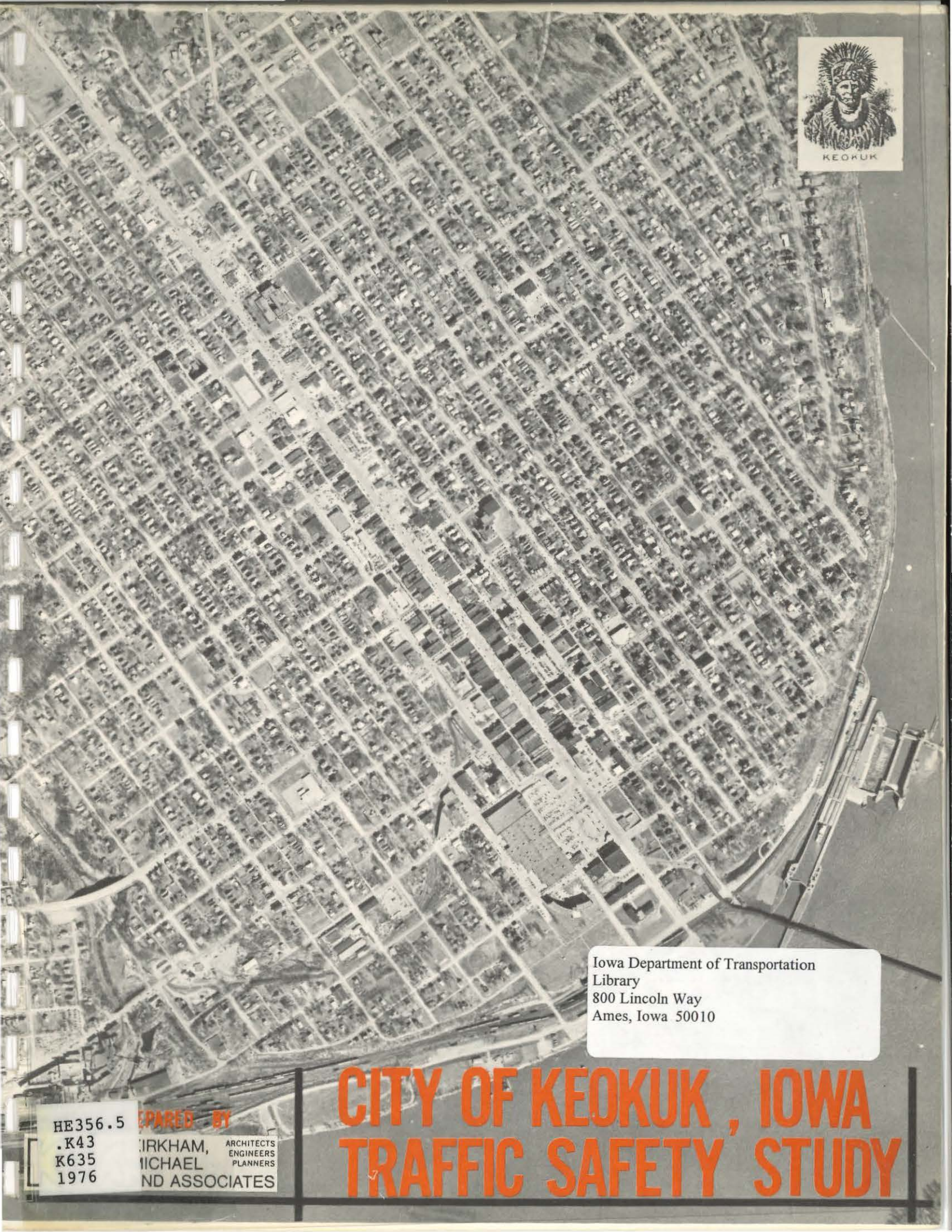

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CITY OF KEOKUK, IOWA
TRAFFIC SAFETY STUDY

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EPARED BY
IRKHAM,
IICHAEL
ND ASSOCIATES
ARCHITECTS
ENGINEERS
PLANNERS

TRAFFIC SAFETY STUDY

KEOKUK, IOWA

THIS REPORT WAS PREPARED THROUGH A GRANT PROVIDED BY THE UNITED STATES DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION, PURSUANT TO SECTION 402, TITLE 23 OF THE UNITED STATES CODE.

Prepared by: KIRKHAM, MICHAEL AND ASSOCIATES
Architects - Engineers
Omaha - Minneapolis

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SUMMARY

A special summary of the results and conclusions of the study has been prepared to give the reader a quick insight into the report content and the study outcome. The following major conclusions and recommendations concerning the different aspects of the study were arrived at and are summarized in the following paragraphs. Each of the items are analyzed in detail in the body of the report.

1. Traffic Signalization, Timing, Phasing.
   The synchronization of the series of signalized intersections on Main from 3rd to 14th Streets is hampered by the congestion that occurs from parking, turning and other flow stoppages. It is recommended that a slightly longer cycle be introduced on a trial basis to aid traffic flow. Also the "green time" of Main Street compared to the cross streets is disproportionate according to traffic volumes. The recommended trial cycle has increased the green time on Main Street to aid the higher volumes of vehicles.

2. Traffic Signing
   In general the signing system of the City is in good shape. Old signs are being replaced with new signs that meet standard MUTCD* criteria. Some specific recommendations for sign installation and replacement are included in the report. The most serious sign deficiencies occur at the school, park and playground areas.

3. Pavement Marking
   The City undergoes an intensive pavement remarking program each year and observed markings appear to be adequate for the most part. It is recommended that marking procedures conform to the patterns outlined in the Manual on Uniform Traffic Control Devices.

---

* The Manual on Uniform Traffic Control Devices is a U.S. Department of Transportation publication concerning traffic control devices. The Manual illustrates and describes uniform standards for various traffic control signs and signals.

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7. Accident Prone Intersections

There were 27 intersections which had 5 or more accidents in 1974. Practically all of these had a similar rate of accidents in 1973 also. Each of these intersections was examined and analyzed for methods of possible accident reduction. Most of the accidents occurred on Main Street between 3rd and 14th Streets which also carries the highest volume of traffic. Other high accident locations were the shopping center entrance on Main Street Road at 23rd Street and the Belknap-Main Street Road-Boulevard Road Complex. Recommendations for improvement of intersections with high accident rates are included in the report.

8. Accident Reporting

Records of all accidents reported to local police are kept in a card file at the Police Station. Investigating Officer Reports of accidents with damage in excess of $250, personal injury, or fatality which are required by law, are kept at the station only if written up by a local police officer. Of 516 reportable accidents in Keokuk in 1974 only 358 Investigating Officer Reports were available. Presumably, those written by other law enforcement agencies such as the State Patrol are not filed locally. A new statewide system of accident reporting and filing now being initiated by the State should make access and recall of records a much simpler task. Keokuk will be included and familiarization of the system by local officials is encouraged.

9. Intersection Improvements

Physical improvements have been recommended for the following locations:

1. Shopping Center Entrance at 23rd & Main Street
2. Belknap - Main Street Road - Boulevard Road
3. Plank Road and Middle Road
4. Diagonal connection between Messenger Road and Main Street Road.

The recommended improvements are superimposed by overlays on photo enlargements.

10. Bridges
Five bridges including the Keokuk Municipal Bridge were examined and recommendations were made as to replacement and safety improvements. A discussion of each bridge is included in the report.

11. Speed Limit Analysis
Speed checks over measured distances were made on Messenger Road and Main Street Road north of 16th Street to determine the prevailing speed travelled by most drivers on these streets. The 85 percentile speed was determined and it is recommended that the speed limit on Messenger Road be reduced to 35 mph and the speed limit on Main Street Road be retained at 35 mph.

INTRODUCTION - OBJECTIVES

This study was initiated by the City of Keokuk, Iowa in order to determine the best methods of improving vehicle and pedestrian safety and service. The study consisted of an overall appraisal of the City's traffic problems and includes specific investigations into traffic flow, accidents, parking, bridges, sidewalks and school crossings. Also included are speed limit analyses on certain streets and intersection improvement recommendations.

The study, financed by a Federal grant and administered by the Iowa Department of Transportation and the Keokuk City Officials, was performed by Kirkham, Michael and Associates and got underway in September of 1975 and was completed in February, 1976.

BACKGROUND

The historic City of Keokuk, located at the extreme southeast tip of Iowa, in Lee County, at the confluence of the Mississippi and Des Moines Rivers has long been known as the "Gate City" because of its strategic position below the Mississippi River Rapids. The City was a major port of embarkation for midwestern soldiers during the Civil War and continues to be a major landmark for Mississippi River freight traffic as one of the largest lock systems on the River is located there. The City also is an important overland transportation center as the junction of U.S. Highways 218 and 136 located in the downtown area. The Keokuk

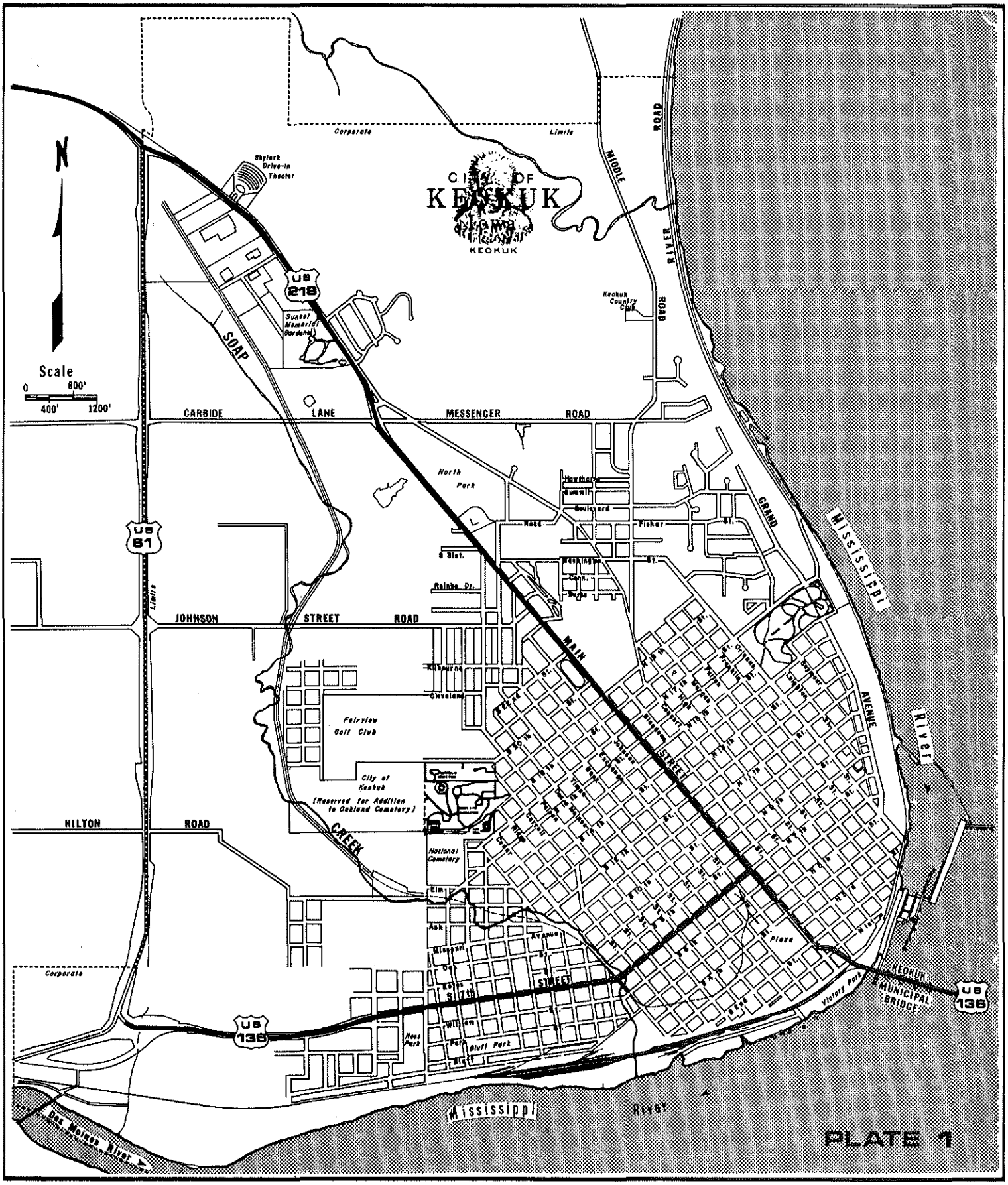
Municipal Bridge which carries U.S. 136 traffic across the Mississippi has a relatively high volume of commuter traffic servicing the tri-state area of Iowa, Missouri and Illinois.

Approximately 63 percent of the Keokuk work force commutes to and from the City daily and approximately 37 percent of these reside out of the State and must cross one of the bridges leading to the City. The predominate modes of commuter transportation are almost exclusively automobiles, pickups and trucks. Because of the geographic location of the City and the layout of the roadway network, a considerable volume of traffic passes through the downtown area each day. An increase of congestion and an increase in the rate of traffic accidents has prompted City Officials to investigate methods of alleviating the traffic problems and improving safety.

It is the intent of this study to explore some of the more economical methods of traffic flow and safety improvement which hopefully can be implemented at a reasonable cost to the City.

STREET SYSTEM

The City of Keokuk rests on a projecting peninsula formed by a sharp bend in the Mississippi River which flows due south on the east edge of the City and due west along the south edge. The topography of the area probably affected the original platting as the older streets and lots are laid out on a diagonal which almost splits the northwest-southeast directional quadrant. The street system consists of a grid pattern with feeder roads leading out to rural areas from the central core in a north and west direction as shown on Plate 1. Federal Highway, U.S. 218, passes directly through the City on Main Street which connects to the Keokuk Municipal Bridge, a toll facility, with a swing span which opens frequently for river traffic with high clearance requirements. Another Highway, U.S. 61, bypasses the City to the west and connects to U.S. 136, which is also 7th Street. Seventh Street connects to Main Street in the central business district as traffic is funnelled to the Municipal Bridge. Traffic congestion becomes a problem because of the single, 2 lane, bridge and it is complicated further when a bridge opening forces traffic to stop. Besides the highways, there is no designation of major streets other than what people have become accustomed to use and this is reflected by traffic volume counts. The east-west streets which carry the most traffic are 7th, 10th, 13th, and 17th east of Main and 5th, 7th, 10th, 14th and 18th west of Main. The major



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Keokuk Traffic Study

Fall, 1975

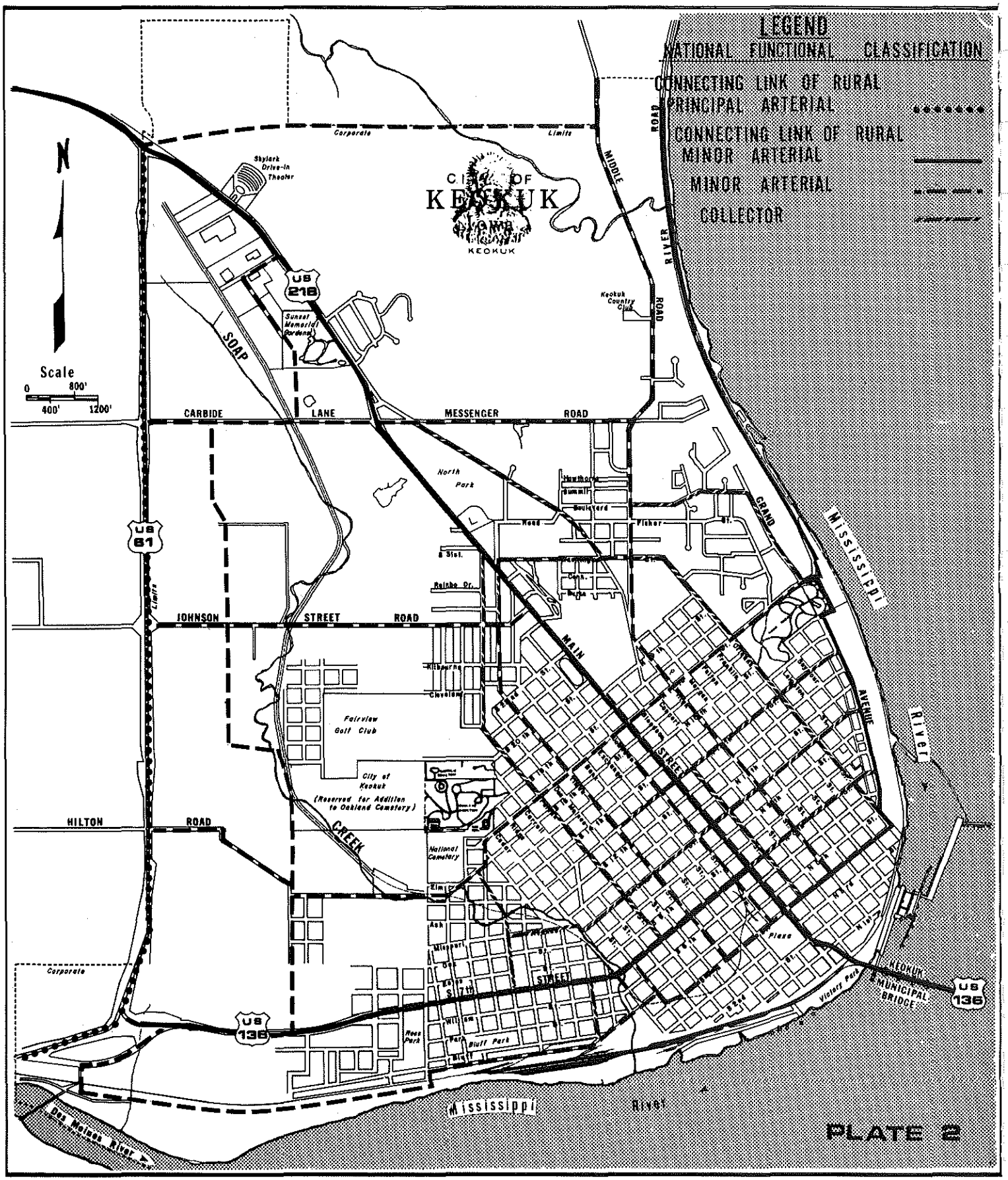
PRESENT STREET SYSTEM

north-south streets are Orleans, High, Concert, Blondeau, Main, Johnson, Timea and Palean. With the exception at Main which is 70 feet wide from curb to curb, the other major streets are wide enough for only 2-lane traffic. Parking is allowed on all streets.

The City has had comprehensive plans and updates over the years which have recommended extensive street system expansion especially in the western sectors of the City. The 1975 Comprehensive Plan was accepted by the City but the primary street layout has been revised from that shown in the 1975 Plan. The revised Plan is more realistic in that it utilizes existing alignments with the exception of a north-south arterial which will connect U.S. 136, and improve Des Moines Avenue, Johnson Street Road, Middle Road and U.S. 216.

The revised plan and functional classification of each route is shown on Plate 2. A systemized plan as this will allow priorities to be assigned which will reduce traffic flow inhibitors, thus lowering exposure to accidents.

Keokuk has a growing industrial base and an efficient street system is necessary to serve commuting workers and other traffic normally generated by large factories and plants. Soap Creek has been a natural barrier for expansion to the west and roads and bridges must be improved if this barrier is to be overcome. Plate 3 shows the location of some of the major industrial plants and the tendency has been to utilize the vacant areas that are served by the



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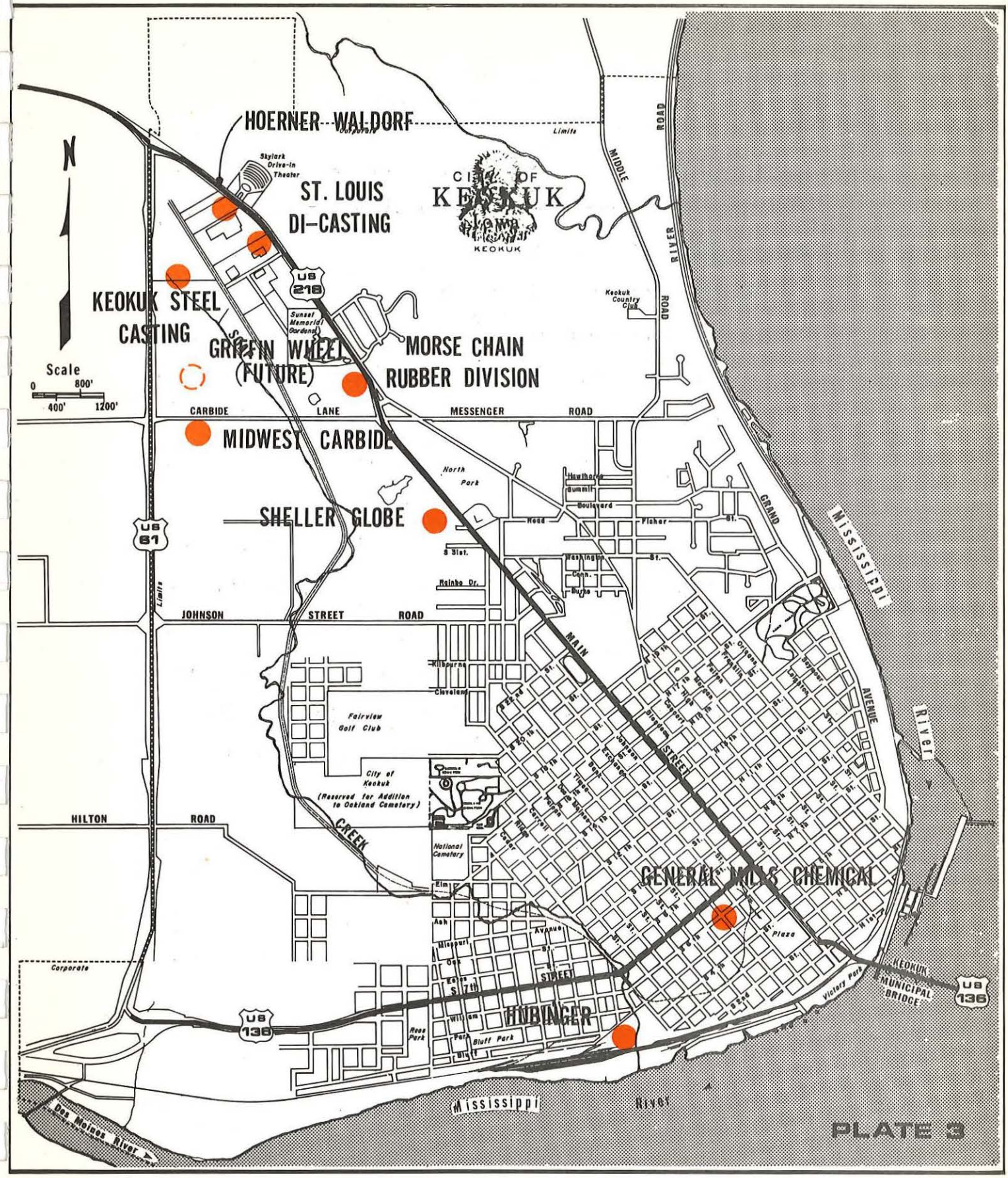
PRIMARY STREETS PLAN



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MAJOR INDUSTRIAL SITES — TRAFFIC GENERATORS

existing major roads. Completion of primary street plan will open up more areas to development and enhance the economic growth of the City.

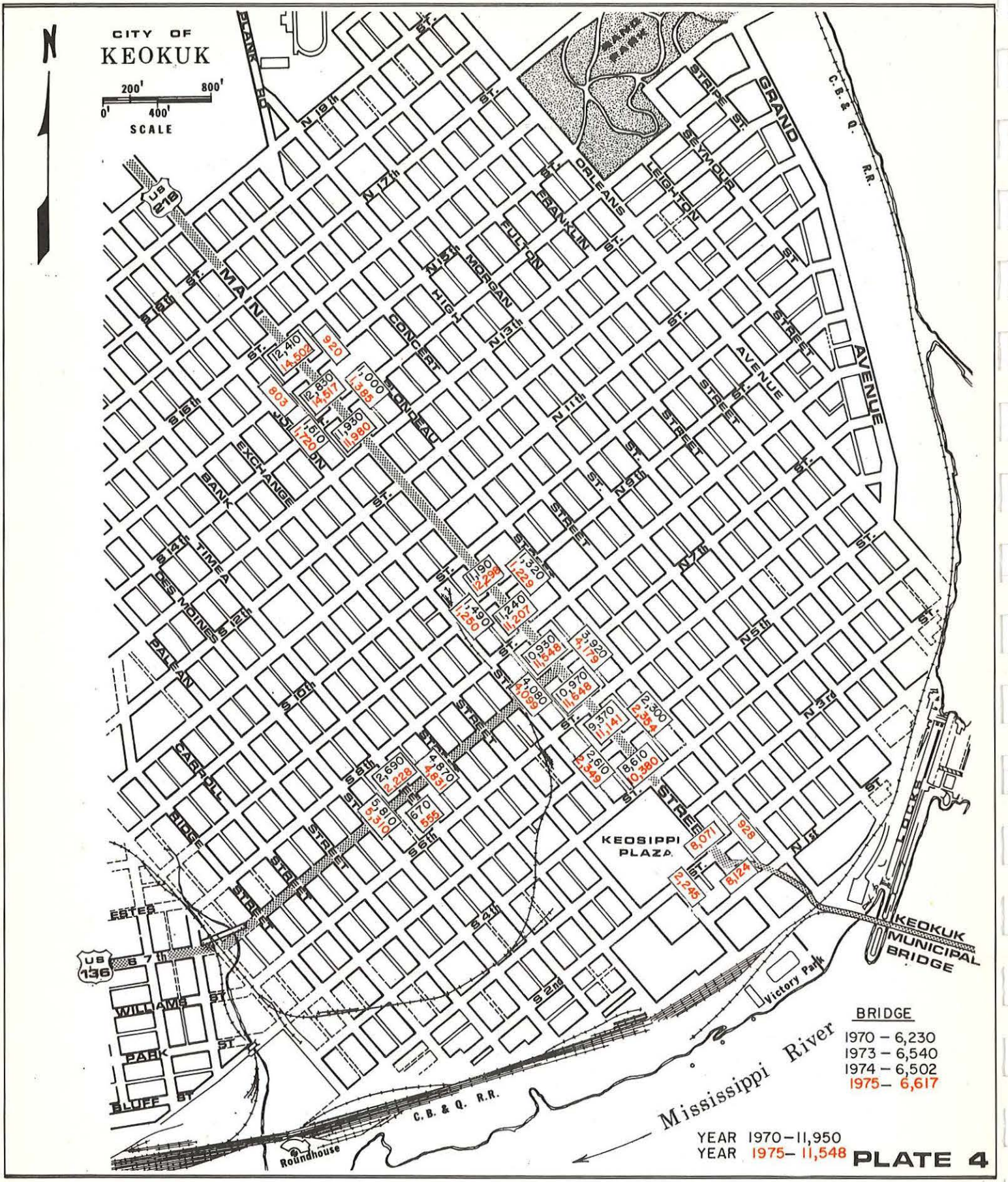
A new manfacturing plant, the Griffin Wheel Company, is scheduled to be completed in 1977. This plant will be located north of Carbide Lane, south of the Keokuk Steel Casting Plant. Another smaller plant the KSH Company, will be located on Royal Road near the St. Louis Die Casting Plant.

The concentration of industry in the northwest sector of town is placing large volumes of commuter traffic on Main Street Road and the feeder roads such as Carbide Lane and Royal Road. As the new plants open, congestion and accidents in the area will increase and new facilities such as signalization and widening may be required to handle these future increased volumes.

TRAFFIC VOLUMES

Traffic counts were taken in the City by the Iowa Department of Transportation in the summer of 1975. Unfortunately most of this very current data was not available for this study. The latest data prior to this is from counts made in 1970 which are shown on Plate 4 and were also made by the Iowa Department of Transportation.

Some preliminary traffic volumes for key intersections were released and are indicated on Plate #4. The 1970 volumes for the same locations are also shown for comparison. The traffic volumes appear to be increasing as the 1975 volumes are higher at several locations. Bridge crossings were higher and Main Street traffic at 14th was considerably higher. The 1975 volumes were used for computing the capacity analysis of the key intersections in the section on Traffic Flow Analysis.



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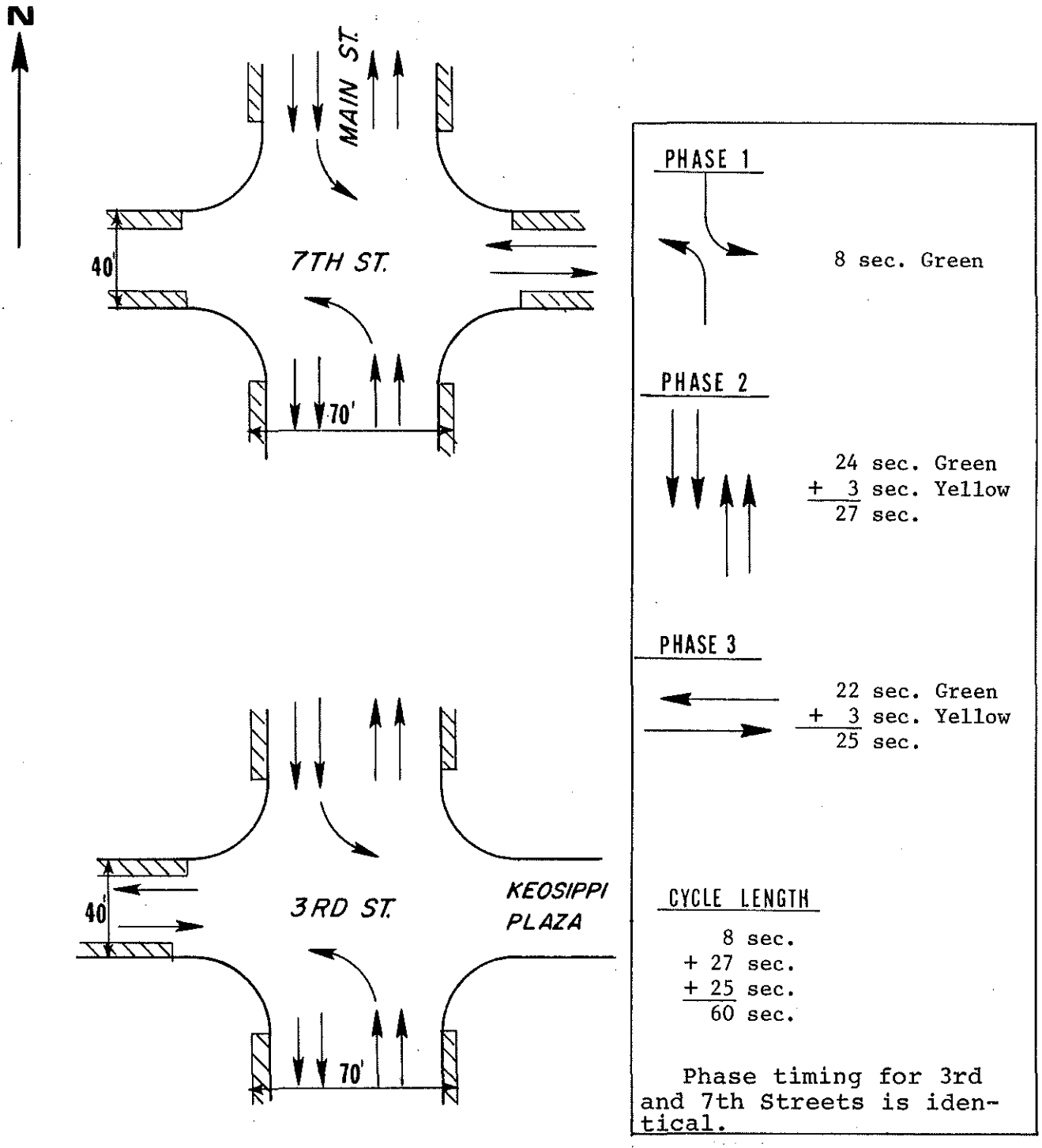
TRAFFIC VOLUMES

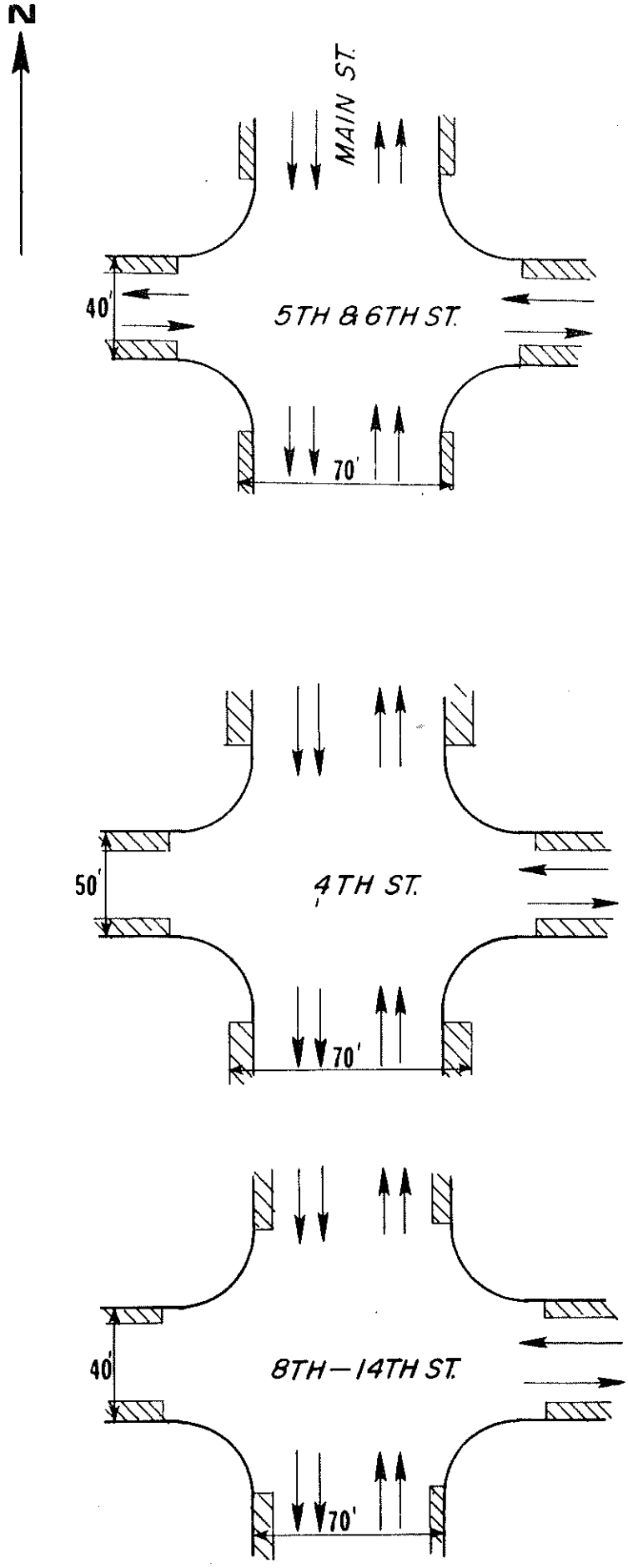
SYSTEM ANALYSIS

SIGNALIZATION

The major grouping of signalized intersections occurs on Main Street which also carries the highest traffic volume. There are twelve signalized intersections on Main which run consecutively from 3rd to 14th Street. The signals are controlled in pairs with fixed-time controllers, each controller being interconnected with two sets of signals. The signal pairs start with 3rd and 4th, 5th and 6th, etc. up to 13th and 14th Streets. The speed limit on Main Street is presently 20 miles per hour to 14th Street, 25 miles per hour to 16th Street and 35 miles per hour to beyond the Plank Road-Main Street Junction and 55 miles per hour at the City limits. The actual running speed varies considerably and during busy or even normal periods it is difficult to traverse the length of Main Street without stopping several times. Third and Seventh Streets have left turn arrows which are needed but limit the signal progression. The various signal times and phasing of the present system are as shown in the following diagrams:



TRAFFIC SIGNAL PHASE TIMES — MAIN STREET



PHASE 1

30 sec. Green
\+ 3 sec. Yellow
33 sec.

PHASE 2

24 sec. Green
\+ 3 sec. Yellow
27 sec.

CYCLE LENGTH

33 sec. + 27 sec. = 60 sec.

The Following Lights are interconnected in pairs:
3rd & 4th
5th & 6th
7th & 8th
9th & 10th
11th & 12th
13th & 14th

Phase timing is identical for the intersections shown.

TRAFFIC SIGNAL PHASE TIMES — MAIN STREET

The objective of signal timing is to alternate the right-of-way between traffic streams in such a manner as to minimize average delay to all vehicles and pedestrians. Vehicles on Main Street have 6 seconds more green time than side street traffic. This is a bit disproportionate as the cross street volumes are considerably lower. The ratio of cross street volume to Main Street volume is as much as 1 to 10 in some cases. If one considered vehicle count ratios alone, the green time on Main could be increased lowering the green time on the cross streets which would accommodate the large Main Street volumes more equitably. Another important factor to consider, however, is the pedestrian crossing time on Main Street. Because of the considerable width of the street, 70 feet curb to curb, a minimum green on the cross streets is needed to allow pedestrians enough time to cross in safety. Starting time of 5 seconds and a walking speed of 4 feet per second are values frequently used. With these values, a minimum green interval is determined by the following formula:*

$$G = 5 + \frac{D}{4} - Y$$

where
- G = minimum green interval in seconds
- D = length in feet of the longest crosswalk in use during the phase (or the portion of that distance subject to vehicular conflicts)
- Y = duration of the associated yellow interval in seconds.

For Main Street the minimum walking time equals:

$$G = 5 + \frac{70}{4} - 3 = 19.5 \text{ seconds}$$

---

* Traffic Engineering Handbook
Institute of Traffic Engineers

The existing cross street green time is presently set at 24 seconds which is more than the minimum indicating that about 4 additional seconds of green time could be transferred to the Main Street movements.

In order to determine the optimum cycling and signal phasing for the most efficient flow on Main Street, several combinations of traffic flow timing were investigated by the use of time-space diagrams. This is a graphic tool which plots distance versus time, with the slope of the plotted line representing speed of vehicles. Another parallel line placed at the end of the first green cycle is usually drawn also and the space between the lines represents a group, or platoon of cars traveling on the street. Red, green and yellow bands representing various phasing lengths of the traffic signals are placed at the intersecting streets and are positioned in such a manner to allow the platoon of vehicles to reach the intersections during a green period. Various combinations of cycle length, signal interval, and operating speed can be adjusted for an optimum sequence. Desirable progression is possible only if the cross streets are located at ideal distances to match a reasonable operating speed of the moving vehicles. The traffic in both directions on the primary street has to be considered.

The Main Street signal system in the downtown area is presently set up as a synchronized system and during certain non-busy periods it is possible to go from 14th Street to

3rd Street without stopping. One has to maintain the correct speed to accomplish this. As previously mentioned, however, the system bogs down during normal traffic because of the retail nature of the area which has parallel parking, considerable left turning and passenger discharge and pick-up. Several different combinations of phasing and cycle times were tried by utilizing the time space diagram, and the combinations shown on the following pages are the plans that were arrived at which are nearest to optimum timing for the lanes in both directions.

