEHICULAR TRAFFIC COUNTS

Intersection	Hourly Traffic Volume AM Peak	Midday	PM Peak
4th & Valley			
4th - NB	66	117	152
4th - SB	---	---	---
Valley - EB	263	324	308
Valley - WB	124	273	267
3rd & Valley			
3rd - NB	74	107	145
3rd - SB	73	167	274
Valley - EB	201	263	294
Valley - WB	136	319	392
Main & Valley			
Main - NB	287	349	267
Main - SB	202	326	457
Valley - EB	131	174	200
Valley - WB	68	122	148
8th & Jefferson			
8th - NB	33	43	66
8th - SB	42	38	76
Jefferson - EB	92	116	111
Jefferson - WB	63	125	152
7th & Jefferson			
7th - NB	54	130	180
7th - SB	13	32	51
Jefferson - EB	58	116	150
Jefferson - WB	27	45	70
6th & Jefferson			
6th - NB	146	121	130
6th - SB	107	129	172
Jefferson - EB[1)]	34	114	139
Jefferson - WB[1)]	43	64	77
5th & Jefferson			
5th - NB	---	---	---
5th - SB	146	205	269
Jefferson - EB[2)]	30	77	82
Jefferson - WB[2)]	22	69	83
4th & Jefferson			
4th - NB	126	173	202
4th - SB	---	---	---
Jefferson - EB	48	52	53
Jefferson - WB	70	102	100

TABLE 1 Continued

TABULATION OF VEHICULAR TRAFFIC COUNTS

Intersection	Hourly Traffic Volume AM Peak	Midday	PM Peak
3rd & Jefferson			
3rd - NB	87	177	157
3rd - SB	75	151	201
Jefferson - EB	51	111	113
Jefferson - WB	97	133	159
Main & Jefferson			
Main - NB	296	336	319
Main - SB	208	353	473
Jefferson - EB	52	110	104
Jefferson - WB	80	122	130
6th & Washington			
6th - NB	86	210	127
6th - SB	2	---	4
Washington - EB	237	257	220
Washington - WB	178	251	326
5th & Washington			
5th - NB	---	---	---
5th - SB	161	266	322
Washington - EB	269	308	322
Washington - WB	131	213	295
4th & Washington			
4th - NB	130	230	319
4th - SB	---	---	---
Washington - EB	261	296	319
Washington - WB	111	229	342
3rd & Washington			
3rd - NB	79	141	163
3rd - SB	74	85	180
Washington - EB	226	265	322
Washington - WB	126	168	290
Main & Washington			
Main - NB	298	310	345
Main - SB	250	317	388
Washington - EB	178	270	284
Washington - WB	53	75	139

TABLE 1 Continued

TABULATION OF VEHICULAR TRAFFIC COUNTS

Intersection	Hourly Traffic Volume AM Peak	Midday	PM Peak
Main & Columbia			
Main - NB	227	277	271
Main - SB	184	260	291
Columbia - EB	60	66	86
Columbia - WB	114	88	96

1) West of 6th Street

2) East of 5th Street

downtown area. More detailed information concerning specific traffic movements is included in the Data Appendix.

Accident Data

Traffic accident records were studied for the years of 1972, 1973, and 1974 to determine the accident pattern at various intersections in the central business district. Collision diagrams were prepared for each signalized intersection for these three years and are shown in the Data Appendix. Specific information relating to the frequency and severity of accidents experienced during these years has been taken from the collision diagrams and summarized in Table 2, page 9.

As shown in this table, the intersection of Main and Washington Streets experienced the greatest number of accidents during this period, a total of 62 collisions. However, seven of the 15 signalized intersections experienced at least 40 accidents during these three years. Most of the collisions were not severe involving only property damage. More specifically, accidents involving a personal injury accounted for less than ten percent of the total and no fatalities were recorded.

It is notable, however, that the accident rate at these intersections expressed in terms of the number of accidents per million vehicles entering the intersection is surprisingly large. The intersection of 5th and Jefferson recorded the highest rate averaging nearly 20 accidents per million vehicles entering the intersection

TABLE 2

TRAFFIC ACCIDENT SUMMARY

Intersection	Number of Accidents[1]				Accident[2] Rate
	Property Damage	Injury	Fatality	Total	
4th & Valley	30	1	--	31	4.4
3rd & Valley	45	--	--	45	4.7
Main & Valley	42	--	--	42	4.0
8th & Jefferson	26	2	--	28	7.4
7th & Jefferson	20	1	--	21	5.8
6th & Jefferson	19	1	--	20	4.6
5th & Jefferson	59	1	--	60	19.2
4th & Jefferson	30	4	--	34	9.5
3rd & Jefferson	48	--	--	48	8.5
Main & Jefferson	56	2	--	58	5.8
6th & Washington		N.A.			
5th & Washington	20	3	--	23	2.6
4th & Washington	23	3	--	26	2.9
3rd & Washington	42	--	--	42	4.8
Main & Washington	60	2	--	62	5.3
Main & Columbia	12	2	--	14	1.8

1) Total for the years of 1972, 1973, and 1974.

2) Expressed as the number of accidents per million vehicles entering the intersection.

N.A. Not Available

during this time period. Twelve of the 15 signalized intersections had rates in excess of three a value frequently used as a standard in this type of analysis. Accident rates above this level are considered to be greater than normal.

This high accident frequency can be attributed to a number of causes, the most important of which is the fact that many of the signals are not adequately visible to motorists approaching the intersection. Locations having especially poor signal visibility are noted in the following section of the report in which intersections are discussed on an individual basis.

A second factor contributing to the accident rate is the fact that angle parking is utilized in much of the downtown area. Use of angle parking on busily traveled streets frequently results in a high incidence of accidents. Motorists backing out from angle parking spaces have difficulty observing approaching traffic and as a result have a tendency to back into the path of oncoming vehicles. Specific locations experiencing this problem are cited in the next section of the report.

Traffic Signal Inventory

Each of the 15 signalized intersections were inventoried to determine existing phasing and timing as well as the type and condition of signal equipment. All of these intersections have pretimed signal control and use one dial throughout the entire day. Thus, signal phasing and timing remains constant. Although the signal equipment at these intersections is

physically interconnected, signal phasing has not been synchronized to obtain a progressive flow of traffic along the system.

Eight inch circular lenses are used for the red, yellow, and green, post mounted signal indications. In some instances circular signal lenses are also used to indicate to pedestrians when walking is permitted. Nonstandard messages such as "wait" or "leave curb" are used at some locations to direct the movements of pedestrians. Table 3, page 12, summarizes the existing signal timings at intersections in the study area. As shown, many of the intersections have identical phasing and timing.

Travel Time Studies

At the direction of the Consultant, City personnel conducted a number of peak hour and off-peak travel time studies along the downtown street system. Vehicle delays were recorded and the average travel speed noted between intersections. As shown in Table 4, page 13, the average travel speed along the downtown streets varied from 11 miles an hour to 15 miles per hour. However, most speeds were in the range of 12 to 17 miles per hour. The best operating speeds were achieved along Washington Street while speeds along 5th Street generally averaged the slowest, approximately 11 miles per hour. This data was particularly helpful in determining the appropriate speed to use in designing a traffic signal progression system in a later phase of this study.

TABLE 3

EXISTING SIGNAL TIMING

Intersection	Green Time (%) [1]		Clearance Time (%)
	North-South	East-West	
4th & Valley	44	44	12
3rd & Valley	46	46	8
Main & Valley	46	46	8
8th & Jefferson	44	44	12
7th & Jefferson	44	44	12
6th & Jefferson	44	44	12
5th & Jefferson	44	44	12
4th & Jefferson	44	44	12
3rd & Jefferson	44	44	12
Main & Jefferson	44	44	12
5th & Washington	50	40	10
4th & Washington	44	44	12
3rd & Washington	44	44	12
Main & Washington	44	44	12
Main & Columbia	44	44	12

1) Signals operate on a 50 second cycle.

TABLE 4

TRAVEL TIME SUMMARY

Street	Direction of Travel	Averaging Operating Speed (mph)
Valley	5th to Main	14.0
	Main to 5th	16.4
Jefferson	8th to 6th	12.7
	5th to Main	10.9
	Main to 5th	11.8
	6th to 8th	13.1
Washington	6th to Main	17.3
	Main to 6th	17.5
6th	Jefferson to Washington	13.8
	Washington to Jefferson	12.9
5th	Washington to Valley	11.1
4th	Valley to Washington	16.6
3rd	Valley to Washington	12.0
	Washington to Valley	13.0
Main	Valley to Columbia	15.1
	Columbia to Valley	16.1

STUDY RECOMMENDATIONS

Using the data discussed in the previous section of the report, each major intersection in the central business district was studied to determine needed signal improvements. The following pages discuss the traffic capacity and accident studies performed at each location and enumerate those recommendations proposed for each intersection.

4th and Valley

A two phase signal controls vehicular movements at the intersection of 4th and Valley Streets. Street widths are sufficiently wide (50 feet to 60 feet) to permit the flow of two-way traffic. However, 4th Street is one-way northbound north of this intersection. Angle parking is allowed along both streets.

Traffic problems at this location are threefold. The intersection is experiencing a high accident rate, primarily because of angle parking present near the intersection and because of inadequate signal visibility. Fifty percent of the collisions for which detailed information is available, involved a vehicle leaving a parking space colliding with another vehicle passing through the intersection. A lack of adequate signal visibility contributes further to this accident problem. Two far signal indications, required by the National Manual on Uniform Traffic Control Devices, are not being used.

Finally, eastbound left turns are relatively heavy during the PM peak hour period. However, a holding lane is not available to store these vehicles until they have adequate time to make a safe left turn.

To correct the above mentioned problems, the following improvements are recommended.

1. The diagonal parking should be replaced by parallel parking on east, west, and south legs of the intersection. A portion of the diagonal parking should also be eliminated on the north approach to the intersection.

2. The pavement should be restriped to provide left turn lanes on the east, west, and south approaches.

3. Many of the existing signal heads should be relocated and additional heads installed to provide far left and far right signal indications within the 20 degree cone of visibility recommended by national standards.

4. Twelve inch red signal indications should be used on all approaches.

5. Walk - don't walk rectangular pedestrian heads should be used to direct pedestrians using all four crosswalks.

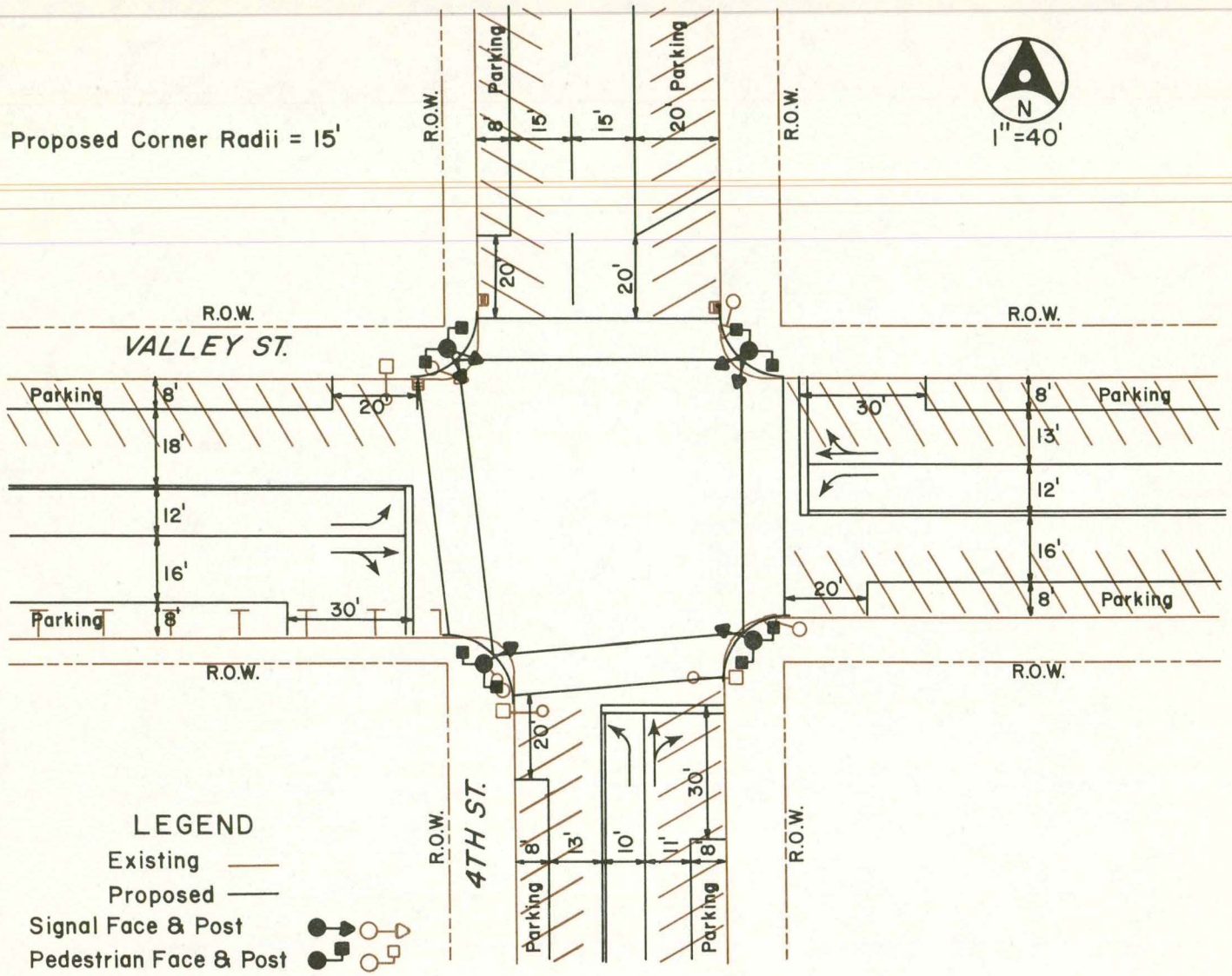
6. The signal timing should be revised to provide a greater portion of the green time to Valley Street.

7. The curb corners should be cut back to give a minimum turning radius of 15 feet.

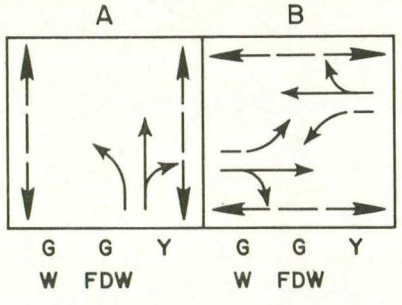
These recommendations are shown in detail in Exhibit 2, page 16. Additional information concerning traffic volumes, accident patterns, and capacity studies are included in the Data Appendix.

3rd and Valley

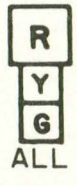
Two-way traffic movements are permitted on both streets at this intersection. Diagonal parking is allowed on the north, east, and west intersection legs. Third street is



SIGNAL PHASING



SIGNAL HEADS



PEDESTRIAN HEADS

PROPOSED IMPROVEMENT

4TH ST. - VALLEY ST.