Diagram A maintains the existing cycle at 60 seconds and the existing green and red intervals at 30 seconds green for Main Street traffic to 24 seconds of green on the numbered cross streets. The only change is the adjustment of the offset time between the start of the cycles on the various streets. With the adjustment shown on the chart vehicular traffic, averaging 16 mph, can traverse the system in both directions without stopping.* This plan is limited by the narrow "through band" which is the measure of the number of vehicles traveling in the group or platoon. Southbound traffic has a 10 second band allowing approximately 8 cars in a group whereas the northbound band is 15 seconds wide with 12 car groups possible depending on spacing of individual vehicles.

---

* This of course is during periods of free flowing traffic without excessive tie-ups. Signal systems, no matter how sophisticated, cannot unsnarl blocked traffic.

MAIN STREET-
TIME SPACE DIAGRAM—A

RED
YELLOW
GREEN

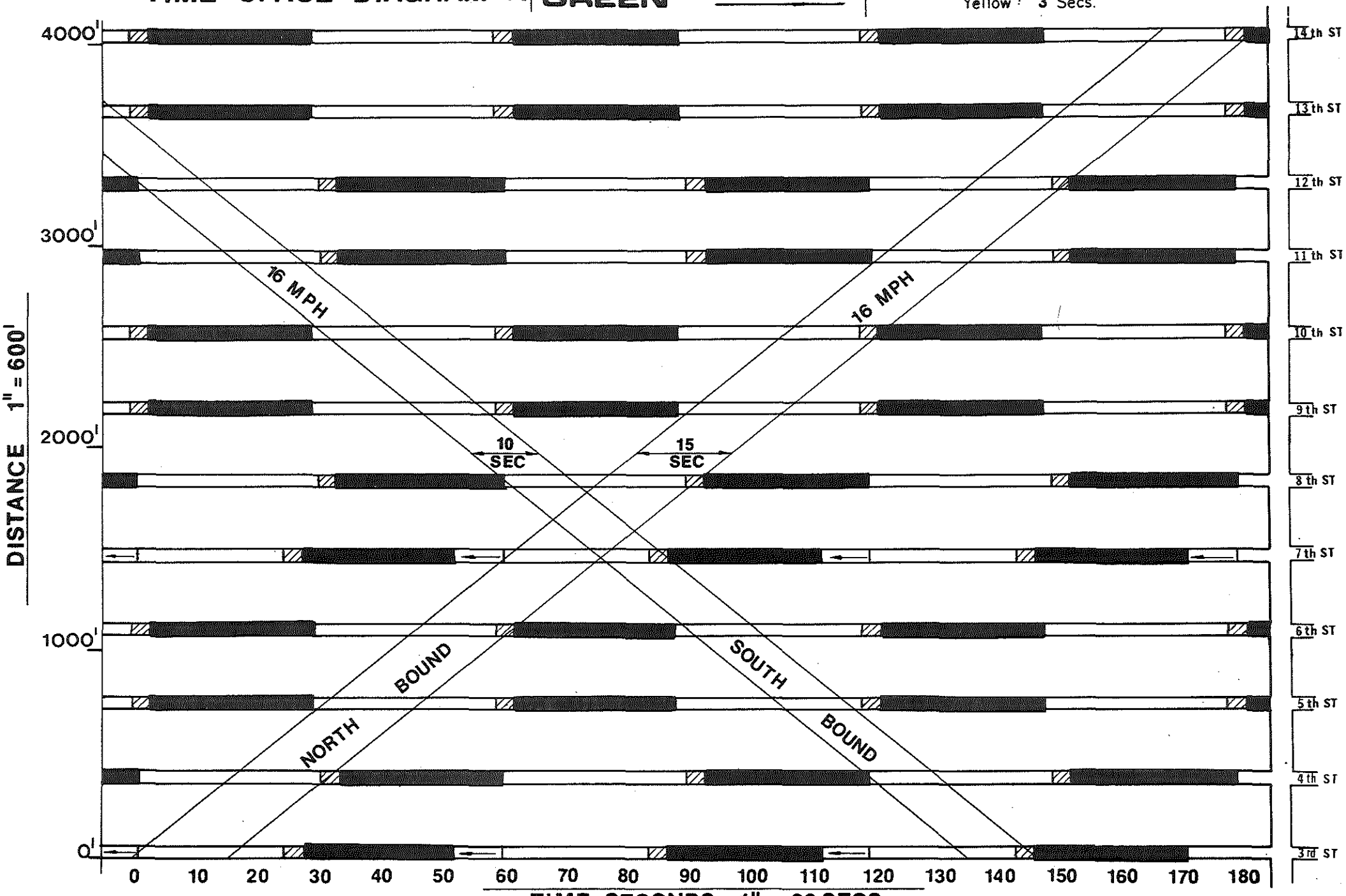
CYCLE 60 SECONDS

Phase Lengths:

Main Street : **30** Sec Green

Cross Streets : **24** Sec Green

Yellow : **3** Secs.



MAIN STREET-
TIME SPACE DIAGRAM—B

RED
YELLOW
GREEN

CYCLE 60 SECONDS
Phase Lengths:
Main Street : 33 Sec Green
Cross Streets : 21 Sec Green
Yellow : 3 Secs.

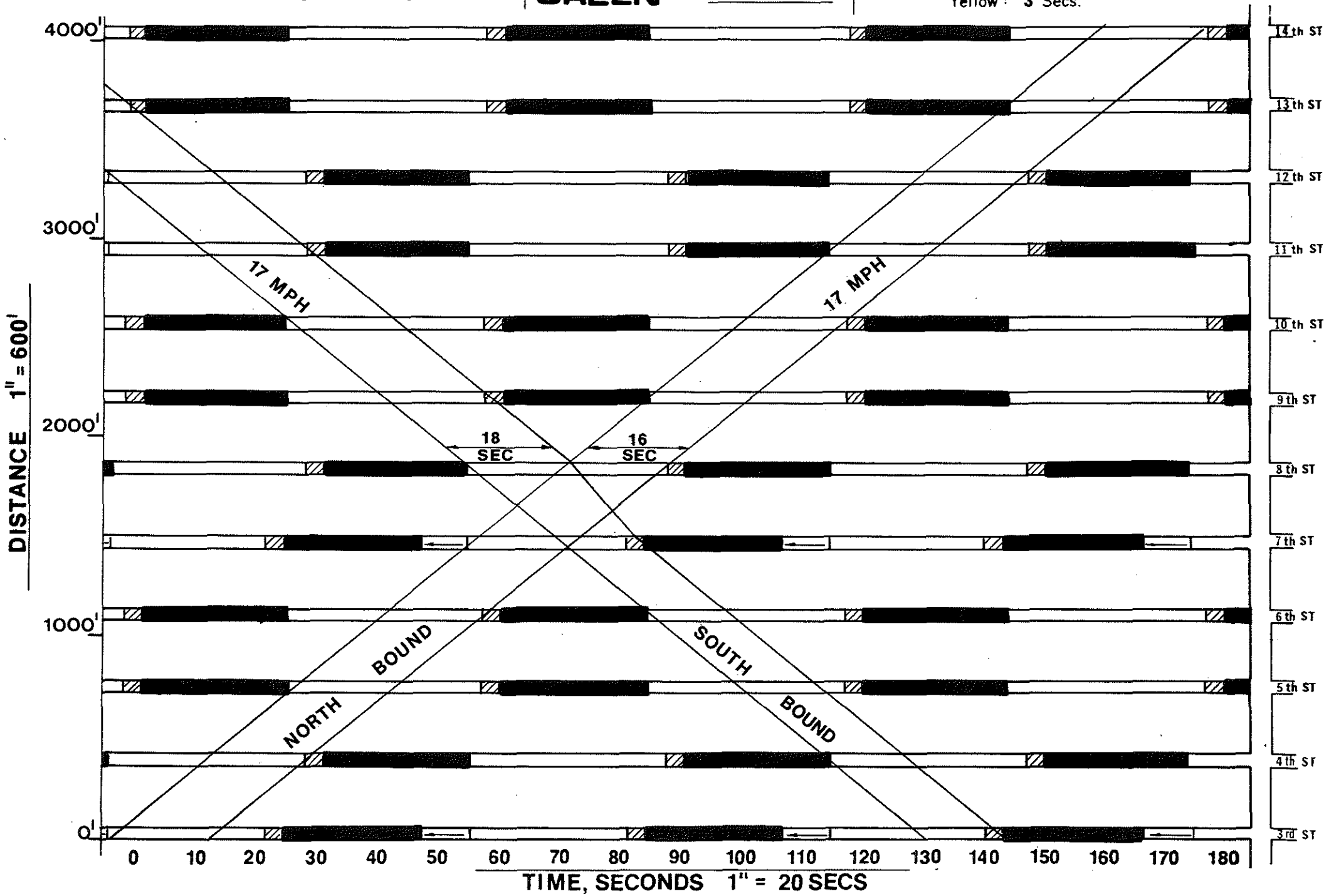


Diagram B maintains a 60 second cycle, however, the green-red interval is adjusted to give Main Street traffic 3 seconds of additional green on each cycle. The extra seconds are gained by decreasing the green time on the cross streets. The "through bands" on this plan are wider allowing larger groups of vehicles to traverse the system without stopping. This plan improves traffic flow on Main Street but decreases the amount of time for vehicles and pedestrians on the cross streets to get across Main Street.

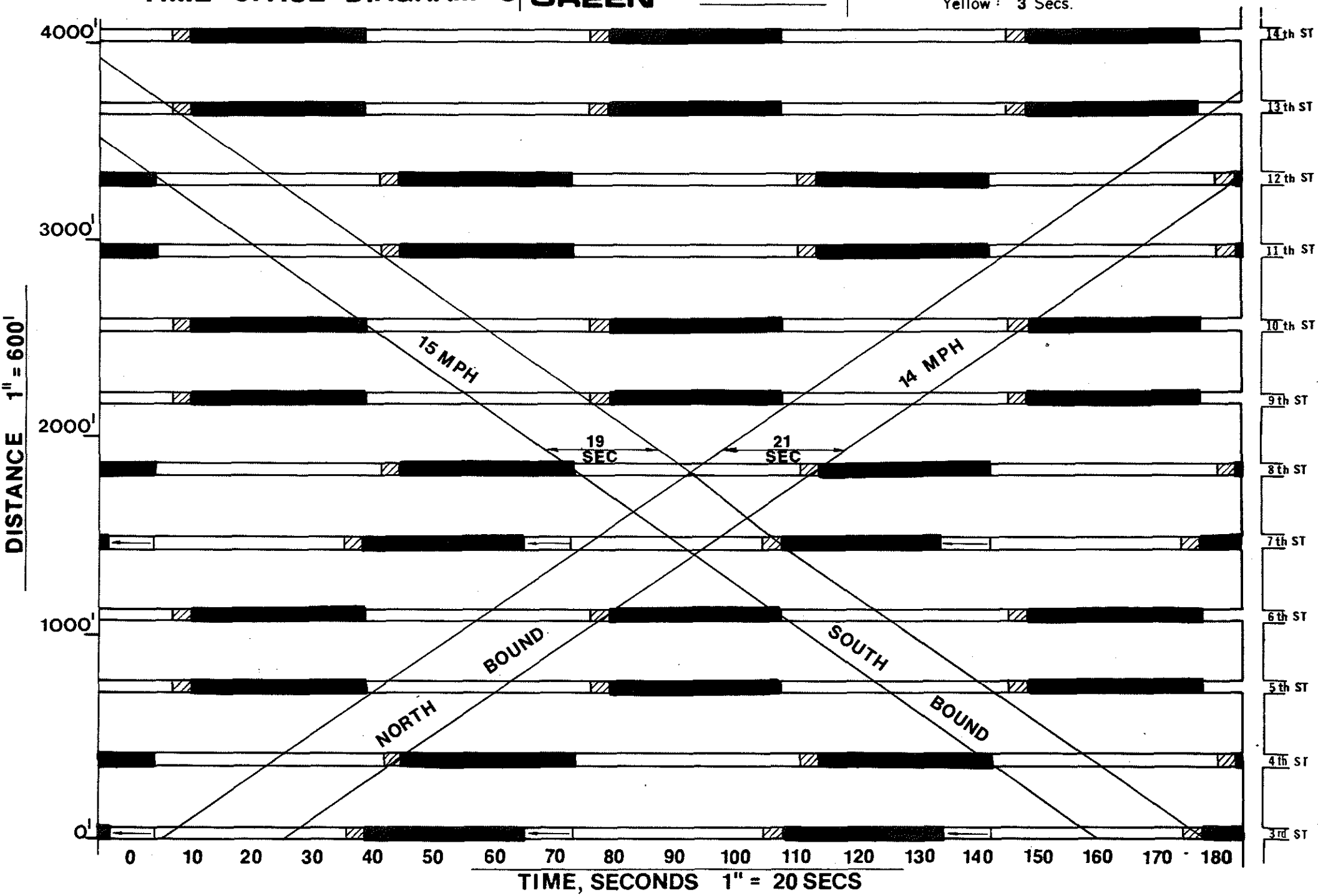
Diagram C has the cycle length increased to 70 seconds with Main Street receiving 38 seconds of green during each cycle. The cross street green is increased to 26 seconds which is 2 seconds longer than these streets have at the present time. The advantages to this plan is that it offers better flow for traffic in both directions.

Northbound traffic, after receiving a green light at 3rd Street, can hit successive green lights throughout the Main Street system if a fifteen mile per hour average speed is being maintained. The lead cars in a platoon of southbound vehicles can do likewise in the opposite direction but the number of cars in the platoon may not be quite as large. Generally speaking a longer cycle time will accommodate more vehicles per hour, however, cycles longer than necessary for traffic volume present can produce unnecessary delays. Another advantage of the longer cycle is the extra time for

MAIN STREET-
TIME SPACE DIAGRAM—C

RED
YELLOW
GREEN

CYCLE 70 SECONDS
Phase Lengths:
Main Street : 38 Sec Green
Cross Streets : 26 Sec Green
Yellow : 3 Secs.



pedestrian crossings. This can be particularly beneficial to older pedestrians who need additional time especially in inclemate weather.

It is recommended that the Main Street system be adjusted to a 70 second cycle on a trial basis. Some experimental settings on the offset times of the various intersections may be necessary to achieve the optimum settings. This should be done during times of low traffic such as week-end mornings or late evenings. If, after an adequate test period, the 70 second cycle does not prove to be effective, the controllers can always be changed back to the 60 second cycle system.

The trial systems discussed here are referred to as double alternate systems. With this type of system the signals on adjacent intersections are interconnected with each other as shown on the diagrams on pages 12 and 13. During the course of this study various other progressive signal systems were tried including triple alternate and limited progressive systems. These systems did not prove to be feasible as speed and distance combinations could not be arranged to achieve complete progressive traffic flow.

There are, of course, many overriding factors to traffic delay other than signal timing; this is especially true in Keokuk which has the unusual situation of a toll drawbridge which has to be opened several times a day, near one end of the only signal system.

A factor that could have a major effect on Main Street traffic in the future is the location of a new Mississippi River Bridge now under study by the Iowa Department of Transportation. The problems with the existing bridge and the new bridge potential is discussed in more detail in the Bridge section of this report.

There has been some concern for re-routing thru traffic off Main Street especially truck traffic which is a major cause of noise and congestion. Any re-routing of this traffic will be directly affected by the new bridge location. The latest study concerning the bridge was completed in 1968 and the two most feasible alternates had approach alignments which connected to Main Street at Second Street. Because of this direct connection neither alternate would be conducive to re-route thru traffic from Main Street. Other alternates of the 1968 study included connections to U.S. 61 and Timea Street, however these plans were not as feasible as the Main Street alternates.

Local input will be important in determining the location of a new bridge and a unified stand by local officials, community groups and businessmen should play a mojor part in determining the final alignment of the new bridge.

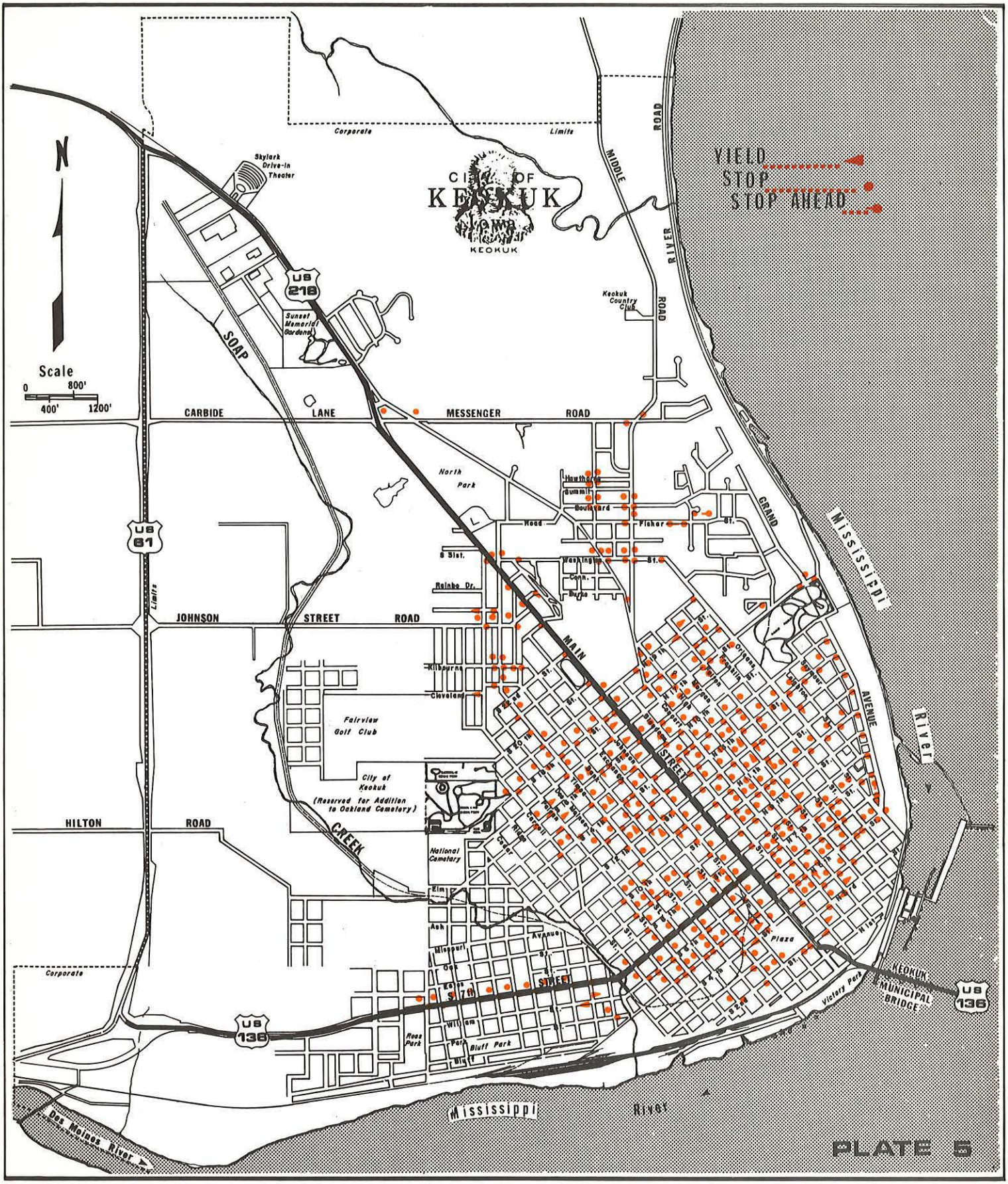
TRAFFIC SIGNING INVESTIGATION

An inventory of the traffic control signs and signals was made throughout most of the developed areas of the City and sign locations are shown on plates 5 thru 8. Since the the 1971 *Manual on Uniform Traffic Control Devices was introduced there have been Federal Directives issued to change the old signing system to conform to a uniform system of signing that is consistent throughout the United States. In general, the City's sign system is in relatively good shape, as old signs are being replaced with modern, conforming signs. Eventually, the system will conform to the standard signing policy adopted by the U.S. Department of Transportation.

An examination of the traffic signs throughout the city was made and these recommended for replacement are listed by type and location. It was found that the streets that are also part of the highway system, that is Main Street (U.S. 218) and Seventh Street (U.S. 136), are in conformance with the Uniform Manual. In order to prepare a comprehensive report on the sign system, the signs were grouped according to category and the following tabulation lists the conditions of the various groups of signs.

---

* The need for uniformity has been recognized for sometime and in 1970 a manual was composed which was authored by several parent organizations including the American Association of State Highway Officials, the Institute of Traffic Engineers, the National Committee on Uniform Traffic Laws and Ordinances, the National Association of Counties, and the National League of Cities. The manual was adopted by the Federal Highway Administration as the National Standard for Traffic Signs and Controls on the classes of streets and highways.



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Keokuk Traffic Study

Fall, 1975

STOP & YIELD SIGNS

1. Stop Signs

Practically all of the stop signs throughout the network system were of the proper size, shape and color, however, in several cases the signs are not reflectorized. All signs enforced during night hours are required to be reflectorized or illuminated. On many stop signs the red background is seriously faded and these should have the highest priority of replacement or refinishing.

A complete listing of the STOP signs that need replacing is as follows:

Location	No. of Stop Signs Which Should Be Replaced
6th & Carroll	1
6th & Johnson	1
7th & "B"	1
7th & Orleans	2
7th & Fulton	2
7th & High	1
7th & Pleasant	1
7th & Blondeau	1
7th & Oregon	1
9th & Blondeau	1
9th & Bank	1
9th & Timea	2
9th & Palean	1
10th & Blondeau	1
10th & Concert	1
11th & High	1
12th & Blondeau	2
13th & Blondeau	1
13th & Fulton	1
13th & Morgan	1
14th & High	2
14th & Morgan	1
14th & Fulton	1
16th & Exchange	2
16th & Concert	1
16th & High	2
16th & Orleans	1
17th & High	1
17th & Orleans	1
17th & Concert	1
19th & High	1
21st & Turner	1
Bank & Kilborne	1
Boulevard Road & Crestwood Lane	1
Boulevard Road & Park Lane	1
Washington & Middle Road	1
Plank & Washington	1
Middle Road and Washington	1
Park & "C"	2
Total	47

Besides replacement the following action concerning STOP signs is also recommended.

Install stop signs for the lowest volume movement at the 15th and Fulton Streets intersection. The proximity of the Graham Hospital makes this an important priority.

Two new stop signs should be at 10th and Exchange requiring Exchange Street traffic to stop for Tenth Street traffic.

Tree trimming is needed to allow better vision of stop signs at 15th and Concert.

A new stop sign is needed to control exiting traffic at the north access to Rand Park.

The stop sign which stops 20th Street traffic at the south entrance to the K-Mart Shopping Center should be removed.

Change yield sign to stop sign at McKinley and Cleveland.

The stop sign at Kilborne and Exchange should be reversed. The Public should be made aware of this change. This could be accomplished by the use of a temporary stop ahead sign until the Public is familiar with the change.

The visibility of the stop sign at Grand and Orleans Avenue should be improved.

There are several minor intersections predominantly on the west side of town that lack traffic control signs in either direction. Accident rates do not reflect a problem with these locations, however, they should be watched and corrected by controlling the minor movement if accidents begin to happen.

2. Yield Signs

There are several yield signs within the street network, excluding the streets on the highway system, that are of the old style, that is yellow background with black lettering. (See Photo Plate 9). These should be phased out and replaced with the red and white triangular sign that meets the standing yield sign criteria. Also there are some intersections where a yield sign controls the minor movements where normally a stop sign is used for this purpose. The Uniform Manual states that yield signs should not ordinarily be placed to control traffic flow at an intersection, however, in some cases where a stop may not be necessary it is permissible.

A listing of the older style yield signs recommended for replacement is included below:

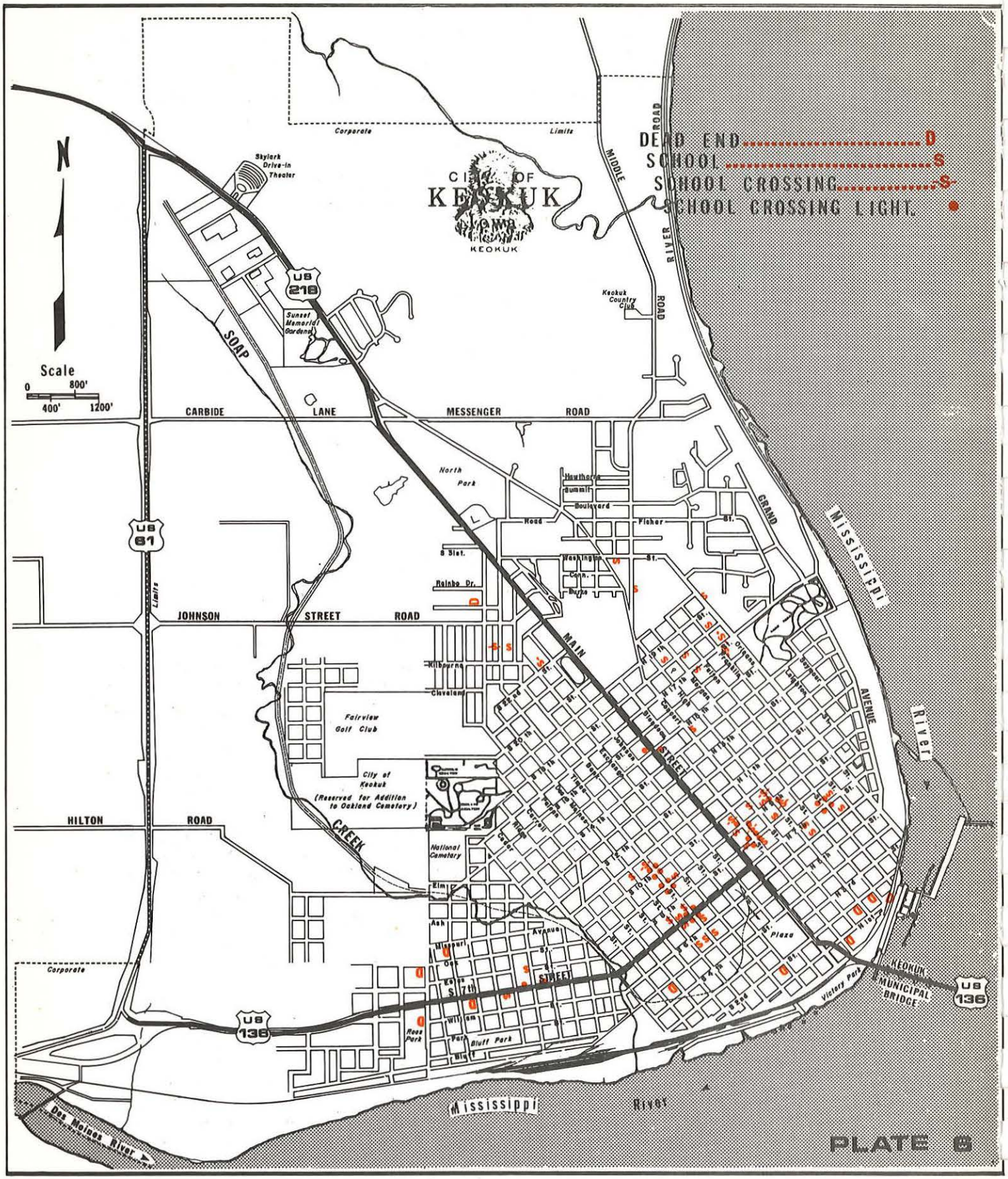
Location	No. of Yield Signs Which Should Be Replaced
2nd & Blondeau	2
4th & Exchange	2
5th & BJuff	2
Park and "B"	2
8th and Morgan	2
8th and Exchange	2
11th and Morgan	2
11th and Exchange	2
12th and Bank	2
12th and Morgan	2
14th and Bank	2
15th and Johnson	2
16th and Johnson	2
17th and Johnson	2
William and "B"	2
Total	30

3. School Advance and Crossing Signs

A serious deficiency in the City's sign system is the use of non-standard school and school crossing signs. In most cases the school crossing signs or school warning signs are of the old type and should be replaced with the new symbolized type. Two symbolized signs are used for each crossing. One is a School Advance sign and the other is a School Crossing sign. The signs should be placed in accordance with Sections 7B-9 and 7B-10 of the MUTCD. Of the eleven schools in the City, all need updated advance and crossing signs except the crossings of 7th Street and the crossings at Main Street. A total of 36 new signs are needed.

4. Speed Limit Signs

Several of the speed limit signs are of the old type in that they are smaller than the uniform speed limit signs. This is probably one of the least serious of the sign deficiencies but when replacement becomes necessary it is recommended that the standard size and type to regulate speeds be used. Two additional 25 mph signs are needed on West Commercial Street. The curve on Hilton Road has westbound signed for 35 mph and eastbound signed for 25 mph. The limit should be 25 mph in each direction.



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ARCHITECTS ENGINEERS PLANNERS

Keokuk Traffic Study

Fall, 1975

SCHOOL SIGNS

5. Railroad Crossing Signs

The only major at-grade railroad crossing, located at Seventh and Johnson Streets, is marked with a standard cross buck and flashing red light which appears to be adequate as accident records show a low rate of accidents at this location. There are other railroad crossing signs in need of maintenance and repair and this should be done by the City or the particular railroad company.

The crossbuck signs at the following locations need to be replaced.

3rd and Des Moines
3rd and Timea
4th and Ridge
5th and Ridge
5th and Exchange

6. One-Way Signs

A few of the one-way street designation signs on minor streets and alleys are of an older style (See Photo) and should be replaced with the larger signs which conform to the Uniform Manual. The "Do Not Enter" signs at the termination of the major one-way streets are of the red and white standard design and apparently there has been little problem with motorists traveling in the wrong direction. Approximately 8 one-way signs need to be replaced.

7. Playground Signs

Another serious deficiency in the City's sign system is the lack of advanced warning signs for the parks and playground areas in the City. This is especially true in those areas which have tot lots and concentrated playground equipment for small children. Special signs which warn of CHILDREN AT PLAY and SLOW CHILDREN should be installed. The following playgrounds should have signs installed as at concentrated play areas as soon as possible.

1. Kilbourne Park - 4 signs
2. Rand Park - 2 signs
3. Bluff Park - 2 signs
4. Kiser Park - 2 signs
5. Tumelty Park - 2 signs

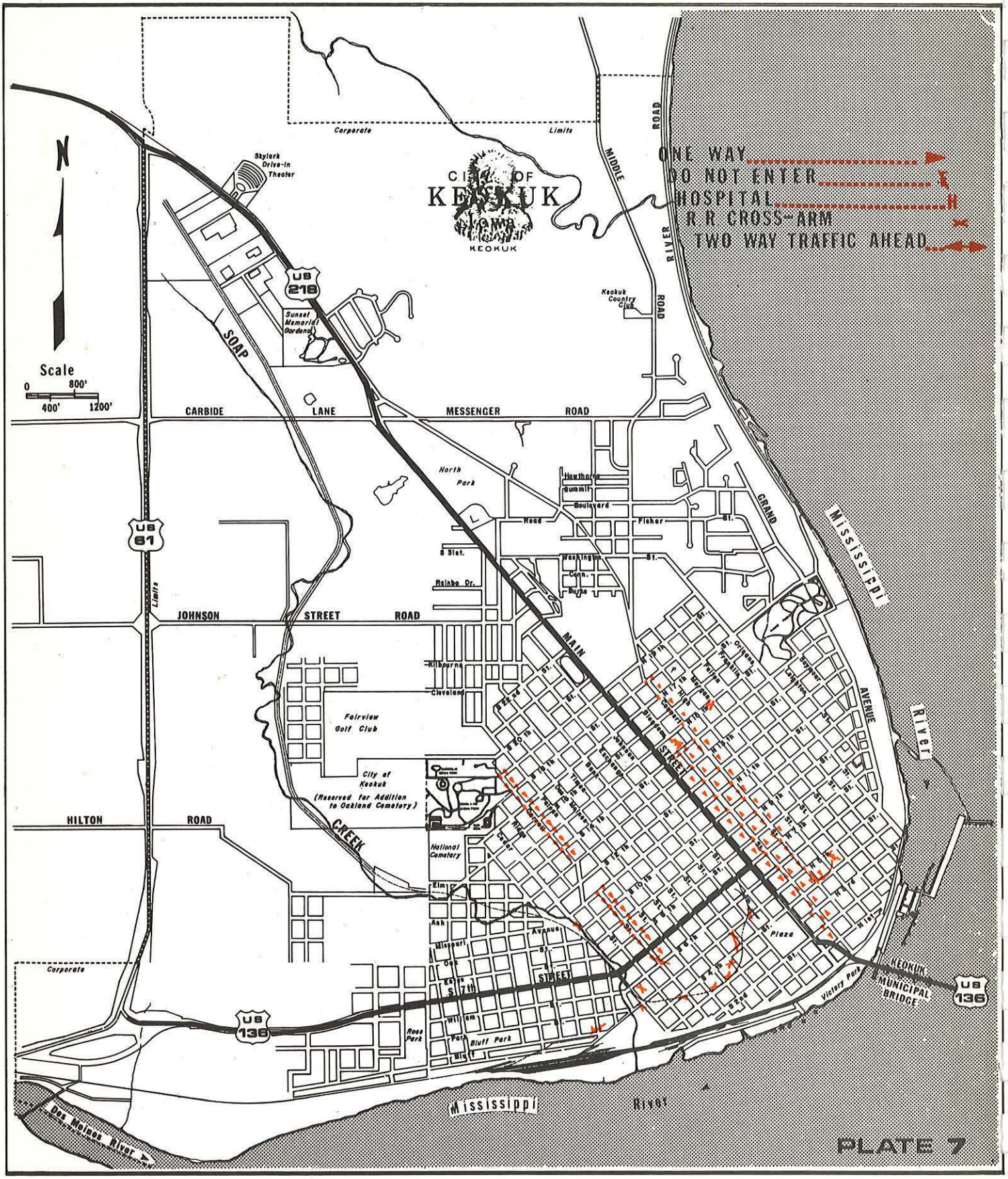

PLATE 7

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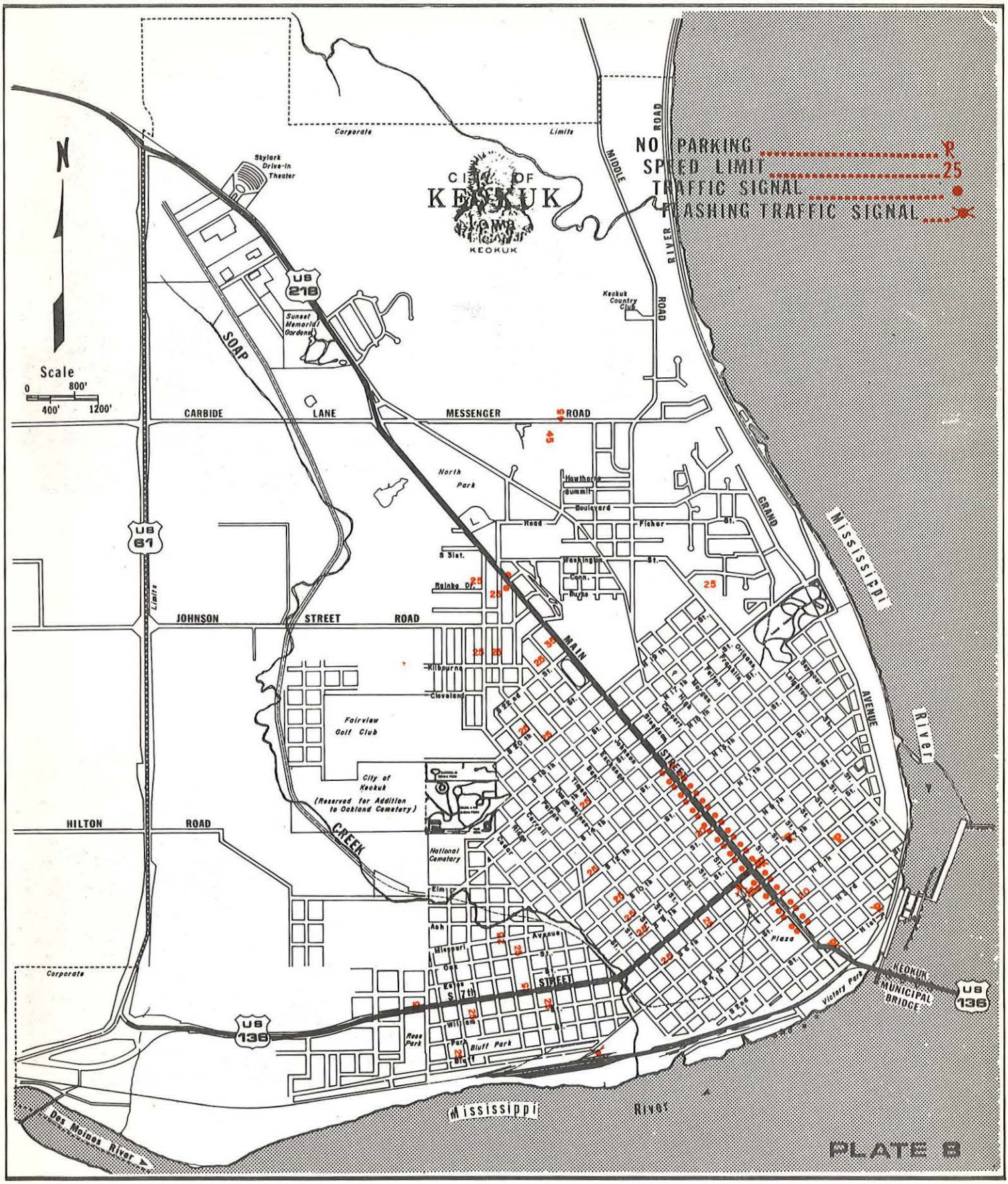
REGULATORY & INFORMATION SIGNS



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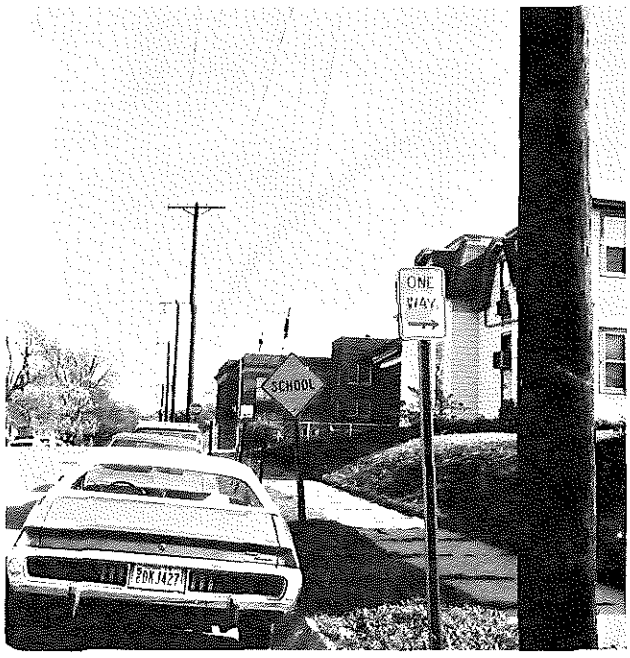
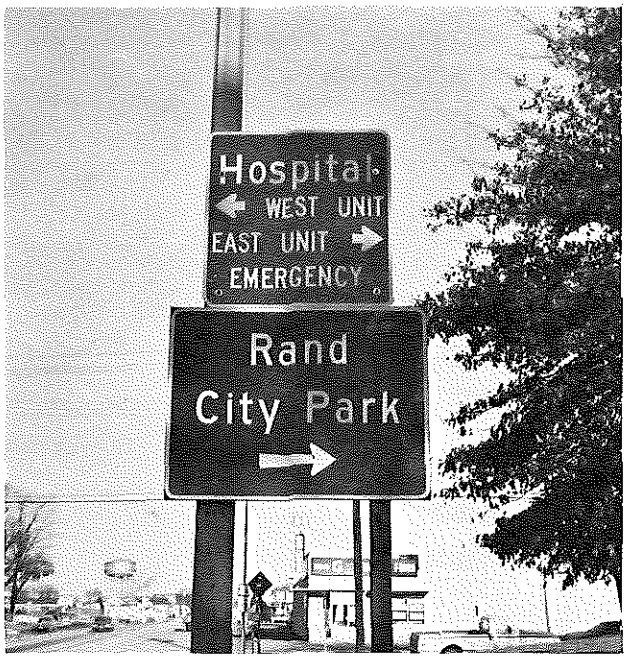
REGULATORY SIGNS

KEOKUK TRAFFIC SIGNS



The yield, school and one-way signs shown above are typical signs that should be replaced with standard signs.