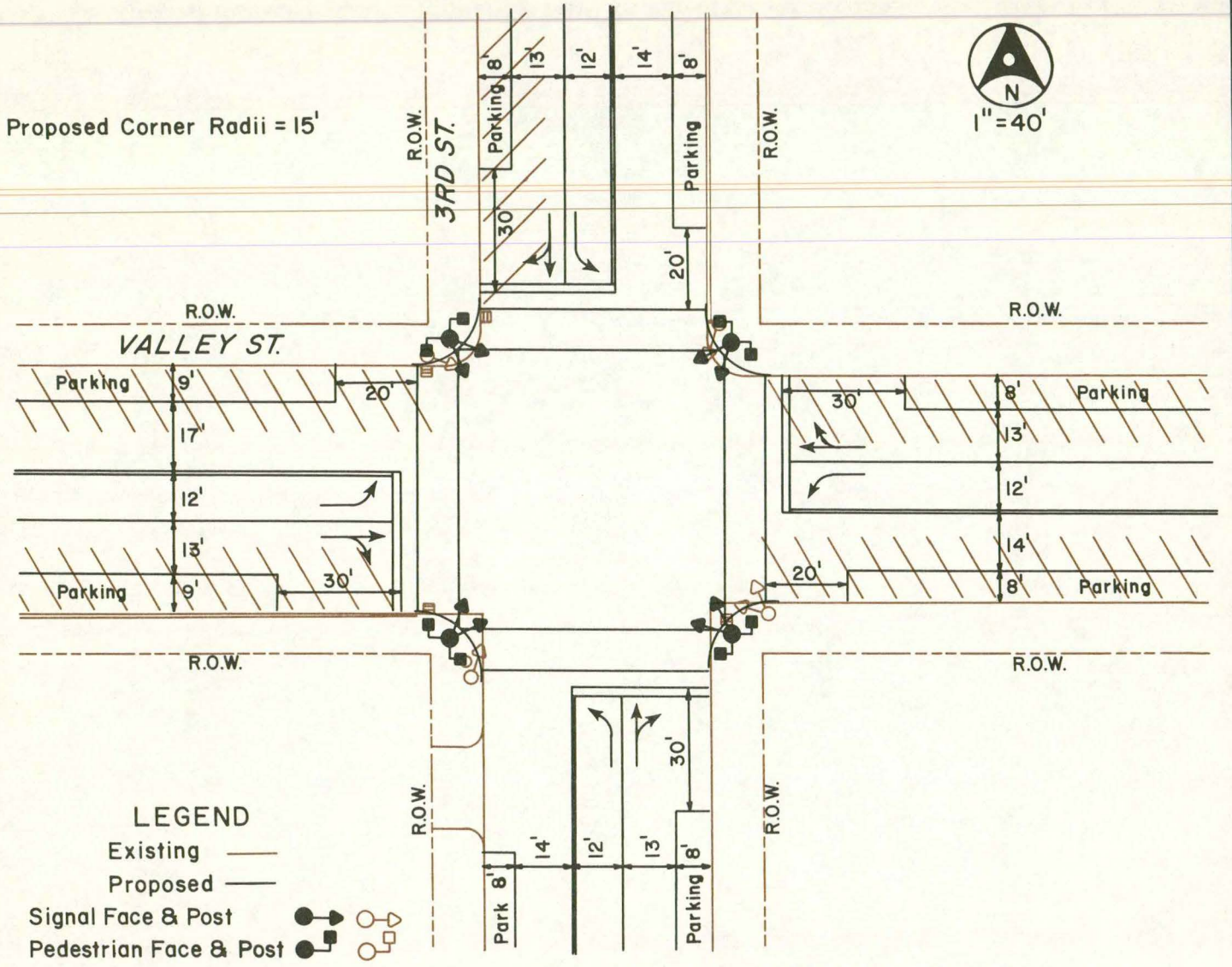
EXHIBIT 2

55 feet wide, while Valley Street is 55 feet wide on the east approach and 60 feet on the west approach.

Forty-five accidents were reported at this location during the past three years thereby constituting a rate of 4.7 accidents per million vehicles entering the intersection. This high rate can be attributed to the presence of angle parking and the lack of adequate signal visibility. Twelve of the 21 collisions for which specific information is known involved a vehicle entering or leaving a parking space. Signal visibility is also inadequate as evidenced by the fact that only one of the four approaches has a far left signal indication. Consequently, numerous rear end and right angle collisions have also occurred.

A number of improvements are recommended to accommodate traffic flows. These recommendations, illustrated in Exhibit 3, page 18, are listed below.

1. Replace the diagonal parking on both streets with parallel parking.
2. Restripe the pavement on all approaches to allow a left turn and through traffic lane on each approach to the intersection.
3. Add 12 inch red signal indications on all approaches.
4. Install rectangular walk and don't walk pedestrian signals.
5. Relocate the existing signal heads and install additional far left signal indications so that motorists will have adequate far right and far left indications.
6. Retime the traffic signal to give a greater percentage of the green time to Valley Street, the more heavily used of the two streets.
7. Reconstruct the curb corners so as to increase the corner radii to a minimum of 15 feet.



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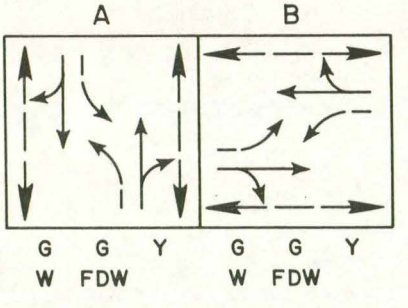


SIGNAL HEADS

PEDESTRIAN HEADS

PROPOSED IMPROVEMENT

3RD ST. - VALLEY ST.

EXHIBIT 3

Additional information pertaining to traffic movements, capacity analyses, and accident patterns at this location can be found in the Data Appendix.

Main and Valley

The intersection of Main and Valley Streets is one of the most heavily traveled in the central business district. Left turns off of Valley Street are heavy during the PM peak hour, averaging nearly 100 in each direction.

Parallel parking is allowed on Main Street while diagonal parking is permitted along the south side of Valley Street east of this intersection. Both streets are approximately 55 feet wide.

Forty-two traffic accidents have been recorded during the past three years, a rate of four accidents per million vehicles entering the intersection. These collisions are principally of two types. Nine of the 33 accidents for which information is available involved a vehicle entering or leaving a parking space. Another 13 relate to rear end or right angle collisions involving motorists along Main Street. On the basis of this accident pattern, it appears motorists using Main Street have difficulty observing the traffic signal in time to respond.

A number of changes are suggested to improve traffic flows. These include:

1. Elimination of angle parking along the south side of Valley Street east of the intersection.
2. Restriping of the intersection to provide through and left turn lanes on each approach. A separate right turn lane should also be allowed for eastbound traffic on Valley Street.

3. Placement of mast arm signal indications for northbound and southbound motorists on Main Street to provide better signal visibility for approaching drivers.

4. Use of 12 inch red signal indications on all post mounted signals and 12 inch red, yellow, and green signal indications on the mast arms.

5. Installation of rectangular walk and don't walk pedestrian heads at the pedestrian crossings.

6. Retime the traffic signals to give a greater amount of green time to Main Street.

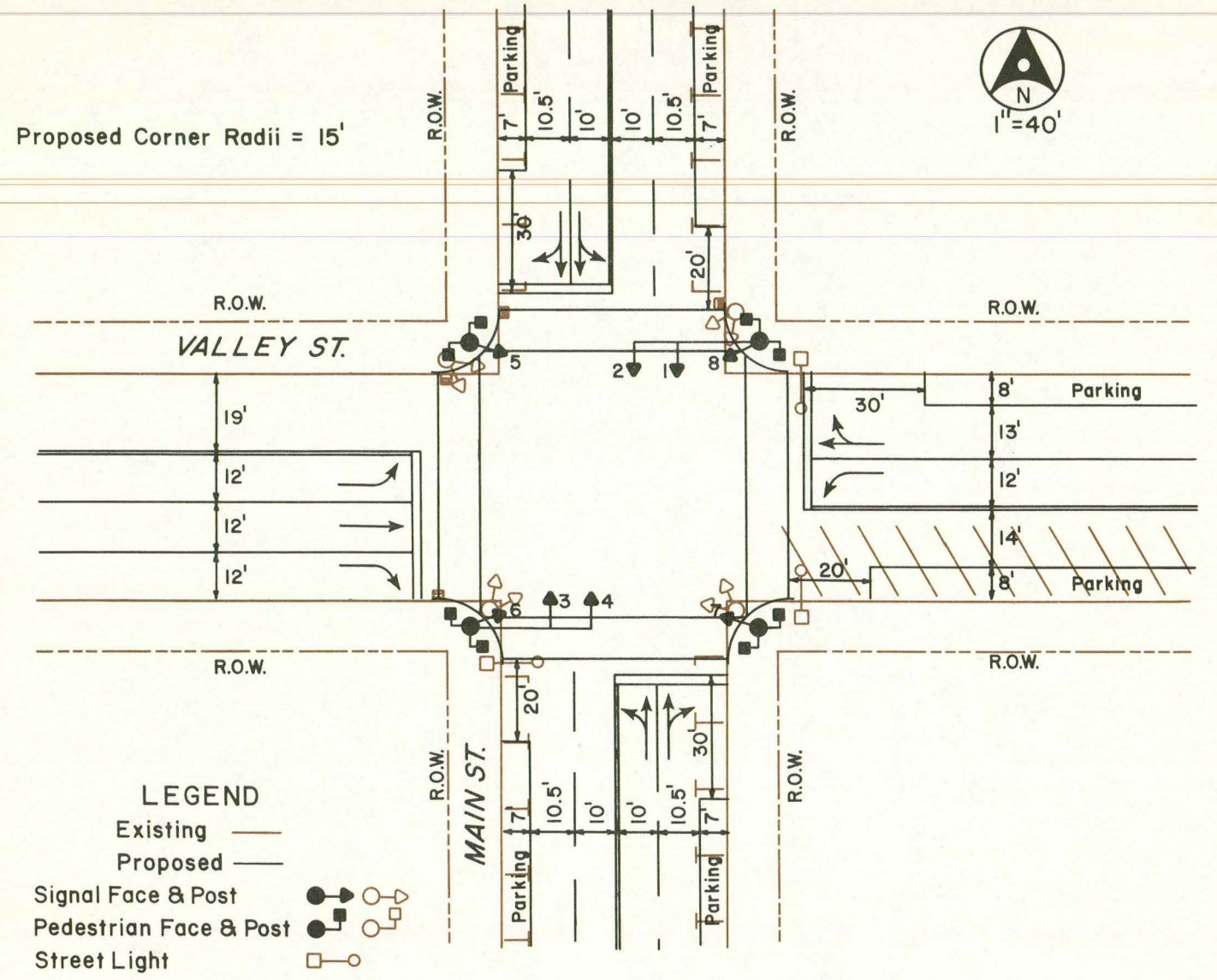
7. Increase the radii on the curb corners to 15 feet.

These recommendations are illustrated in Exhibit 4, page 21. Further information pertaining to vehicular movements, capacity analyses, and the accident pattern is given in the Data Appendix.

8th and Jefferson

Traffic movements at the intersection of 8th and Jefferson are relatively light averaging only 400 vehicles during the PM peak hour. Existing traffic capacity is more than adequate because both streets are approximately 55 feet wide.

In spite of the relatively low traffic volumes, 28 traffic accidents have been recorded at this location in the past three years. This frequency of accidents coupled with the low traffic volumes translates into an accident rate of approximately seven and one half collisions per million vehicles entering the intersection, the third highest in the central business district. Most of these collisions are either rear end or right angle and are undoubtedly caused



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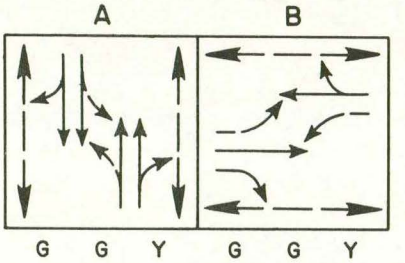

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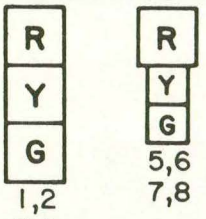


PEDESTRIAN HEADS

PROPOSED IMPROVEMENT

MAIN ST. - VALLEY ST.

EXHIBIT 4

by substandard signal visibility. For example, motorists approaching on three of the four intersection legs do not have a far left signal indication.

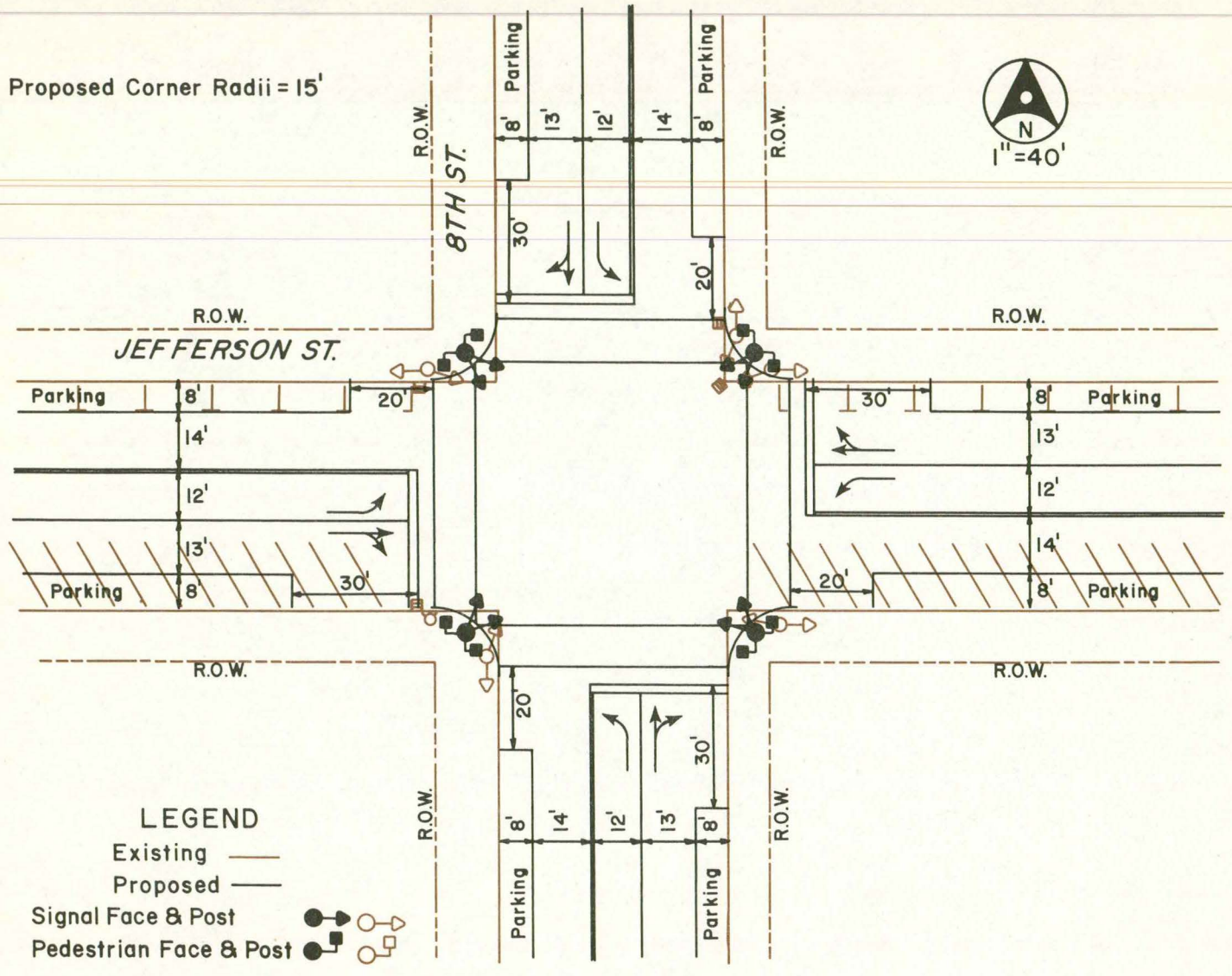
A number of improvements are recommended to facilitate traffic flows at this location. These include:

1. Eliminate the existing diagonal parking along the south side of Jefferson Street and replace it with parallel parking.
2. Restripe the approaches to this intersection to allow a through and left turn lane on each approach.
3. Provide 12 inch red signal indications on all approaches.
4. Provide rectangular walk - don't walk pedestrian signal indications on all approaches.
5. Relocate the existing signal heads and add additional heads to give adequate far right and far left signal indications on all approaches.
6. Cut back the corners so as to provide a 15 foot turning radius on each corner.
7. Retime the signals to give more green time for Jefferson Street.

The above recommendations are illustrated in Exhibit 5, page 23. Additional data concerning the traffic characteristics of this intersection can be found in the Data Appendix.

7th and Jefferson

Traffic movements along 7th and Jefferson Streets are relatively low, averaging less than 250 vehicles during the PM peak hour. Both streets are relatively wide. Consequently, the existing intersection capacity is more than adequate to handle traffic flows.