The signs shown above are helpful to the visitor and are a definite asset to the City's sign system.

8. Special Signs

a. Signal Warning

Because of the high number of rear end auto collisions at the Belknap Boulevard and Main street, intersection a special traffic warning sign such as type W3-3 with the signal ahead logo (listed in the Uniform Manual) should be installed on the South Main Street approach to this intersection near 25th Street. This is the first signalized intersection for northbound traffic since 15th Street and northbound traffic approaches the intersection at a fairly high rate of speed.

b. Drawbridge Warning

Although not specifically required in urban areas a DRAWBRIDGE AHEAD sign should be installed in view of the high accident rate at the approach to the Municipal Bridge. A Hazard Identification Beacon interconnected and controlled from the bridge tenders station should help reduce the accident rate at this location. The flashing signal should be turned on when the drawbridge is open and traffic is halted. The drawbridge signals and gates that are on the bridge along with the warning siren appear to function satisfactorily.

c. Narrow Bridge Signs

The narrow bridge sign on the north approach of the River Road Bridge should be replaced as it has taken a shotgun blast. Also the black and white warning boards are in need of repair and should be extended. Reflective warning boards are needed at the southwest corner of the 10th Street bridge and could be hung on the chain link fence presently there. Narrow bridge signs are needed on both approaches to this bridge also. The narrow bridge sign on the east approach should be replaced and the new one placed in a more visible position. An advisory speed sign of 15 mph with curve arrow is needed on both approaches to the 10th Street bridge.

d. Snow Emergency Signs

Many cities across the country have designated certain key streets as snow emergency routes where traffic is prohibited when a snow emergency has been declared. This has to be implemented by ordinance and is done at the discretion of the individual cities. The need for an emergency route system can best be judged by the City officials and City staff depending on past experience in snow removal difficulty.

e. Street Signs

Most streets within the City of Keokuk are adequately marked as little trouble was encountered finding specific locations around the City. Practically all of the signs are beginning to rust and will need replacing eventually. This is not a vital need and can be done as the signs become unreadable. Some signs were missing probably due to vandalism.

f. Miscellaneous Signs

Other miscellaneous signs such as public camping, suggested bicycle routes and public telephone locations are helpful to the traveller. Standard signs of this type are available in attractive colors and their use is encouraged.

The City is to be commended on the liberal use of informational signs such as the scenic drive, park and hospital locations and directions to public parking in the downtown area.

On the whole the City of Keokuk appears to be above average as far as to the adequacy of their signing system. Signs are expensive and replacement of all sub-standard signs at once would be very costly, however, there is special Federal funding available such as the Safer Roads Demonstration Program (23 USC 405) through which financial aid is available

to assist local governments in sign replacement. It is mandatory that old signs be replaced with those which meet criteria of the Uniform Manual and city officials have reported that this is the present policy which is evident by the new signs that have been recently installed. A special sign maintenance area in the City shops may prove beneficial. In some cases special decals are available for updating existing signs to conform to the uniform standards.

A major problem in sign maintenance is vandalism of existing signs. Defacing, shooting and pilfering are the major abuses and sometimes serious accidents are caused because a sign has been stolen from a key location. Public education can help this situation, as some people don't realize that they themselves are paying for the sign replacement.

Some court houses and city halls have disfigured signs on display with the cost of replacement noted adjacent to the individual signs. These are placed near the license renewal area and is an effective method of making citizens aware of sign replacement costs.

SIGN REPLACEMENT PRIORITY

It is recommended that the following order of priority be followed in adding and replacing signs in the City's sign system.

1. Add playground warning signs.
2. Add new stop signs in the order of discussion.
3. Update school approach signs.
4. Install reflective boards, narrow bridge signs and advisory speed signs at 10th Street Bridge.
5. Repair hazard marker boards for the River Road Bridge at Price's Creek.
6. Install signal ahead sign for northbound traffic at 25th and Main Streets.
7. Install "No Left Turn" sign at Belknap Boulevard and Main Streets.
8. Install "Drawbridge Warning" sign at approximately 3rd and Main Streets.
9. Install speed limit signs as discussed with Messenger Road changed to 35 mph as top priority.
10. Replace yield signs as discussed.

PAVEMENT MARKINGS

Pavement markings for pedestrian and vehicle direction are an essential part of traffic operation and are also covered by the Uniform Manual of Traffic Devices.

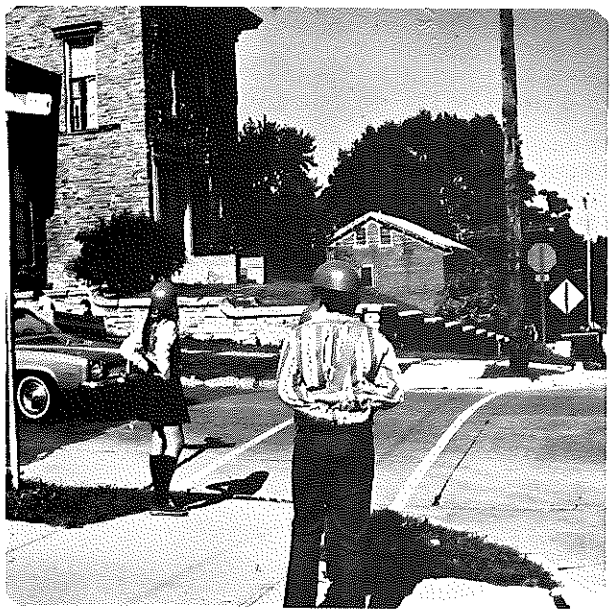
Sometimes markings are more effective than other means of regulatory signs as they do not divert the eyes of the driver from the roadway. (See Photo below) Unfortunately the markings have limitations as they can be obscured by mud or snow and generally do not last long in areas of heavy traffic.

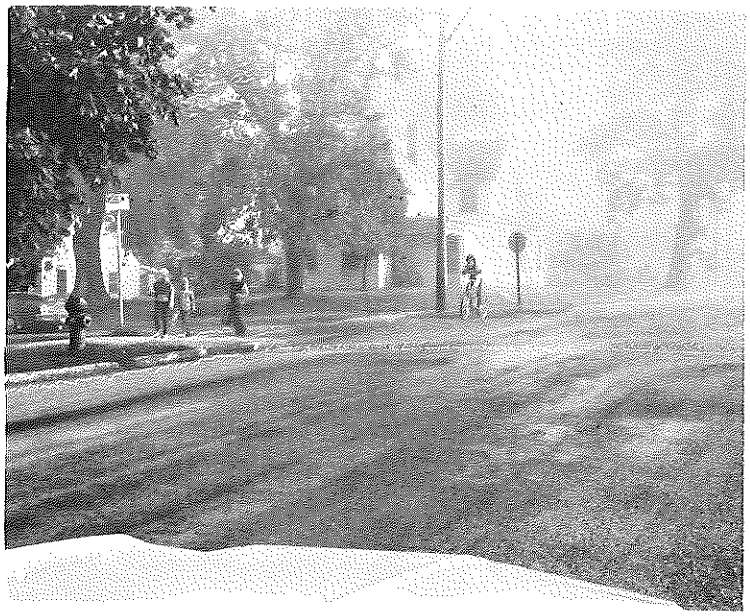
The City of Keokuk undertakes a pavement marking project every year, renewing and adding markings where they are needed. In the Uniform Manual there are detailed instructions as to the size, type and location of markings that should be applied.

These guidelines should be adhered to and the marking crews instructed accordingly. If consistent marking policies are followed year after year, there will be less driver confusion and hopefully a reduction in the number of accidents.

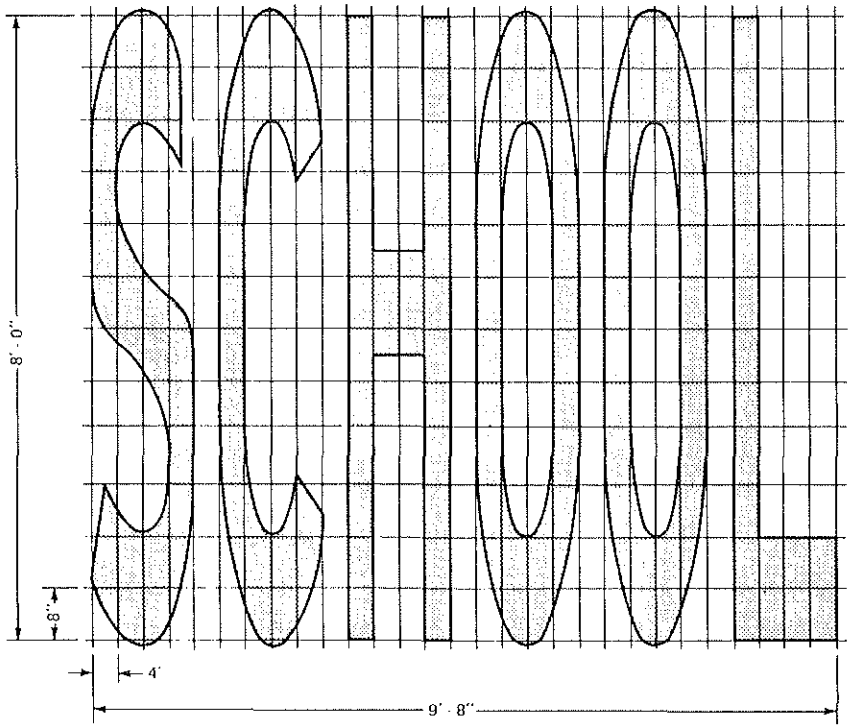
The adjacent photo is a typical example of the City's pavement marking methods.

Existing school crossing markings are generally two white lines outlining a four foot space at the street intersections (See Photos below).





Larger and bolder parallel strips not less than 6 inches in width and not less than 6 feet apart are required at all crossings. It is recommended that the mid-block crossing on 7th Street at the Lincoln School and the mid-block crossing on 14th and 15th Street for the Junior High School be cross hatched as well as striped. It is also recommended a word message as shown below be used on 7th



Street (U.S. 136) at the east and west approaches to the Lincoln School.

It is estimated that approximately 1000 sq. ft. of additional pavement marking is needed annually. Funding for pavement marking is available through the Pavement Marking Demonstration Program (23 USC 151).

SIDEWALKS

It is estimated that approximately 30% of the developed City of Keokuk does not have hard surfaced sidewalks. The Keokuk Engineering Department has recently initiated a sidewalk repair and construction program by making a survey of the City's sidewalk system and the degree of repair and construction needed. The survey performed by part-time student employees, took place during June of 1975 and resulted in a complete inventory of the blocks that presently do not have sidewalks and the areas that are in need of sidewalk repair.

By City law, it is a responsibility of the adjacent property owners to provide and maintain sidewalks. The City is presently pursuing the sidewalk construction and improvement program by sending out letters requesting that the property owners repair existing walks or construct new walks on their own. The present program is on a volunteer basis and hopefully, there will be a good response from the owners. If the volunteer program does not work out and provide the desired results, then the City has the option to do the work and assess the cost back to the individual owners. Since this program has been underway only a short time it is still too early to determine the results.

There will undoubtedly be many owners who do not respond and, depending upon the action of the city officials, it will be up to the engineering department to contract for sidewalk replacement with the cost being assessed back to

these owners. There are also several areas of City owned property mainly in park areas that are in immediate need of sidewalk construction as there are pedestrians now using the streets, creating potentially dangerous situations. (See Photo below) In conjunction with the sidewalk replacement program, it would be advisable to initiate construction on the city owned areas as well. A tentative priority list is included in this section. These were areas that were observed during a period of data gathering and field review during the course of this study. Other areas may also have high priority as determined by city engineering department personnel through citizen complaints and long term observation over the past years.

Municipal Pool Area

Cardinal Stritch High School

The photos above emphasize the need for sidewalks. Both areas have high volumes of pedestrian traffic.

TENTATIVE PRIORITY LIST FOR SIDEWALK CONSTRUCTION

City Owned Property

1. Plank Road adjacent to North Park and the Municipal swimming pool. 1100 lin. ft.

2. Tumelty Park, north and east side. 640 lin. ft.

3. Rand Park, north side. 1750 lin. ft.

4. Kiser Park, north and east sides. 640 lin. ft.

5. Kilbourne Park, north side. 360 lin. ft.

6. Other parks and playground areas where children walk in the streets.

The following is a list of private properties that should be urged to have sidewalks constructed.

1. Plank Road adjacent to Cardinal Stritch High School.

2. The Private areas on both sides of the main approaches to the Keokuk Public High School on Plank Road and Middle Road.

3. The private areas adjacent to the main pedestrian access to the newer subdivision areas north of Rand Park including Bel-Air Street, Boulevard Road and Park Lane.

4. Decatur Street near Hawthorne School from Plank Road to Messenger Road.

The City Engineer's Office has a complete listing of the need and condition of curb and sidewalk conditions throughout the City. It is recommended that the replacement and repair program be continued. It is also advisable to firmly enforce the ordinance directing that sidewalks be constructed in all new residential subdivisions.

PARKING

An investigation and analysis of the parking arrangements and parking needs of the Keokuk Central Business District (See Plate 10) was made to explore the possibility of providing additional and more convenient parking for the benefit of the local merchants, the employees and the numerous shoppers. The major change in the Central Business District in the past few years has been the addition of the Keosippi Plaza which is a suburban type shopping center uniquely located at the edge of the downtown retail district. The Plaza parking lot offers free parking and attracts a considerable number of cars, however, since it is located at the very southern end of the core retail district, it is out of walking range for many shoppers who desire to trade at the shops and stores in the central and northern segments of the retail area. This can be detrimental to some businesses especially if there is no available parking space, metered or not, within a block or two of the particular establishment the shopper wishes to patronize.

Parking in the Central Business District consists of metered on-street parking along with several private lots and the public "park and shop" lot adjacent to Blondeau between 5th and 6th Streets. There are additional public lots at 7th and Johnson Streets and the library lot at 5th and Concert, but these are beyond walking distance from the retail core area for the average shopper. The parallel

stall, on-street parking, is very popular and during busy periods most spaces in the core areas are filled.

An intensive parking survey of the Keokuk Central Business District was made by the AAA Motor Club of Iowa to determine parking needs and if a sufficient number of parking stalls were available to meet parking space demand. This study was performed in 1972 and data concerning the issues of spaces and the length of occupancy was gathered by High School students on a May Wednesday of that year. The data was subsequently compiled and analyzed and recommendations were made concerning meter timing and pointed out a need for expansion of employee and shopper off-street parking. During the course of this study, there was considerable data gathered which is still valid and it is the intent of this current traffic study to avoid repetition of material previously covered and recommendations resulting thereof. The 1972 parking stall inventory revealed there were 2,947 parking spaces in the Central Business District. Of these, 1584 were street parking spaces, 1208 were private spaces in parking lots and there were 155 publicly owned spaces also in parking lots. Since then there has been no major loss or gain in the spaces so that figure is presumed to be relatively accurate today. Assuming a current population of nearly 15,000 people, this amounts to a parking space availability ratio of roughly 196 spaces per thousand population. This is considerably higher than most U.S. cities in the 10,000 to 25,000 population group (see next page). On the other hand, Keokuk ranks low on the number of municipally owned

off-street parking facilities. A study of 302 U.S. cities in the 10,000-25,000 population group revealed that an average of 253 off-street parking spaces were provided by local governments for use by residents and workers. This compares to only 155 municipally owned spaces in Keokuk which indicates a need for additional facilities of this type.

*Number and Percent of Total Parking Spaces Classified by Type of Facility (U.S. Cities)

Population Group of Urbanized Area	Type of Facility			Average Number of Total Spaces	Spaces per 1,000 Population
	Curb	Off-street			
		Lot	Garage		
10,000 - 25,000	1,090 (43%)	1,530 (57%)	10 (0%)	2,630	150
25,000 - 50,000	1,430	2,420	140	3,990	120

* Source: Parking Principles, Highway Research Board Special Report No. 125 (Washington, D.C.: Highway Research Board, 1971), p. 9.

**Number and Type of Municipally Owned Off-street Parking Facilities (U.S. Cities)

City Population	No. Of Cities Surveyed	Parking in the CBD				Parking Outside the CBD			
		No. of Garages	No. of Spaces	No. of Lots	No. of Spaces	No. of Garages	No. of Spaces	No. of Lots	No. of Spaces
5,000-10,000	251	5	780	680	41,640	3	70	131	13,447
10,000-25,000	302	22	2,231	1,141	76,361	0	0	218	22,001
25,000-50,000	166	18	3,558	929	72,894	0	0	210	25,040

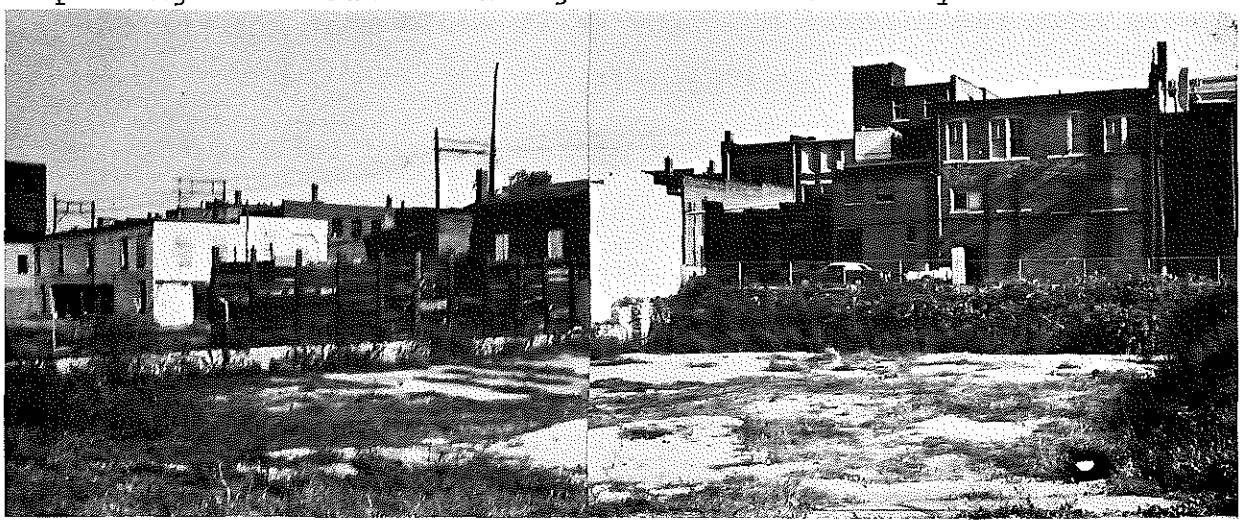
** Source: W.D. Heath, J.M. Hunnicutt, M.A. Neale and L.A. Williams, "Parking in the United States - A Survey of Local Government Action", National League of Cities, Department of Urban Studies, Washington, D.C., 1967, pp. 1-25.

Observations of on and off-street public parking in the C.B.D. were made on three different days, September 25th, October 29th and November 10th, 1975 to determine parking availability. The survey was taken in the afternoon hours between 2:00 and 3:00 P.M. which is a peak parking accumulation period for communities in the 10,000 to 25,000 population range. Parking spaces were available during these periods,

however, the on-street parking on some blocks was full and block circling was needed to find spaces. Spaces were more available the further they were from the core area. The Park and Shop lot at 6th and Blondeau was nearly full, but spaces were available. The public lot at 7th and Johnson Street had only a few cars probably because it is on the fringe of the retail core area out of normal walking range. It was necessary to walk across railroad spur track to reach the CBD from this lot. The library lot at 6th and Concert and the reserved spaces near the municipal building were not included in the survey as these are special purpose lots and have very little impact on the core retail area. The survey indicated that on normal days there are generally parking spaces available, but certainly not an excess. It is apparent that during the busy shopping season between Thanksgiving and New Year's, there will be a deficit of public parking spaces.

Although not in a critical state, public parking in the Central Business District should be expanded. City officials along with the Keokuk Chamber of Commerce have been concerned with this problem and several suggestions have been made as to the best methods for improving the parking situation. It appears the most viable plan is for the City to obtain the semi-vacant half block area, between 6th and 7th Streets east of Johnson Street and convert this into a Municipal Parking Facility. This area, in its unimproved state, was previously used for parking overflow but problems with flooding and drainage have resulted in its abandonment. The

site lies in a 6 to 10 foot deep depression just behind the Main Street business buildings between 6th and 7th Streets (see Plate 5). Both Johnson Street on the west and the alley to the east lie higher than the proposed site. There will be construction expense as the area will have to be filled and paved. Provisions for drainage and building removal will also be required. The main advantages of this site is the convenient location to the core retail area. There have been some excellent proposals to develop this parking area in conjunction with a walk thru mall included in the "New Faces for Old Places" program now being supported by the Chamber of Commerce. Another advantage of the site is its adequate size for worth while development. There is room for more than 150 parking spaces on the site almost doubling the existing off-street public parking area. As one can see in the series picture below, the Johnson Street site as presently maintained, has a weed control problem and is on the verge of becoming a blighted area. The development of converting this area into a landscaped functional parking area would be a major asset to the City.



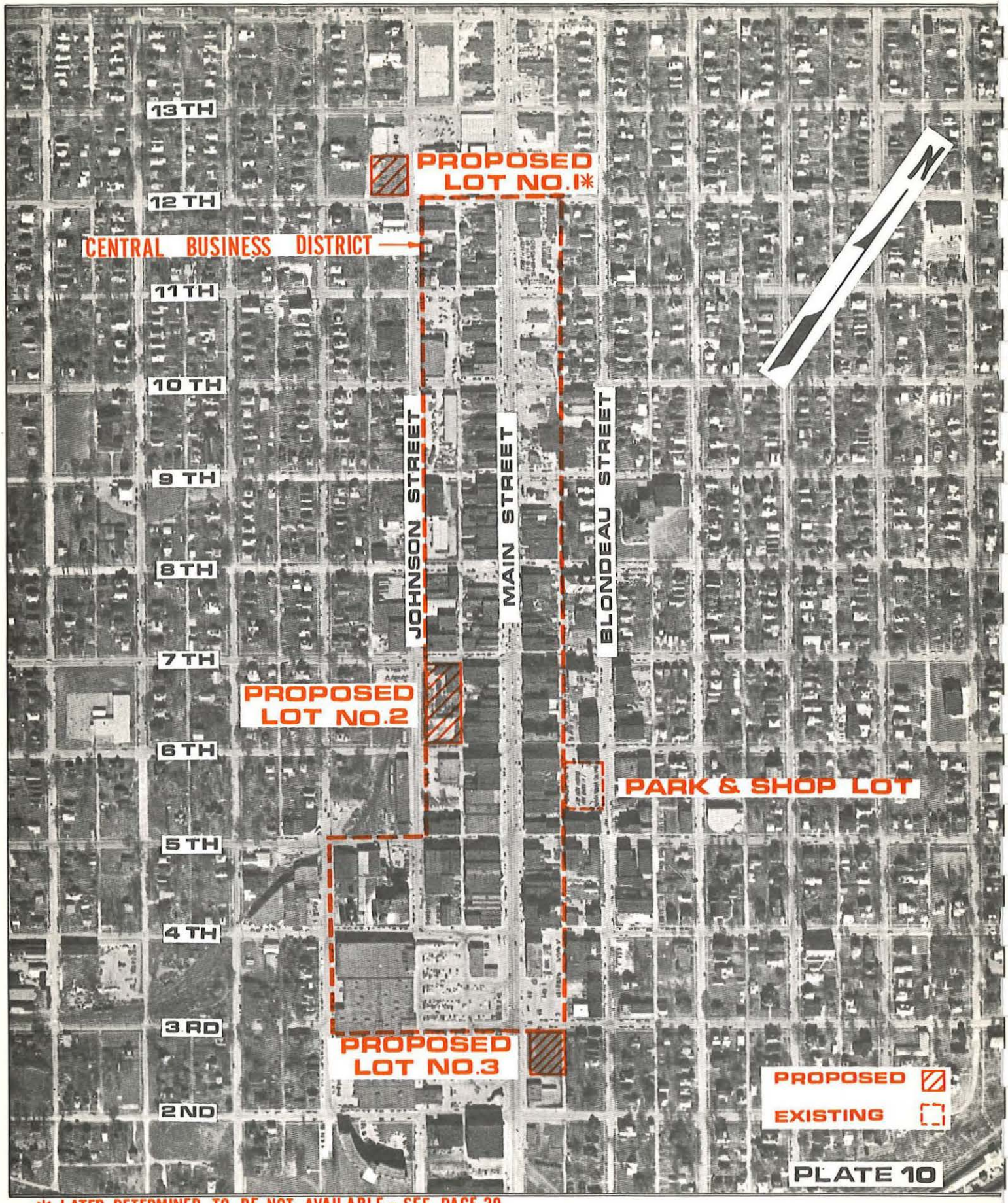
Site of proposed municipal parking lot between 6th and 7th Streets adjacent to Johnson Street.

There are other vacant lots in the downtown area that could possibly be used for parking, however, these are some distance from the core retail area and out of walking distance for most shoppers. These areas are shown on Plate 10 and could be utilized for employee parking or shopper overflow. The northernmost area is a vacant quarter block located on the northwest corner of 12th and Main Streets and was a former service station site. Very little construction work would be required to convert this to a parking area as some of the existing pavement could be utilized. Another area located at the southern edge of the C.B.D. is the vacant lot adjacent to the Country Kitchen restaurant at 3rd and Main Streets. This lies across from the Keosippi Plaza and has probably already been used for overflow parking for Plaza patrons. These latter lots could be obtained on a lease basis if a demand for additional parking in the future should arise. Conversion back to private development property could be easily made if it was later found appropriate to do so. Development at the Johnson Street lot should have the highest priority as it would meet the current needs and provide the most benefit.

The availability* of these aforementioned lots as to ownership and lease agreements, etc. has not been investigated. The physical location of the lots has been their main asset and the reason for selecting them for parking expansion. In any case, the cleaning up of these lots with grading and surfacing would be a major asset and

* During the later stages of the study it had been determined that proposed Parking Lot No. 1 would not be available for public parking purposes.

improve the value and the aesthetic aspects of the specific areas. It should also be mentioned that even though the vacant areas may be used for parking, this type of land use is not irretrievable and if further development or construction would outweigh the parking value, this could easily be accomplished.



* LATER DETERMINED TO BE NOT AVAILABLE - SEE PAGE 39

KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

MUNICIPAL PARKING LOTS

ONE WAY STREETS - EAST SIDE

The adjacent streets of Blondeau and Concert, east of Main Street is the only one way pair system in the City. There is one-way travel on Carroll Street, a minor street on the west side of town for a few blocks and some alleys near the downtown area are designated one-way. One way operation is generally more efficient than two-way operation because of the elimination of left turn conflicts, the simplication of intersection controls, increased safety and the advantage of multi-lane operation. It is estimated that the advantage of one-way operation in traffic flow capability is in the magnitude of 10 to 20 percent depending on the individual systems. Another major advantage of a one-way system is that they can be implemented immediately without construction and large capital expenditures. Generally all that is necessary is appropriate signing and driver familiarization.

Because of many physical restrictions and stop controls there is very little advantage to the Blondeau/Concert Street one-way pair. The width of each street from curb to curb is approximately 35 feet and parallel parking is allowed on both sides. The parking stalls on each side of the street are seven feet wide and are designated by pavement markings. This leaves two driving lanes which are 10-1/2 feet in width. The narrowness of the driving lanes limits capacity as it is very difficult for cars two abreast to move down the street. The difficulty is compounded when parked cars are protruding into the driving lanes. Another

major problem with the one-way pair system is the numerous stop signs that are encountered when traveling on these streets. Blondeau commences one way travel northbound at 4th Street and reverts back to two-way movement at 13th Street. There are 3 stop signs and two flashing red school lights (when activated), that slow traffic flow on Blondeau which substantially reduces its effectiveness as a traffic carrier. Concert begins one-way travel southbound at 13th street and reverts back to two-way at 4th Street at the southern end of the Central Business District. In this distance there are 5 stop signs which also delay traffic considerably. High street is the first two-way street to the east of the one-way pair and traffic on that street moves about as efficiently as the one-way pair. Installation of some of the stop signs and signals were prompted by the presence of Washington Central School located between the one-way pair from 8th to 9th Streets. Other physical limitations to the one-way pairs as they exist are the presence of several valley gutters and restriction of sight distances on some intersections. In order to make the one-way system more effective some of the traffic flow inhibitors must be removed. The following is a list of recommendations for improving traffic flow on the one-way system.

1. Eliminate parking on one side of both Blondeau and Concert streets to provide two full width travel lanes and one full width parking lane. Parking should be eliminated on both sides of Concert Street north of 18th Street. Appropriate lane marking should then be added.

2. Begin a program that will replace the pre-timed school signal warning lights at 8th and 9th on Blondeau with conventional signals that are pedestrian actuated and vehicle actuated on the lower volume cross streets.

3. Eliminate four-way stop signs on 8th and 9th on Concert leaving those predominant east-west thru streets, that is 7th, 10th and 13th Streets. Install pedestrian actuated lights for use by school children instead of the 4-way stop signs.

4. Eliminate the valley gutters in the east-west direction by overlay or reconstruction. The following intersections need this repair:

    5th and Concert
    6th and Concert
    16th and Concert
    19th and Concert

It is realized that some of the action taken to achieve better traffic flow on the one-way streets may be expensive and not entirely popular, however, it is believed that the improvement of these streets will benefit a majority of the citizens and reduce travel time and accidents.

The recommendations on the one-way pair should be considered as interim improvements as the overall primary street plans for the City develops. The major arterial carrier in that sector will be High Street with Blondeau Street a collector and Concert considered to be a local street. As previously mentioned it may be some time before that happens and the recommended improvements should prove worthwhile until the overall plan is realized.

ONE WAY STREETS - WEST SIDE

There has been considerable discussion concerning the possibility of designating one-way traffic on a pair of appropriate streets west of Main to improve north-south traffic flow in that area. Johnson Street would be the logical choice for the northbound route but there is no adjacent street suitable to carry one-way traffic south unless Timea is used which is three blocks west of Johnson. Main Street is another possible choice for the southbound leg but the economic ramifications would have to be assessed before such a move was taken. Generally small cities which serve as regional trade centers are reluctant to one-way the main street.

A one-way pair system is more efficient if the streets carrying traffic in the opposite directions are adjacent to each other or as near as possible to reduce confusion to motorists and to facilitate traffic flow. Actually a pair of one-way streets resembles a divided highway with a wide median strip and they are generally separated by a distance of one block. The hilly terrain and the condition of Exchange Street, which parallels Johnson on the west, would disqualify it's use as the southbound half of the one-way pair. Timea Street which connects to Belkap Boulevard at 22nd Street would be ideal for southbound traffic if it was closer to Johnson Street.

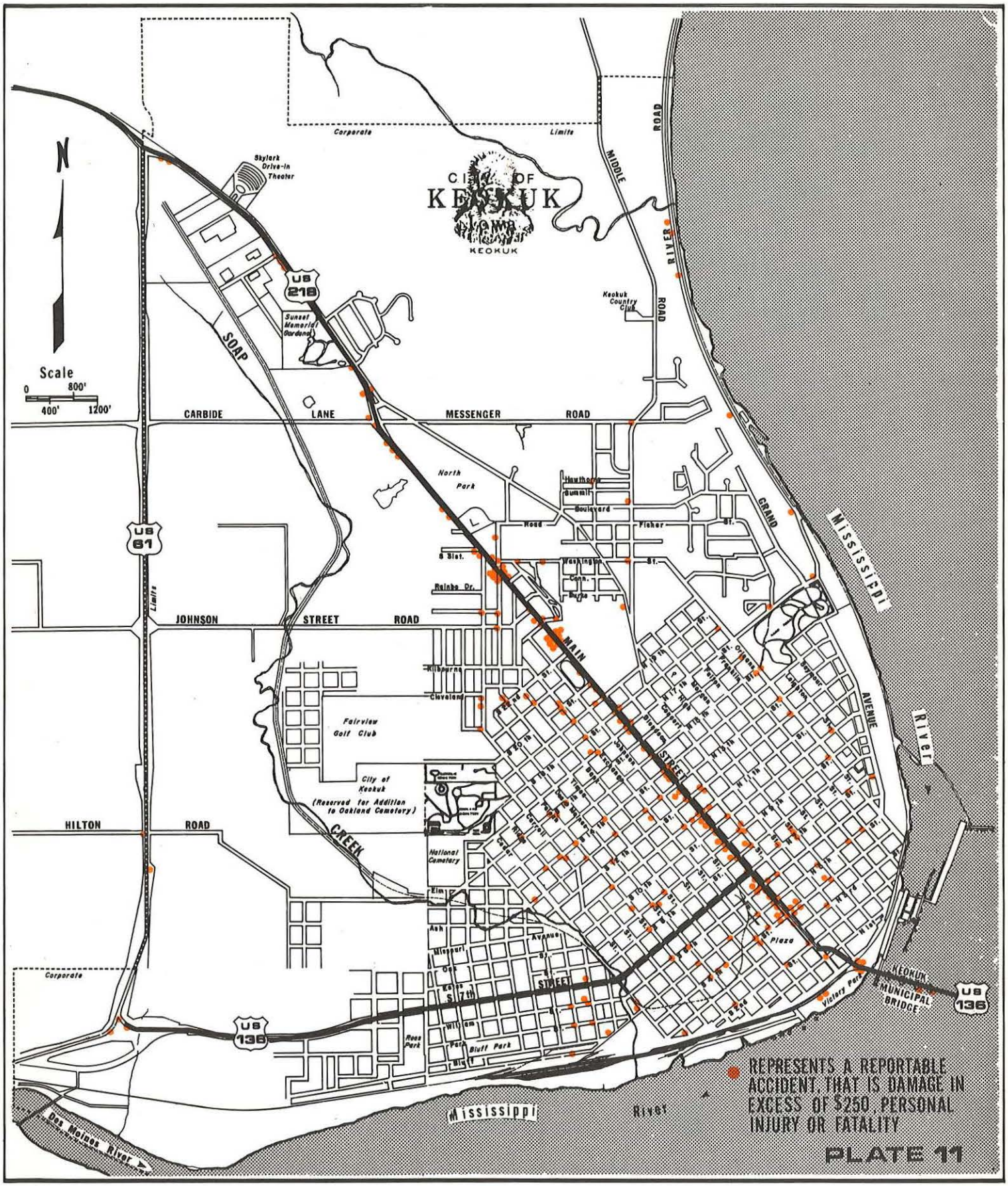
Because of the spatial difference between the only suitable streets, Johnson and Timea, and the extra traffic load that would be placed on Exchange Street by southbound drivers who normally use Johnson and do not wish to travel the extra distance to Timea, it is not recommended that a one-way pair be provided west of Main Street at this time. If traffic on Johnson Street turns into a major problem in the future, a one-way pair using Johnson Street for northbound traffic and Timea for southbound traffic may be employed. Because of the small cost of converting streets to one-way traffic, this one-way pair could be introduced on a trial basis in order to weigh the advantages and disadvantages and the effects on the other adjacent streets. Public education to any change in the normal traffic pattern is necessary for a smooth transition and to eliminate confusion. This could be accomplished through the use of the news media (radio, television, newspapers, etc.).

ACCIDENTS

A main objective of this study is to reduce the number and severity of accidents within the City of Keokuk. Most accidents can be attributed to the human element represented by the driver and the pedestrian. There is much that can be done to improve deficiencies in the transportation system and though sometimes very costly, the public is starting to demand that these improvements be made both in the vehicle and the roadway. The State and Federal governments are spending millions of dollars to improve road design and are mandating that vehicle manufacturers improve the safety of the vehicle. All of this, of course, eventually becomes the burden of the driving taxpayer, and hopefully the monies spent can be redeemed by the saving of lives and property.

Iowa State Law requires that all accidents in which a person is killed or injured or total damage in excess of $250 is sustained be reported on special forms provided by the Department of Motor Vehicles. Plate 11 indicates the location of the majority of these reportable accidents occurring within the City of Keokuk.

The number of accidents varies from community to community and generally the larger the population, the more accidents occur each year. In 1974 Keokuk had 516 reportable accidents which included 3 fatalities and 125 person injuries. Total accidents in the City which include major and minor accidents,



KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

Keokuk Traffic Study

Fall, 1975

REPORTED ACCIDENT LOCATIONS 1974

are on the rise again after receding in 1974. The following statistics furnished by the Keokuk Police Department, show the accident rate for the past four years.