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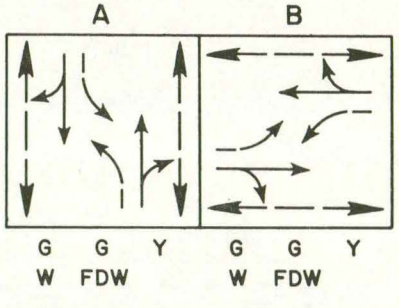


SIGNAL HEADS

PEDESTRIAN HEADS

PROPOSED IMPROVEMENT

8TH ST. - JEFFERSON ST.

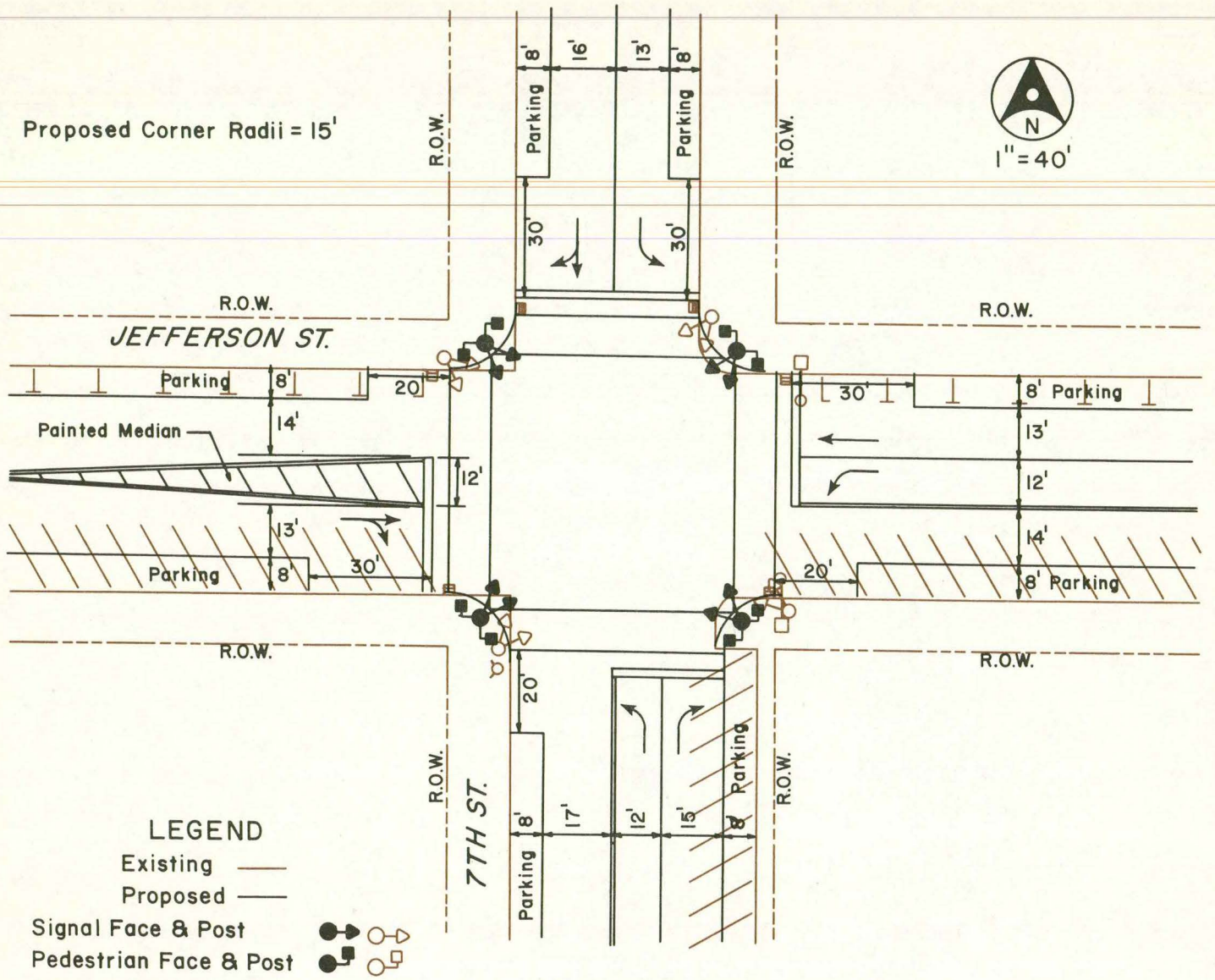
EXHIBIT 5

As at most of the other intersections in the central business district, the accident rate at this location is above normal. The 21 reported accidents during the past three years constitutes a rate of nearly six accidents per million vehicles entering the intersection. Nearly 50 percent of the accidents for which information is available involve a vehicle parking or unparking from a diagonal parking space. Therefore, the use of angle parking would appear to contribute to the traffic problem.

A number of improvements are recommended to reduce the heavy incidence of accidents. These recommendations are illustrated in Exhibit 6, page 25, and are also listed below.

1. Eliminate the diagonal parking on both streets and replace it with parallel parking as shown in Exhibit 6.
2. Restripe the approaches to the intersection so that separate left turn lanes are provided on the east and south approaches. An island should be painted on the west leg of the intersection opposite the left turn lane thereby forcing motorists using this lane to turn south into 7th Street.
3. The signal heads should be repositioned at the intersection to improve signal visibility.
4. Twelve inch red signal indications should be used on all approaches.
5. Rectangular walk - don't walk pedestrian heads should be used on all approaches.
6. The curb corners should be cut back so as to provide 15 foot corner radii.
7. The signal phasing should be revised to provide 30 percent green time in the north-south direction and 58 percent green time on the east-west approaches.

Additional information concerning traffic movements and accident patterns at this intersection is available in the Data Appendix.



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PEDESTRIAN HEADS

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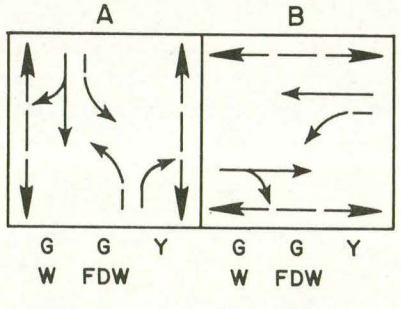
SIGNAL PHASING



13 17 6 42 16 6 60 Sec. Cycle

PROPOSED IMPROVEMENT

7TH ST. - JEFFERSON ST.

EXHIBIT 6

6th and Jefferson

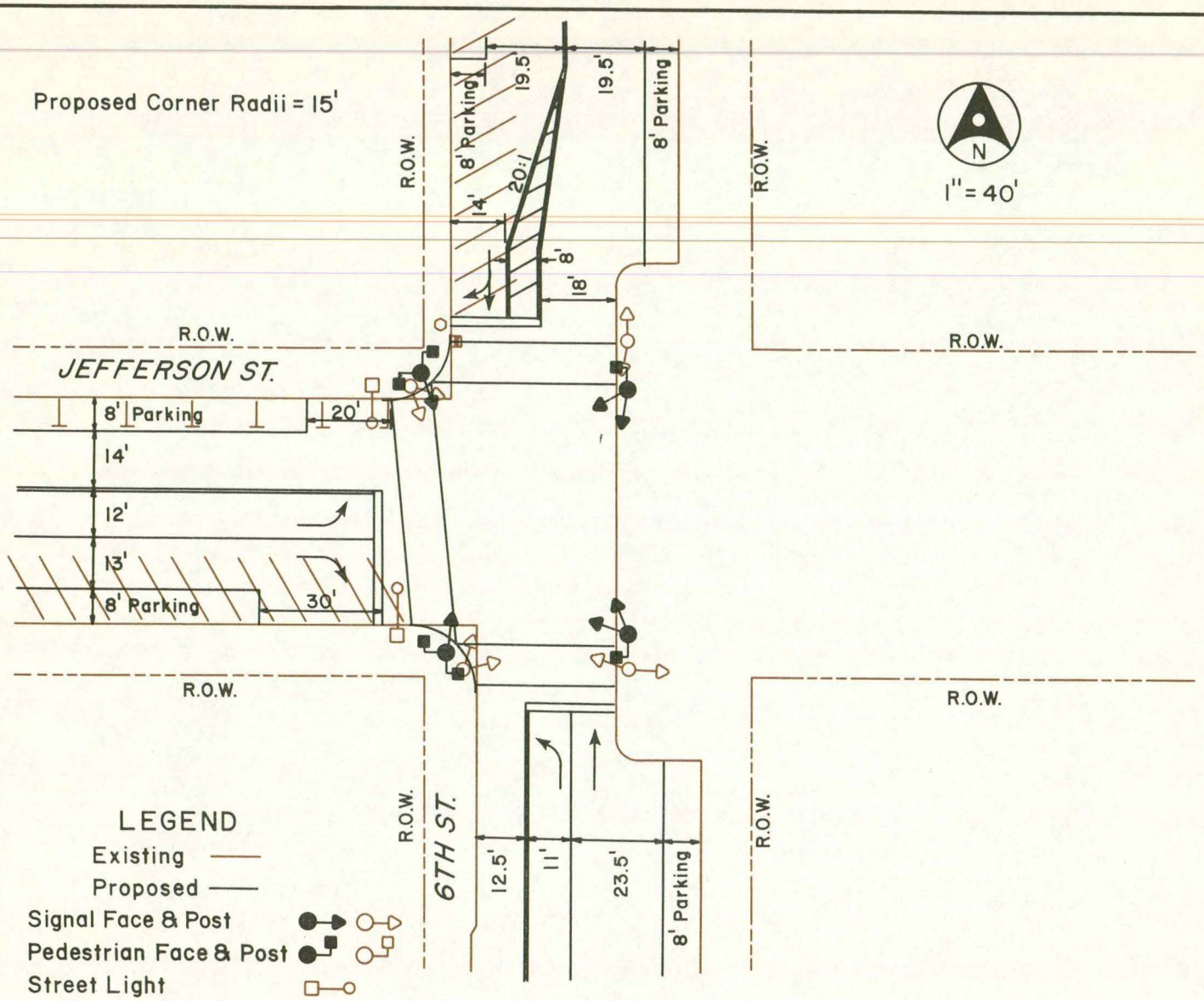
Jefferson Avenue has been closed between 6th and 5th Streets to provide a shopping mall. Consequently, traffic volumes at 6th Street are relatively low averaging 400 vehicles per hour during the PM peak hour. Both streets have a width of approximately 55 feet. This width is more than adequate to handle the existing and anticipated traffic volumes.

As at many of the signalized intersections in the downtown, the frequency of accidents at this intersection is somewhat greater than would normally be expected. It should be noted, however, that a substantial portion of these accidents occurred on the east leg of the intersection during 1972 and 1973 prior to the time this leg was closed for the pedestrian mall.

Two thirds of the accidents recorded in 1974 involved a collision with a vehicle parking or unparking. On this basis, it is reasonable to conclude that the principal traffic problem at this intersection involves a conflict between through traffic and motorists parking and unparking along the curb. Some improvement in signal visibility is also desirable, particularly for motorists entering the intersection from the west.

To alleviate the above mentioned problems, it is recommended the following traffic solutions be implemented.

1. Remove diagonal parking along the north and west legs of this intersection, replacing it with parallel curb parking as shown in Exhibit 7, page 27.



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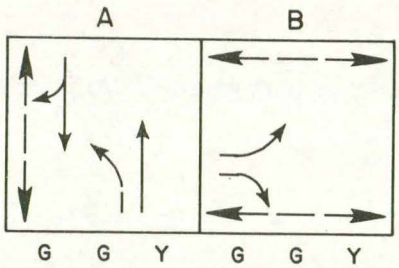
SIGNAL PHASING



17 13 6 41 17 6 60 Sec. Cycle

PROPOSED IMPROVEMENT

6TH ST. - JEFFERSON ST.

EXHIBIT 7

2. Restripe the intersection to provide two approach lanes on the west leg, a left turn and a right turn lane. Sixth Street should also be restriped to provide a left turn lane for northbound traffic and to channelize southbound traffic.

3. As noted above, signal visibility should be improved by repositioning the signals to give the motorists better visibility, particularly of the far left indications.

4. Twelve inch red indications should be used on all signal heads.

5. Rectangular walk - don't walk pedestrian indications should be installed.

6. The northwest and southwest corners of the intersection should be cut back to provide 15 foot turning radii.

7. Signal timing should be adjusted to provide 30 and 58 percent green time for the north-south and westbount traffic movements respectively.

Exhibit 7, page 27, illustrates the above recommendations. The Data Appendix contains additional data relating to traffic. volumes and accidents at this intersection.

5th and Jefferson

As a result of the pedestrian mall, Jefferson Street forms a T intersection with 5th Street at this location. Because of the relatively wide street widths (55 feet) and the low traffic volumes (approximately 425 vehicles per hour during the PM peak hour), the intersection has more than adequate capacity.

Traffic accidents are an extremely serious problem. During the past three years 60 accidents have occurred, resulting in a rate of approximately 19 collisions per million vehicles entering the intersection. This rate is

twice that of any other signalized intersection in the central business district. As noted from the collision diagrams shown in the Appendix, approximately one third of the accidents for which information is available involved vehicles either parking or unparking from a parking space. The diagonal parking permitted north and south of the intersection contributes to this problem.

As a means of stimulating commercial activity in the central business district and to de-emphasize vehicular movements along Jefferson Street, the City plans to narrow the Jefferson Street pavement between 5th Street and 3rd Street to 36 feet thereby allowing additional area for pedestrian movement. This plan should reduce the flow of traffic through the 5th Street intersection which in turn should alleviate, to some degree, the serious accident problem currently being experienced.

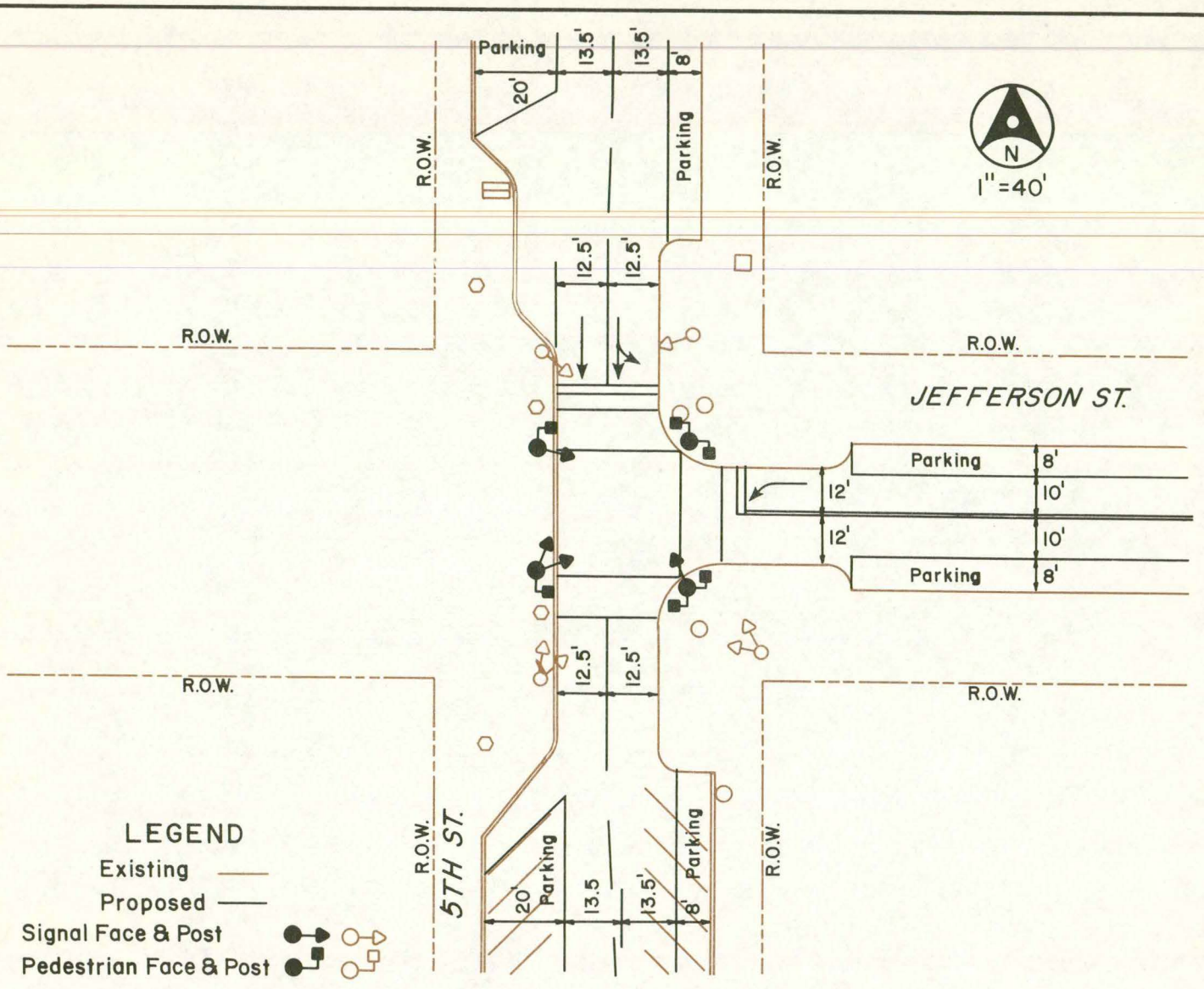
There are a number of additional improvements which should be implemented. These are enumerated below and shown in more detail in Exhibit 8, page 30.

1. Eliminate the angle parking along the east side of 5th Street south of the intersection and replace with parallel parking.

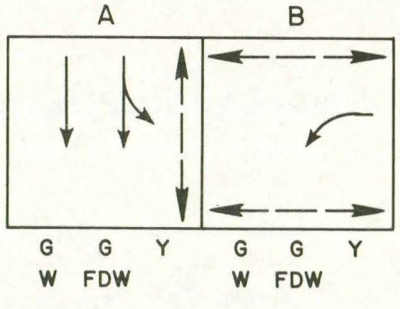
2. Reposition the signal heads so their visibility to motorists will be improved. This repositioning is particularly desirable in light of the fact that Jefferson Street will be narrowed east of the intersection.

3. Install 12 inch red signal indications on all approaches.

4. Utilize rectangular pedestrian walk - don't walk signal indications at all crosswalks.



SIGNAL PHASING



56 8 6 16 8 6 60 Sec. Cycle

SIGNAL HEADS

ALL

PEDESTRIAN HEADS

ALL

PROPOSED IMPROVEMENT

5TH ST. - JEFFERSON ST.

EXHIBIT 8

5. Revise the signal timing so as to allow the majority of the green time (64 percent) for north-south traffic.

Additional information pertaining to the traffic volumes and accident pattern at this intersection is available in the Data Appendix.

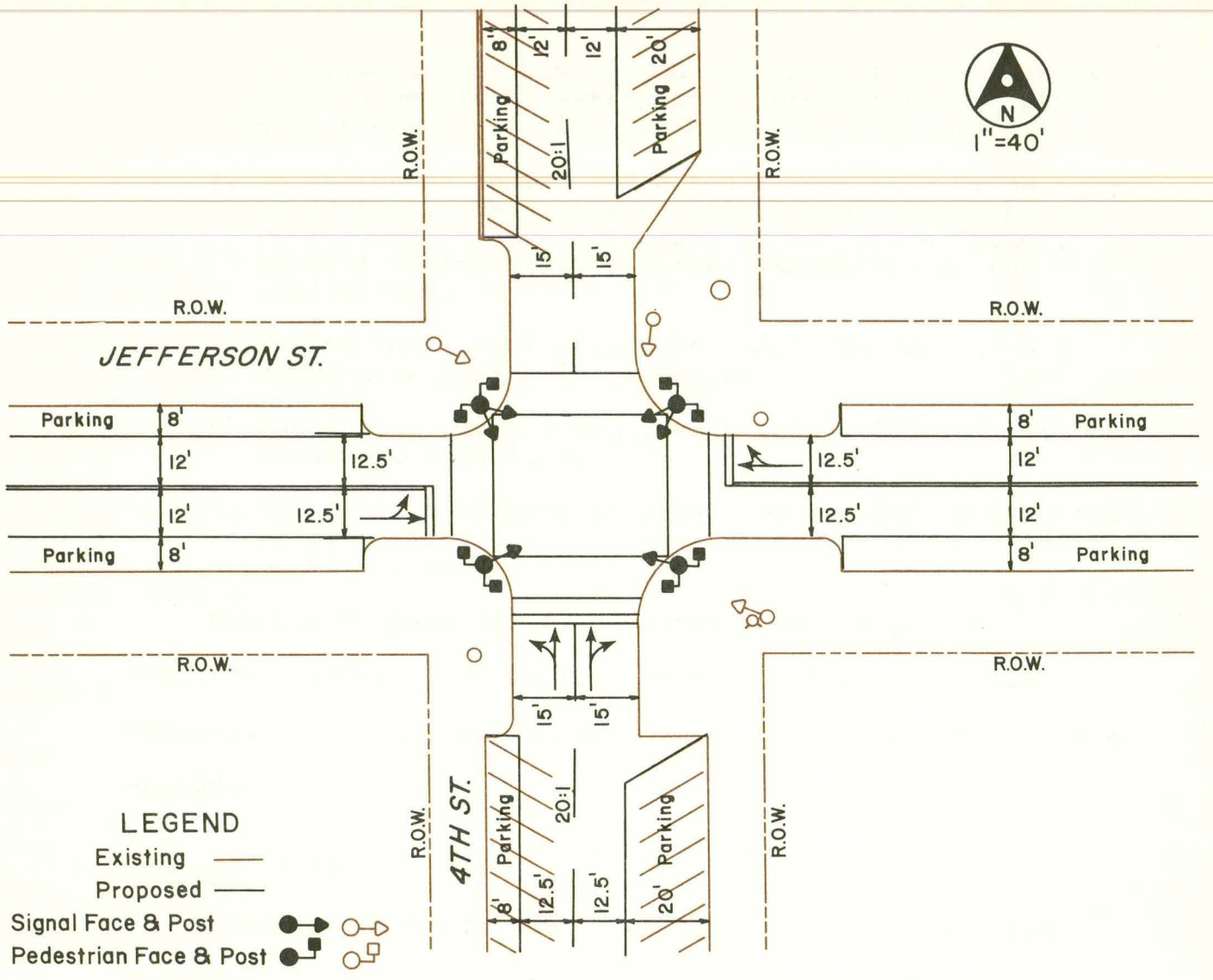
4th and Jefferson

As indicated previously, Jefferson Street will be narrowed to 40 feet in this area to stimulate commercial activity, provide greater walking space for pedestrians, and de-emphasize the flow of traffic on Jefferson Street. Because vehicular volumes are relatively low, the narrowing of Jefferson Street should cause little disruption to the existing traffic pattern.

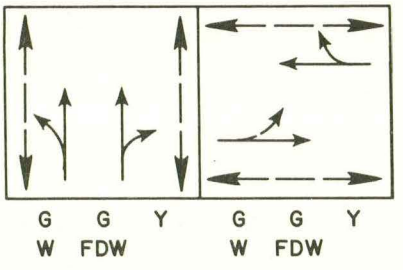
The principal problem at this intersection is its high frequency of traffic accidents. During the past three years 34 collisions were reported, an accident rate of 9.5 accidents per million vehicles entering the intersection. This rate is the second highest in the central business district.

Most of these accidents involved motorists traveling along Jefferson Street. The de-emphasis of vehicular flows along this street plus a repositioning of the traffic signals to give better visibility should help alleviate the problem. A number of other traffic improvements are also recommended. These are listed below and shown in detail in Exhibit 9, page 32.

1. Diagonal parking is presently allowed along both sides of 4th Street. Parallel parking should be

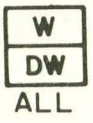


SIGNAL PHASING



SIGNAL HEADS

PEDESTRIAN HEADS



PROPOSED IMPROVEMENT

4TH ST. - JEFFERSON ST.

EXHIBIT 9

It appears that the use of diagonal parking contributes greatly to the accident problem at this location. The City's plan to narrow Jefferson Street west of 3rd Street and replace the diagonal parking along Jefferson Street with parallel parking should improve this situation. A number of other improvements should also be implemented to reduce traffic hazards. These are enumerated below and shown in detail in Exhibit 10, page 35.

1. Parallel parking should be substituted for the diagonal parking along Jefferson Street on both sides of the intersection. In addition, diagonal parking along the east side of 3rd Street should be eliminated and the pavement restriped to provide wider moving traffic lanes.

2. Reconstruction of Jefferson Street west of this intersection will necessitate repositioning of the traffic signals so that they will be more visible to motorists along Jefferson Street.

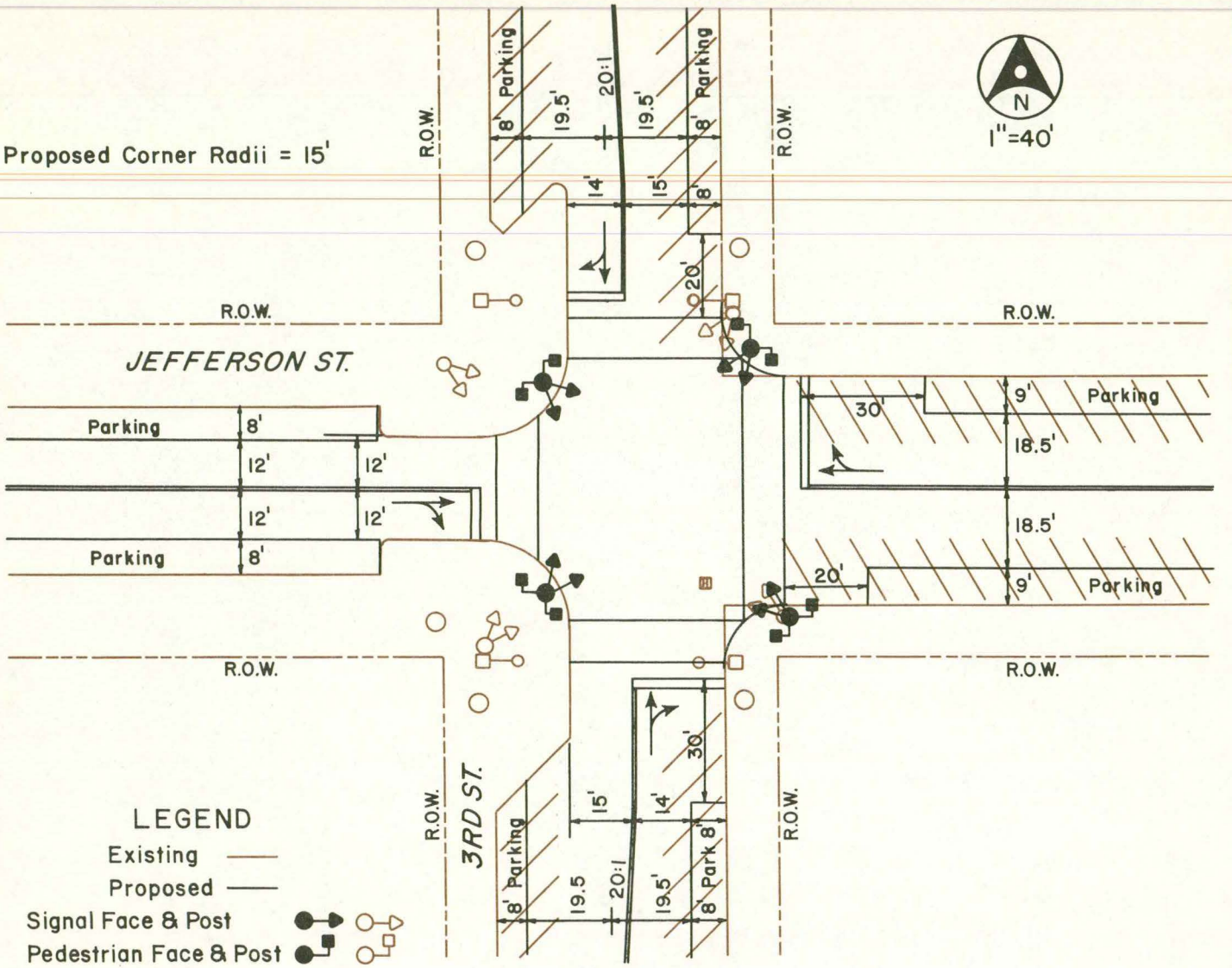
3. Twelve inch red signal indications should be used on all approaches.

4. Rectangular pedestrian heads should be used on all crosswalks.

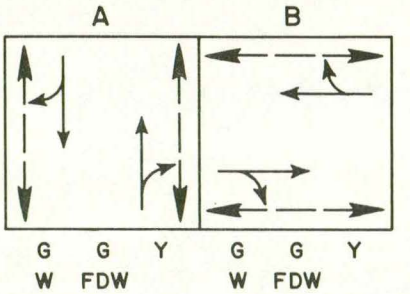
5. With a de-emphasis of vehicular flows along Jefferson Street, the signals should be retimed to give additional green time to 3rd Street. This timing and phasing is shown in Exhibit 10.

6. The northeast and southeast curb corners should be rebuilt to give wider turning radii.

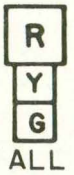
Additional information pertaining to existing traffic and accident conditions at this intersection are included in the Data Appendix.



SIGNAL PHASING



SIGNAL HEADS



ALL

PEDESTRIAN HEADS

ALL

PROPOSED IMPROVEMENT

3RD ST. - JEFFERSON ST.

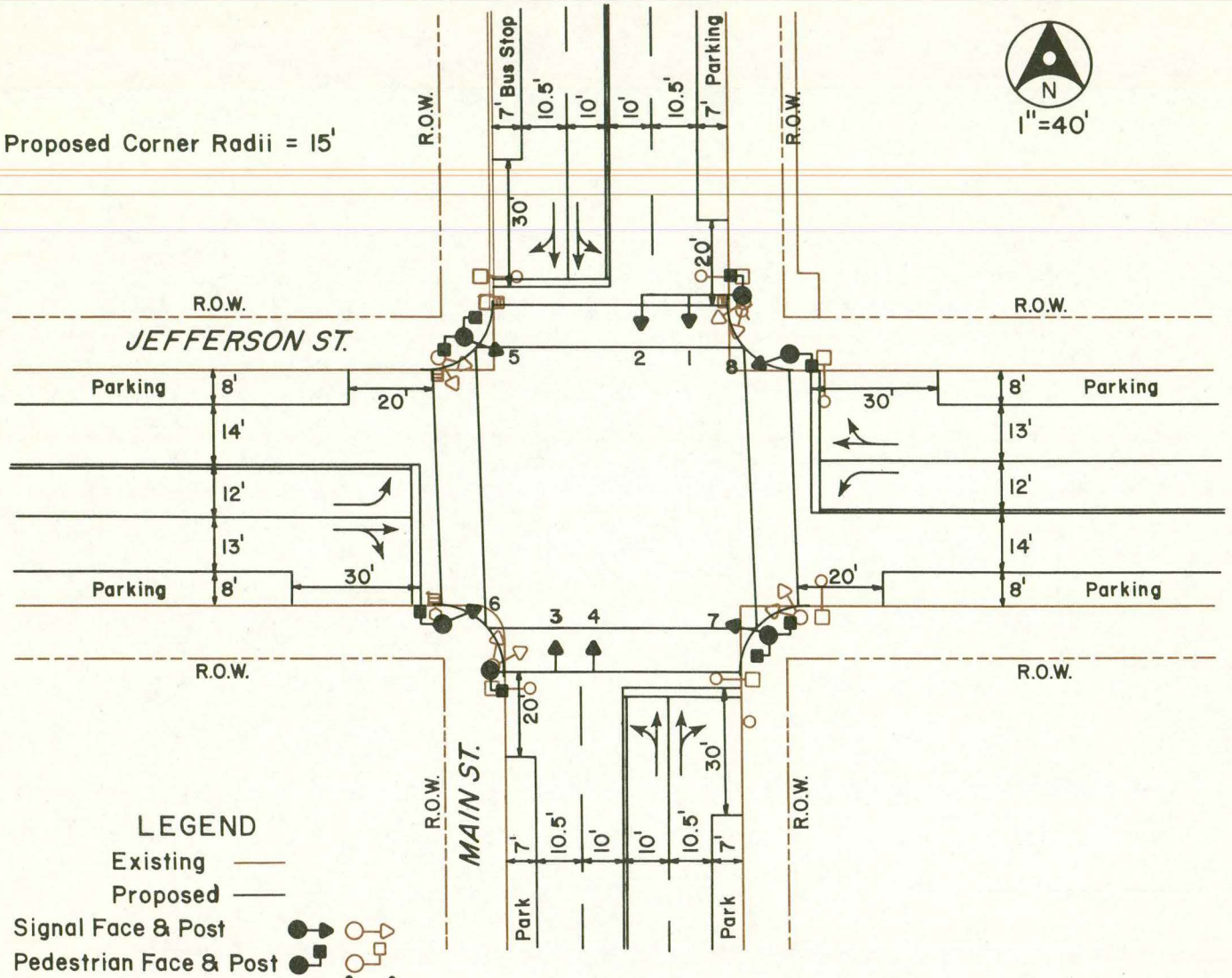
EXHIBIT 10

Main and Jefferson

Main Street is the major carrier of traffic in the Burlington central business district. Consequently, the intersection of Main and Jefferson is one of the most important in the downtown. Both streets are 55 feet wide and are capable of handling relatively heavy traffic flows. Because diagonal parking is not allowed on either of these streets two moving traffic lanes are provided on each approach to the intersection.