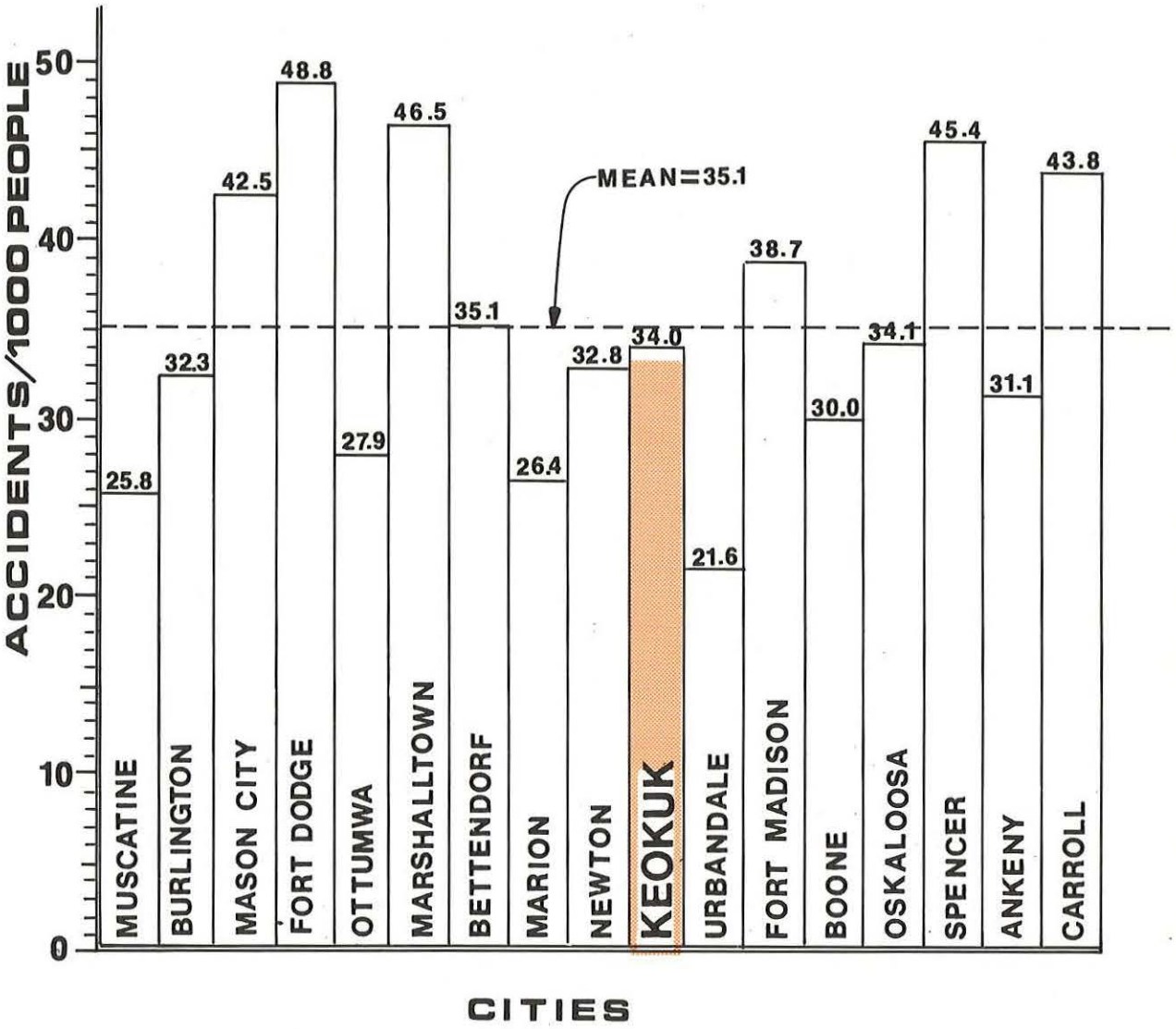
	1972	1973	1974	1975
No. of Accidents	1122	1319	1180	1228
No. of Fatalities	2	0	3	2
No. of Personal Injuries	55	104	125	92

In order to determine where Keokuk ranked accident-wise with other Iowa communities of similar size statistical figures of accidents in 1974 were obtained from the Research Division of the Iowa Department of Public Safety. The seventeen selected communities range in size from 8 to 30 thousand people and are listed below according to population.

REPORTABLE TRAFFIC ACCIDENTS - 1974

Community	Population	Total No. of Accidents	Personal Injury Accidents	Fatalities
Muscatine	32,405	836	195	2
Burlington	32,366	1,046	238	1
Mason City	31,839	1,354	333	3
Fort Dodge	31,263	1,525	289	1
Ottumwa	29,610	827	232	1
Marshalltown	26,219	1,220	233	0
Bettendorf*	22,314	783	174	0
Marion*	18,028	476	124	0
Newton	15,619	513	116	0
KEOKUK	15,173	516	125	3
Urbandale*	14,434	312	72	0
Fort Madison	13,996	541	108	0
Boone	12,468	374	73	2
Oskaloosa	11,224	383	80	0
Spencer	10,278	467	108	2
Ankeny*	9,151	285	62	0
Carroll	8,716	382	57	0

* Adjacent to a larger city



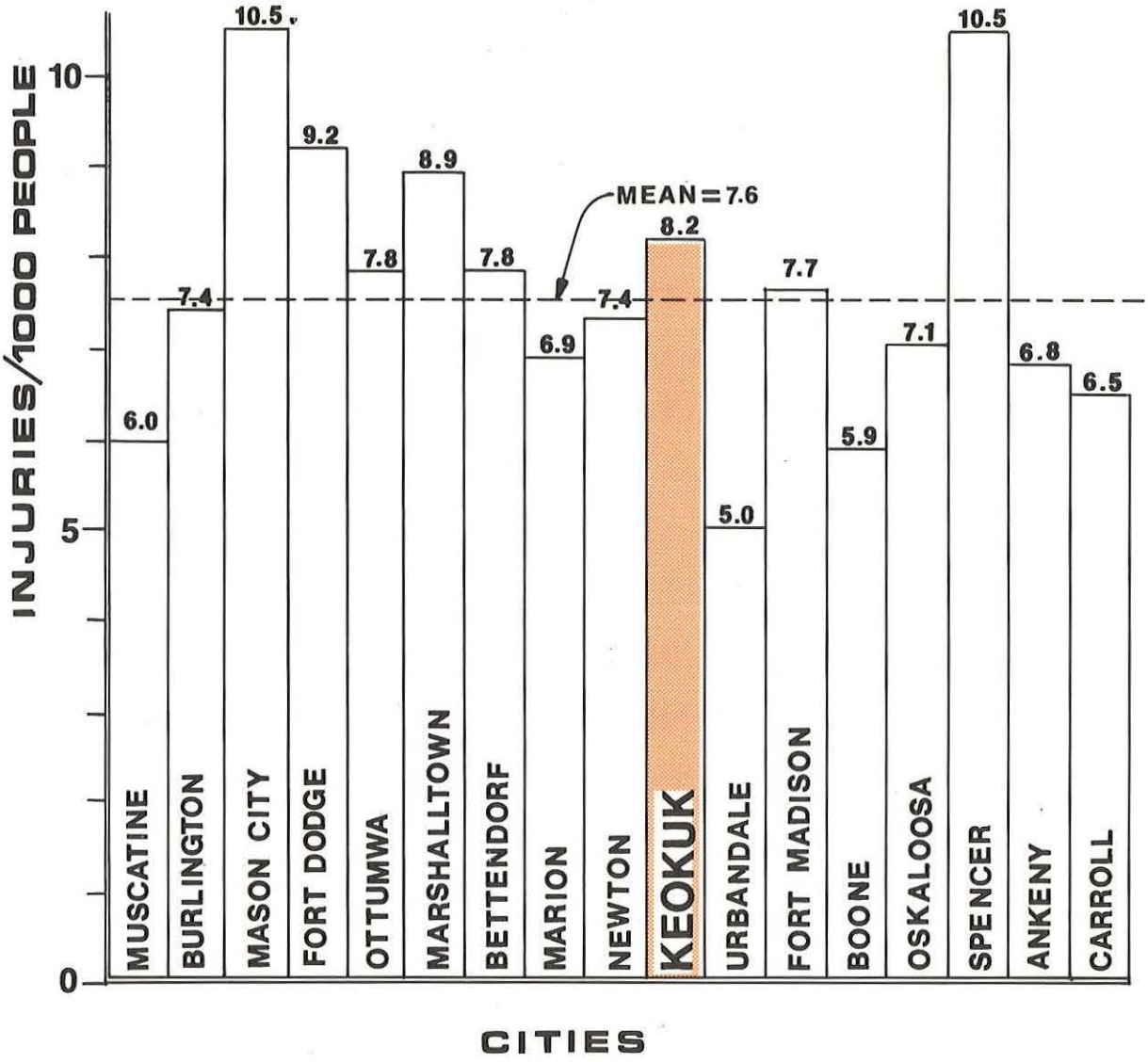
*ACCIDENTS PER THOUSAND POPULATION SEVENTEEN IOWA CITIES–1974

* REPORTABLE

KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 12

A more meaningful comparison of the seventeen cities is obtained by plotting the rate of accidents according to the number of people in each community. The graph shown on Plate 12 points out this relationship. Keokuk experienced 34.0 accidents per thousand population in 1974 which is slightly lower than the average of all the selected cities of 35.1 accidents per thousand. An indication of the severity of accidents is obtained by examining Plate 13 which compares only the personal injury accidents suffered by the various cities. In this category Keokuk has a slightly higher rate of injuries than the other cities with 8.2 personal injury accidents per thousand people. The latter graph indicates the accidents that take place in Keokuk are a bit more severe than the average of the other cities. In general, Keokuk is about average with cities of similar size in the State but there should be no consolation from this fact. A continuous effort to reduce the number of accidents should be maintained.

There were 3 fatalities in Keokuk in 1974 which was the highest among the comparison cities. One of these was an unusual accident on U.S. Highway 61/218 bypass and involved a deer which was struck by a car causing the car to cross the centerline and crash into an oncoming car in the opposite lane. Another fatality occurred at the U.S. Highway 218 (Main Street Road) and Belknap Boulevard intersection as one car ran the red light hit a truck and another car passing through



PERSONAL INJURY ACCIDENTS PER THOUSAND POPULATION

SEVENTEEN IOWA CITIES–1974

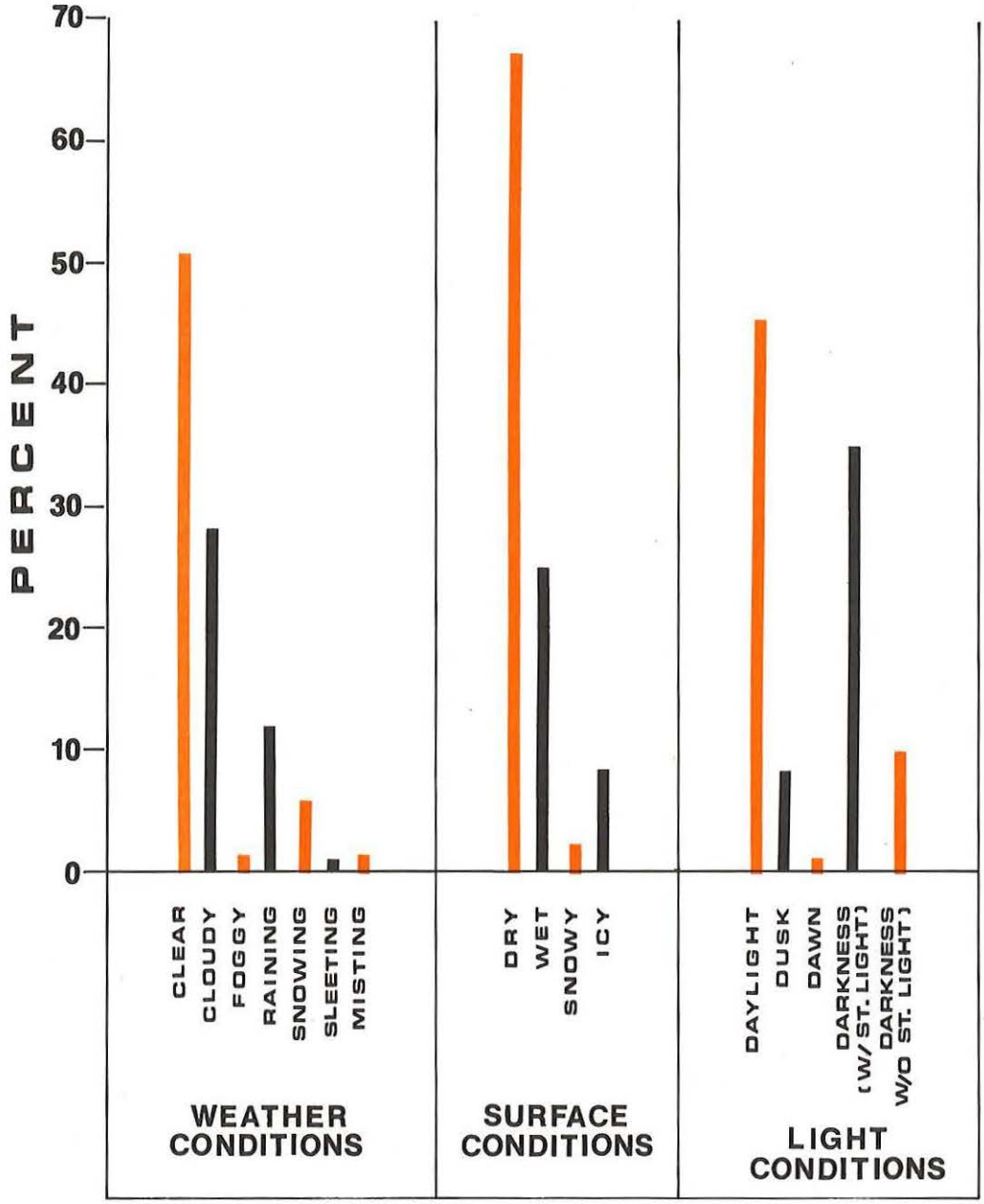
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 13

the intersection. The third fatality occurred during the night on River Road at the bottom of Anschutz Hill. This was a one car accident, the driver lost control as he passed over a large patch of ice and hit a guardrail. Of all the personal injury accidents there were 5 that involved pedestrians which is suprisingly low as there is a considerable portion of the City without sidewalks. Each pedestrian accident occurred in a different location and there appears to be no definite pattern to pedestrian - vehicle accidents. Four of the pedestrian accidents involved young people running into the street and another involved a car that hit a pedestrian as he got out of a parked car.

Characteristics affecting the accidents in Keokuk such as weather, time of day, etc. are graphically illustrated on Plates 14 thru 17. Many of the reportable accidents occurred during daylight hours in clear weather and dry conditions. This reflects the fact that traffic volumes are higher during these periods and indicates that drivers should be alert at all times, not only during periods of bad weather or other abnormal conditions.

Most accidents in the City occur during the evening hours and Friday is the most dangerous day of the week. In 1974 the months of January, May, August and December were the most dangerous as approximately 30 accidents occurred in each of these months.

Most accidents in the City occurred on Main Street in the downtown area with several occurring at the shopping center entrance near 23rd Street. The following tabulation lists the locations that had 5 or more accidents in 1974.



FACTORS AFFECTING ACCIDENTS
KEOKUK 1974

KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 14

Location	No. of Accidents	*No. of Accidents per 100 Thousand vehicles passing Through the Intersection
2nd & Main	7	.19
4th & Main	18	.37
5th & Main	21	.44
6th & Main	8	
7th & Main	18	.31
8th & Main	16	.35
9th & Main	10	.21
10th & Main	14	.29
11th & Main	6	.13
12th & Main	13	.27
13th & Main	15	.31
14th & Main	6	.12
15th & Main	7	.13
16th & Main	6	
18th & Main	5	
19th & Main	5	
24th & Main	8	
Main @ 23rd (Shopping Center)	9	
28th & Main (Belknap Blvd.)	12	.24
Keokuk Municipal Bridge	18	.76
5th & Johnson	5	
11th & Johnson	5	
13th & Johnson	6	
5th & High	5	
7th & High	6	
13th & High	8	
10th & Timea	5	

* 1974 volumes are estimated as no counts were made that year. The 1974 estimated volumes were computed by pro-rating 1970 & 1975 volumes.

In total there were 27 intersections that had 5 or more accidents in 1974 but unfortunately there is not an equal number of collision diagrams as most of the accidents were minor and not reportable. Also some diagrams are not available for reasons stated in the section on accident reporting. The collision diagram gives the accident history of the intersection at a glance and it is extremely useful for safety analysis. Remedies for certain kind of chronic accidents can be implemented if the characteristics of the accidents are known. An analysis of each of these 28 high

accident intersections follows and the available collision diagrams for these locations are included at the end of this section.

2nd and Main Streets. There were 7 accidents at this intersection in 1974 with only one investigating officer report available indicating that most of these accidents were of a minor nature. Failure to yield the right-of-way was the cause of that accident. Second Street traffic stops for Main Street and the vehicle at fault stopped and then proceeded to strike a vehicle on Main. The intersection is at the crest of a steep hill leading to the park area below and this may be the major cause of these accidents especially in inclement weather. Physically there is little that can be done to change the intersection without a lot of expensive modification to the adjacent terrain. Highway 218 turns easterly to the Municipal Bridge approach approximately one block south of 2nd Street and northbound traffic coming up the hill from the south is controlled by a yield sign. A stop sign would be more appropriate here because of the much larger traffic volume on U.S. 218. Because of the very steep grade at this point vehicles would have a difficult time starting up again after a stop during icy conditions. It is recommended that the yield sign be retained for the time being.

4th and Main Streets. This intersection located adjacent to the Keosippi Plaza is one of the busiest intersections at the southern end of the central business district. There were 18 accidents at this location in 1974 with 10 reports being written up. The collision diagram of 4th and Main Streets indicates there were 2 rear end accidents, 2 improper turn accidents, one left turn accident and one car out of control that struck a motorcycle. Another accident occurred near the intersection at the entrance to the Holiday Inn Motel as a vehicle turned left in front of another vehicle. There is not definite trend of any one type of accident and most can be attributed to high volume of traffic in the area. Another possible reason for the frequency of accidents is the number of driveways into the Keosippi Plaza Shopping Center. As one can see on the aerial photo, Plate 18. A high volume of entering and exiting vehicles near a busy intersection can increase the number of accidents considerably. Since the access has been established for some time there is probably little that can be done without adverse economic ramifications to the adjacent businesses.

5th and Main Street. This intersection is signalized and it is located in the downtown area also in one of the busiest parts of the City. The intersection experienced 21 accidents in 1974 and there are only 2 accident reports available. One involved four cars as the offending vehicle was turning left from 5th Street onto Main Street, hit two parked cars plus another car on Main Street waiting for a red light. The other accident involved a rear end collision on Main as one car stopped for a light and the other car failed to stop in time. It is assumed that the balance of the accidents were minor as few reports are available. Again, this is one of the busiest intersections in the City and accidents will continue to happen. There is no definite solution apparent. Synchronization of the traffic signals will undoubtedly help reduce the number of rear end collisions at this location.

6th and Main Street. This intersection experienced 8 accidents in 1974 and 4 of these were serious enough to require a written report. The collision diagram for this intersection is included in this section. There were 2 accidents involving injuries which resulted from fail-to-yield situations and there were 2 accidents involving rear end collisions. Rear end collisions are common at signalized intersections, however, the left turn angle accidents indicate the need for a left turn phase in the signal system. Because there were only 2 accidents of this type this does not appear to be a chronic situation. Therefore, a special left turn signal at this location is not recommended.

7th and Main Street. This intersection located in the heart of downtown Keokuk is also the junction of U.S. Highways 136 and 218. This intersection is signalized and it is the only intersection in the downtown area with left turn arrows. Unfortunately there are only 2 accident reports available for this intersection and the major cause of accidents cannot be determined. It is assumed that the majority of the accidents occurring at this intersection were minor because written reports were not required.

8th and Main Street. There were 16 accidents at this location in 1974 with only 2 accident reports filled out. In both cases a rear end collision was the cause of the accident. As with 7th Street intersection, most of the accidents were minor and no specific reasons other than the intersection carries a high volume of traffic can be attributed to the cause of the accidents.

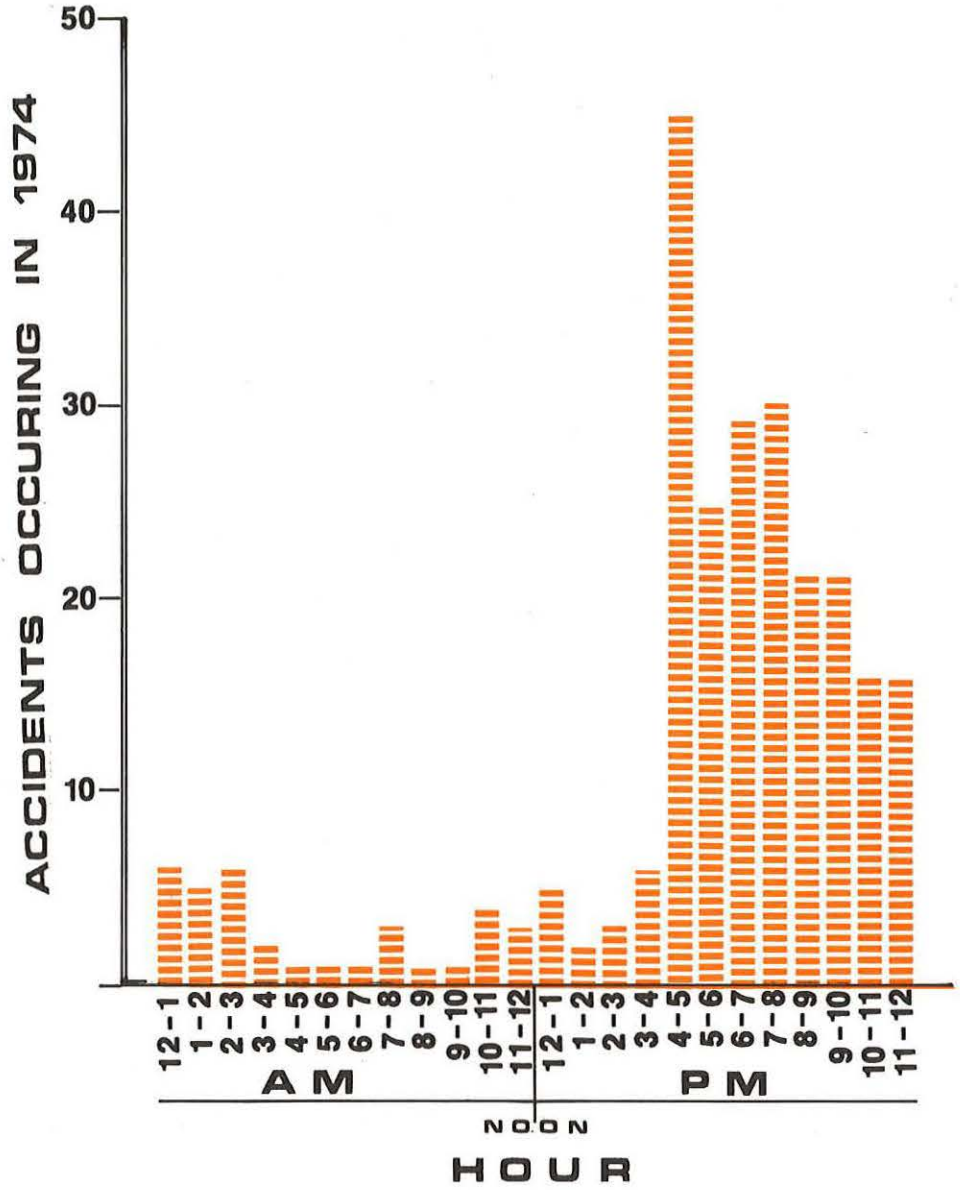
9th and Main Street. This is again a signalized intersection in the downtown area that carries a considerable volume of traffic and this intersection experienced 10 accidents in 1974 and 2 written reports are available. One accident was caused by a vehicle sideswiping another vehicle. The other accident was caused when a moving vehicle struck a car parked at the curb. Again, no definite pattern is apparent for the remaining accidents.

10th and Main Street. This is a signalized intersection in the downtown area that experienced 14 accidents in 1974, 5 of these were severe enough to require the filing of a written report. Each of these accidents were the result of rear end collisions with 3 injuries being sustained. Synchronization of signals will help alleviate this type of accident as groups of vehicles in a starting and stopping situation are susceptible to this type of accident.

11th and Main Street. This is a downtown signalized intersection that had one of the lowest rate of accidents in 1974 with a total of six. Two of these were serious enough to be reported. One of these was an unusual accident as a vehicle struck a building while being driven in an alley. The other accident was a rear end collision occurring on Main Street at 11th.

12th and Main Street. This is another typical intersection in the downtown area and a total of 13 accidents occurred at or near this intersection in 1974. Of these, there were written reports made on 5 accidents. Two of these involved rear end collisions another involved an improper turn from the wrong lane as the vehicle turned from 12th Street to Main. Another car jumped the curb and struck a gas pump and another accident involved a vehicle turning left striking an oncoming vehicle. Like the other Main Street intersections the rear end collision was the most common type of accident.

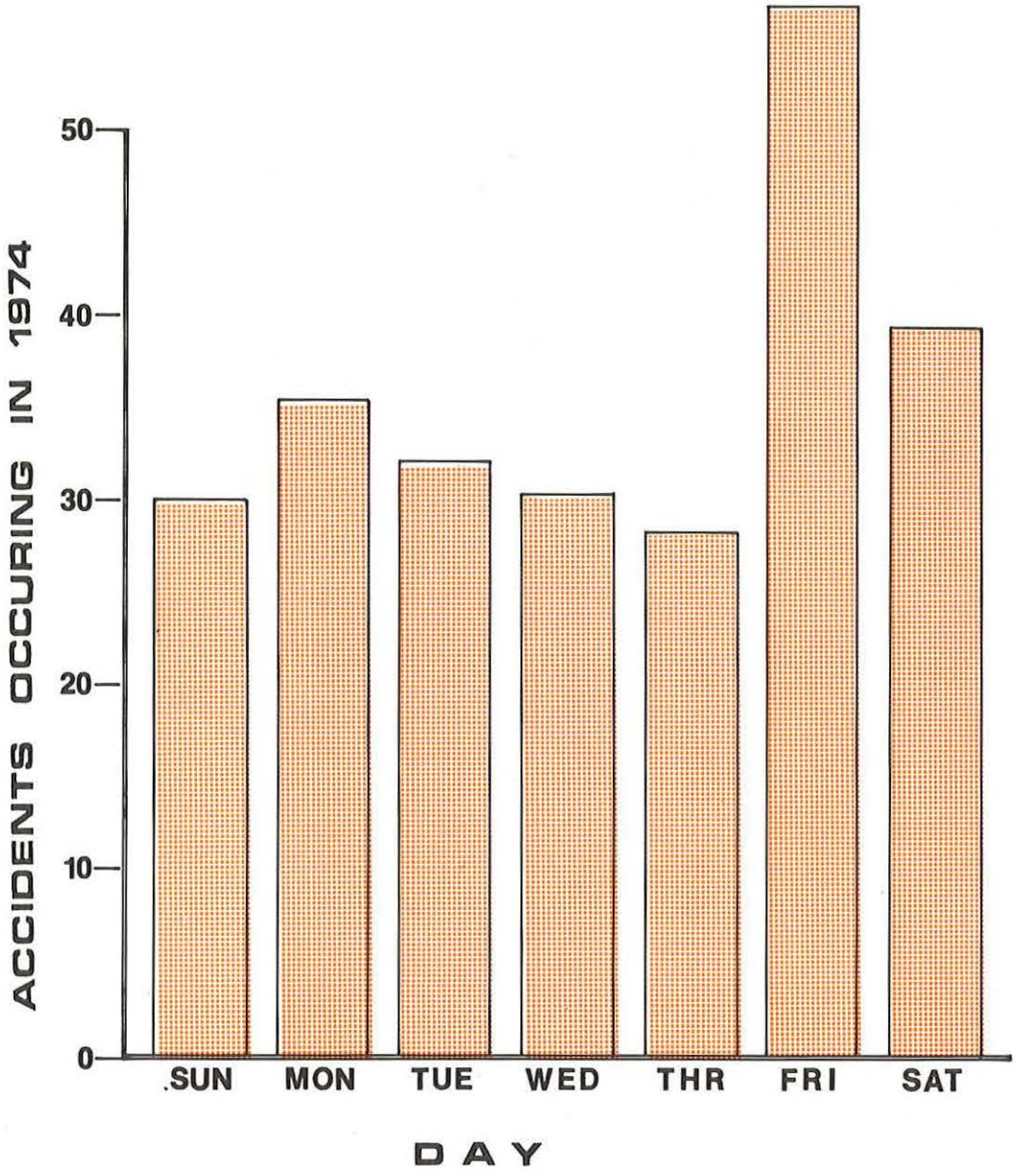
13th and Main Street. Thirteenth and Main Streets had a total of 15 accidents in 1974 with reports written on 3 of these. One involved a vehicle in which the accelerator stuck and crashed into a car that was parked at a gas station. The other two accidents happened almost simultaneously in an unusual manner as a car was being towed with a rope the rope broke and two cars that were parked along the curb were struck. It is assumed that the other 12 accidents occurring at this location were minor in nature.



ACCIDENTS PER HOUR

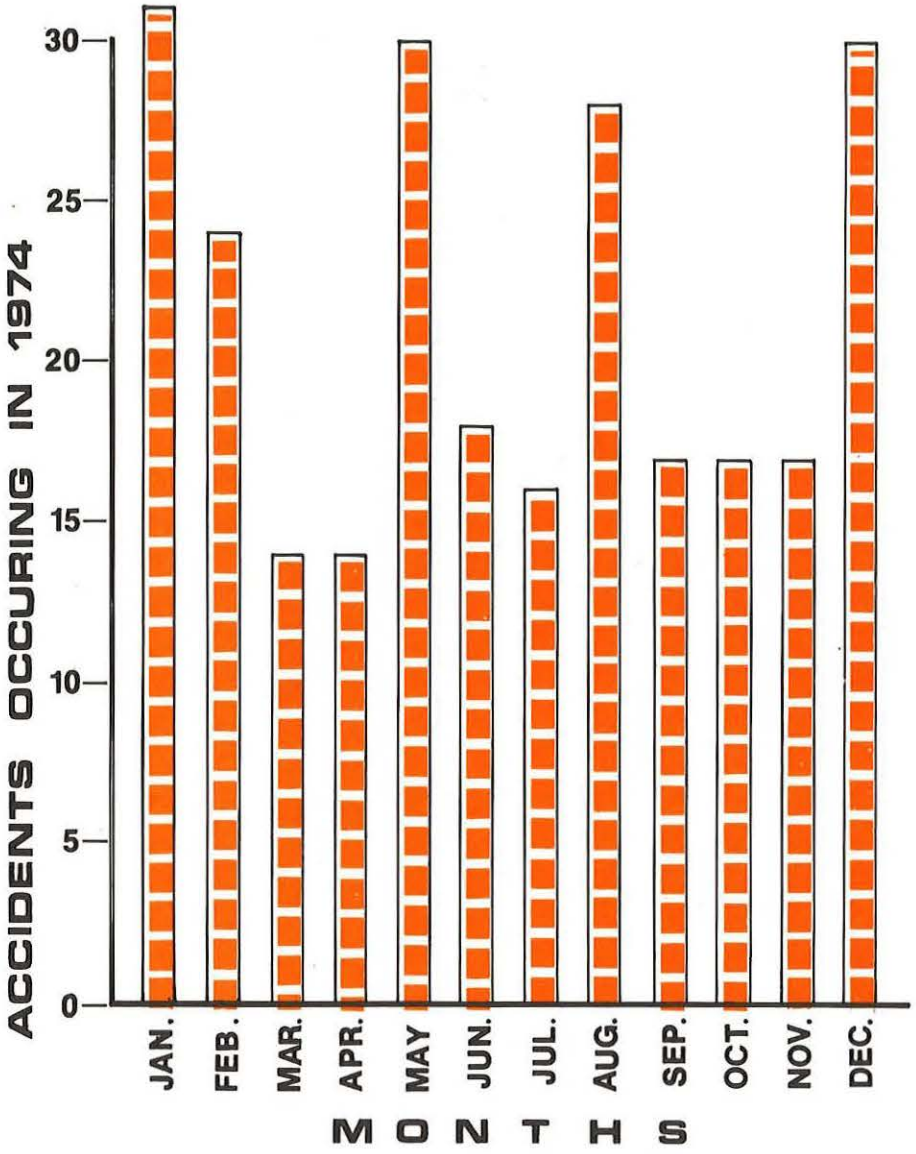
KEOKUK 1974

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 15



ACCIDENTS PER DAY
KEOKUK 1974

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 16



ACCIDENTS PER MONTH

KEOKUK 1974

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	PLATE 17

14th and Main Street. This intersection had a total of 6 accidents in 1974, 4 of which were serious enough for a written report. All 4 involved rear end collisions. Two were on Main Street and two were on 14th. Again, signal light synchronization to decrease the amount of vehicle stopping will lower the rate of this type of accident.

15th and Main Street. This intersection had a total of 7 accidents in 1974, 3 of which had written reports filed. One accident was a rear end collision. Another was the result of an improper lane change of two vehicles coming in contact, going the same direction. The third accident was caused by a vehicle travelling out of control and ran into three cars between 15th and 17th Streets.

16th and Main Street. This intersection at the north end of the central business district experienced 6 accidents in 1974 which is considerably less than the other Main Street intersections. Of the 6 accidents there were 3 serious enough to have investigating officer reports written up. Two of these were rear end collisions and the third involved a side-swipe as a result of an improper lane change.

18th and Main Street. This intersection had 5 accidents in 1974 with 2 written reports. Each accident resulted from failure to yield right-of-way in a left turn situation.

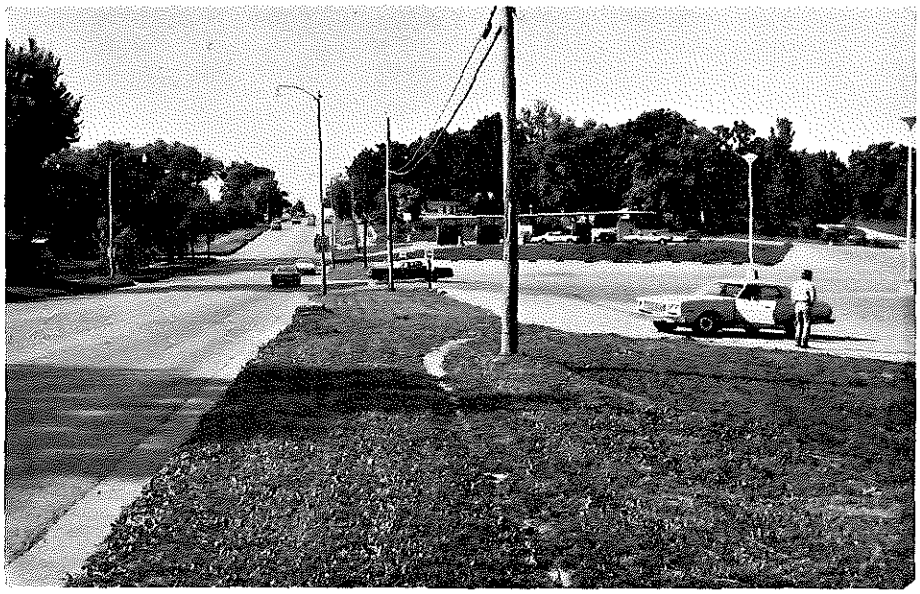
19th and Main Street. This intersection also had 5 accidents in 1974, 3 of which were serious enough for written reports. One involved a bicycle that came out of an alley onto the street and was struck, another involved a side-swipe accident at mid-block and the third was a rear end collision.

Practically all of the downtown Main Street intersections, 4th to 15th Street, have similar characteristics in that each are signalized, each have parallel parking to within a few feet from the corner and each have restricted sight distance because of the store buildings on all quadrants. It is not practical to improve the intersection by reconstruction because of the high cost of adjacent right-of-way. Most of the reported accidents are rear-end collisions and angle collisions caused by stopping and improper left turns. A continuous left turn storage lane from 3rd to 14th Street would ease the left turn problem and lower the accident rate, however, parking spaces on one side of the street or the other would have to be sacrificed to make room for an additional lane.

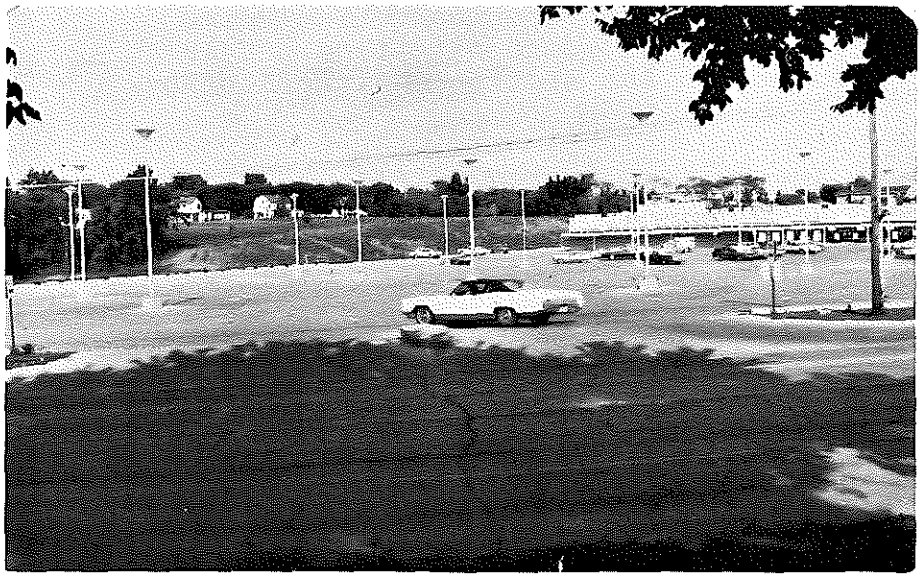
Parking spaces are at a premium now and the economic ramifications are probably too adverse to consider the removal of on street parking at this time. In the future, when additional off street parking is developed, the storage lane for left turns should be further investigated.

Main Street @ 23rd. This is the entrance to the shopping center identified by the Gibson Store and the Giant Food Store and has been the scene of several accidents since the center was opened. There were 9 accidents in 1974, 8 of which were serious enough to warrant investigative officer reports including 4 personal injuries. Five of the accidents were caused by northbound cars on Main Street striking cars that were exiting the shopping center. In two cases cars went out of control and struck roadside objects, probably during an attempt to stop and avoid hitting a car ahead. Two accidents involved southbound cars turning left into the center, one was hit from the rear and the other hit an oncoming car. The predominant type of accident here appears to be the direct conflict of an exiting vehicle with the traffic flowing on Main Street. There is also evidence that a left turn lane for vehicles from the north going into the center is needed. This intersection is one in which there are physical changes recommended including signalization to improve the accident situation. This site is further discussed in the section on intersection improvement.

Main Street Road at the Belknap Boulevard and Boulevard Road Intersection. This is a high rate accident intersection in Keokuk with 12 accidents occurring in 1974, nine of which were serious enough for written reports. Five accidents were the result of rear end collisions, two vehicles were struck in the rear while waiting to turn left and three were struck in the rear while waiting for the signal light to change. There was one vehicle out of control that went through the light and struck an oncoming car, two accidents involved motorcycles one in which the motorcycle was hit while turning left and the other in which a motorcycle hit a left turning car. Another accident involved a side-swipe as a result of an improper lane change. The area is probably one of the most complex areas in the Keokuk Street System as the streets intersect at a sharp angle. The area is fully developed with practically unlimited access, and other streets intersect close to the major intersection on the north and northwest legs. (See Plate 19.) Recommendations for improvement of this intersection are included in the intersection analysis section of this study.



Looking North



Looking East

Looking Southeast

Shopping Center Entrance at 23rd and Main Streets. Site of 9 reportable accidents in 1974.

2400 Block on North Main. This area had a total of 6 accidents in 1974, 3 of which were serious enough for accident report write-ups. Twenty-fourth and Main and 25th and Main are T intersections with 25th Street being the main access to Johnson Street Road which is one of two roads into the western sector of the City. Johnson Street Road is now being improved and traffic volumes are expected to increase. In each of the 4 reported accidents all involved vehicles struck while waiting to turn left to gain access to Johnson Street Road. This indicates a need for a left turn storage area and if volumes continue to raise a signal light may be warranted in the future. More on the improvement of this area is included in the intersection analysis section of this report.

The Keokuk Municipal Bridge. This is one of the most dangerous areas in the City of Keokuk as 18 accidents occurred here in 1974. Six of these were serious enough for motor vehicle accident reports. Several of the accidents occurred around the toll house area as rear end collisions, objects being struck adjacent to the highway and side-swiping because of the narrowness of the travel lane. The approach curb to the toll house is also a significant factor in the number of accidents in this area. The deficiencies of this entire area are discussed in the bridge evaluation section of the report and improvement will be based on the decision whether or not to replace the existing bridge. Warning signs augmented by flashing red lights at the bridge approach may help to reduce the number of accidents. Also, a revision in toll collection procedures as will be discussed later may also reduce the number of accidents in this area.