Fifty-eight traffic accidents were recorded at this location during the past three years of which nearly half involved a vehicle parking or unparking. Most of the remaining were either rear end or right angle collisions. The heavy accident pattern can be contributed to two factors. Vehicles are permitted to park along the curb extremely close to the intersection. Consequently, a great deal of friction occurs as motorists pull in and out of these parking spaces. A second factor is the need for improved signal visibility. Better signal visibility would give more warning to motorists as they approach the intersection thereby allowing them greater time to react to signal phase changes. The following improvements are recommended to accommodate traffic flows.

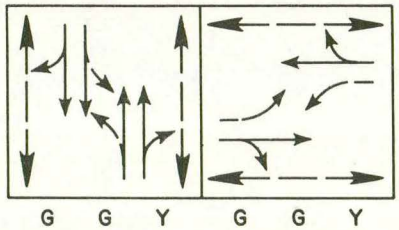
1. As shown in Exhibit 11, page 37, parking should be eliminated along the curb for a minimum of 30 feet back on the approach lanes to the intersection. A 20 foot parking restriction should also be imposed along the curb opposite these approach lanes. These restrictions will provide better visibility for motorists as they enter the intersection and eliminate many of the vehicle conflicts discussed previously.



LEGEND

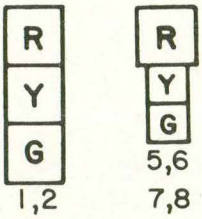
- Existing
- Proposed
- Signal Face & Post
- Pedestrian Face & Post
- Mast Arm & Post
- Street Light

SIGNAL PHASING



45 17 6 9 17 6 60 Sec. Cycle

SIGNAL HEADS



PEDESTRIAN HEADS

PROPOSED IMPROVEMENT

MAIN ST. - JEFFERSON ST.

EXHIBIT II

2. Mast arm signal indications should be installed along Main Street to improve signal visibility and 12 inch signal indications used on these mast arms.

3. Twelve inch red signal indications should be used on all post mounted traffic signals.

4. Rectangular pedestrian walk and don't walk signal heads should be installed to control pedestrians at the crosswalks.

5. The curb corners should be cut back to provide a minimum 15 foot radius on each corner.

6. The signal timing should be modified to give greater green time to Main Street traffic.

These recommendations are illustrated in detail in Exhibit 11, page 37, of this report. Collision diagrams and other specific traffic data relating to this intersection are included in the Data Appendix.

5th and Washington

Washington Street is another heavy carrier of traffic in the central business district. Nearly a thousand vehicles use this intersection during the PM peak hour period. Because both streets average 55 to 60 feet in width and 5th Street is one-way southbound, adequate capacity exists to handle these major traffic flows. Diagonal parking is permitted along the west side of 5th Street. Two moving traffic lanes are available on 5th Street as well as along the Washington Street approaches.

In contrast to many other intersections in the central business district, the accident rate at this location is not unusually great. However, some improvement in signal visibility is desirable. The improvements recommended are listed below.

1. The signal heads should be repositioned on the mast arms so that these heads are placed more directly over the lane of traffic they control. This improvement is particularly desirable for southbound traffic on 5th Street. In order to place these heads over the appropriate traffic lanes, a new mast arm will be required along the south side of the intersection.

2. Twelve inch signal indications should be used on all approaches.

3. Rectangular walk and don't walk pedestrian heads should also be installed to control pedestrians.

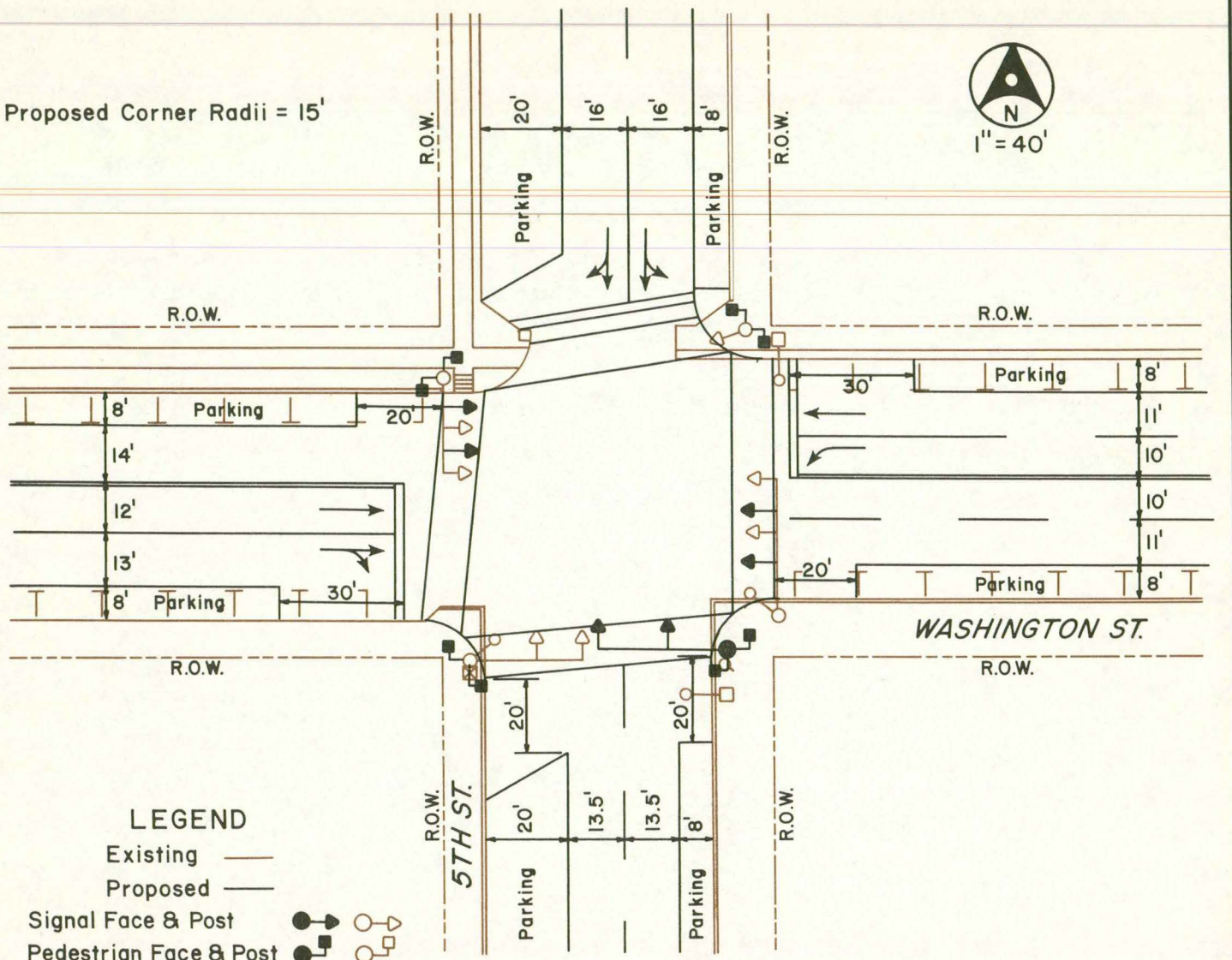
4. The traffic controller should be retimed to give greater green time to motorists along Washington Street. Although this street handles nearly two-thirds of the vehicles, Washington Street motorists presently receive only 50 percent of the green time.

The above mentioned recommendations are illustrated in detail in Exhibit 12, page 40. Further information pertaining to traffic volume and traffic accident patterns are given in the Data Appendix.

4th and Washington

Traffic volumes at this intersection approximate those at the previously discussed location. Nearly a thousand cars enter during the PM peak hour period. Fourth Street is one-way northbound. Both streets average between 55 and 60 feet in width and have adequate capacity to handle existing traffic flows. Diagonal parking is permitted along both sides of 4th Street.

Although the overall accident rate is not above normal, two-thirds of the reported accidents involve a vehicle entering the intersection from the south approach of 4th



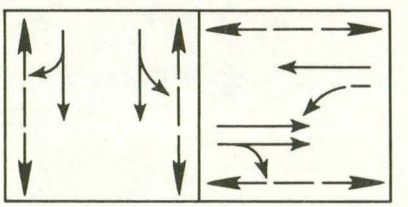
SIGNAL HEADS

R
Y
G
ALL

PEDESTRIAN HEADS

W
DW
ALL

SIGNAL PHASING



12 18 6 41 17 6 60 Sec. Cycle

PROPOSED IMPROVEMENT

5TH ST. - WASHINGTON ST.

EXHIBIT 12

Street. As shown in the collision diagram in the Appendix, the diagonal parking along this approach contributes to the accident problem. The frequency of right angle and rear end collisions involving northbound motorists also points out the need for better signal visibility.

To improve traffic flows, it is recommended the City implement the following traffic engineering improvements. These recommendations are also illustrated in Exhibit 13, page 42, of this report.

1. Diagonal parking should be eliminated along the east curb line of 4th Street south of this intersection. Use of parallel parking along this side of the street will enable the City to stripe two approach lanes thereby reducing traffic conflicts. To further reduce interference between moving and parked vehicles, it is recommended that parking be prohibited for a minimum of 30 feet in advance of the intersection on all approaches.

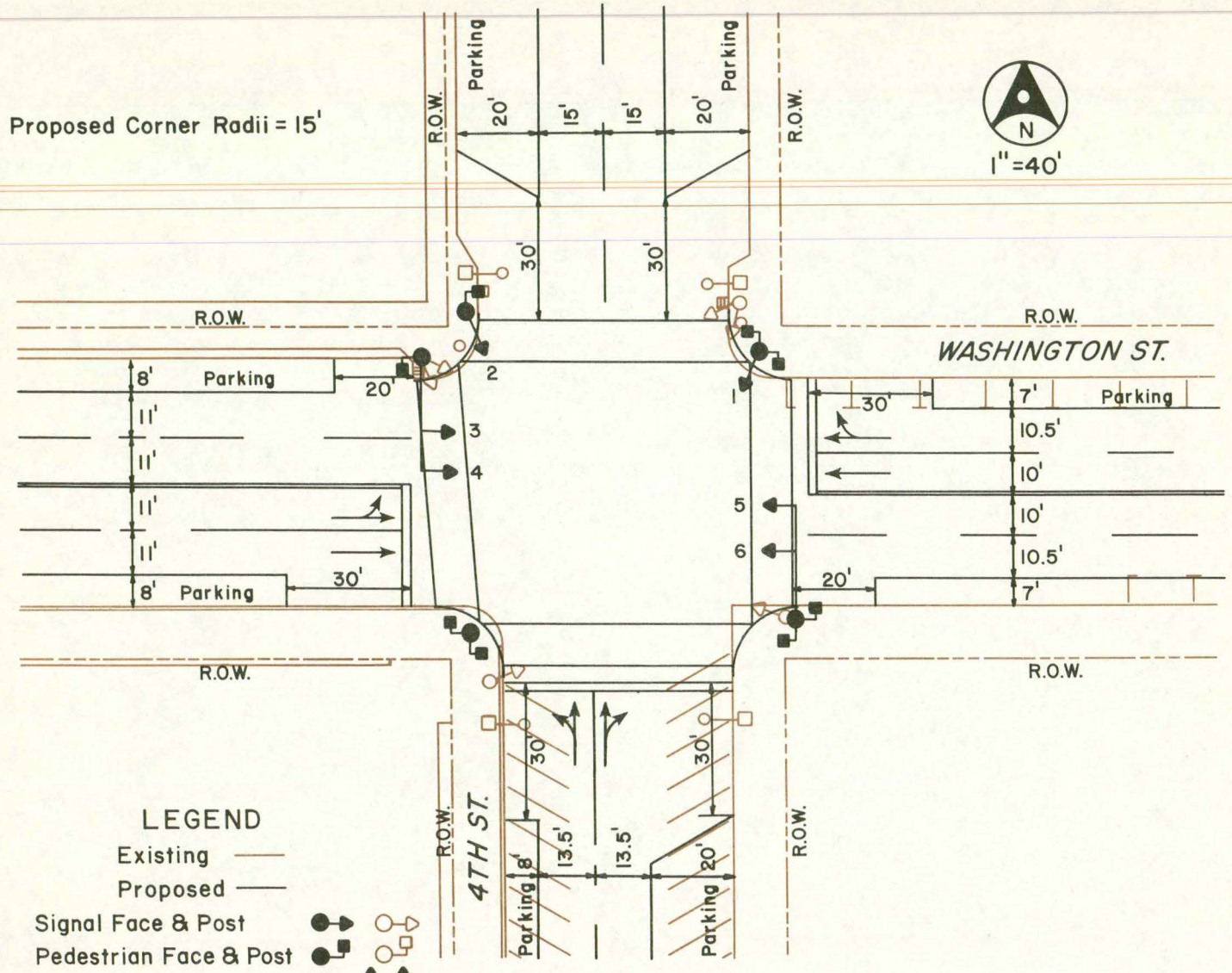
2. Washington Street is the heavier carrier of traffic. To give motorists along this street better signal visibility, it is recommended that mast arms be installed for both the eastbound and westbound flows.

3. Twelve inch signal indications should be used on all mast arm installations, and 12 inch red signal indications used on the post mounted signal heads.

4. Rectangular walk and don't walk pedestrian indications should be installed for all crosswalks.

5. Curb corners should be cut back to give a minimum of 15 foot radii on all corners.

6. Washington Street carries two-thirds of the vehicles entering this intersection. However, the signal timing gives an equal amount of green time to motorists on both streets. This timing should be revised to give approximately two-thirds of the green time to Washington Street traffic.



PROPOSED IMPROVEMENT

4TH ST. - WASHINGTON ST.

EXHIBIT 13

The Data Appendix contains traffic volume counts, capacity analyses and collision diagrams illustrating traffic patterns at this intersection.

3rd and Washington

Two-way vehicular movements are allowed on both Third and Washington Streets. As at the two previously discussed intersections, approximately two-thirds of the traffic volume moves along Washington Street. Both streets average between 55 and 60 feet thereby giving the intersection adequate capacity to handle existing traffic volumes. Some diagonal parking is permitted along the east side of 3rd Street south of the intersection.

Forty-two traffic accidents were reported during the past three years, a rate of nearly five accidents per million vehicles entering the intersection. A substantial portion of these collisions involved situations in which one or more motorists failed to yield the right-of-way. One can conclude, therefore, that signal visibility is inadequate. To alleviate this problem as well as to generally improve the flow of traffic, the following improvements are recommended.