5th and Johnson. This intersection located in the downtown area had 5 accidents in 1974 with none serious enough to be reported. The intersection is in a commercial area with buildings on three sides which restrict sight distance. The street carries a considerable amount of traffic and improvements would be expensive because of the close proximity of the structures to the travel lanes. Because there are no written reports on the accidents no pattern or characteristic can be determined.

11th and Johnson. This intersection located in the downtown area also had 5 accidents in 1974 none of which were reported. The sight distance is good on three corners, however, the west leg of the intersection has a steep grade to the west and could be a considerable problem during icy conditions. Sight distance on the northeast corner is very poor and there is a considerable volume of traffic being carried on Johnson Street.

13th and Johnson. This intersection had a total of 6 accidents in 1974 one of which was serious enough to be reported and this involved a vehicle swerving into the path of another vehicle resulting in a head-on collision with two injuries. There is considerable traffic activity at this intersection with an IGA parking lot on the southeast corner and the Police and Fire Station on the southwest corner. The hilly terrain on the east/west approaches also complicates the situation. These accidents are probably a result of the high degree of activity in the area and physical improvements may not improve the frequency occurrence. Special warning signs such as "Watch for Emergency Vehicles" will prove to be beneficial.

5th and High Streets. This intersection located at the crest of a hill had a total of 5 accidents in 1974 one of which was serious enough for an investigation report to be written. This is a busy intersection as many people use it as an access to a public library, YMCA, YWCA, the County Court House, and the Keokuk Municipal Building. Fifth Street stops for High Street and the reported accident was caused when a vehicle on 5th stopped but then pulled into a vehicle northbound on High Street. This intersection is in a residential area and sight distance is a problem, however, there is little that can be done in the matter of physical improvements. Larger stop signs should be installed if this intersection continues to have 5 or more accidents per year.

7th and High Streets. This intersection experienced 6 accidents in 1974, 3 of which were severe enough to be reported. The intersection lays at the crest of a slight hill and there are also problems with sight distance as there are some large trees on the east corners and a large brick building at the edge of the right-of-way on the northwest corner. Parking is not allowed for a short distance on the northwest corner. The southwest corner is a residential lot and sight distance is unobstructed. Failure to yield right-of-way is the major cause of accidents at this location and a most efficient remedy is improving sight distance where possible. Physically there is little that can be

done. Again, additional warning signs may reduce the accident rate.

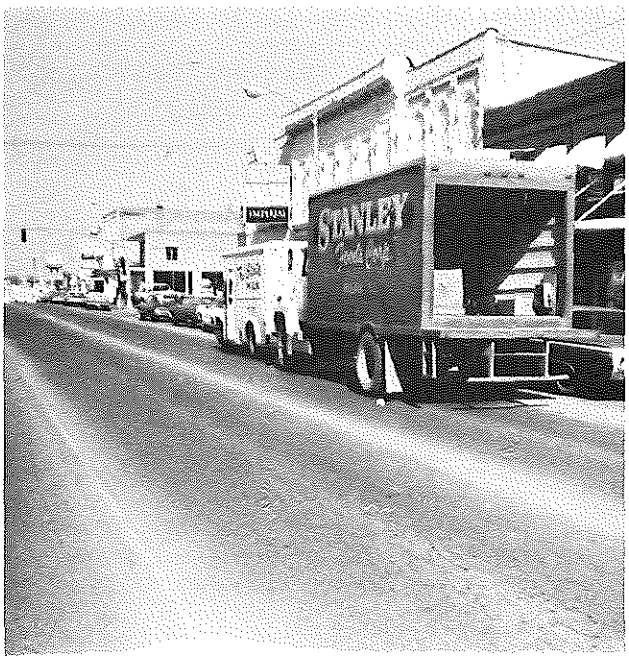
13th and High Streets. This intersection carries a large volume of traffic in both directions and experienced a total of 8 accidents in 1974. Thirteenth Street stops for High Street which carries more volume so the stop sign locations seem to be appropriate. There is no apparent problem to the intersection other than the fact that it does carry a high volume of traffic, parking is allowed to within two feet from the radius point which may be a factor in some of the accidents. Parking should be restricted two stalls back from each intersection quadrant to allow improved sight distance which should reduce the accident rate.

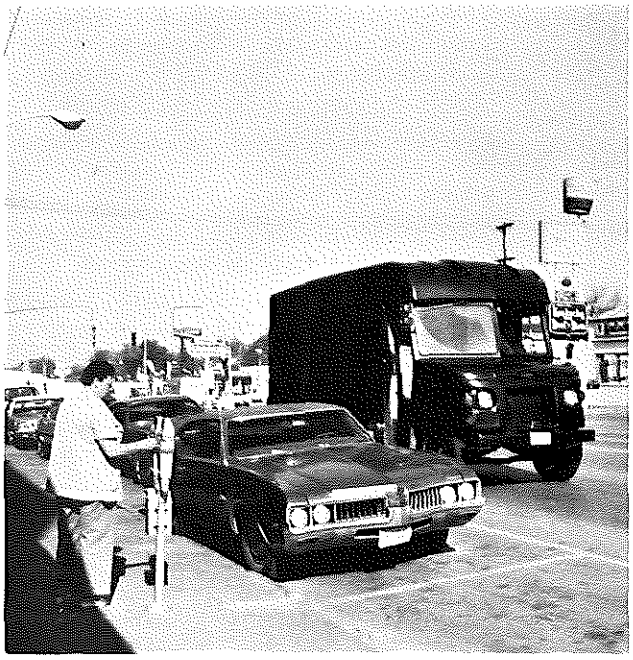
10th and Timea. This intersection had a total of 5 accidents in 1974, one of which was serious enough for submittal of a written report. The intersection is located close to the Wells-Carey School and has a pushbutton activated system with a flashing red light on 10th Street. Sight distance appears to be adequate. There doesn't appear to be any specific reason for the accidents, however, Timea does carry a relatively high volume of traffic which contributes to the high accident rate. This intersection has a high volume of pedestrian traffic also, however, the reportable accident that occurred in 1974 involved a vehicle sideswipe with a police car as the driver was being questioned on an unrelated offense.

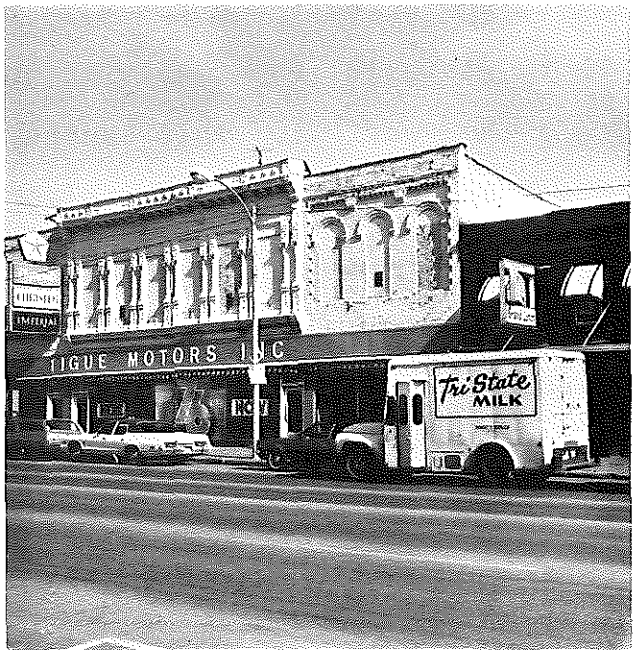
During the field investigation for this study it was observed that access to the streets and roads is practically unrestricted (See Photo Plate 18) especially in the commercial areas where traffic is the heaviest. This can be a source of accidents as control is lost and exposure time to possible vehicle conflicts is increased. It is difficult to remedy existing situations of this type, however, more control on future drives and curb openings should be imposed and enforced.

Another potential cause of accidents in the downtown area is the practice of double parking of vans and delivery

trucks which is common on Main Street. The photos below illustrate typical situations. Again, this problem is difficult to control as deliveries and pickups have to be made for a business to operate. It may be wise to require future establishments to provide a delivery access at the rear of the stores.

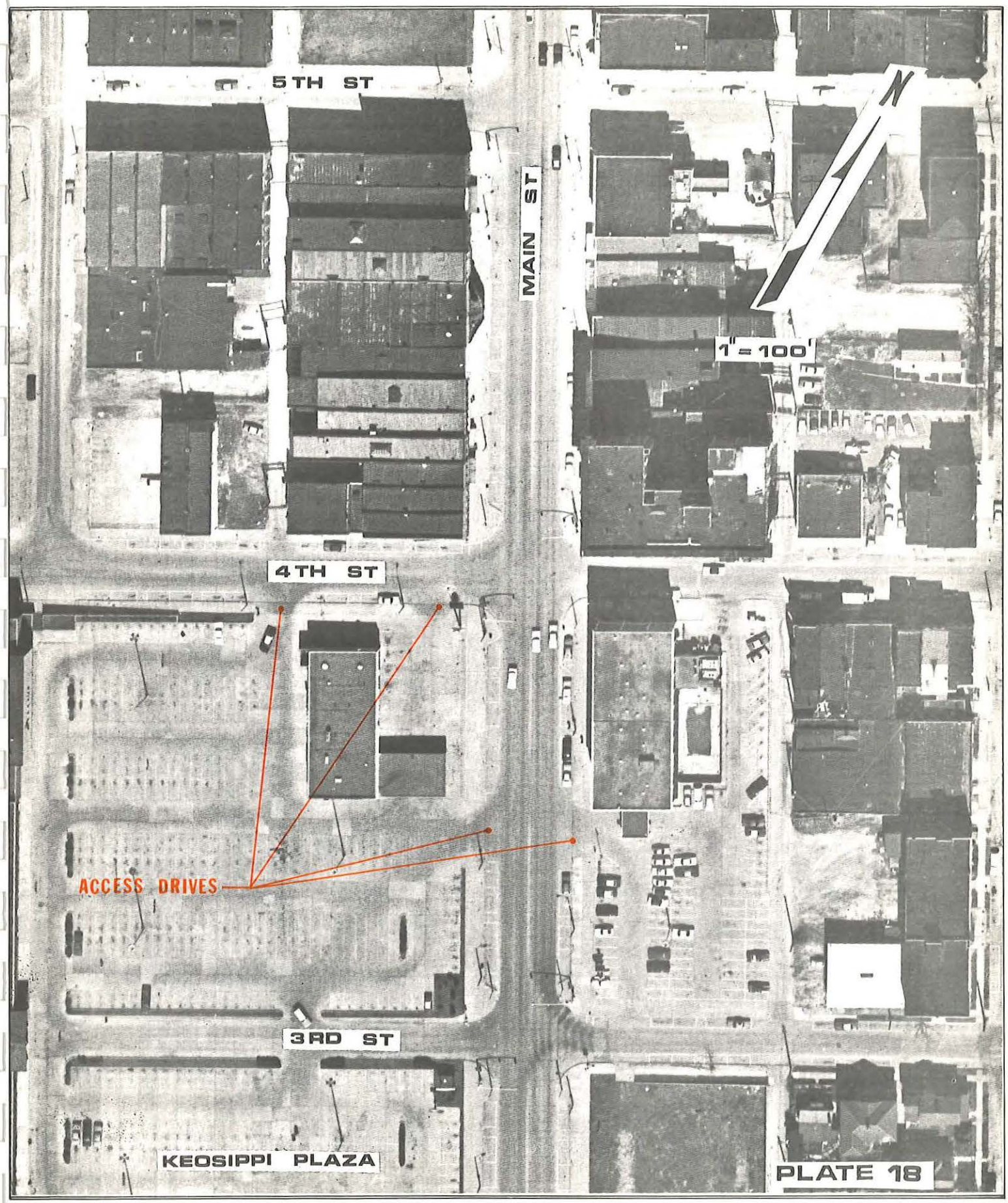






Main Street in the Keokuk Business District.

Some examples of double parking.



KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

MAIN STREET AT 3RD, 4TH, & 5TH ST.

ACCIDENT REPORTING

Of the 516 reportable* accidents in Keokuk during 1974 there were only 358 Investigating Officer Reports available. These were obtained at the Keokuk Police Department and were used in the study analysis. The balance of the other reportable accident write-ups, which by law, must be submitted probably were sent directly to the State by individuals or State Patrolmen and were filed by the Iowa Department of Public Safety in their computerized system. These are not currently available and could not be obtained for use in the study analysis. Records of all accidents, including minor accidents, in which local officers were called to the scene are kept in a card file system at police headquarters. These indicate location, date, time, driver and road condition, type and result of accident. Officer investigation reports made by local officers are also kept on file but records of accidents investigated by State Patrolmen or other law enforcement agencies, even though they may have taken place in the City, are not kept on file locally.

A new system of accident reporting and filing now being initiated in the State of Iowa is called the ACCIDENT LOCATION AND ANALYSES SYSTEM (ALAS) and is expected to become functional in 1976. The ALAS system will be a computerized method of

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* Property Damage in excess of $250 and/or personal injury or Fatality Accidents.

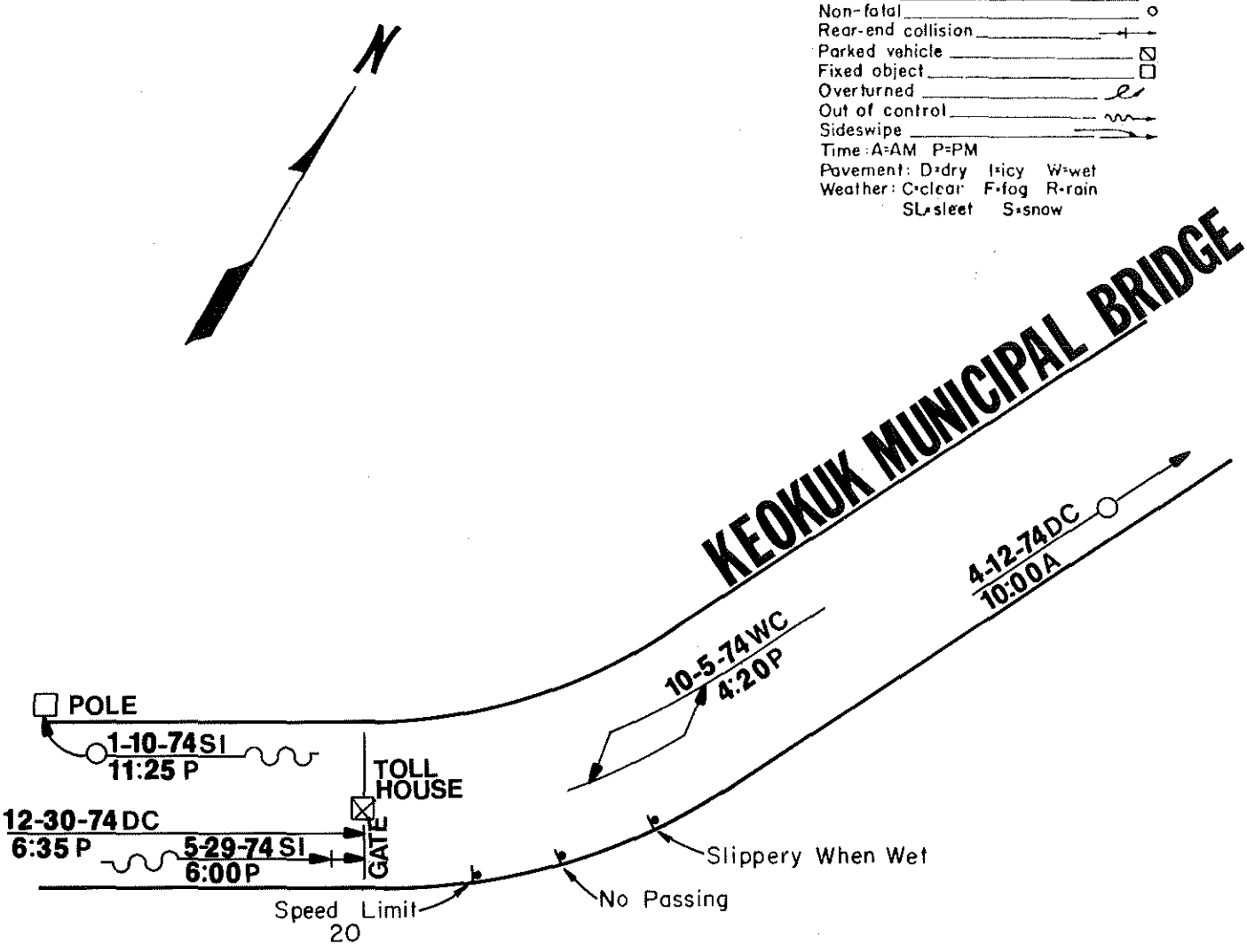
obtaining and storing accident information for future use and study. Users of the system will be able to quickly identify accident prone locations which require special study, and analysis to remedy unsafe areas. The information will be used for design of physical and operational changes to the site in order to reduce accident frequency and severity. The new system will also have the capability for retrieval of a historical data of specific locations including the characteristics and causes of each accident. A state-wide coordinate system has been established by assigning nodes located in specific townships, sections, or cities. Nodes will also be assigned to other prominent features of roadways such as railroad crossings or bridges. In cities and urban areas, intersections of the existing street system will be coded plus other prominent features that a motorist or police officer would normally use to pinpoint an accident location. Accident data will be reported on special write-up sheets that can be entered into the system by transferring the data to punched cards. Officer report forms will be modified to comply with the new system and these will be distributed through local State Patrol offices.

When the base data is compiled and when accident data of various locations across the State are entered into the system then it will be a rapid and simple process for law enforcement officials, safety engineers, insurance companies, etc. to obtain specific information needed to analyze and eliminate accident causes.

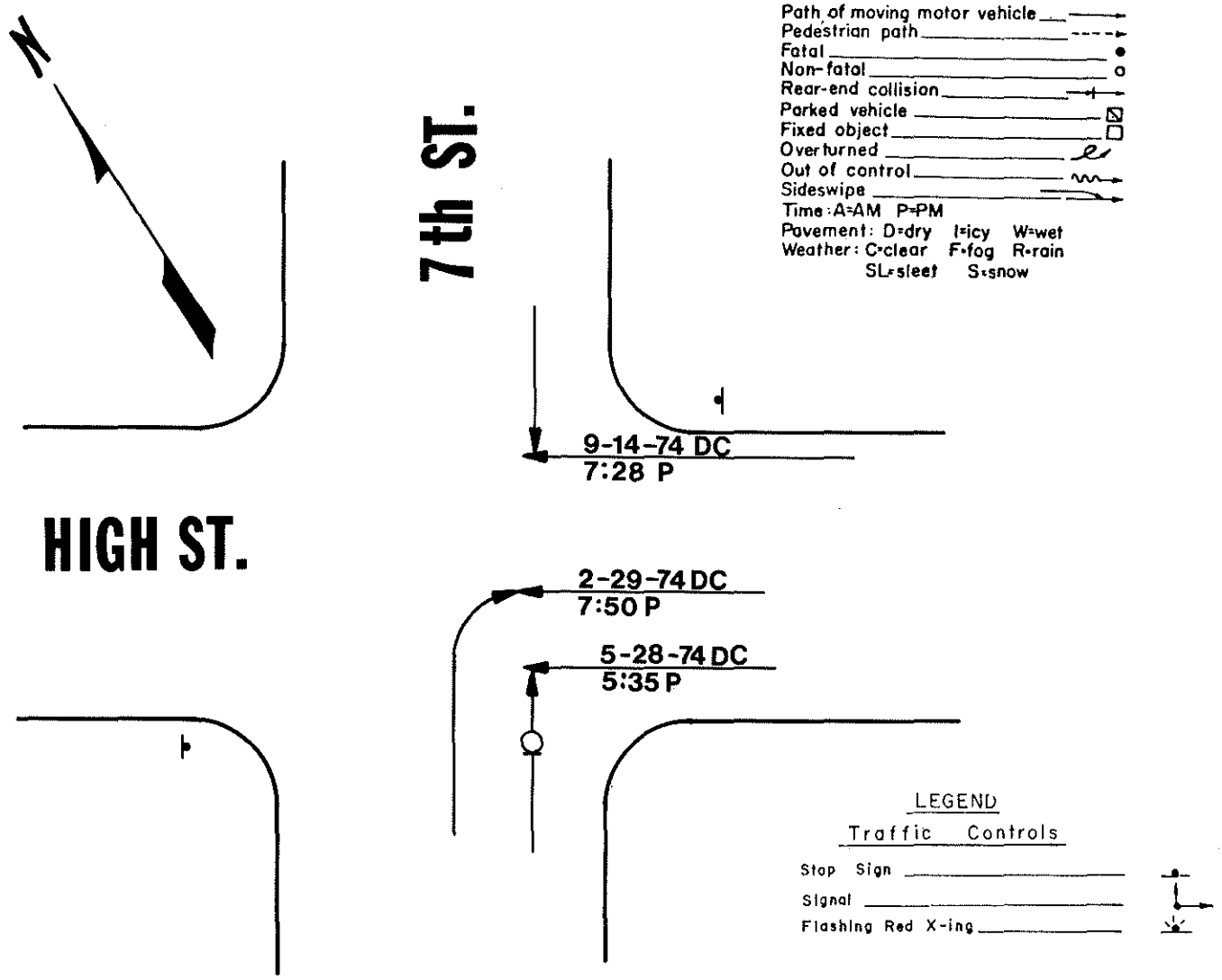
Individual cities such as Keokuk need to be aware and concerned about the new system as it will be a useful tool for local officials as well. When the system goes into effect it will be helpful for officials to become familiar with the coordinate points of their own community in order to communicate effectively with the State Department of Public Safety.

The card system of keeping accident records that is presently used by the Keokuk Police Department is commonly used by medium sized communities who do not have access to computerized facilities. It is recommended that the City continue this method of filing even when the new system is put in to use as their minor accident reports will not be included in the ALAS system.

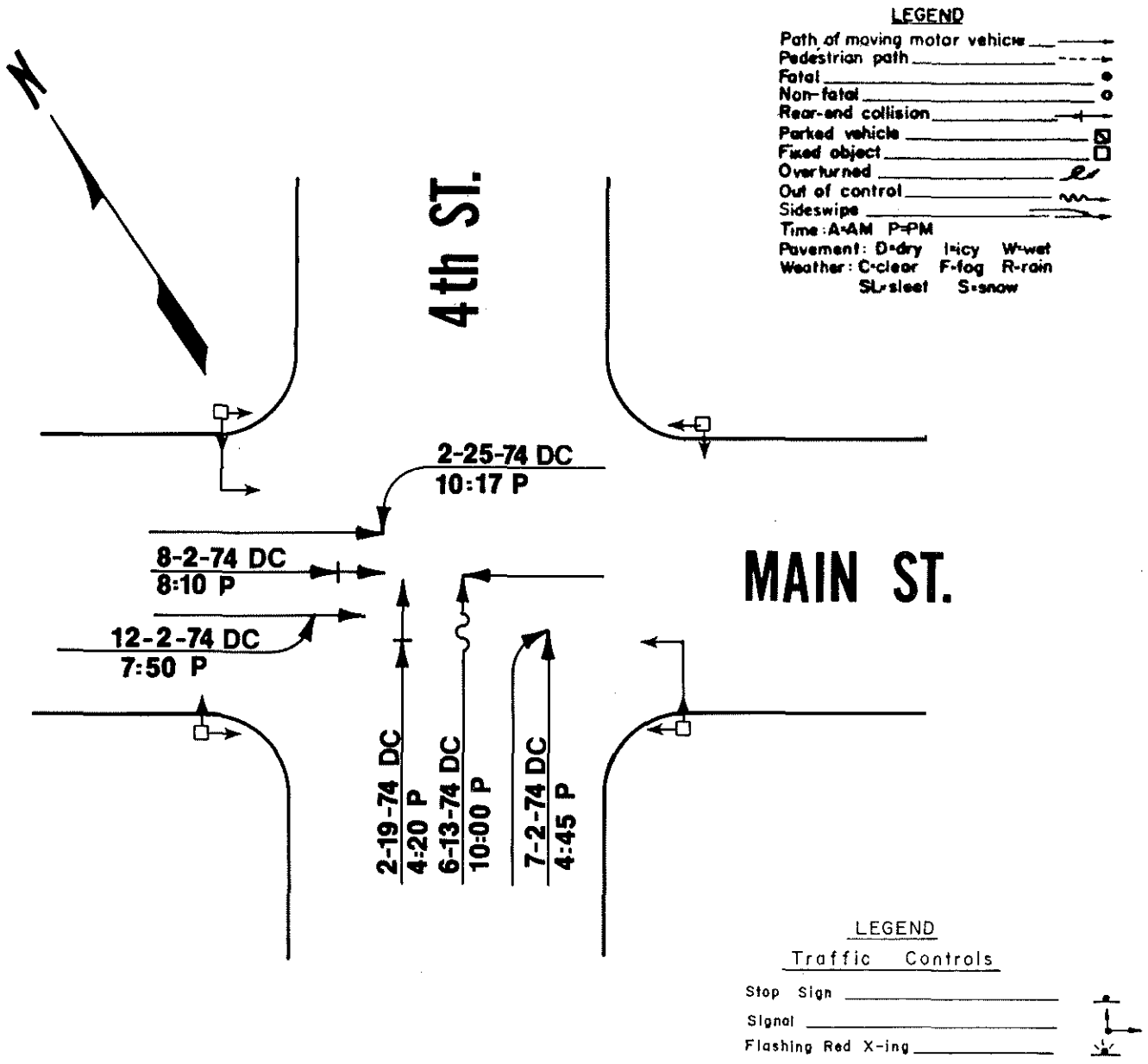
Pin mapping or a similar system which plots accident locations on a large city map is also very effective because dangerous locations can be spotted at a glance. These are more for public benefit and should be located in areas that are accessible to the public. These maps are also valuable for historic purposes and should be kept for at least 5 years.



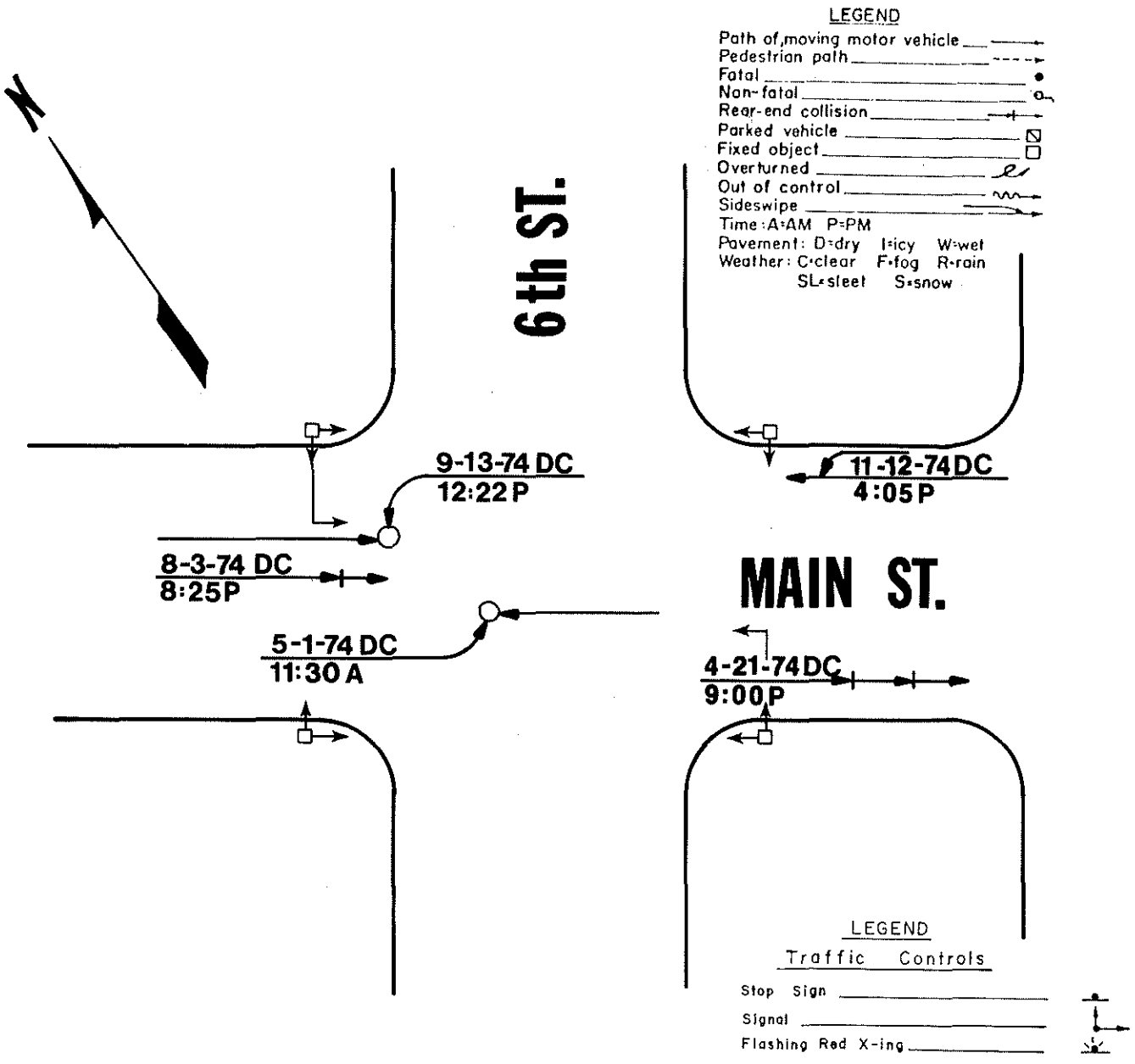
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY FALL 1975**	COLLISION DIAGRAM



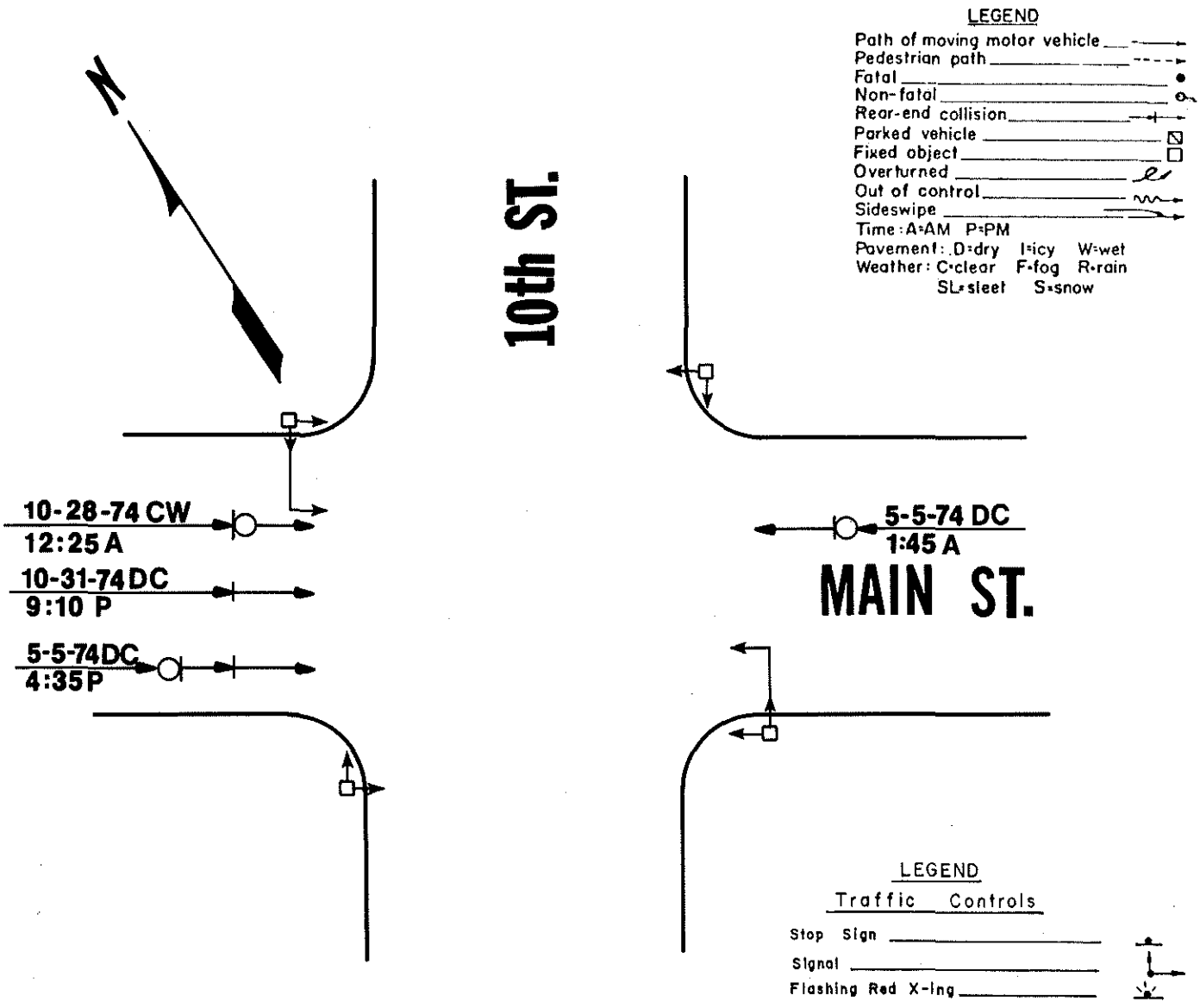
KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** FALL 1975	COLLISION DIAGRAM



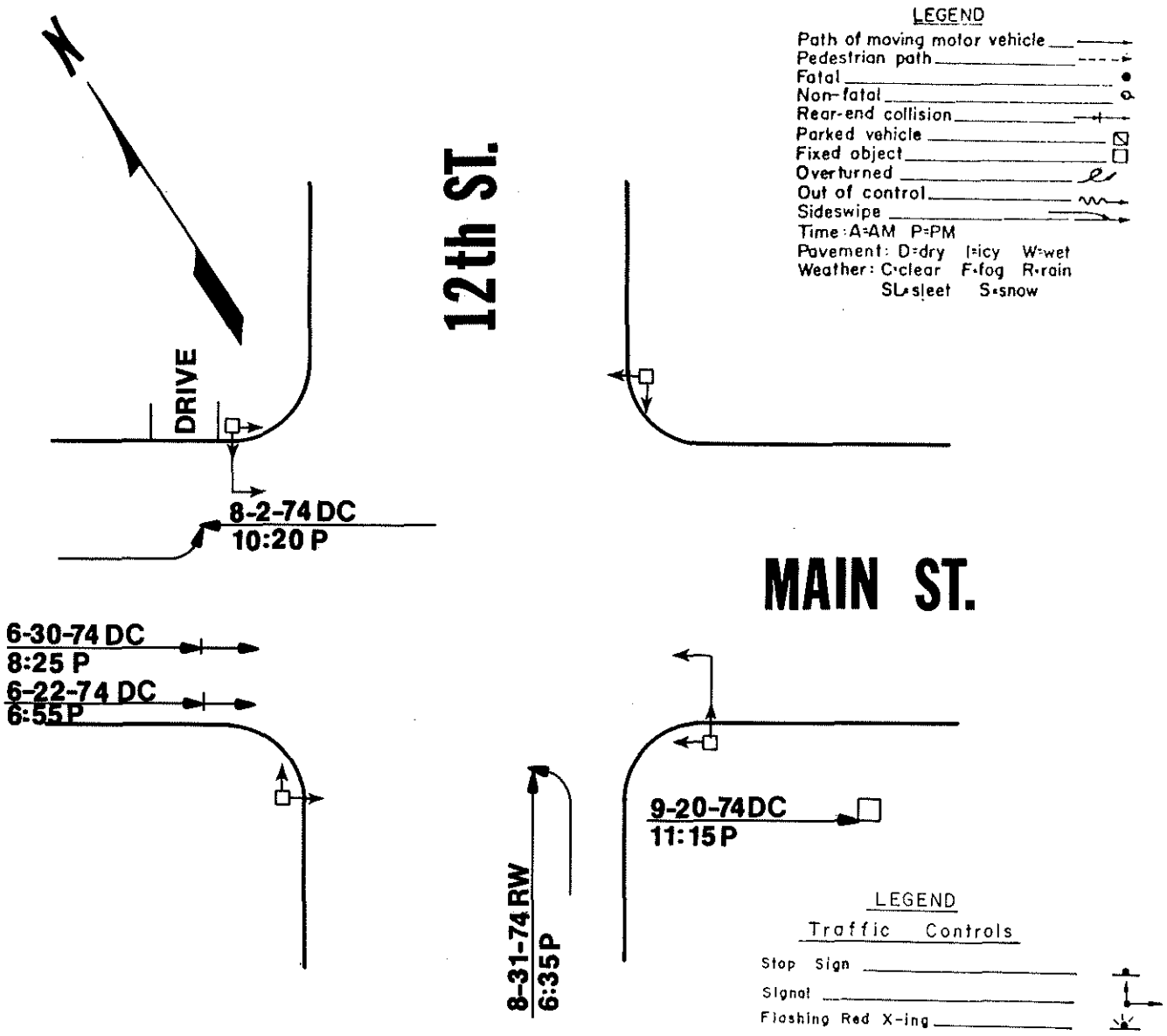
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** FALL 1975	COLLISION DIAGRAM



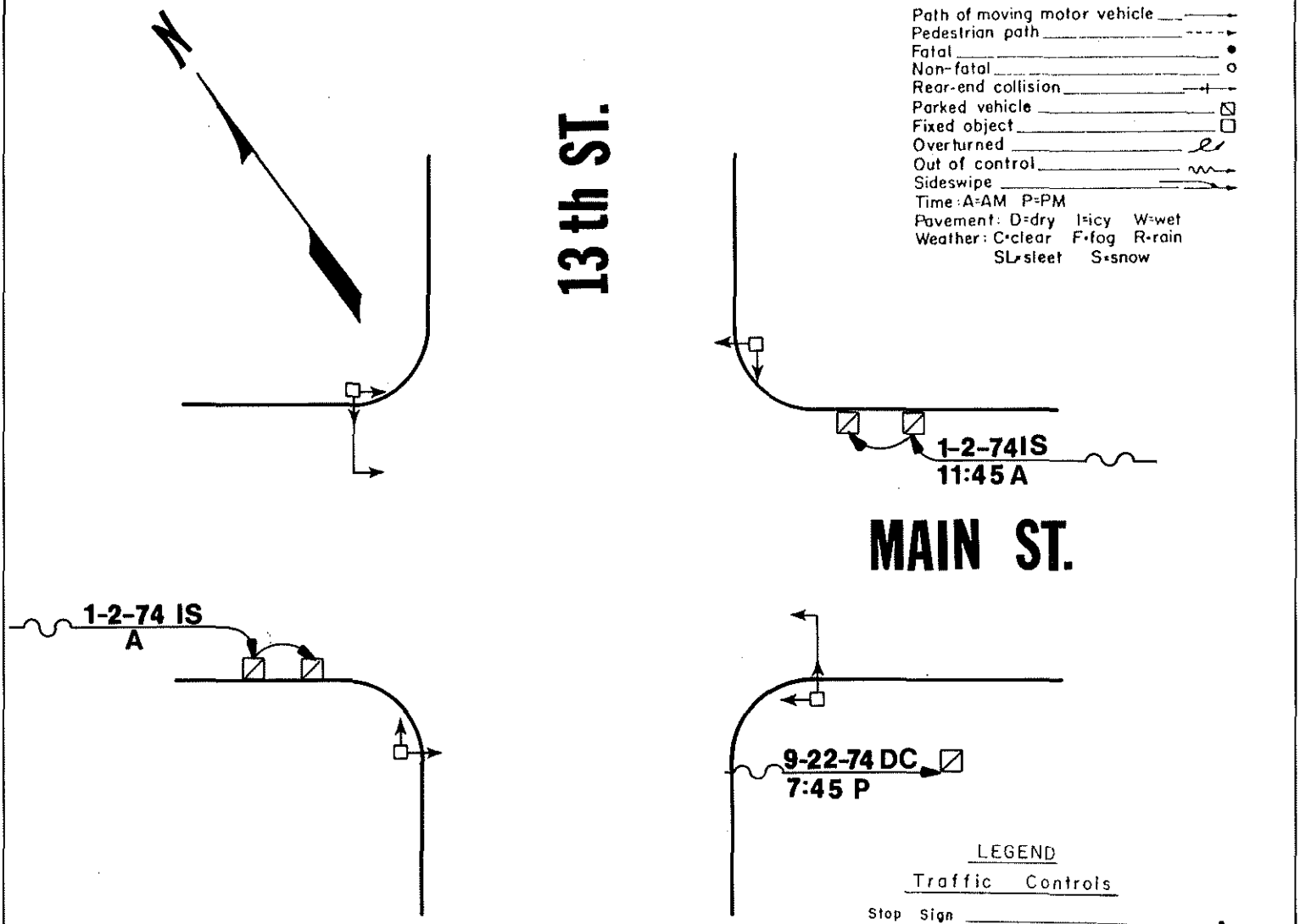
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