1. Signal mast arms should be installed facing motorists traveling both directions on Washington Street to give these drivers better visibility of the signals. In addition the signals along 3rd Street should be repositioned so their visibility will also be improved.

2. The diagonal parking along 3rd Street should be replaced with parallel parking thereby allowing 3rd Street to be restriped for two approach lanes

from each direction. One of these two lanes can be used to store left turning vehicles. Furthermore, parking should be restricted for a minimum of 30 feet in advance of the intersection on all approaches.

3. Twelve inch signal indications should be used on both mast arms and 12 inch red signal indications should be used on all post mounted signals.

4. Rectangular pedestrian walk and don't walk heads should be installed to better control pedestrian movements.

5. The curb corners should be cut back to provide a minimum of 15 foot radii.

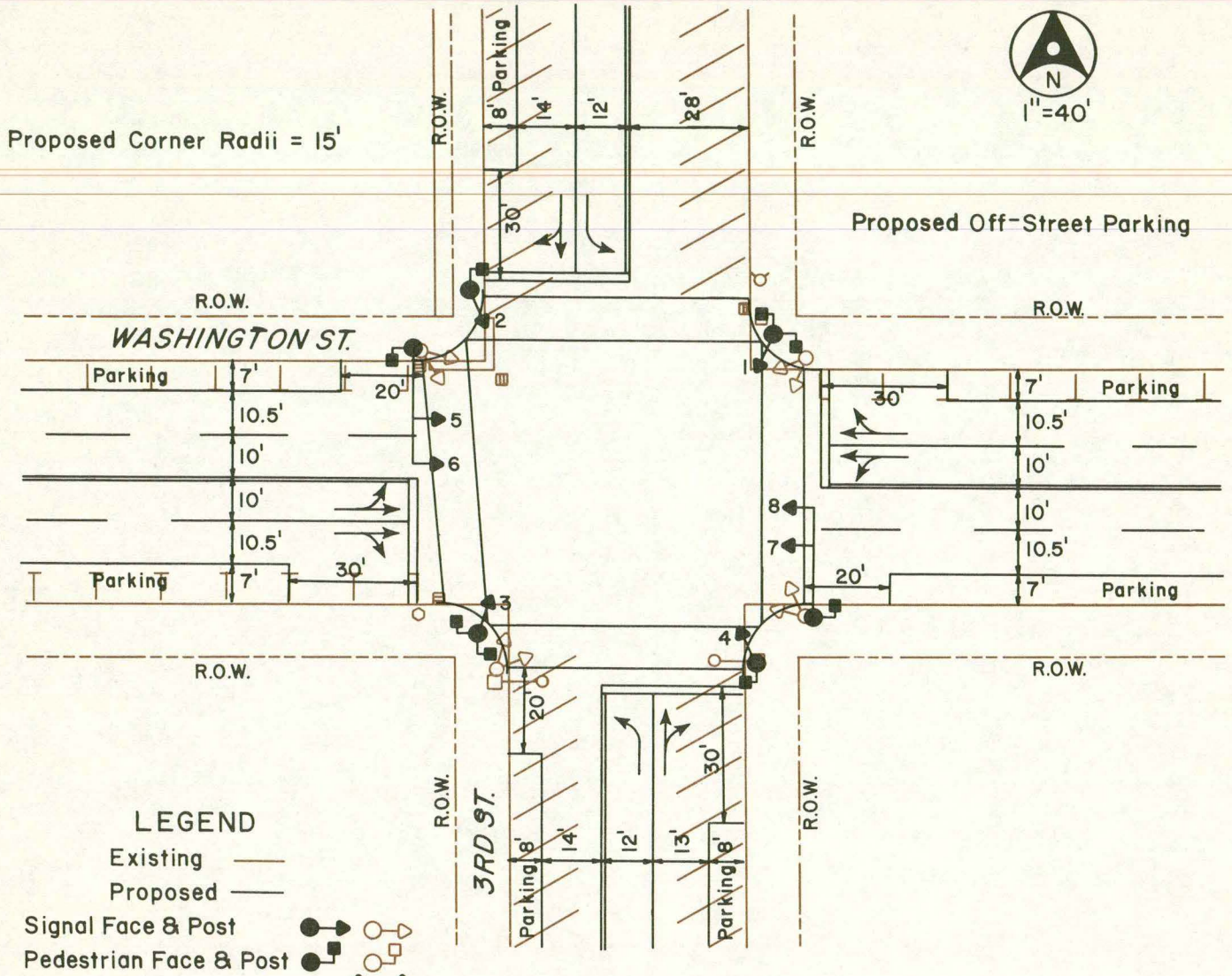
6. The signal timing should be readjusted in line with the existing traffic pattern so that approximately two-thirds of the green time is available for Washington Street motorists.

The above recommendations are illustrated in detail in Exhibit 14, page 45, of this report. Further information pertaining to traffic volumes, capacity studies, and collision diagrams is included in the Data Appendix.

Main and Washington

The intersection of Main and Washington Streets handles the heaviest traffic volumes in the downtown. Nearly 1,150 vehicles enter this intersection during PM peak hour period. Both streets have a width of approximately 55 feet.

Parking is not permitted along Main Street except for the bus transfer station on the west side of the south leg. By moving this to the west side of the north leg of Main Street and Jefferson Street, four through lanes and one left turn lane are available for moving traffic. Four moving traffic lanes and two curb parking lanes are striped on Washington Street. Consequently, the intersection has more than adequate capacity.



LEGEND

Existing ——

Proposed ——

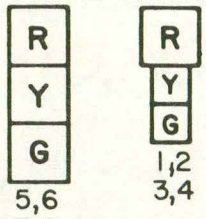
Signal Face & Post

Pedestrian Face & Post

Mast Arm & Post

Street Light

SIGNAL HEADS



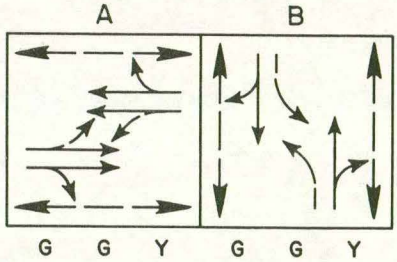
5,6
7,8

1,2
3,4

PEDESTRIAN HEADS

ALL

SIGNAL PHASING



39 19 6 12 18 6 60 Sec. Cycle

PROPOSED IMPROVEMENT

3RD ST. - WASHINGTON ST.

EXHIBIT 14

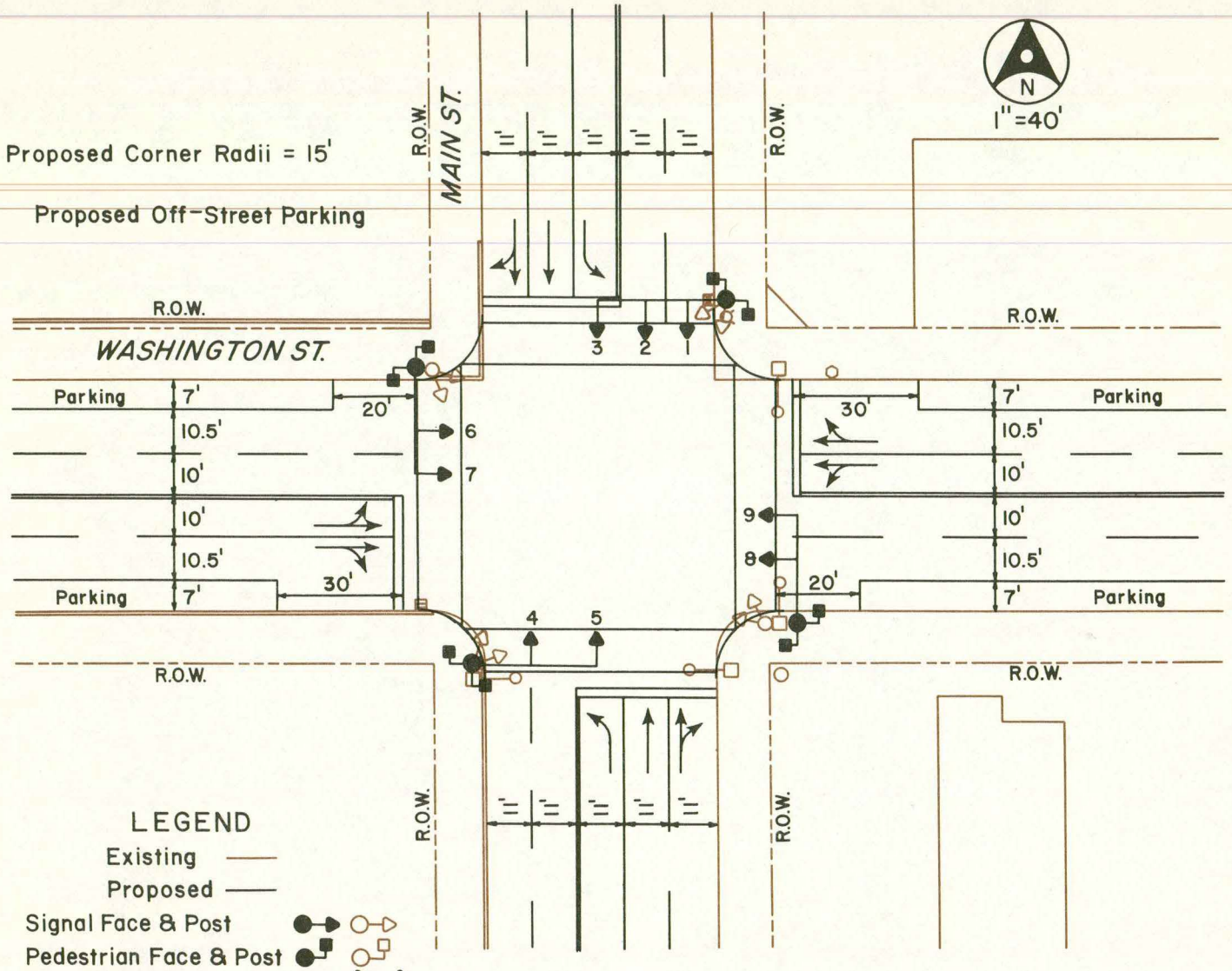
The most serious traffic problem at this location is the large number of traffic accidents which have occurred in recent years. During the past three years 52 accidents were reported, a rate of more than five accidents per million vehicles entering the intersection. As indicated in the collision diagram in the Data Appendix, a large number of these traffic accidents were either rear end or right angle collisions. It is reasonable to assume that one of the causes of this accident pattern is an inability of motorists to observe the traffic signals in time to make the proper decision.

Several right angle collisions also occurred as northbound motorists attempted to turn left onto Washington Street. This left turn movement exceeds 100 vehicles during the PM peak hour period. As shown in Exhibit 15, page 47, a number of traffic signal improvements are recommended to reduce the accident problem. These recommendations include the following.

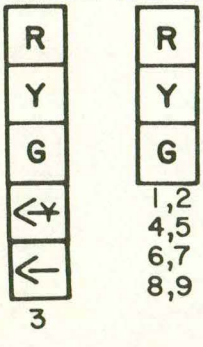
1. Mast arm signal indications should be installed controlling traffic on all approaches. Twelve inch signal indications should be used on all signal heads to improve their visibility.

2. Rectangular walk and don't walk pedestrian heads should be installed at all crosswalks.

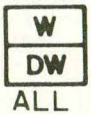
3. The signal phasing should be revised to provide a leading left turn phase for northbound left turning motorists. This phase will give left turning traffic an opportunity to clear the intersection prior to the movement of southbound motorists. Exhibit 15 shows the recommended timing for the new signal phasing.



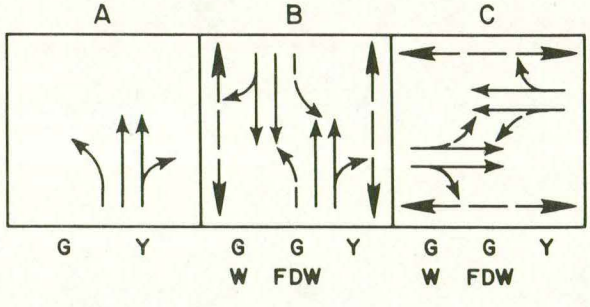
SIGNAL HEADS



PEDESTRIAN HEADS



SIGNAL PHASING



PROPOSED IMPROVEMENT

MAIN ST. - WASHINGTON ST.

EXHIBIT 15

4. The corner curb should be cut back to provide minimum radii of 15 feet for turning vehicles.

The Data Appendix to this report contains additional information pertaining to traffic flows and accident patterns.

Main and Columbia

The intersection of Main and Columbia Streets is located along the northern edge of the central business district. Both streets have a width of approximately 55 feet and allow the two-way movement of traffic. Curb parking is permitted on all legs of the intersection. Traffic volumes are not large on Columbia Street and as a result the intersection's capacity is more than adequate.

The accident pattern is not particularly severe at this location although in reviewing these reports it appears some of the collisions were caused by lack of adequate signal visibility. Consequently, the following signal improvements are recommended.

1. To accommodate the relatively heavy traffic movements along Main Street, overhead mast arms are recommended for northbound and southbound motorists.

2. Twelve inch signal indications should be used on the mast arms and 12 inch red signal indications on the remaining post mounted signals.

3. Rectangular pedestrian heads should be installed for all approaches.

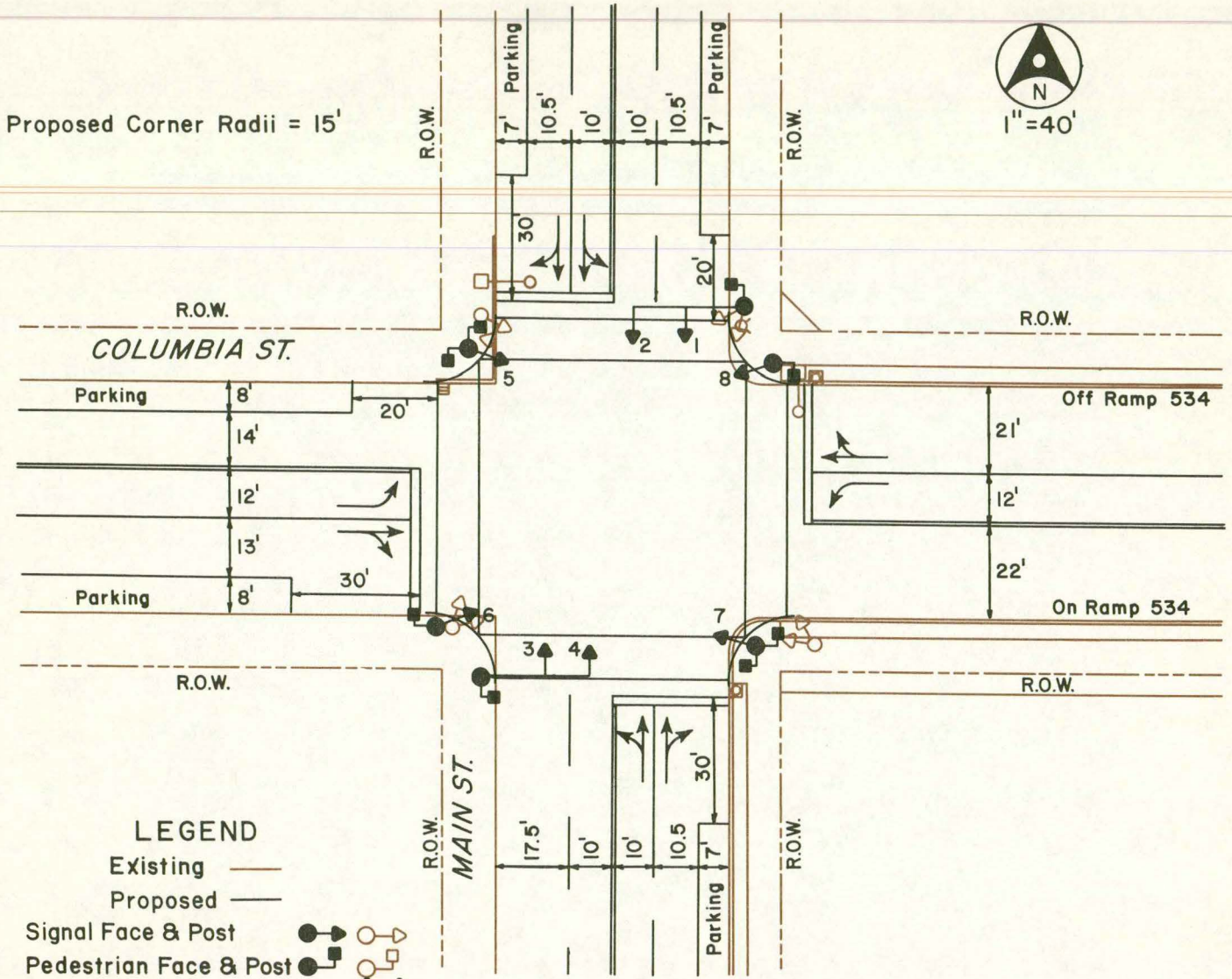
4. To accommodate the heavier traffic flows along Main Street, the signal timing should be revised from a 50/50 green time split to one which favors Main Street.

5. The intersection corners should be rebuilt to have a minimum radius of 15 feet.

The above recommendations are illustrated in detail in Exhibit 16, page 50, of this report. Collision diagrams, traffic counts, and other related data are contained in the Data Appendix.

6th and Washington

The intersection of 6th and Washington is not signalized. Field studies were made to determine if the traffic pattern warrants signalization. These counts indicate the traffic volume is not sufficient to justify installation of traffic signals. Thus, no change in the present means of control is recommended. No other improvements are proposed.



LEGEND

Existing ——

Proposed ——

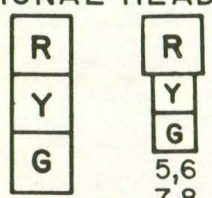
Signal Face & Post

Pedestrian Face & Post

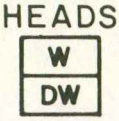
Mast Arm & Post

Street Light

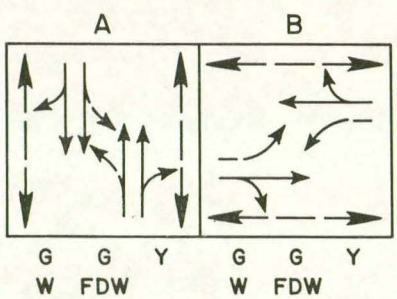
SIGNAL HEADS



PEDESTRIAN HEADS



SIGNAL PHASING



PROPOSED IMPROVEMENT

MAIN ST. - COLUMBIA ST.

EXHIBIT 16

SYNCHRONIZATION OF TRAFFIC SIGNALS

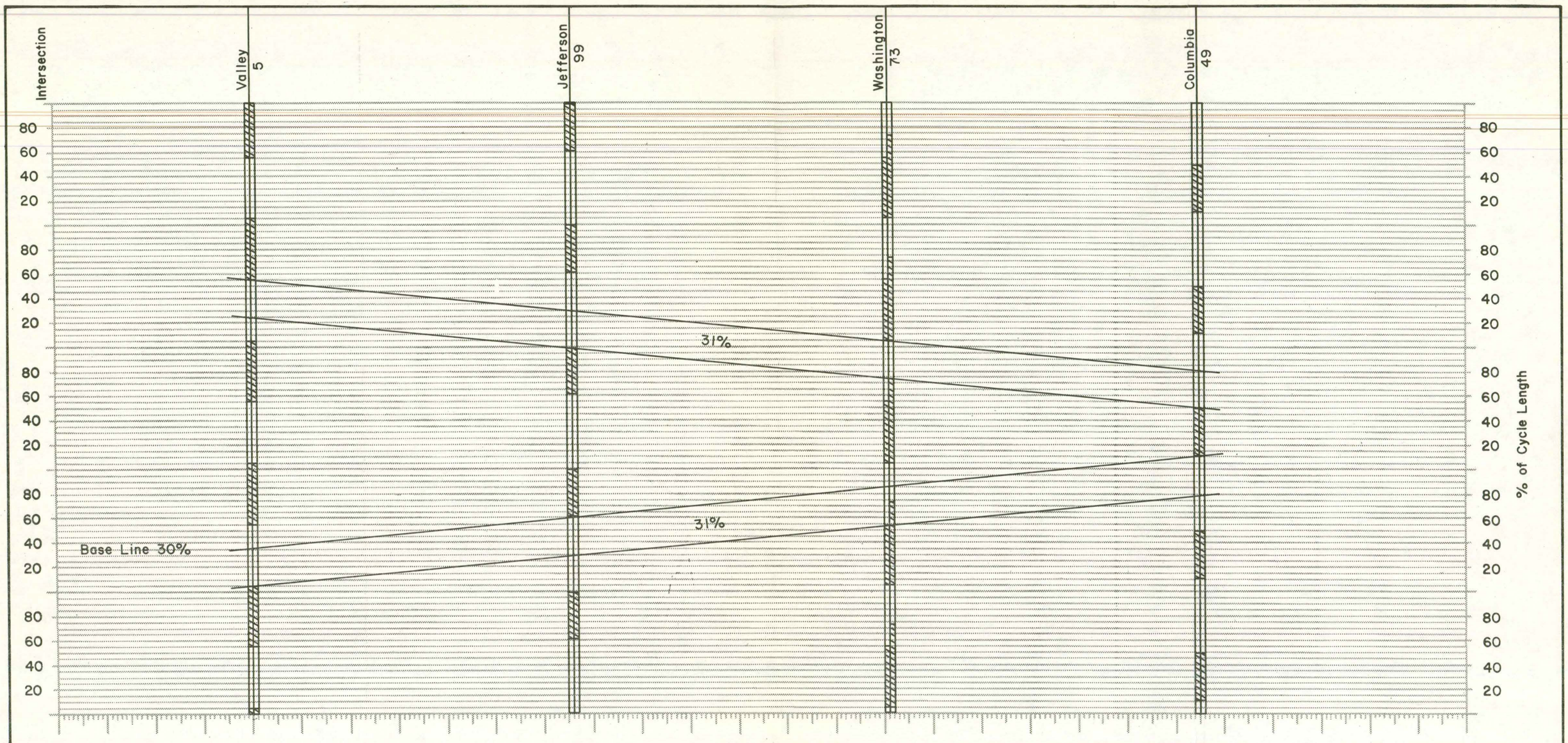
Traffic signals in the central business district are not presently synchronized to give a progressive flow of traffic. The feasibility of developing such a system so that vehicles could progress through the central business district with a minimum of stopping was studied as part of this project. Traffic patterns were evaluated during the AM and PM peak hour periods as well as the midday. In addition, the travel time studies discussed previously were reviewed to determine appropriate speeds to use in establishing a signal progression system.

The travel time studies indicate that vehicle operating speeds vary between 11 and 17 miles per hour in the central business district. On this basis it was assumed that a speed near the midpoint in this range (15 mph) would be an appropriate progression speed.

Exhibits 17 through 22, pages 52 through 57, illustrate the results of this study. These time space diagrams show that it is feasible to establish a traffic progression system on the following steets utilizing a 60 second signal cycle length and a progression speed of 15 miles per hour.

Main Street	3rd Street
Jefferson Street	4th Street
Washington Street	5th Street

Other progression speeds were evaluated but it was determined that a 15 mph speed more closely approximates the desired



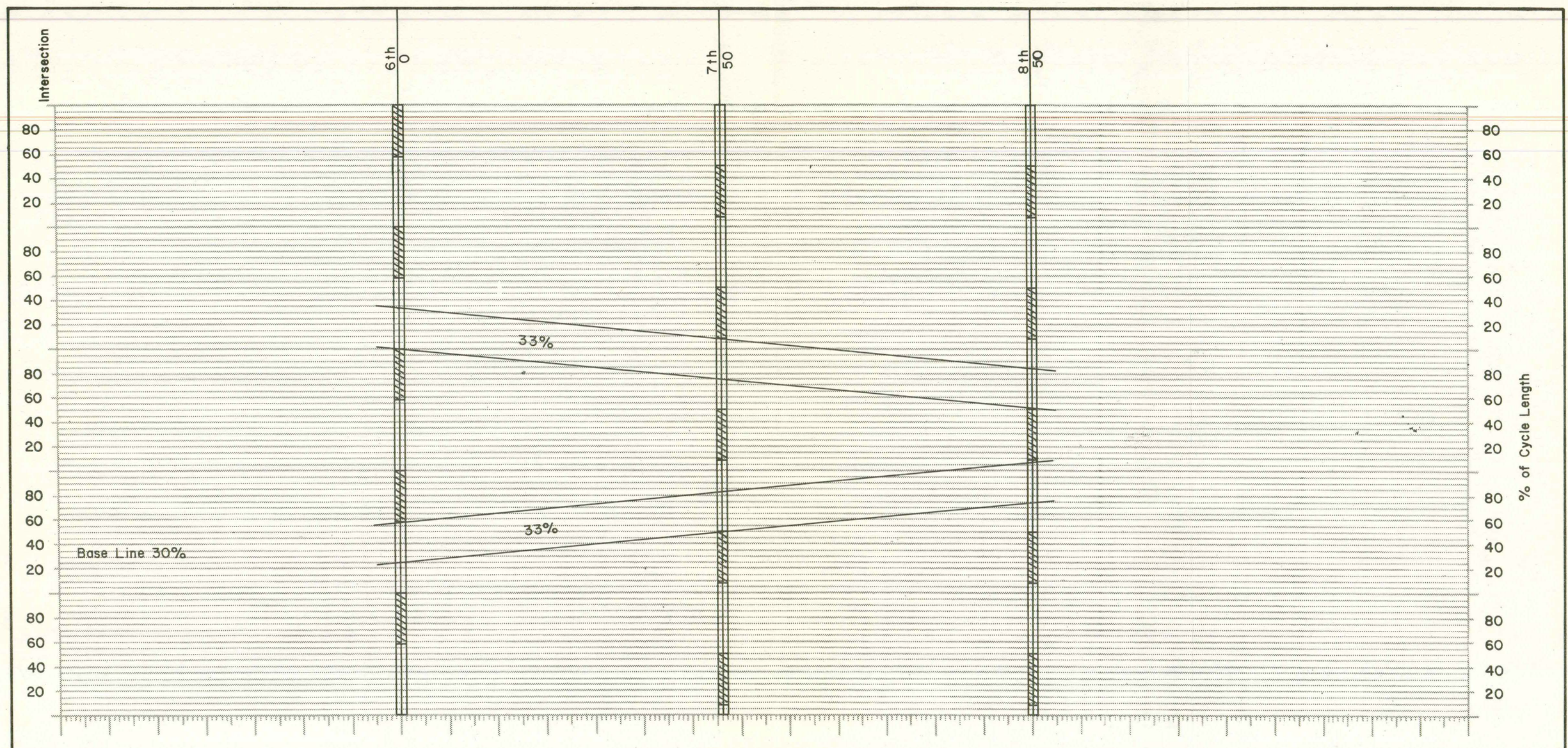
TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET	25	31	57	81														
Intersection	Valley	Jefferson	Washington	Columbia														

EXHIBIT 17

MAIN
ARTERIAL



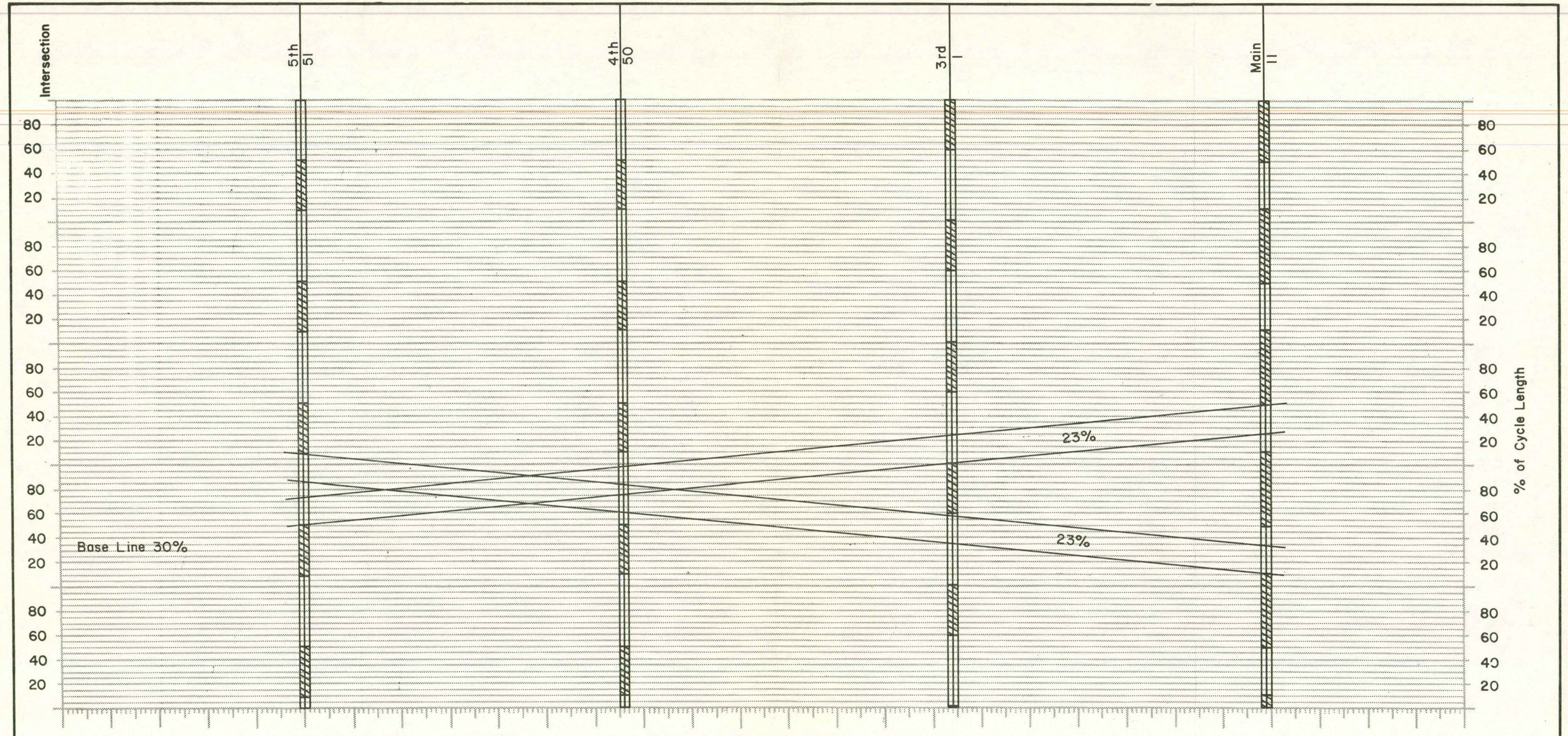
TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET	30	80	80																
Intersection	6th	7th	8th																