LEGEND

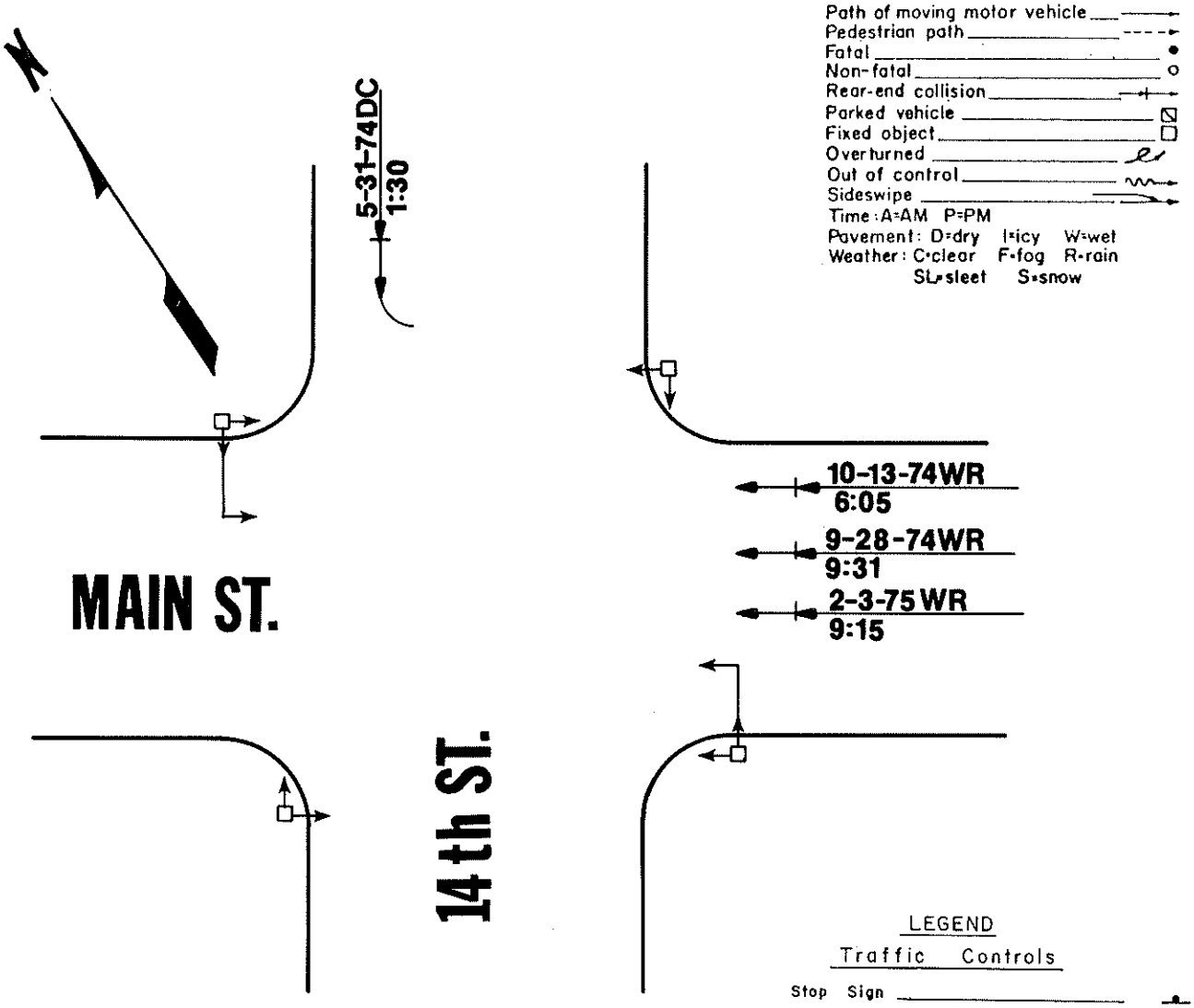
Path of moving motor vehicle
Pedestrian path
Fatal
Non-fatal
Rear-end collision
Parked vehicle
Fixed object
Overturned
Out of control
Sideswipe
Time: A=AM P=PM
Pavement: D=dry I=icy W=wet
Weather: C=clear F=fog R=rain
SL=sleet S=snow

LEGEND

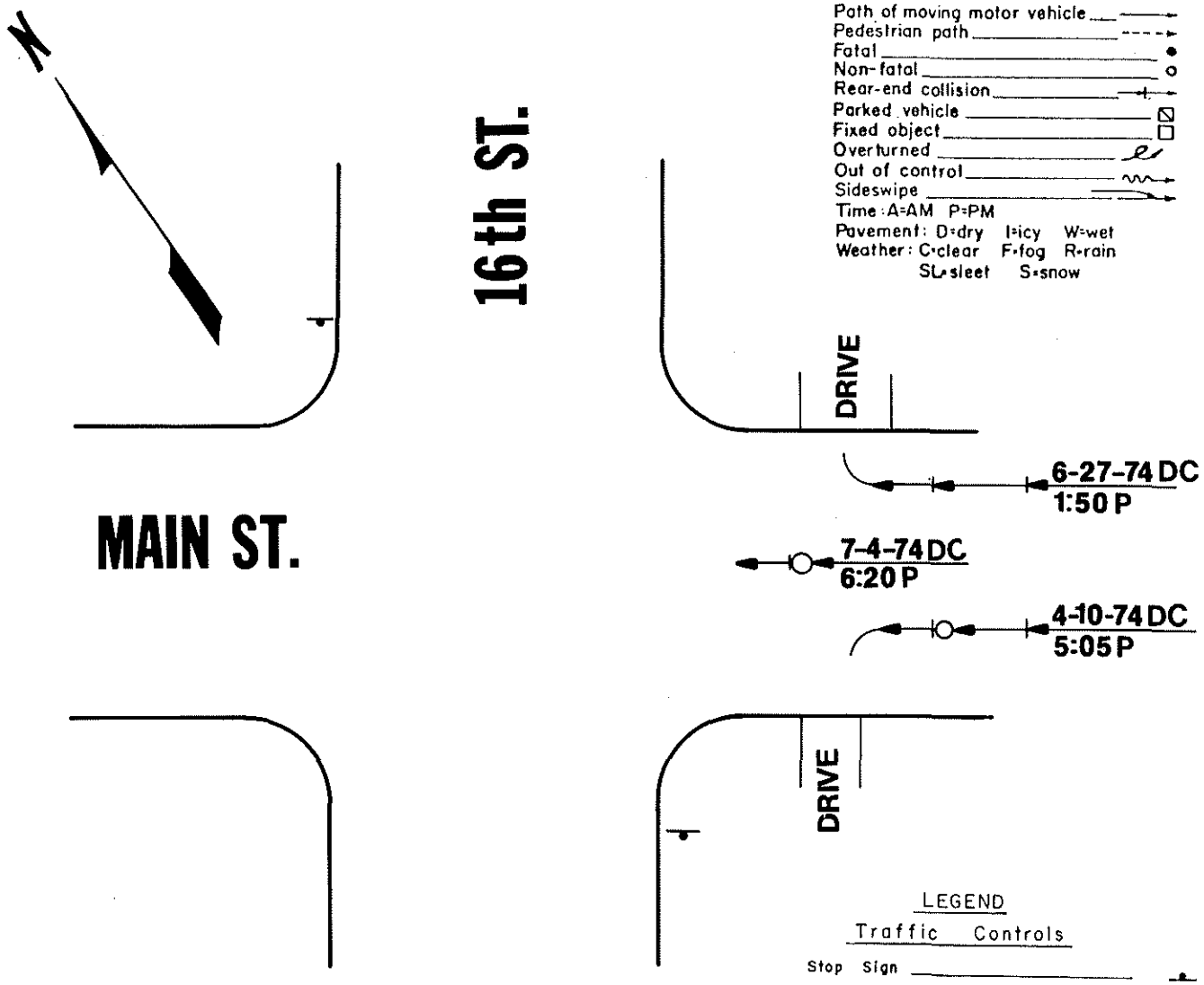
Traffic Controls

Stop Sign
Signal
Flashing Red X-ing

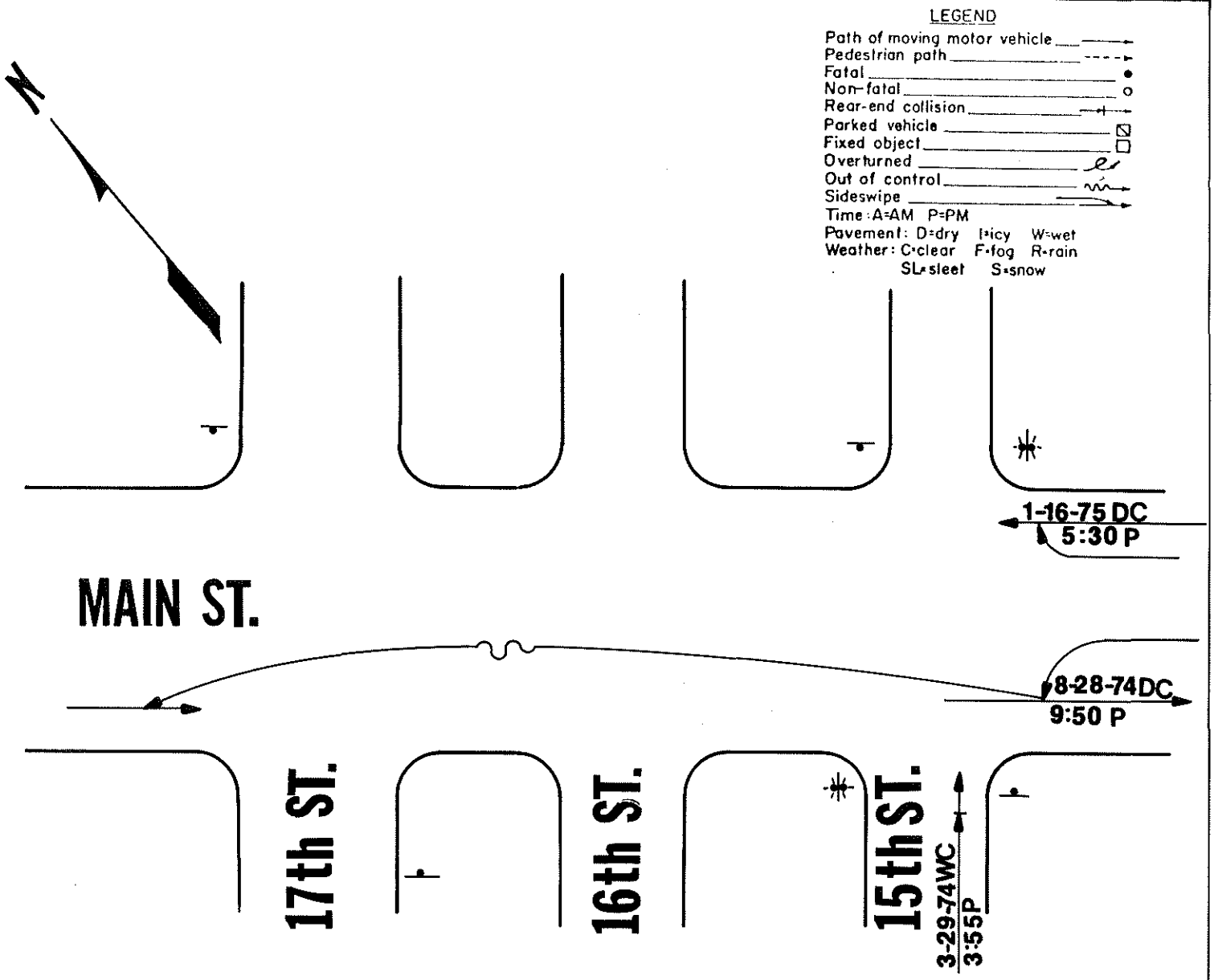
KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



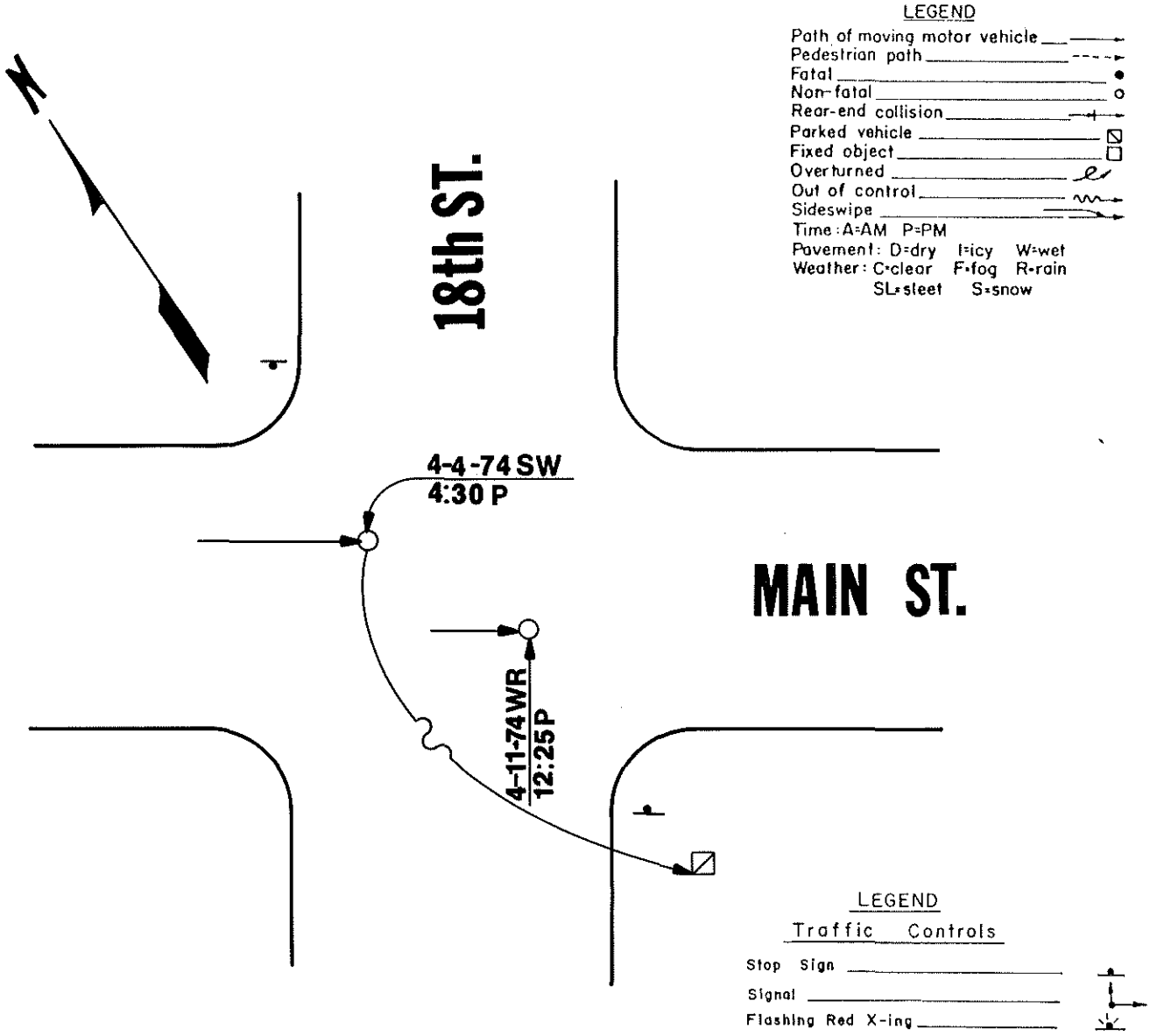
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



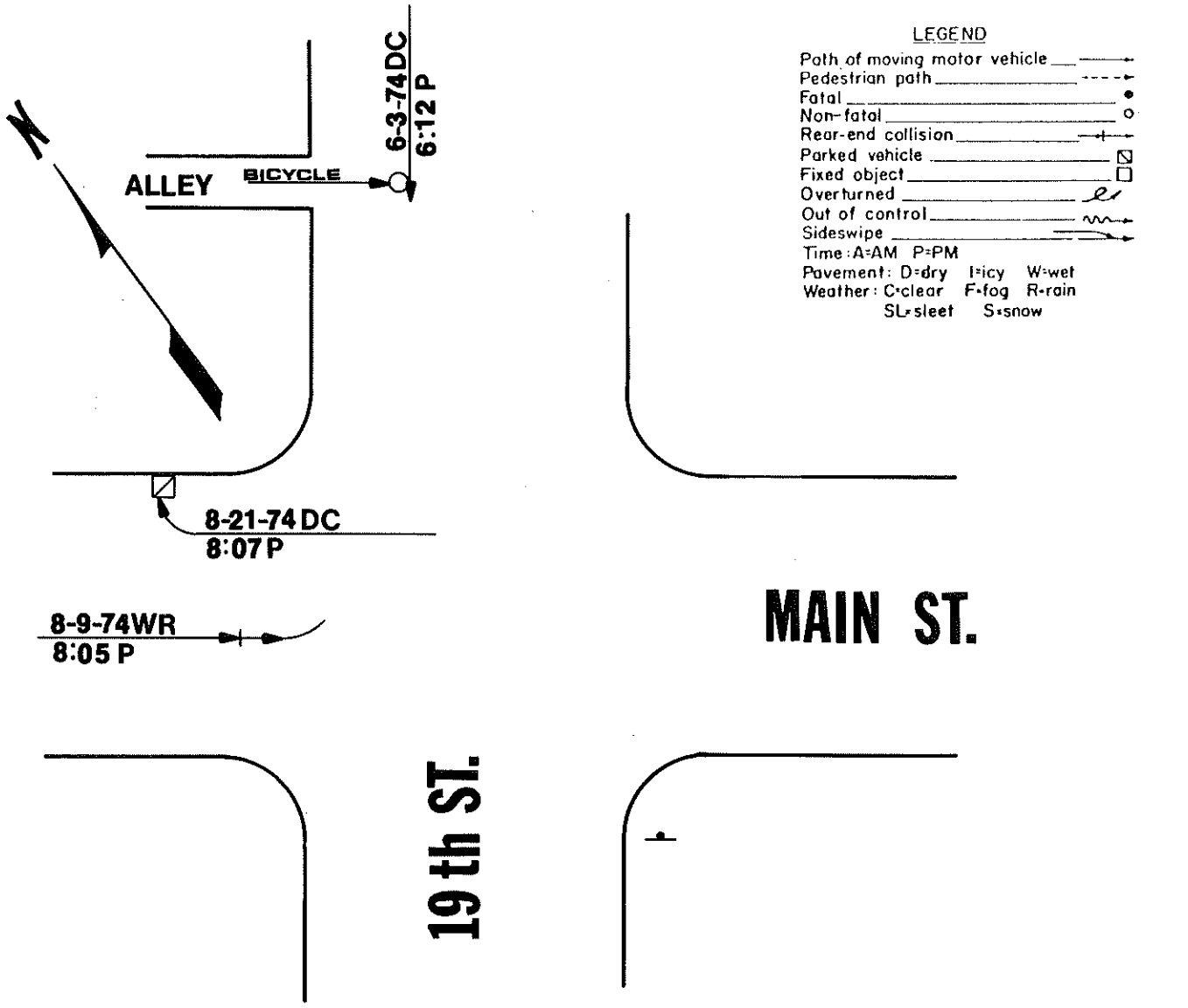
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



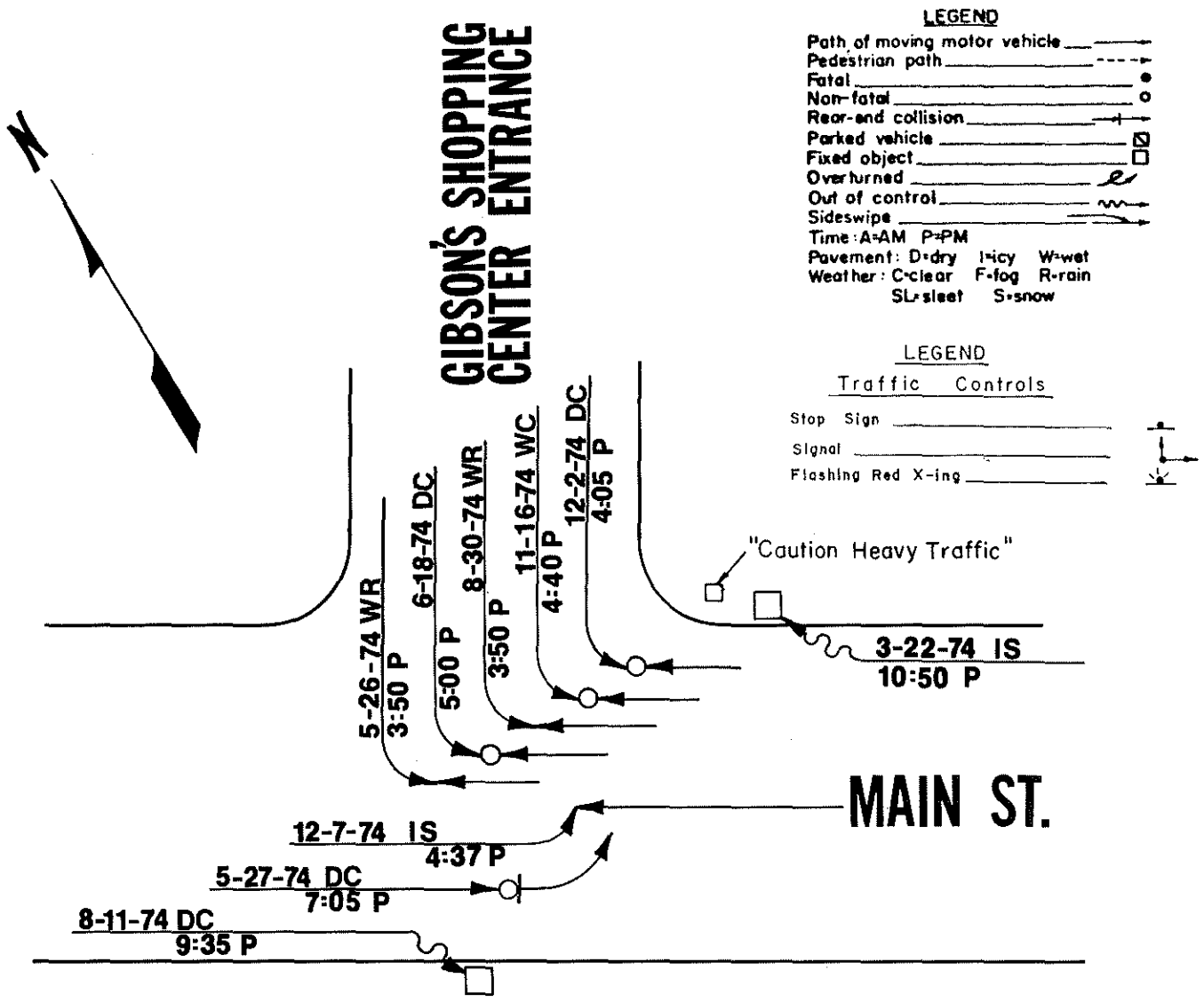
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



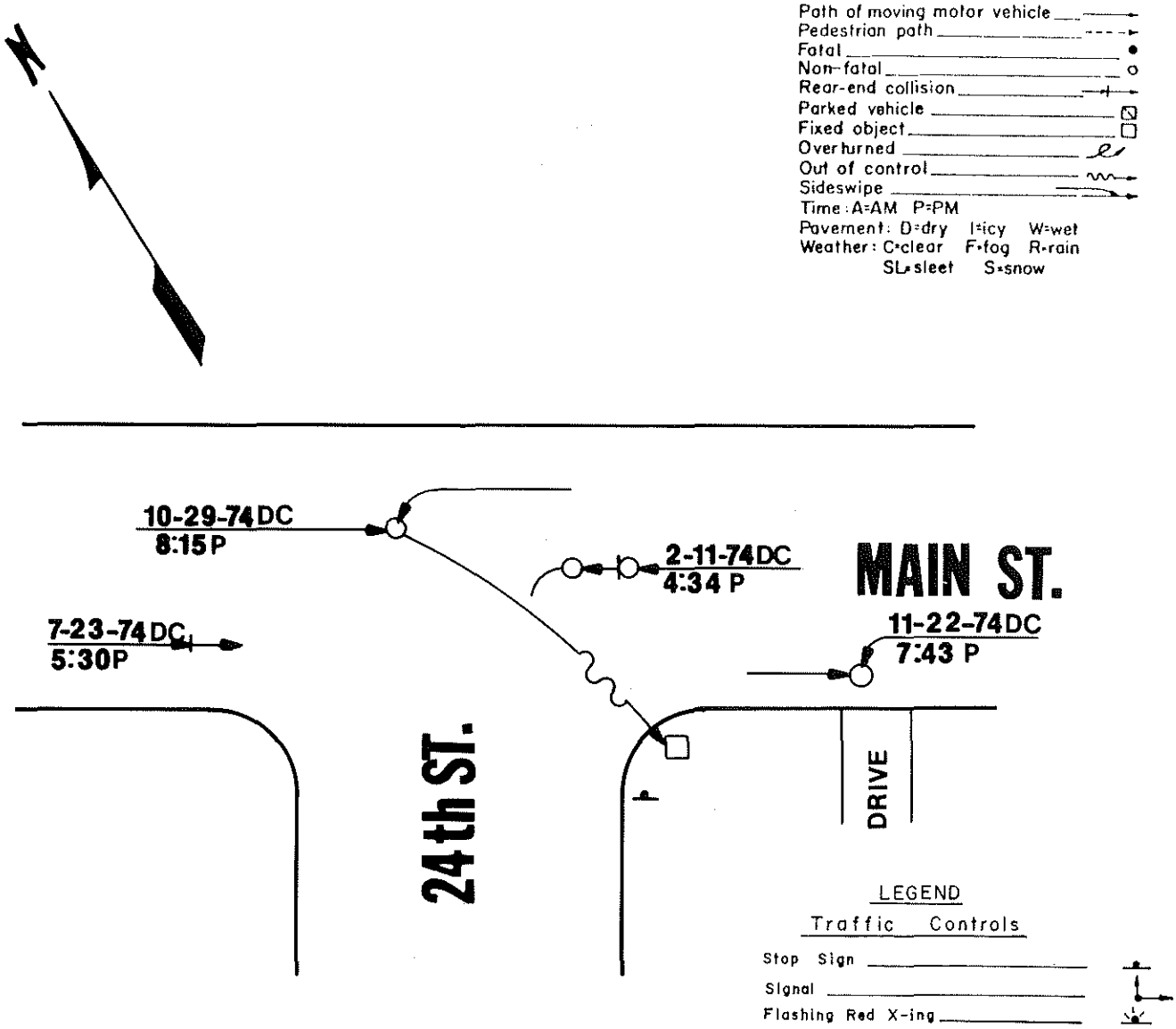
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY FALL 1975**	COLLISION DIAGRAM



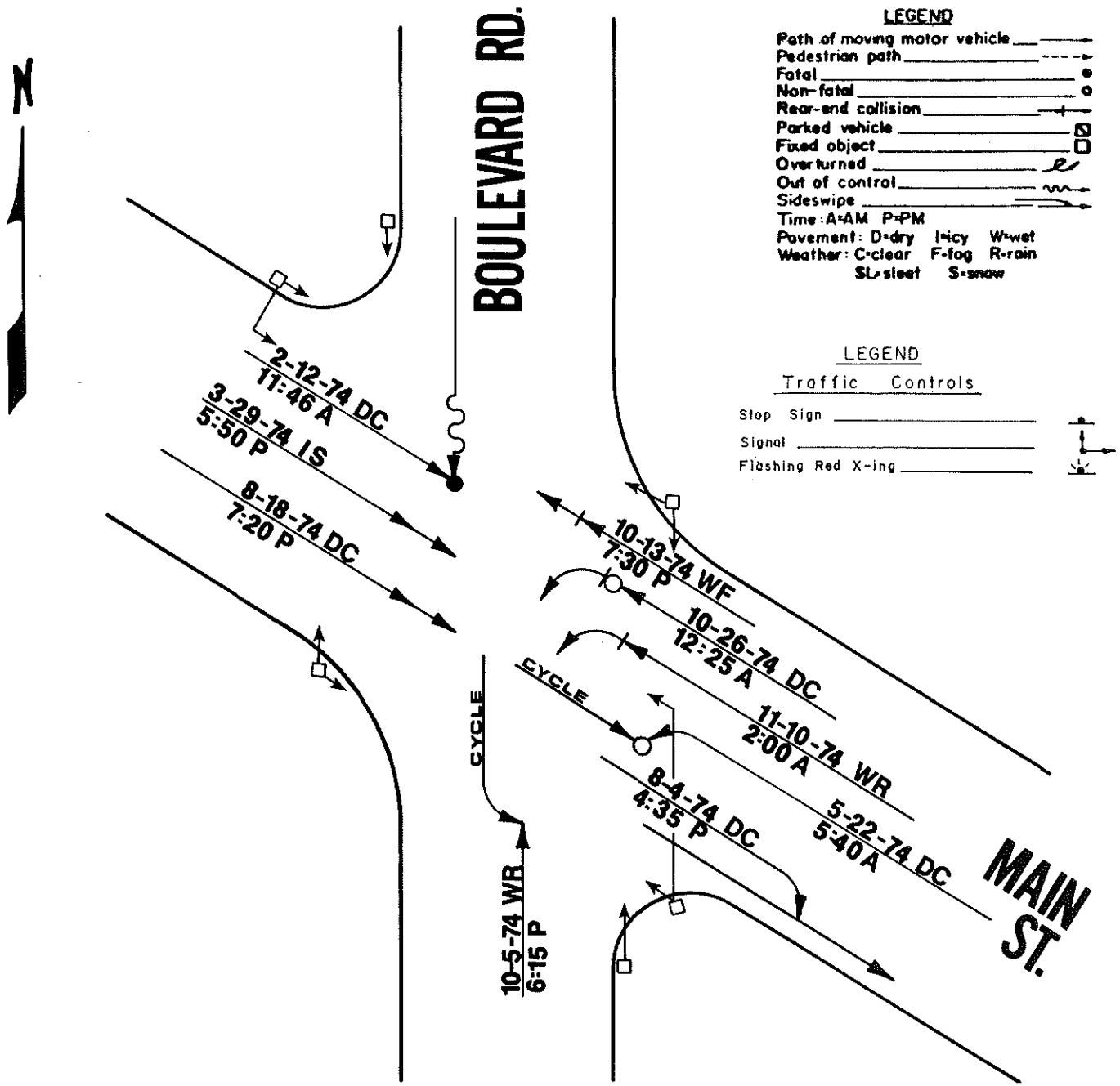
KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	COLLISION DIAGRAM



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	COLLISION DIAGRAM



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** FALL 1975	COLLISION DIAGRAM

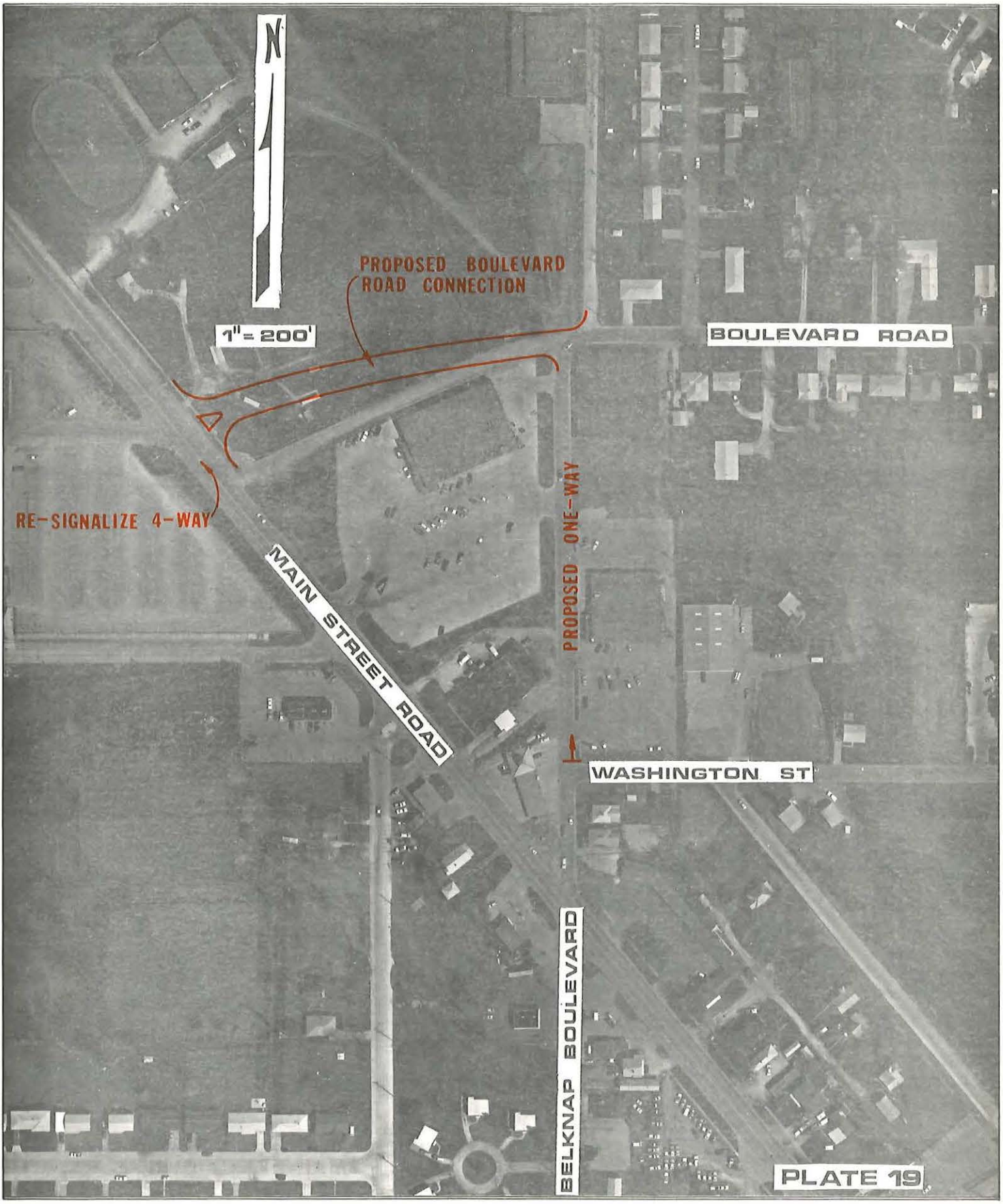
INTERSECTION IMPROVEMENTS

There are several intersections in the City that should be modified to reduce potential hazards and improve traffic flow.

1. Belknap Boulevard - Boulevard Road - Main Street
This intersection complex has a high rate of accidents and is complicated by the sharp skew of the intersecting streets and the close proximity of other street connections. Further complications include full development on all quadrants with practically unlimited access to the various businesses which causes congestion and unorthodox turning movements. A large volume of traffic passes through the intersection as Boulevard Road is a major feeder to the industrial sites from the residential areas in North Keokuk. Because of the close proximity of Washington Street, (See Photo, Plate 19) the layout of the intersection amounts to a 5-legged, at grade arrangement, of a type which is normally difficult to control.

   The intersection cannot be improved physically without additional right-of-way and considerable damage to adjacent property. The least damaging method of improvement would be to connect the east-west segment of Boulevard Road to Main Street Road at the presently signalized Sheller-Globe factory entrance. The north-south segment of Boulevard Road should then be changed to one-way traffic, northbound. Unfortunately this would require the acquisition of the Joyce Baseball Diamond which may be difficult to obtain due to the provisions of Section 4(f)* of the Environmental Policy Act. It is recommended that the City pursue this course, as the Environmental Impact may be less severe than the continuation of the high accident rate. It may also be possible to adjust the ball diamond layout in such a way as to make it completely usable if the adjacent land to the north is available. Traffic flow would improve further if Washington Street were relocated to connect directly to the present intersection, however, this would require a considerable amount of private property including the Chief Motel and is not recommended at this time but could be considered as a future project.

*4(f) is a section contained in the Environmental Protection Act restricting the acquisition of parklands, playgrounds, etc. for roadway right-of-way or construction in which federal funds are involved.



KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	KEOKUK TRAFFIC STUDY FALL 1975	BELKNAP BOULEVARD MAIN STREET ROAD BOULEVARD ROAD

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** **FALL 1975**	**BELKNAP BOULEVARD** **MAIN STREET ROAD** **BOULEVARD ROAD**

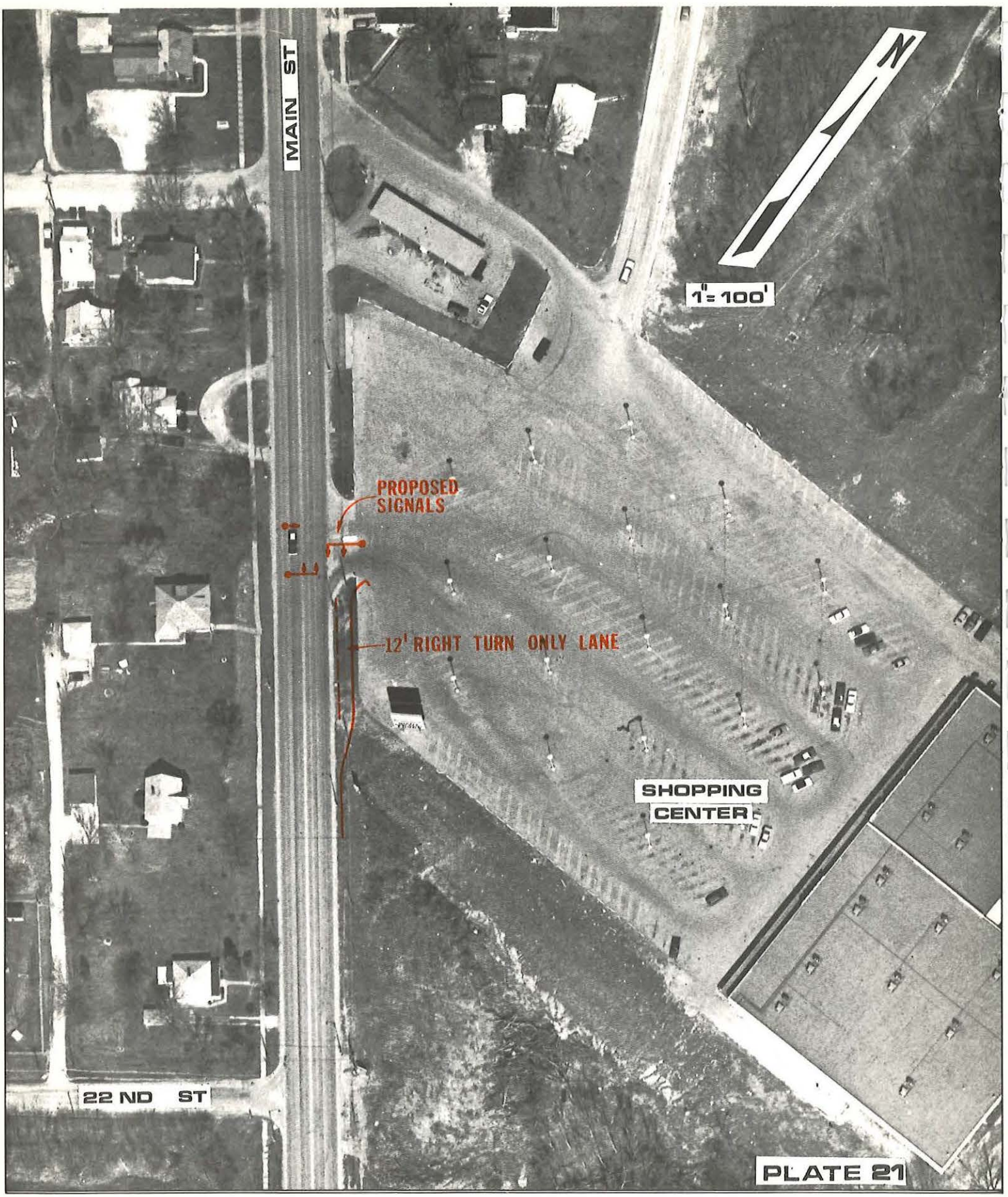
Whether or not any physical changes are made at this intersection, it is recommended that left turns be eliminated by regulation. This should reduce the number of rear-end and angle collisions. This will undoubtedly be a controversial decision as businesses will be affected. Unless some action is taken accidents will continue to take place at this intersection however, and the reduction of these accidents must be weighed against the impact of the recommended improvements.

2. Main Street Road at 23rd Street Entrance to Shopping Center

This site was the scene of many accidents in 1974 and most of the accidents were severe enough to be reported including several injuries. Modifications to this entrance should have immediate priority as the chronic accident situation is expected to continue. The following changes are recommended for this entrance. The modifications are illustrated on the photo overlay shown on Plate 21.

a. Provide a "right turn only" lane to provide vehicles coming from the south storage space while waiting to turn into the center. This will get shopping center patrons out of the fast flowing traffic lanes and decrease the chances of rear-end type accidents. Regulatory signing and pavement marking will be required to complete the proposed improvement.

b. Install traffic signals that are vehicle actuated by cars exiting from the shopping center. Main Street should have a minimum green time of 45 to 50 seconds. Provisions for a future left turn arrow phase for vehicles turning from the north should be provided but not installed until needed. The shopping center entrance at 23rd Street will be further complicated when the new center, now being constructed west of Main Street at 21st Street, becomes operational (See Photo below). The same modifications on Main may also be needed at this entrance. For this reason the controller for the signals should have the compatibility to interconnect with and control an additional signal.



KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** FALL 1975	SHOPPING CENTER ENTRANCE MAIN AT 23RD ST.

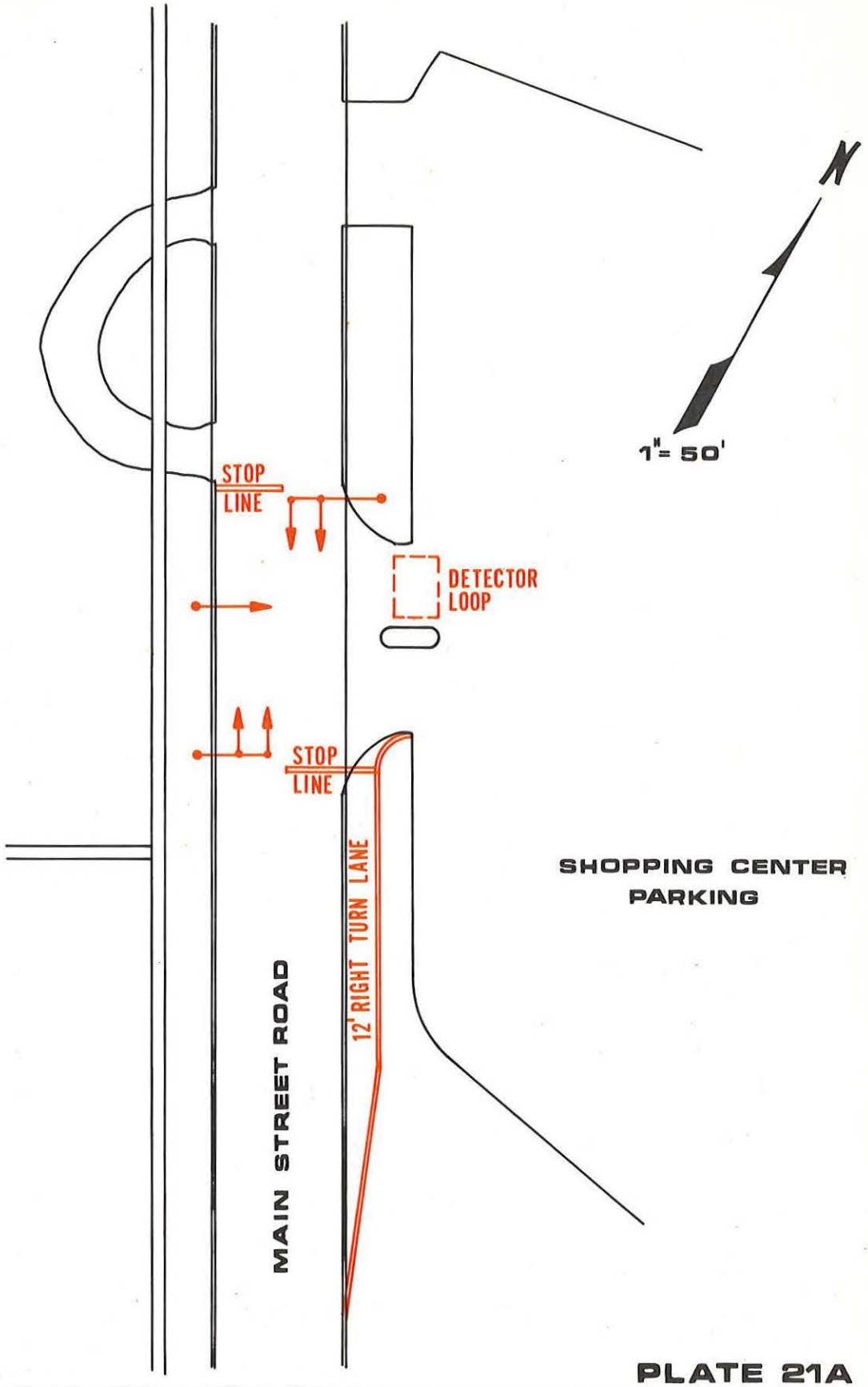


PLATE 21A

KIRKHAM, MICHAEL AND ASSOCIATES ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

PROPOSED SIGNAL FACE ARRANGEMENT
23 RD & MAIN STREETS

c. A left turn storage lane is also needed at this location, however, action on this construction should probably be delayed until the effects of the new shopping center two blocks to the south are known. Widening may be needed at the south entrance also and the two projects should be combined for compatibility.

3. Plank Road - Middle Road

This intersection has unusual geometry but has not experienced the high rate of accidents as some of the other intersections in the City. Perhaps drivers are more cautious in this area as it is obvious that a potentially hazardous situation exists. Traffic circulation in this area is complicated by the presence of the Keokuk Senior High School Complex which approximately 1400 people come and go daily during the school year. A possible solution to the problem at this intersection is to close one end of Plank Road diagonal and convert that segment into a frontage road to serve Burke Street and the adjacent properties.* This plan has disadvantages as it will probably divert more traffic onto Middle Road adjacent to the High School where most of the parking is 90^{o} street parking and this may be more of a hazard than currently exists.

Instead of that plan there are three alternate methods proposed that should eliminate the hazard and confusion of the area. These are discussed as follows:

Plan A, shown on Plate 22-A, proposes a one-way pair from Washington Street to the diverge point between Plank and Middle Road at 19th Street. Traffic would be one-way, northbound on Middle Road past the High School and one-way southbound on Plank Road. A barrier curb would be required to separate traffic as shown. Plan A would eliminate congestion in the High School area but would cause some inconvenience for drivers wishing to go north from the parking lots adjacent to Plank Road on the west.

Plan B, Shown on Plate 22, proposes a connection from Middle Road to Plank Road at Burke Street. Middle Road south of Burke would be closed and could be used for High School parking. This plan has a slightly higher cost than Plan A but would not create adverse travel distance for northbound drivers wishing to use Plank Road.

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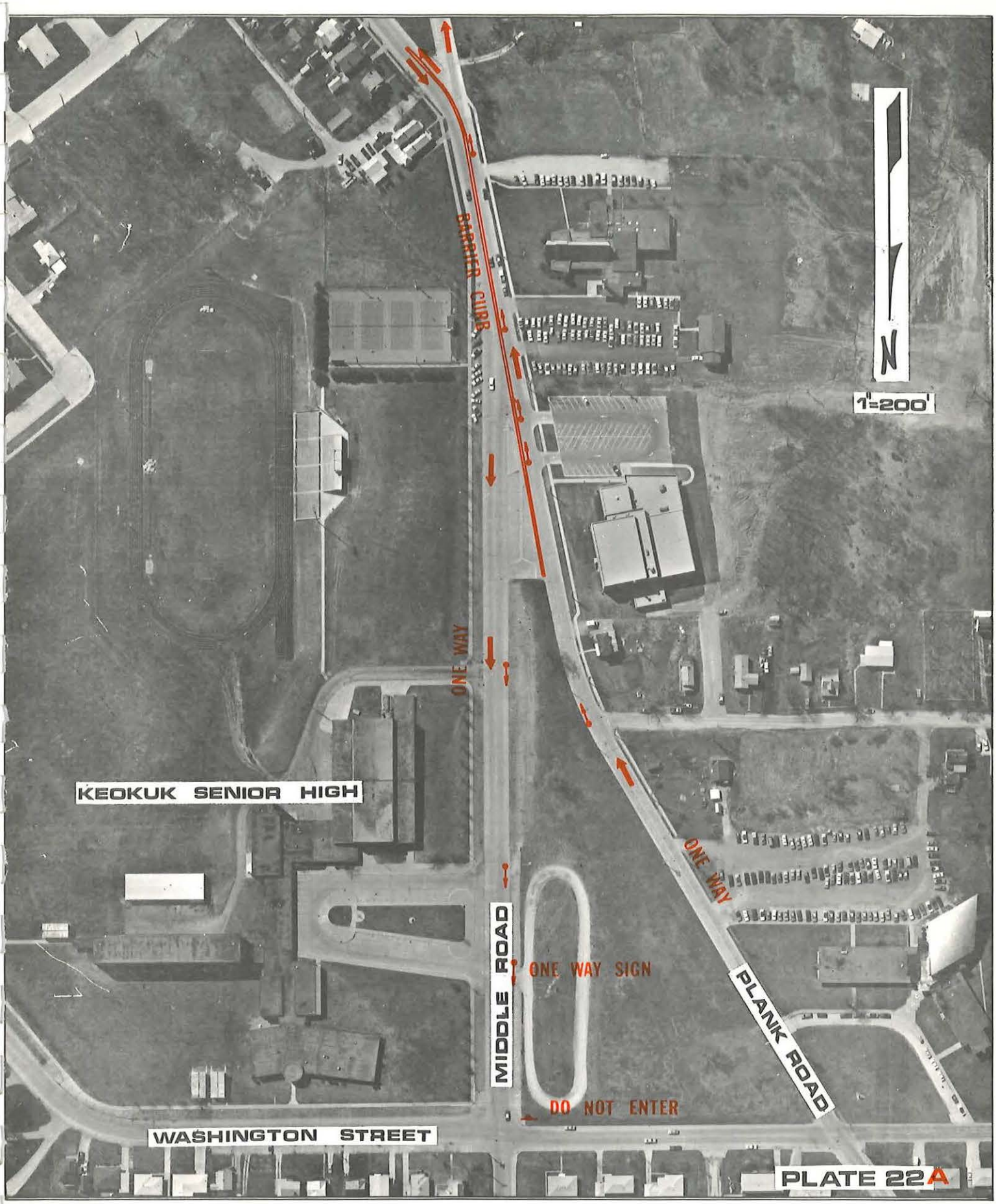
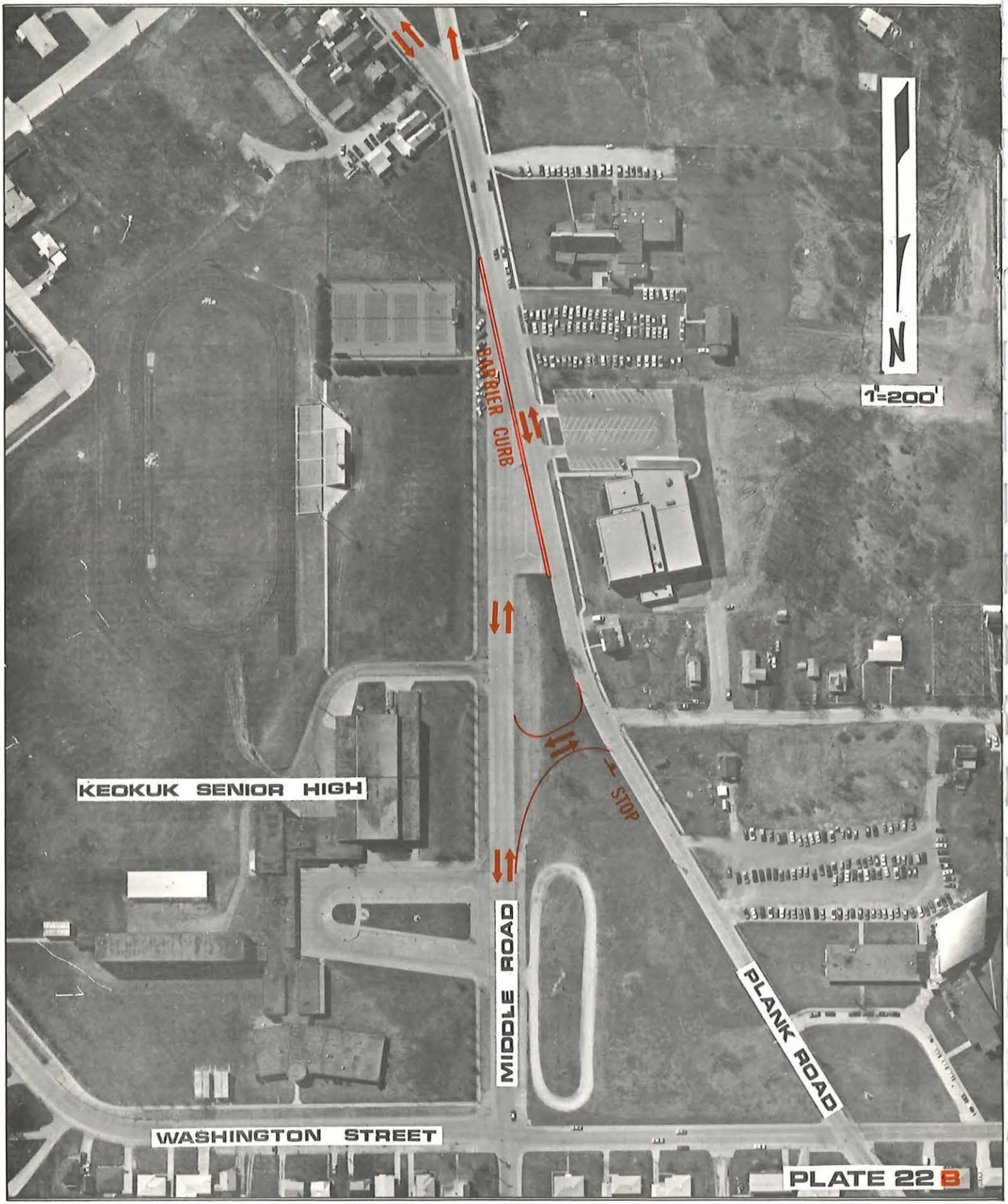
* As recommended in the 1975 Comprehensive Plan.



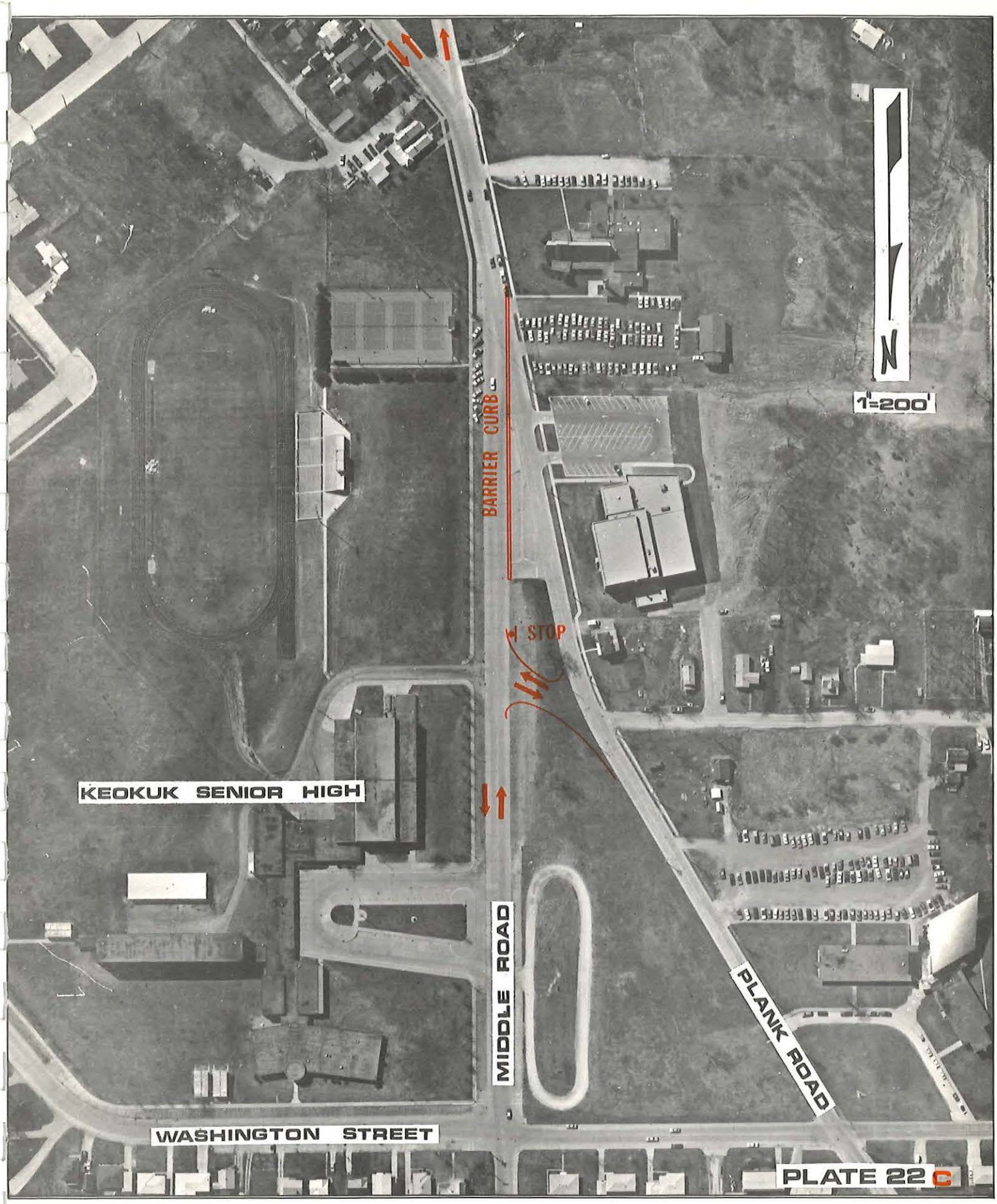
KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS	**KEOKUK TRAFFIC STUDY** FALL 1975	PLANK ROAD—MIDDLE ROAD AT KEOKUK SENIOR HIGH PLAN A



KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

PLANK ROAD—MIDDLE ROAD AT KEOKUK SENIOR HIGH
PLAN B



KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

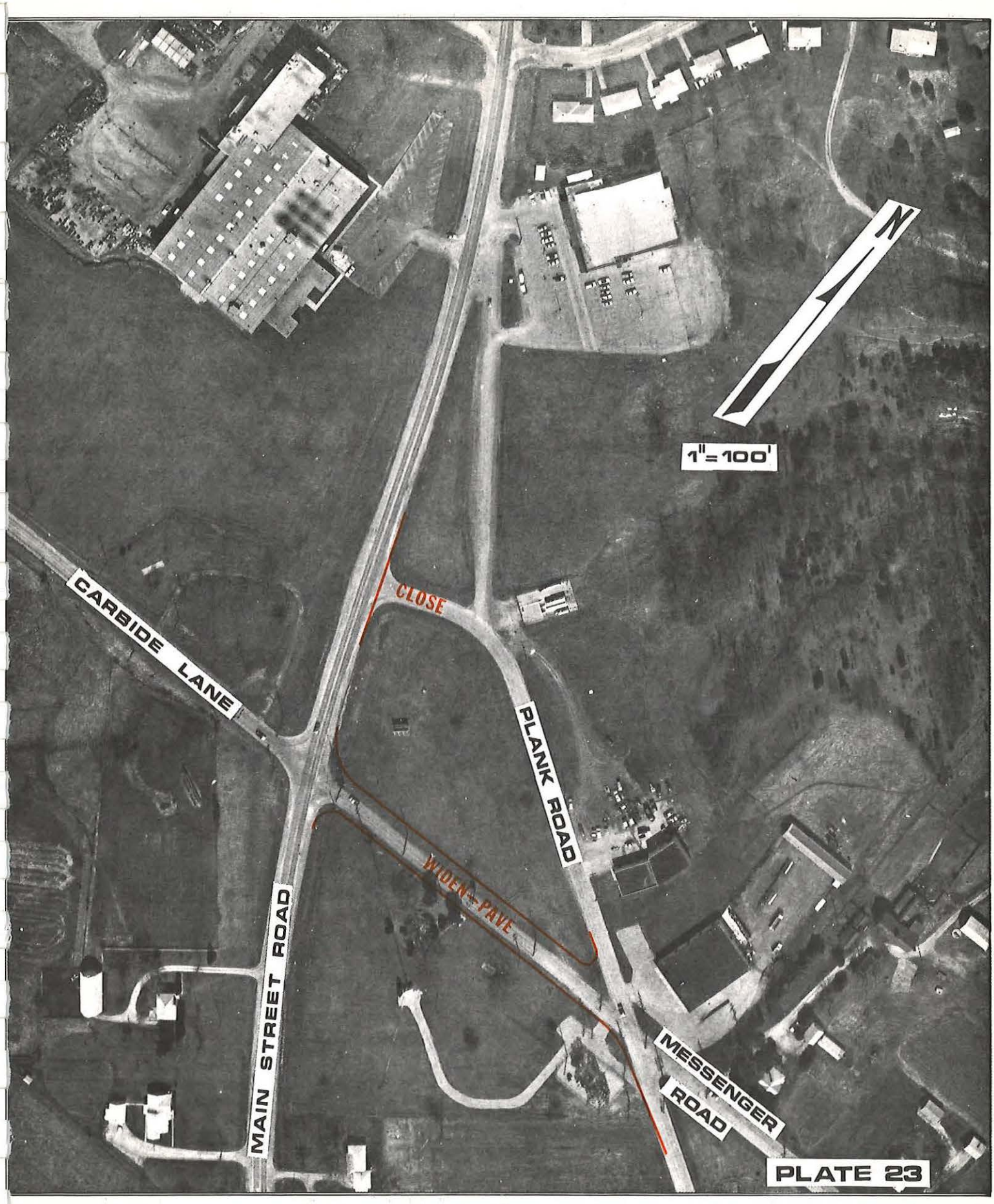
PLANK ROAD—MIDDLE ROAD AT KEOKUK SENIOR HIGH
PLAN C

Plan C, shown on Plate 22-C, is similar to Plan B except Plank Road is connected to Middle Road, again at Burke Street. This plan is more in keeping with the primary street plan of the city in that Middle Road is maintained as a continuous arterial. Disadvantages of this plan is the diversion of more traffic to Middle Road past the High School in an already congested section of that street. This plan would eliminate the possibility of converting the excess area to High School parking. For these reasons it is believed that Plan B has a slight advantage over the other plans and it is recommended that this plan be utilized.

A more expensive plan than either of the above has been considered and this was to segregate both roads complete and maintain two-way traffic on each. This would have required widening and the acquisition of a residence and was rejected on that basis.

4. The Diagonal Connection between Messenger Road and Main Street Road
The two adjacent connections to Main Street Road are not needed and one should be eliminated as it creates needless exposure to potential accidents. It is recommended the Messenger Road connection be maintained as it forms a 4-legged intersection with Carbide Lane. New pavement and widening will be needed on the short section of Messenger Road from Plank to Main. (See Plate 23) The section of Plank Road diagonal could continue to be utilized as a frontage road serving the adjacent businesses.

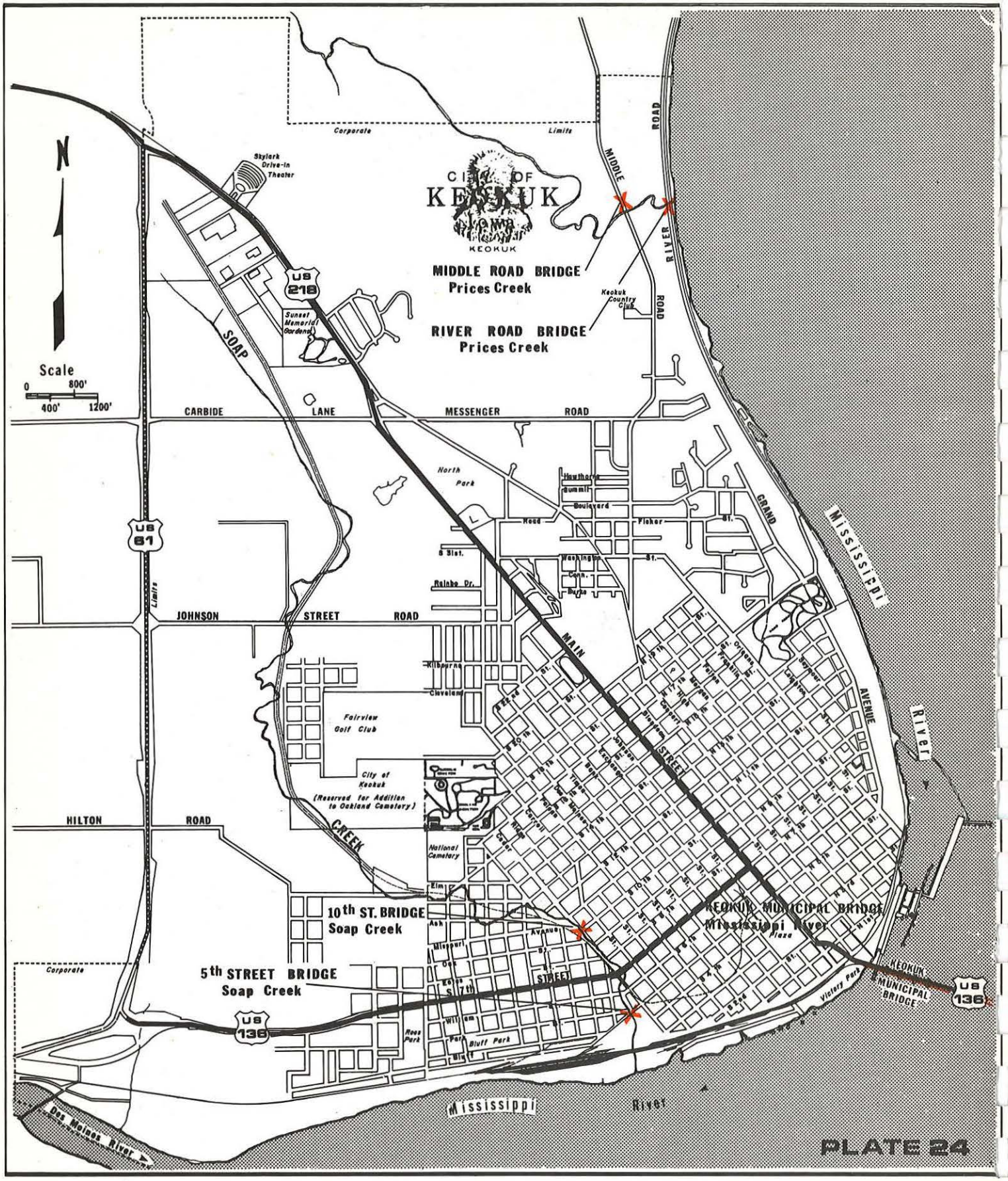
Other intersections in the City that warrant consideration because of the higher accident rates are in the busy downtown area where traffic volumes are higher and many parking maneuvers take place daily. Most of the accidents occurring downtown are minor and appear to be proportional to the higher volumes. There is little that can be done to modify the downtown intersections because of the degree of development, and the lack of space. Better signal synchronization should help lower the rate of accidents in the downtown area.



KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

KEOKUK TRAFFIC STUDY
FALL 1975

PLANK RD—MESSENGER RD
DIAGONAL CONNECTION



KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

Keokuk Traffic Study
Fall, 1975

BRIDGES UNDER STUDY

BRIDGES

The highway and street network in the Keokuk city limits contains several small bridges which carry vehicle traffic over Soap Creek and Prices Creek, the two creeks which drain most of the City proper. The Keokuk Municipal Bridge is a combination railroad and highway bridge over the Mississippi River and has been in service for over one-hundred years. Five of these bridges are to be included in this study and have been examined and analyzed for traffic capacity and safety. These bridges are located on Plate 24 and are discussed individually below:

KEOKUK MUNICIPAL BRIDGE, U.S. 136 across the Mississippi River.

This bridge at the extreme southeast point of the City is the main structure in the Keokuk area and serves as an important Mississippi River crossing for the tri-state region which includes large sectors of Iowa, Illinois and Missouri. The bridge constructed in 1869 and rebuilt in 1915, is a double decked, combined railroad and highway bridge with a swing span to allow tow boats, barges and vessels with high clearance requirements passage into the locks. The bridge is toll operated with the toll being collected on the Iowa side. There is an unusual reverse curve (see photo Plate 25) on the Iowa side of the bridge because of the curvature requirements of the railroad approach below. The bridge has a horizontal clearance of approximately 18 feet and an open grate deck. Since the bridge is located

close to the Mississippi River locks, bridge openings and lockages are a simultaneous operation taking about 12 to 15 minutes. The amount of time the bridge was closed to traffic was checked by Bridge Commission employees for 20 days in March and April of 1974. During that period the draw-gate was lowered 148 times with an average closure time of 14.7 minutes.

The most severe traffic problem in the City of Keokuk results from traffic stoppages caused by the numerous swing span openings (traffic stopped) which, at times, backs up traffic for several blocks in the downtown area.

The table below lists the number of swing span openings and the number of vehicles that crossed the bridge during the last three years.

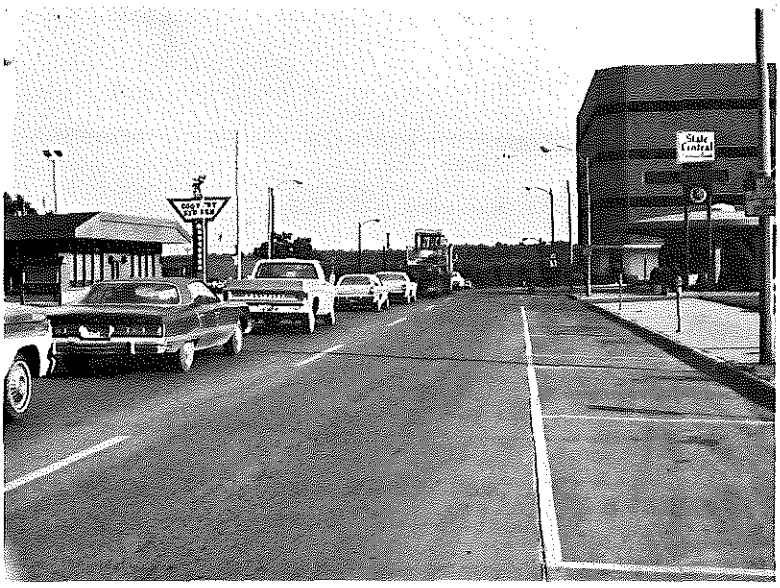
Year	*No. of Vehicles that crossed annually	Average No. of Vehicles that crossed daily	No. of Bridge openings
1973	2,385,846	6,537	2,441
1974	2,374,047	6,504	2,562
1975	2,415,338	6,617	** 2,409

* Includes cars, trucks and miscellaneous
** As of December 30, 1975

The machinery of the existing bridge is well maintained and the opening and closing operations are smooth and efficient. However, the combination of the large number of swing span openings (an average of almost 7 openings per day over the last 3 years) and the constant traffic volume causes congestion as traffic backs up on Main Street and adversely affects traffic movement and circulation in the downtown business district. This is especially critical when a span opening occurs

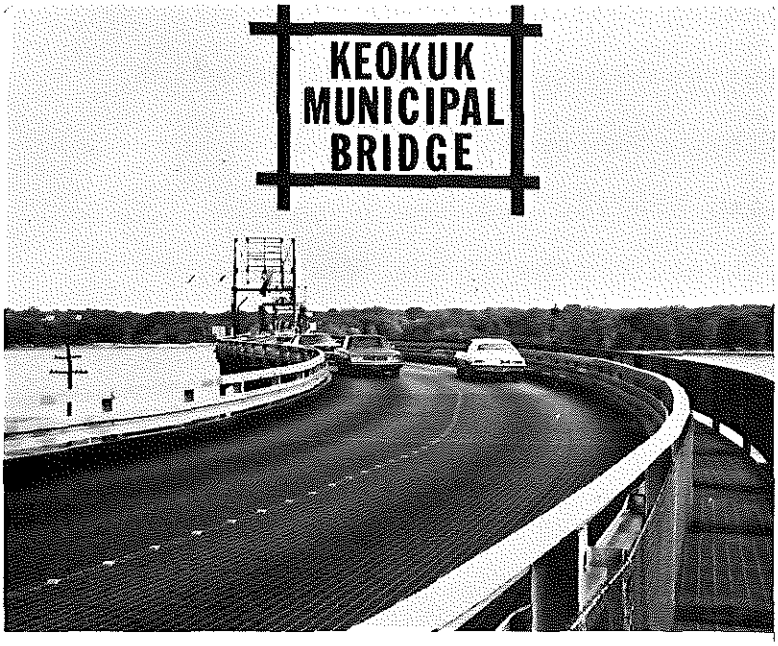
during a rush hour period. Traffic progression breaks down and vehicles begin to back up, sometimes blocking cross street traffic. Even though the bridge may be closed to traffic for less than 15 minutes it takes additional time, as long as 10 minutes, for traffic to get moving again as toll collection on a large number of waiting vehicles delays traffic even more. There are no vehicle interval or "gaps" that normally exist and allow toll collection to proceed without delaying traffic a great deal.

Besides the swing span opening operation which stops all traffic there are other inherent problems with the bridge which adversely affect vehicle capacity. The bridge is barely wide enough for two lane opposing traffic and has a reverse curve alignment which inhibits traffic flow at the west end. The photo, Plate 25 shows the crossing of a wide vehicle during which traffic in the opposite direction had to be stopped for several minutes. Two-way radios were utilized for this crossing. The open grate deck is difficult to drive on and drivers not use to this type of deck have a hard time maintaining the 20 mile speed limit. There is also an uneasyness that the sirens which announce the opening of the swing span and the gates which block the traffic may malfunction offering no protection against driving off the edge of the fixed portion of the bridge into the river. Of course this is not likely to happen as the operator checks the swing span making sure all vehicles are clear before the span opening operation begins. These factors do

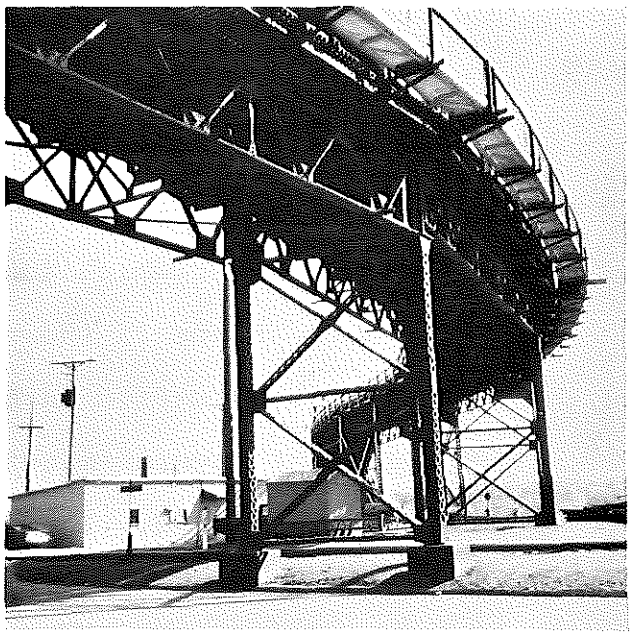


Traffic backed up on Main Street during bridge opening.

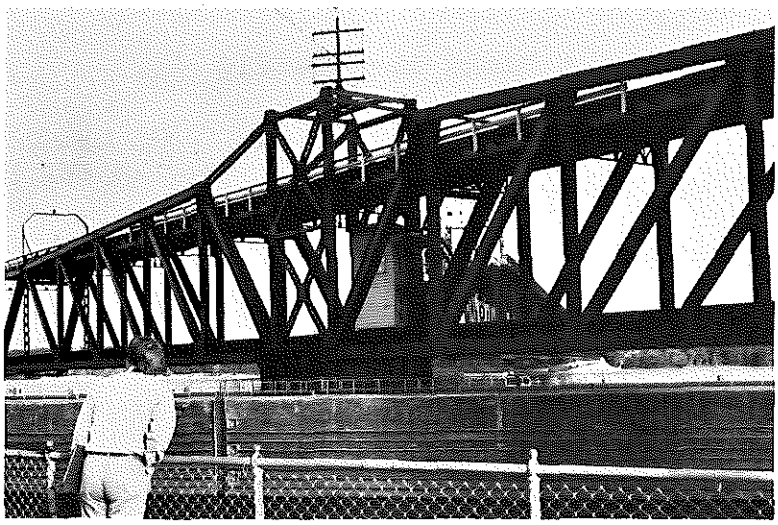
Traffic backed up from Municipal Bridge Tollgate.