EXHIBIT 18

JEFFERSON
ARTERIAL



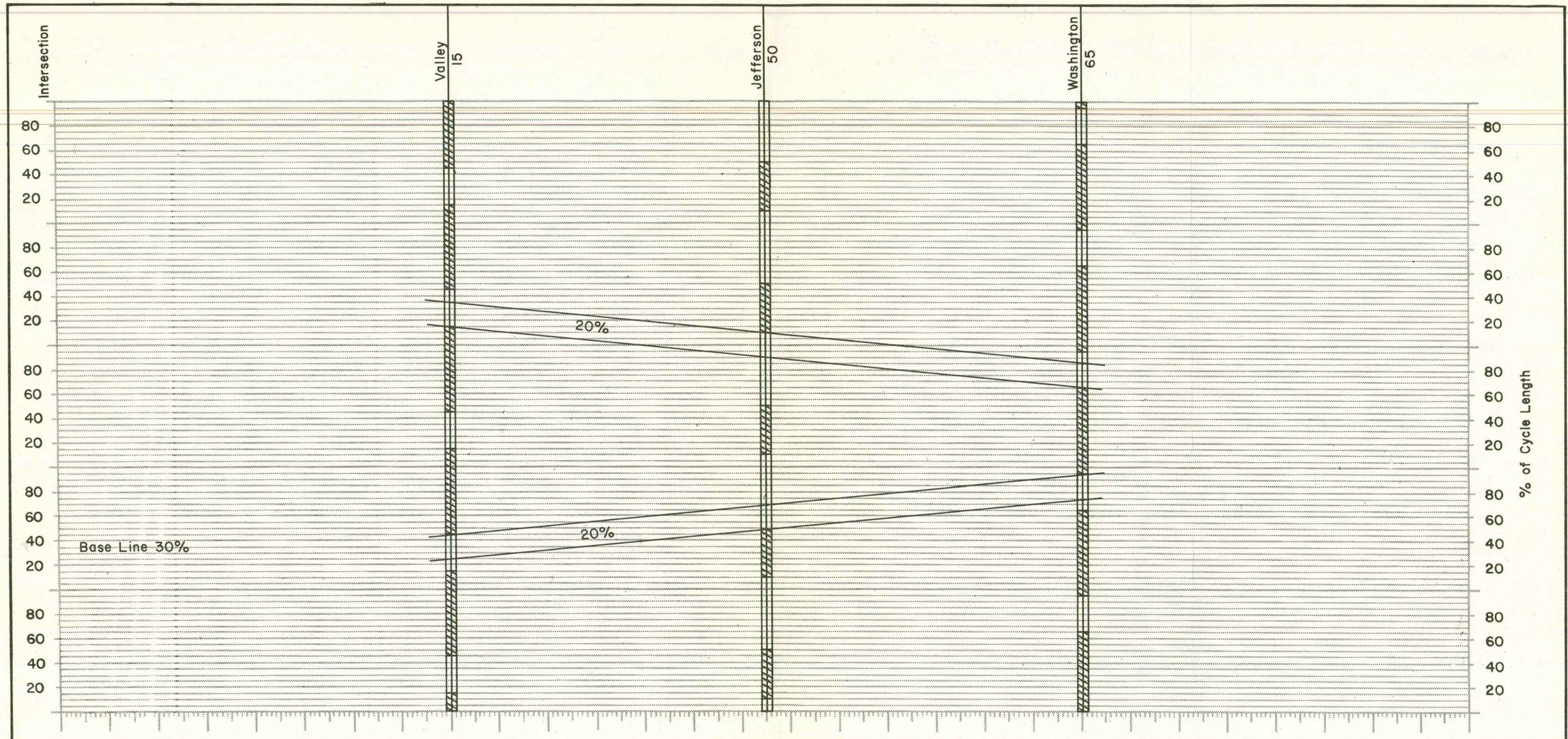
TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET																			
Intersection																			

EXHIBIT 19

WASHINGTON
ARTERIAL



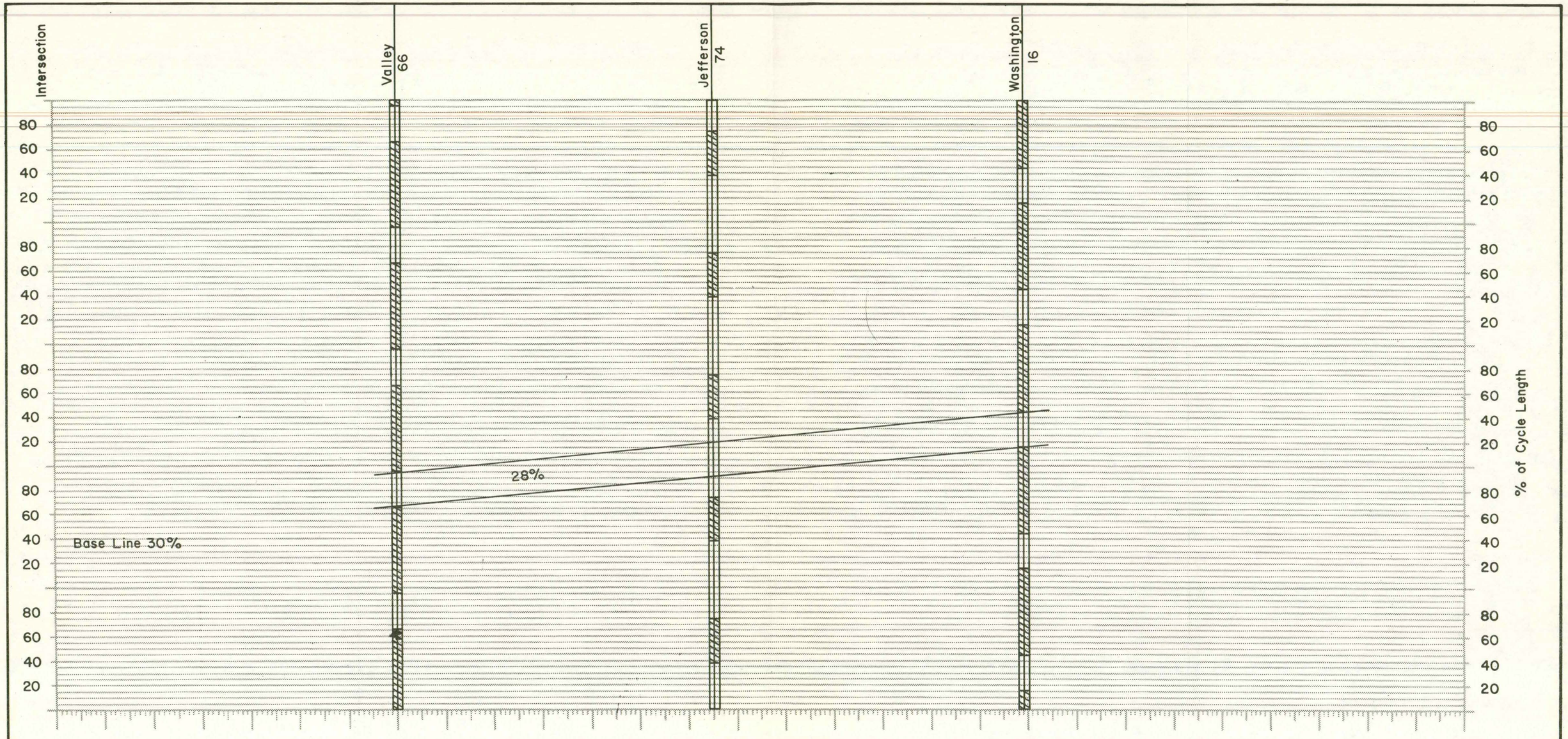
TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET	15	80	65																
Intersection	Valley	Jefferson	Washington																

EXHIBIT 20

3RD
ARTERIAL



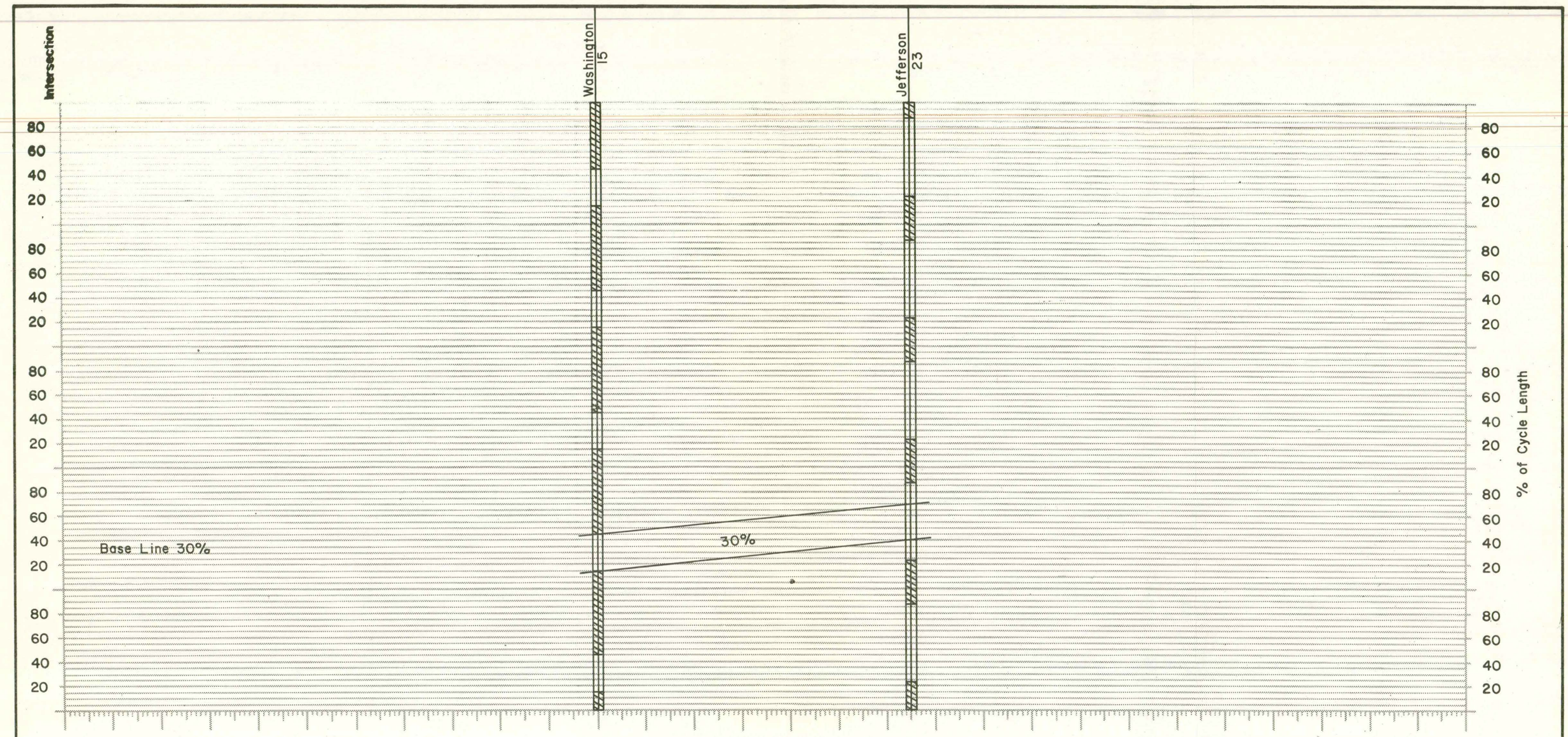
TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET	64	56	14																
Intersection	Valley	Jefferson	Washington																

EXHIBIT 21

4TH
ARTERIAL



TIME SPACE GRAPH

Scale: 1" = 100'
Cycle Length 60 sec.
Progression Speed 15 MPH
Dial ____
Date 7-3-75

OFFSET	15	7																	
Intersection	Washington	Jefferson																	

EXHIBIT 22

5TH
ARTERIAL

operating speed in the central business district and gave the greatest signal band widths.

The time space diagram for Main Street (Exhibit 17) indicates that a traffic progression with signal band widths of 31 percent (19 seconds out of a 60 second cycle) can be established for each direction. In essence this plan would permit motorists proceeding in either direction along Main Street to progress through the entire signal system without stopping providing they average 15 mph and drive within the 19 second band. As shown in Exhibit 17, this 19 second band represents more than 50 percent of the available green time at each traffic signal.

A signal progression was developed for that section of Jefferson Street west of the shopping mall. This design, shown in Exhibit 18, provides a 21 second band width (33 percent of the signal cycle) during which motorists can travel between 6th and 8th Streets without stopping. The 21 second band is available for motorists driving in either direction.

Exhibit 19, page 54, illustrates the recommended signal progression system for Washington Street. Because of the relatively small amount of green time available for motorists using Washington Street at Main Street, only a 14 second green band width can be provided between 5th Street and Main Street. As in the previous systems, the progression speed is 15 mph, utilizes a 60 second signal cycle, and provides a two-way progression.

Signal progression systems were also designed for the north-south streets of 3rd, 4th, and 5th Streets as shown in Exhibits 20, 21, and 22. The 3rd Street system provides a 12 second green band for either direction of flow. Again, the band is somewhat restricted by the amount of green time available for motorists using 3rd Street at some of the major cross streets, particularly Washington Street.

Fourth and 5th Streets are one-way. Therefore, the green band width along these two streets is equal to the maximum amount of green time available to motorists using 4th or 5th Street at the signalized intersections. This band width equals 20 seconds along 4th Street and 21 seconds along 5th Street.

The signal synchronization system should be implemented by physically innerconnecting the traffic controllers at each intersection and making them responsive to a master controller located at one of the downtown intersections. Although, the existing signal controllers are interconnected, they are not sufficiently flexible to accommodate future changes in traffic patterns which might require the use of more than one dial unit. It is recommended that the City purchase new pretimed controllers for installation at each intersection. Our studies show these controllers could be equippped with only one dial unit initially but that they should be expandable to three dial use at a later date if necessary.

CONSTRUCTION PROGRAM

The City of Burlington should implement the improvements discussed in this report at the earliest possible date. An estimate of their cost has been prepared and is contained in Table 5, pages 61, 62, and 63. This table summarizes the cost, by intersection, detailing the specific amount for each improvement. As indicated in Table 5, these improvements total approximately $220,000 including the cost of material as well as contractual labor to implement the change.

The implementation of these recommendations will necessitate the loss of approximately 195 street parking spaces. However, the City currently has plans for increasing the size of off-street parking spaces which should be more than adequate to fulfill future parking needs.

The majority of these proposals will improve traffic safety. It is suggested, therefore, that the City explore the feasibility of obtaining Federal Safety Funds to finance a portion of their cost.

TABLE 5

CONSTRUCTION COST ESTIMATE
FOR RECOMMENDED IMPROVEMENTS

Intersection	Type of Improvement	Estimated Cost	
5th & Valley	Reconstruct Curb Corners		$ 800
4th & Valley	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		10,800
3rd & Valley	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Signal Heads, Miscellaneous Improvements	10,000	
	Subtotal		13,800
Main & Valley	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	6,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		16,800
8th & Jefferson	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Signal Head, Miscellaneous Improvements	10,000	
	Subtotal		13,800
7th & Jefferson	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Signal Heads, Miscellaneous Improvements	10,000	
	Subtotal		13,800
6th & Jefferson	Reconstruct Curb Corners	$ 400	
	Signal Controller	3,000	
	Signal Heads, Miscellaneous Improvements	8,500	
	Subtotal		11,900

TABLE 5 Continued

CONSTRUCTION COST ESTIMATE
FOR RECOMMENDED IMPROVEMENTS

Intersection	Type of Improvement	Estimated Cost	
5th & Jefferson	Signal Controller	$ 3,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		$10,000
4th & Jefferson	Signal Controller	$ 3,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		10,000
3rd & Jefferson	Reconstruct Curb Corners	$ 400	
	Signal Controller	3,000	
	Signal Heads, Miscellaneous Improvements	10,000	
			13,400
Main & Jefferson	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	6,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		16,800
5th & Washington	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	9,000	
	Signal Heads, Miscellaneous Improvements	5,000	
	Subtotal		17,800
4th & Washington	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	6,000	
	Signal Heads, Miscellaneous Improvements	6,000	
	Subtotal		15,800
3rd & Washington	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	6,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		16,800

TABLE 5 Continued

CONSTRUCTION COST ESTIMATE
FOR RECOMMENDED IMPROVEMENTS

Intersection	Type of Improvement	Estimated Cost	
Main & Washington	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	12,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		$ 22,800
Main & Columbia	Reconstruct Curb Corners	$ 800	
	Signal Controller	3,000	
	Mast Arms	6,000	
	Signal Heads, Miscellaneous Improvements	7,000	
	Subtotal		16,800
	TOTAL ESTIMATED COST		$221,900

George L. Crawford and Associates Inc.

Project Staff

George L. Crawford,	President
William F. Bunte,	Senior Associate Engineer
Ralph J. Meller,	Associate Engineer

Technical Support Staff

Joseph T. Ray, Jr.
Richard A. Troxel
Joan C. Marek