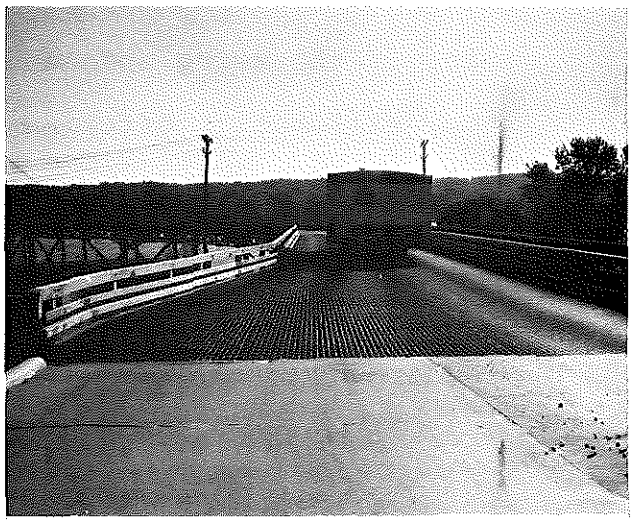
Reverse curve on Bridge at Iowa side.



Reverse curve as viewed from below.



Swing span during opening maneuver.



Wide vehicle crossing the Municipal Bridge.

contribute to lessen vehicle capacity of the bridge. In the last 3 years traffic volumes have been fairly stable at around 6,500 vehicles per day. There is possibly some capacity restraint being built up because of the inadequacies of the present bridge. In other words people have avoided using the bridge and are seeking alternate routes to reach their destination.

The ultimate solution to the Municipal Bridge problem is, of course, bridge replacement with a high clearance structure that meets navigation clearance requirements and would not have to be opened for river traffic. The approach terrain on both sides of the river is very suitable for a high clearance bridge. There are bluffs on each side of the river and traffic has to descend to the present bridge.

Over the past few years there have been studies made and much conversation has taken place concerning a replacement bridge including a detailed study made by private consultants in 1968. The study revealed a replacement bridge was financially feasible and could support a bond issue. The Iowa State Highway Commission felt at that time, however, that the existing bridge was providing a reasonable level of service and a new toll facility could not compete with the existing municipal bridge. The Commission, therefore, rejected the proposal for construction of a new bridge.

Since that time construction costs have risen considerably and a new bridge will be much more expensive than the estimates made in 1968. The Commissioners of the Iowa Department of Transportation are expected to approve an upcoming in-house study which will update the 1968 Toll Bridge report. This update study is expected to be underway in the near future and should give new insight to the bridge replacement feasibility.

The Iowa Department of Transportation employs a rating system which ranks the sufficiency of highway bridges from worst to best on a scale of 0 to 100. The rankings include structural adequacy and safety considerations. The Keokuk Municipal Bridge currently has a bridge structural sufficiency rating of 13 and a safety rating of 20 for a total sufficiency rating of 33. Although still structurally sound the bridge is ranked quite low. Normally smaller bridges are programmed for replacement when the sufficiency rating falls below 50, however, this is not the case in long span river bridges over the Missouri or Mississippi because of the very high cost of replacement. The 1976 five year Construction and Right-of-Way program prepared by the Iowa Department of Transportation does not include any replacement funds for the Keokuk Municipal Bridge.

The passenger car toll for crossing the bridge, by which the bridge generates revenue, is a reasonable 15¢ per trip. This was raised from 10¢ in January 1975 and there was considerable protest to the increase by the using public.

A new toll facility that would be self supporting would undoubtedly have to charge a much higher toll rate in order to retire construction bonds. This may be a factor in determining the type of funding to be sought for bridge replacement. The results of the 1968 toll study up-date will be the latest thinking on a new bridge possibility and a decision on replacement will have to be made by the Iowa Department of Transportation.

There is little that can be done to alleviate traffic conditions at the Iowa approach without replacing the present structure. Considerable congestion is caused by toll collection procedures especially right after a bridge opening or closing cycle because of lack of vehicle gap. A method of prepayment of the toll by regular commuters might speed up traffic flow. This could be accomplished by selling monthly or bi-monthly subscriptions or passage tickets, however, some form of identification would have to be shown to the toll collector as the vehicle passed by the gate. This collection procedure could be done on a trial basis to test its effectiveness. If a noticeable improvement in traffic flow occurs, a permanent subscription system could be implemented.

Another possibility of relieving Main Street congestion would be to seek cooperation from towboat captains that would allow the bridge to remain closed during the rush hour

periods of each day. This would have to be a volunteer action as Federal Law requires that the bridge be opened on demand.

TENTH STREET BRIDGE over Soap Creek.

The 10th Street Bridge (See Plate 26) is an old style structure located at the 10th and Cedar Street Junctions. Tenth Street terminates at the bridge and the street continues to the north on Cedar and then to the west on Missouri Avenue. The present bridge, rebuilt in 1938, is a single span pony truss with a plank floor. The bridge, pictured below, has an eighteen foot clear distance between steel lattice rails, which protect the trusses limiting traffic to a single lane only. Accident records show there have been no serious accidents at the bridge in the past 3 years, however, the bridge is still a potential hazard and should be replaced. Also, 10th Street is expected to be an important east-west collector street as shown on the future primary streets plan. Replacement of the bridge and straightening of the street should be accomplished in the near future even though the primary street system update may be years away. There should be immediate action taken to indicate to motorists that the hazard exists. A standard ONE LANE BRIDGE sign and a turn sign with an advisory speed sign indicating 15 mph should be placed at each approach. A hazard indication such as type 3, 3C-1, marker which has broad, relectorized striping should be installed at the west

Looking East

Looking Southeast

KEOKUK
TENTH STREET BRIDGE
PLATE 26

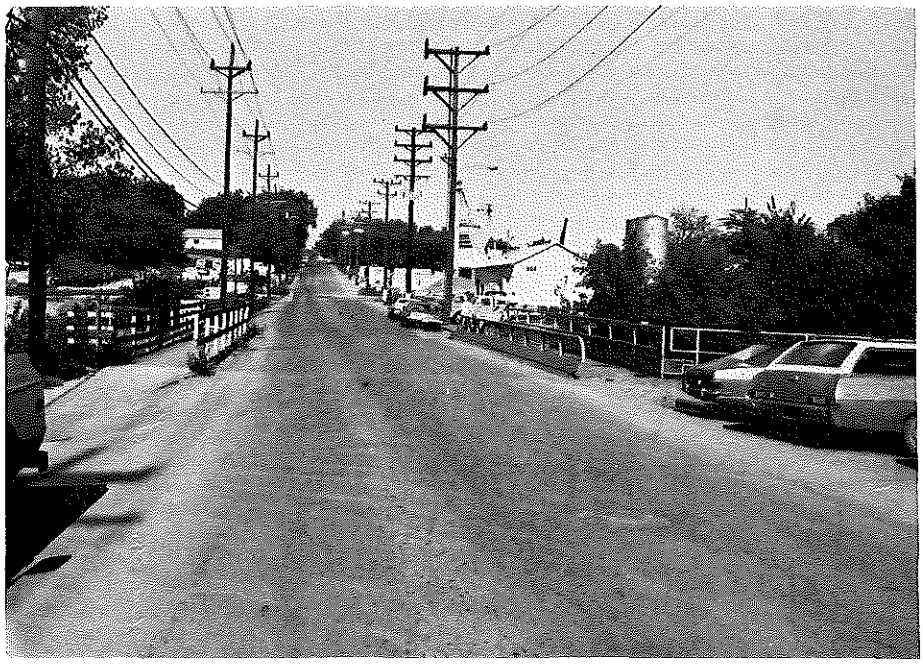
approach to this bridge. The "narrow bridge" signs need replacing also. (See Section on signing)

FIFTH STREET BRIDGE over Soap Creek.

The 5th Street Bridge, located near the Hubinger Company carries considerable vehicle and pedestrian traffic as it is on the main access to a busy commercial area. The bridge, consisting of steel girder and concrete deck construction has a lateral vehicle clearance of 25 feet and pedestrian walkways on each side. Vehicle capacity is limited on the bridge itself and is also limited by the 2 lane approach on 5th Street which allows parallel parking on the east side and 90 degree parking on the west side. The traffic movements generated by the factory entrance are also a major contributor to the congestion in the bridge area. There were 2 reported accidents on the bridge in 1974. In each case, a car hit the pedestrian railing which is on the edge of the travel lane. The only conspicuous safety hazards on the existing bridge are the protruding ends of the pedestrian guardrails but the rails are needed for pedestrian protection. The south railing has a curved end and is less hazardous that the north rail which should be modified in a similar fashion. (See Photo page 77) There are no other traffic safety hazards inherent with the bridge that are not also present in the Fifth Street approaches.

In fact, the bridge with the protected pedestrian walks may be less hazardous than the existing street with the ninety degree parking. One has to back into the driving lane to leave the parking stall. There are also hazardous conflicts resulting from pedestrians walking in the street in this area. In 1970, 5th Street, at this point carried approximately 2,500 vehicles per day. Normally a 2 lane street is capable of handling this much traffic. Because of the local restrictions normal capacity is limited and traffic flow is impeded.

Solution to the congestion and elimination of the safety hazards in this area will be costly. A major construction project including the widening of 5th Street would be required. The bridge should be replaced with a wider structure. Congestion will not be eased without a complete rehabilitation of 5th Street. The entire street contributes to the quality of traffic flow.



(Fifth Street Bridge, looking east.)

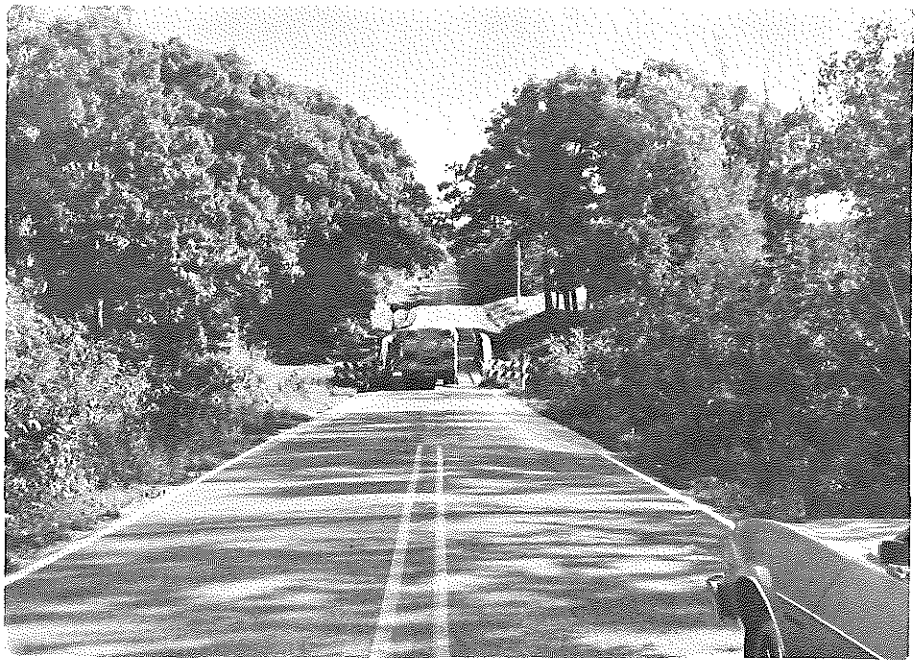
The proposed primary street plan contained in the 1995 comprehensive plan and approved by the City has 5th Street west of Ridge Street listed as an arterial roadway. Although the implementation of the proposed overall street plan is a monumental task and probably won't be realized for many years, there should be a priority system set which would ultimately achieve the long term goal. Bridge replacement is a significant start to the plan. Early construction can save money since inflation is expected to continue and construction costs will be higher in the future.

MIDDLE ROAD BRIDGE at Prices Creek

Middle Road is designated as a major street on the Comprehensive Plan and runs north and south paralleling the Mississippi River in the northeast sector of Keokuk. The road connects the High Street and Plank Road arterial routes to the rural areas north of the City and is the main access to the Keokuk Country Club. Prices Creek is located approximately a mile north of the developed edge of the City and drains nearly 4000 acres of forested territory just inland from the west bank of the Mississippi River.

The present Middle Road Bridge is a pony truss structure with a narrow, one lane roadway with a clear roadway width of 13 feet. The bridge is a safety hazard and is already in the process of being replaced. Several accidents on the site of the existing structure over the past few years have prompted the City to initiate replacement procedings and a new bridge was approved by the Iowa Department of Transportation. Design of the new structure is currently underway and it is anticipated the new bridge can be constructed in 1976.

Because of the imminent replacement of the present bridge there are no specific recommendations other than maintaining the warning signs on the approaches until the new bridge is completed.



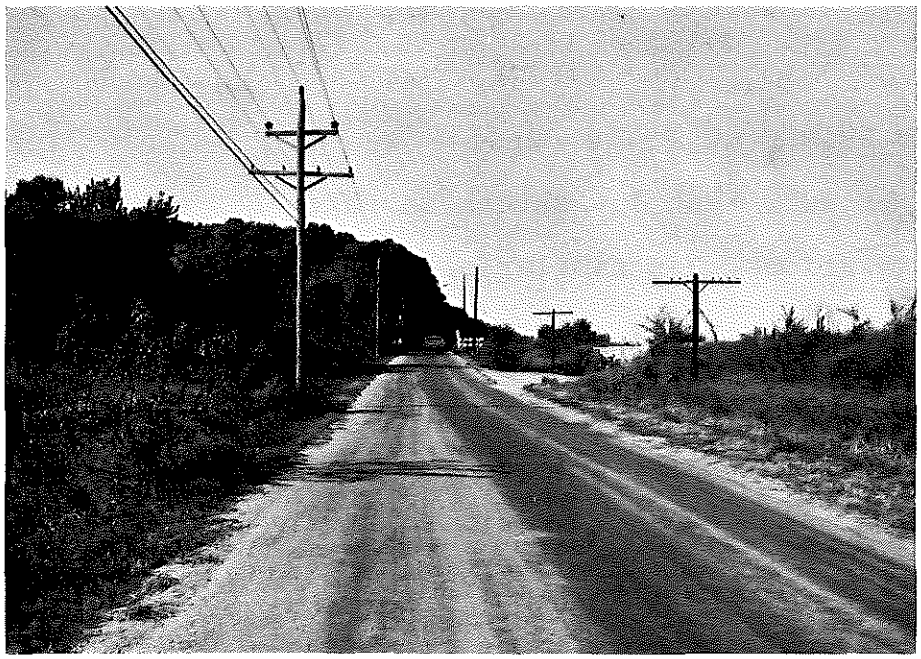
Middle Road Bridge at Prices Creek, looking South.

RIVER ROAD BRIDGE at Prices Creek

This bridge, just downstream on Price's Creek from the Middle Road Bridge, has similar safety deficiencies. Consisting of pony truss construction, the clear roadway is approximately fifteen and one-half feet wide on a two lane approach road. The driving lane width variance between road and bridge is a serious safety hazard.

The water depth under the bridge is controlled by the pool elevation of the dam and at times it is deep enough to inundate a car if it ran off the road. The River Road approaches at the bridge are approximately the same width as the bridge so there is no sudden narrowing as there is on Middle Road, nevertheless, the bridge is quite hazardous and has been the scene of several accidents.

The bridge has high priority on the bridge replacement list and will be replaced when funds are available. In the meantime, there should be new narrow bridge signs installed to alert motorists of the approach hazards and the existing reflective hazard boards should be repaired or replaced. (See Section on signing.)



Looking North

Looking South

KEOKUK
RIVER ROAD BRIDGE
AT PRICES CREEK

PLATE 27

SPEED LIMITS

City officials have requested that an investigation be made into the possibility of modifying the present speed limits on some of the streets within the City. Speed limits are usually determined by the prevailing vehicle speeds, the physical features of the road and accident experience. In 1970, the Traffic Committee for The American Association of State Highway Officials adopted a policy for the establishment of speed zones based on the 85th percentile speed in zones below 50 mph. The percentile speeds are obtained by observing and clocking the prevailing speeds that 85 or 90 percent of the vehicles are travelling regardless of the speed limit.

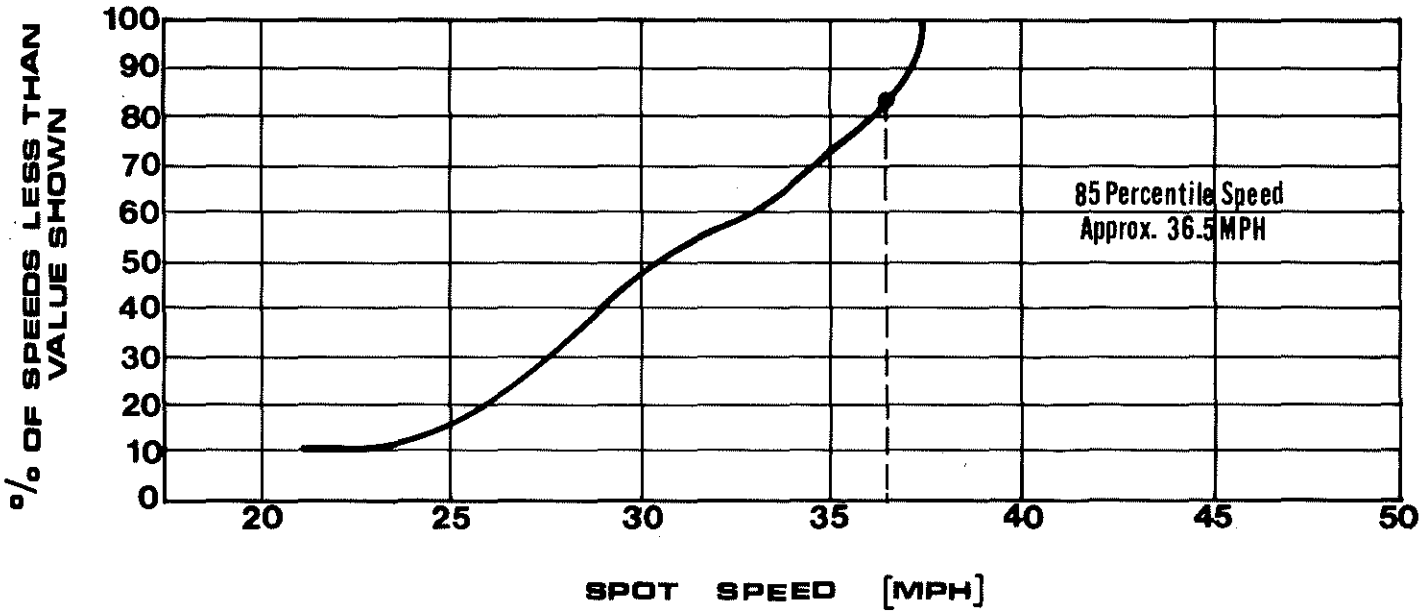
1. Messenger Road

   Messenger Road located at the northern edge of the developed sectors of the City is a key east-west arterial, adjacent to which, development is expected to take place at a rapid rate. The Southeastern Community College has recently relocated to 285 Messenger Road and has been the generator of a considerable amount of new traffic. The speed limit on Messenger Road is currently posted at 45 miles per hour and there has been some discussion about changing the rate. The prevailing speeds on the road were clocked during an average weekday period and were found to be 32.3 miles per hour. Spot speeds of individual vehicles were measured and plotted in the graph below. The 85 percentile speed taken from the graph was 36.5 mph which is 8.5 mph below the current speed limit.

   So far the road has had a low rate of accidents and the physical characteristics consist of long vertical curves and no horizontal curves. There are a considerable number of driveways and these are expected to increase. Weighing these factors it is recommended that the speed limit on Messenger Road be lowered to 35 miles per hour from U.S. 218 to the Middle Road Junction.

CUMULATIVE SPEED DISTRIBUTION

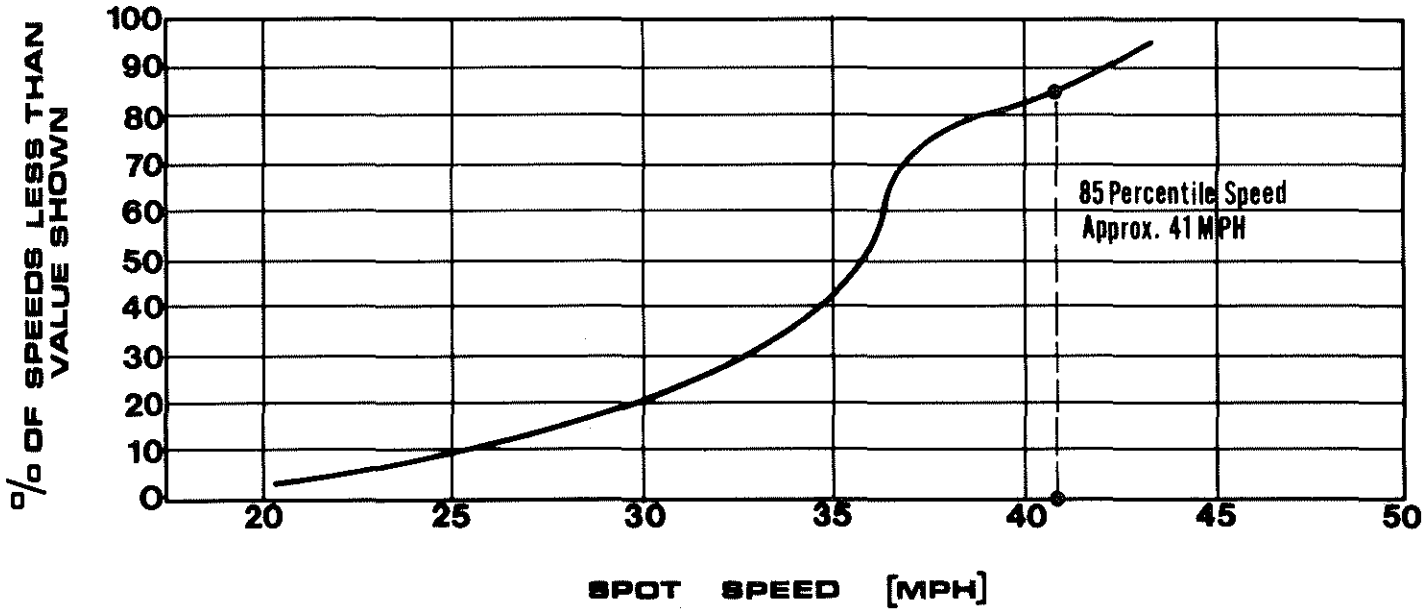
MESSENGER ROAD NEAR THE COMMUNITY COLLEGE



2. Main Street Road north of 16th Street

This sector of Main Street Road carries a high volume of traffic (7000 to 12,000 vehicles per day in 1970) and is practically 100 percent developed from 16th street to Messenger Road. Access is virtually unrestricted and several businesses are the type that generate a lot of drive-in - drive-out traffic. The speed limit changes from 25 mph to 35 mph at 16th Street. The prevailing speed at 22nd and Main was measured on a weekday afternoon and was found to be 36.4 miles per hour. The Keokuk Police also measured the speed rates and found them to average approximately 35 miles per hour. Spot speeds of several individual vehicles were plotted and the 85 percentile speed taken from the graph shown below is 41 mph. There are no horizontal curves and sight distance appears to be adequate. Because of other characteristics of the roadway such as the expanding commercial development and the high rate of accidents at the shopping center entrance at 23rd and Main it is recommended at this time that the speed on this sector of Main Street be retained at 35 miles per hour. In the future, however, as development continues to grow and if accident rates continue to increase a re-evaluation of the sector between 16th and 23rd Streets on Main should be made.

CUMULATIVE SPEED DISTRIBUTION
MAIN STREET ROAD AT 22nd STREET



BLUFF STREET CONNECTION

An inquiry has been made as to the feasibility of vacating a section of Commercial Street between B and E in the vicinity of the Hubinger Company. Bluff Street, between B and D would be reconstructed by paving and widening. A diagonal connection between Bluff and Commercial Streets would be constructed from D to E streets across an existing ravine. This would allow thru traffic to by-pass the busy industrial activity, which involves the access and unloading of grain trucks adjacent to that sector of Commercial Street.

Advantages:

Traffic flow and access will be considerably improved with the implementation of this project because of less conflict with the plant's trucking operations. The elimination of congestion will also lower the accident potential of the area.

Disadvantages:

Additional traffic will be diverted to Bluff Street and eight residences will be affected by the heavier traffic volume. A steep grade of approximately 10% depending on actual field measurements will be required for the connection.

Recommendations:

It is believed that this project will benefit the community as a whole and the advantages outweight the disadvantages. Although traffic will be diverted closer to the eight residences, traffic on this street will not include factory traffic and should be relatively light. The steep grade of the connection is not inconsistent with other streets in the area. It is recommended that the diagonal connection be lengthened as much as possible to flatten the grade and the alignment be set far enough to the north to avoid the railroad switching tracks into the factory. Appropriate control signs should be placed at all intersections.

RECOMMENDED IMPROVEMENTS AND COST ESTIMATES

Estimated costs of the recommended improvements are summarized in this section. Cost of items that can be accomplished with the city work staff or those that would be included in the normal maintenance programs have not been included. Items of minor cost have also been omitted.

Traffic signalization adjustment.

This can be accomplished by the City's engineering staff and no specific costs have been determined. The existing signal system can be modified to increase the cycle time by adjusting of the existing controllers. Some additional contacts for the controller timers will be required and can be purchased at a nominal cost.

Bridges

Fifth Street bridge - modify ends of north handrail similar to south end, lump sum.		$ 600.00
Prices Creek Bridge - River Road hazard markers, lump sum.		$ 200.00
10th Street Bridge		
Advisory speed limit signs 2 @ $30.00	=	$ 60.00
Hazard marker Boards 1 @ $60.00	=	60.00
Narrow Bridge Sign 2 @ $45.00	=	90.00
Keokuk Municipal Bridge		
Drawbridge ahead sign with flashing becon and toll house interconnect.	L.S.	700.00
Total Bridge Work		$ 1,710.00

Traffic Signing

Several new signs are needed and are specifically listed in the section on traffic signing. The signs are generally installed by the city staff so installation costs are not included.

Type of Sign	Number	Unit Cost*	Estimated Cost
Stop	47	$ 30.00	$ 1,410.00
Yield	30	30.00	900.00
School Advance	18	35.00	630.00
School Crossing	18	35.00	630.00
Speed Limit	5	30.00	150.00
Railroad Crossbuck	5	30.00	600.00
One-way	8	20.00	160.00
Slow Children	6	20.00	120.00
Slow, Children at Play	6	20.00	120.00
Signal Ahead	1	60.00	60.00
No Left Turn (2 signs)	1	45.00	45.00
		TOTAL	$ 4,825.00

* Installed by City Staff.

Sidewalks

A minimum of 4490 square feet of sidewalk is needed at an estimated cost of $22,450.

One-way Streets

It has been recommended that several modifications be made to Blondeau and Concert Streets to improve traffic flow. The estimated cost of these modifications are tabulated below:

Resurface to remove valley gutters 4 intersections @ $8,000 =	$ 32,000.00
Replace 4-way stop intersections with pedestrian and vehicle actuated signals 2 intersections @ $30,000 =	60,000.00
Replace pre-timed school signal warning lights with pedestrian and vehicle actuated signal lights 2 intersections @ $30,000 =	60,000.00
Lane line marking	1,600.00
Total	$153,600.00

Intersection Improvements

1. Shopping Center entrance at 23rd and Main Streets.

Construct 12 ft. right turn lane 100 ft. with 60 foot taper.	$ 5,800.00
Signalization lump sum	$32,000.00
Lane painting lump sum	$ 220.00
Total	$38,020.00

2. Belknap Boulevard, Main Street Road, Boulevard Road

Boulevard Road Connection Grading, Paving and Drainage, lump sum	$55,000.00
Modification of signals at factory entrance to 4-way lump sum	$20,000.00
One-way signs 2 @ $20.00 =	40.00
Do not Enter Signs 1 @ $50.00 =	50.00
Modify Ball Diamond Lump Sum	$10,000.00
Total	$85,090.00 (exc. R.O.W.)

Plank Road and Middle Road

Plan A

Convert to One-way pair

900 linear feet of barrier curb	$ 3,600.00
Do not Enter Sign 1 @ $50.00	50.00
One-Way Signs 8 @ $20.00	160.00
Lane line marking	720.00
	$ 4,530.00

Plan B

Pave connection from Middle Road to Plank Road lump sum	$ 6,000.00
520 linear feet of barrier curb	2,080.00
Stop Sign 1 @ $30.00	30.00
Directional Sign 1 @ $40.00	40.00
Total	$ 8,150.00

Plan C

Pave connection from Plank Road to Middle Road, lump sum	$ 6,000.00
480 linear feet of barrier curb	1,920.00
Stop Sign 1 @ $30.00	30.00
Directional Sign 1 @ $40.00	40.00
	$ 7,990.00

Diagonal connection between Messenger Road and Main Street Road.

Grading, paving and drainage, lump sum	$14,000.00
800 linear feet curb and gutter	$ 4,800.00
Total	$18,800.00

PRIORITY AND STAGING OF RECOMMENDED IMPROVEMENTS

A priority order of tasks to be accomplished has been prepared and is tabulated below. The listed items were based on relative cost and the level of benefit to the safety and traffic flow improvement program.

1. Renew efforts for replacement of Municipal Bridge.

2. Enlarge pavement marking program as discussed.
   Additional Annual Cost = $360.00

3. Begin sign replacement program following priorities outlined on page 27.
   Sign Cost = $4,825.00

4. Complete installation and repair of Bridge signing and construction work. Cost = $1,110.00

5. Construct right turn lane and signal system at the shopping center entrance, 23rd and Main Streets.
   Cost = $38,020.00

6. Adjust Main Street signalization system to 70 second cycle on trial basis. Cost minimal.

7. Modify north handrail on 5th Street Bridge.
   Cost = $600.00

8. Begin sidewalk construction program on city property with top priority in areas of highest pedestrian traffic. Cost = $22,450.00

9. Modify Plank Road, Middle Road connection according to Plan "B". Cost = $8,150.00

10. Modify Belknap Boulevard, Main Street Road, Boulevard Road intersection. Cost = $85,090.00 (exc. R.O.W.)

11. Construct diagonal connection between Messenger Road and Main Street Road. Cost = $18,800.00

12. Connect Bluff Street to Commercial Boulevard.
    Cost to be determined upon completion of engineering plan.

FUNDING

Funding for the work recommended in this report may be obtained from sources such as the Federal Aid Safety Programs, revenue sharing, general obligation bonds and Road Use Tax allocated to cities. The Federal Aid Safety programs that are available are listed as follows:

1. Pavement Marking Demonstration Program (23 USC 151)
2. Safer Roads Demonstration Program (23 USC 405)
3. Federal-aid Urban Funds (FAUS)

A finance report from all sources for street purposes during the period from January 1, 1974 through June 30, 1975 had been previously prepared by the City and is included in this section. During the eighteen month period receipts exceeded expenditures by $146,199.00.

A total of $32,775.00 was spent for maintenance of traffic services with no funds being used for construction or reconstruction of traffic facilities. The parking funds available for the same period totaled $60,535.00 of which $40,606.00 was used for maintenance and parking operations. The parking lot fund balance as of June 30, 1975 was $12,950.00.

The estimated budget for the current fiscal year (July 1, 1975 to June 30, 1976) has $49,000.00 allocated for street light expansion and $1,360.00 for the purchase of a paint striper. Other street funds are allocated for maintenance, supplies and snow removal.

STREET RECEIPTS JANUARY 1, 1975 JUNE 30, 1975	ROAD USE TAX FUND ONLY	STREET FUND ACCOUNT	OTHER FUNDS	TOTALS
Ending Balance Last Financial Report	$88,264.00	$ 24,876.00	$173,919.00	$ 60,779.00
ACTUAL RECEIPTS				
Road Use Tax	452.216.00			452,216.00
Property Taxes		39,633.00	361,289.00	400,922.00
Special Assessments			47,990.00	47,990.00
Misc. (Itemize on Next Page)		122,191.00	184,663.00	306,854.00
Proceeds From Bonds Sold			156,173.00	156,173.00
Interest Earned				
TOTAL RECEIPTS	452,216.00	161,824.00	750,115.00	1364,155.00
TOTAL FUNDS AVAILABLE	540,480.00	186,700.00	576,196.00	1303,376.00
LESS TOTAL EXPENDITURES	-437,012.00	- 136,993.00	-583,172.00	-1157,177.00
BALANCE June 30, 1975	103,468.00	49,707.00	6,976.00cr	146,199.00

ACTUAL EXPENDITURES	ROAD USE TAX FUND ONLY	STREET FUND ACCOUNTS	OTHER FUNDS	TOTALS
MAINTENANCE				
ROADWAY MAINTENANCE	$327,146.00	$ 35,368.00		$ 362,514.00
SNOW AND ICE REMOVAL	26,371.00			26,371.00
STORM SEWERS	3,300.00		62,658.00	65,958.00
TRAFFIC SERVICES		2,232.00	30,543.00	32,775.00
STREET CLEANING	18,802.00			18,802.00
CONSTRUCTION OR RECONSTRUCTION				
ENGINEERING			8,050.00	8,050.00
RIGHT OF WAY PURCHASED			44,605.00	44,605.00
ROADWAY CONSTRUCTION			144,271.00	144,271.00
STORM SEWERS				
TRAFFIC SERVICES				
SIDEWALKS				
ADMINISTRATION			6,000.00	6,000.00
STREET LIGHTING			71,286.00	71,286.00
TREES		17,929.00		17,929.00
EQUIPMENT PURCHASED	680.00	81,464.00		82,144.00
MISC.			91.00	91.00
BONDS AND INTEREST PAID				
PAID ON BONDS RETIRED	50,000.00		148,000.00	198,000.00
INTEREST PAID ON BONDS	10,713.00		67,668.00	78,381.00
TOTAL EXPENDITURES JANUARY 1, 1975 JUNE 30, 1975	437,012.00	136,993.00	583,172.00	1157,177.00

The bonded indebtedness of the City of Keokuk is summarized in the table below. The figures are current as of December 31, 1975.

TYPE		TOTALS (outstanding)
General Obligation Bonds		
Street	1956	$ 10,000.00
	1958	21,000.00
	1966	70,000.00
	1967	195,000.00
	1969	50,000.00
	1972	280,000.00
Sewer	1962	25,000.00
	1971	450,000.00
G.O. Funding		200,000.00
		$1,301,000.00
REVENUE BONDS		
Water	1971	$ 440,000.00
Sewer		800,000.00
SPECIAL ASSESSMENT BONDS		
	1974	$ 138,000.00

DEBT LIMIT, CITY OF KEOKUK 1975

OUTSTANDING GENERAL OBLIGATION BONDS	VALUATIONS OF CITY PROPERTY INCLUDING MONIES AND CREDITS 27%
1,301,000.00	36,674, 473.00
TOTAL PROPERTY VALUATION 100%	**MAXIMUM DEBT LIMIT 5% OF TOTAL PROPERTY VALUATION**
135,831,383.00	6,791,569.00
TOTAL ADDITIONAL DOLLAR AMOUNT CITY CAN SUPPORT & STAY WITHIN LEGAL LIMIT	**% OF OUTSTANDING DEBT TO MAXIMUM ALLOWABLE BY LAW**
5,490,569.00	19.16%

The financial data and discussion have been provided as general information for the Keokuk City Officials. Such information has been offered to give city officials a brief summary of the City's financial position and not as recommendations regarding funding.

KEOKUK TRAFFIC SAFETY STUDY

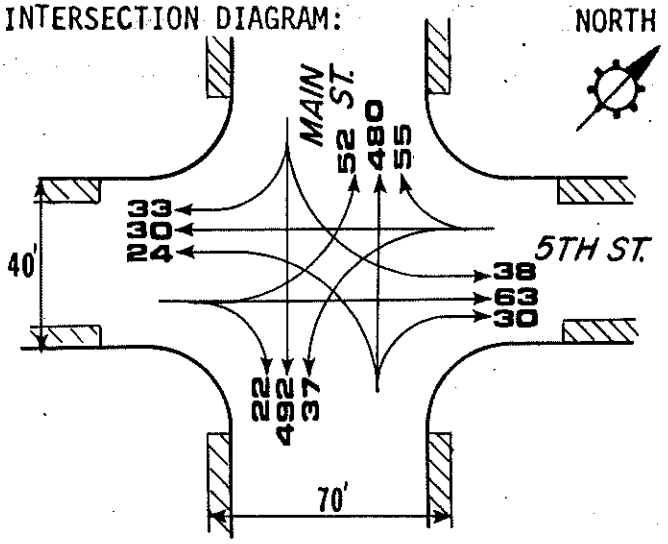
APPENDIX

INTERSECTION CAPACITY WORKSHEET

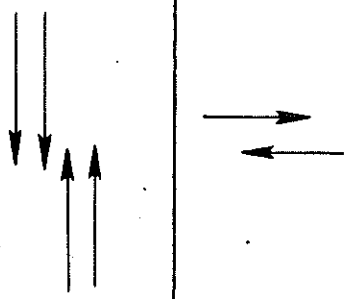
KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS

INTERSECTION: U.S. 218 Main Street & 5th Street — BY RLH — DATE: 11/5/75

INTERSECTION DIAGRAM:



SIGNAL PHASING (Cycle Length 60)



	PHASE 1	PHASE 2	PHASE	PHASE
Green Time	30 + 3 = 33	24 + 3 = 27		
G/C	0.55	0.45		

1975 DHV

GENERAL CONDITIONS:

Metro Area Population 15,000 — Type of Area CBD

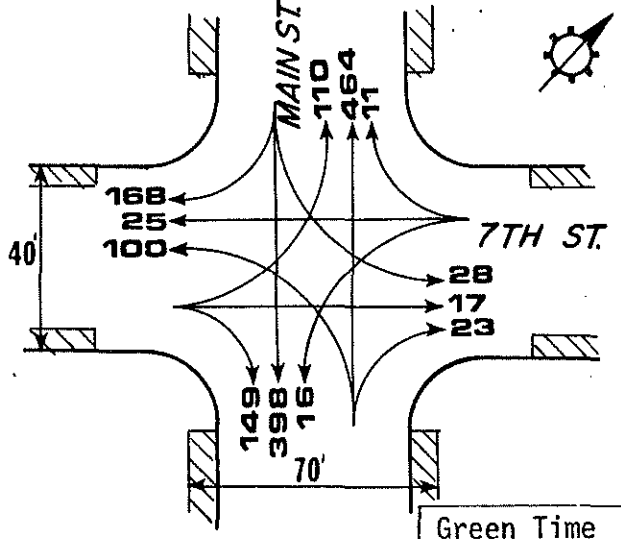
SPECIFIC CONDITIONS:						
Street	Main	5th Str.				
One- or Two Way	Two	Two				
Parking Condition	Parking	Parking				
Direction	S.B.	E.B.				
Movement	All	All				
Volume	563	137				
Peak Hour Factor	0.77	0.77				
Width (Approach)(Exit)	35'	20'				
Trucks (No.) (%)	3	3				
Right Turns (No.) (%)	6	16				
Left Turns (No.) (%)	7	38				
Local Buses (No. and Stops)	None	None				
Level of Service	(A)	(A)				
ANALYSIS:						
Charts/Tables Used	5	5				
WA	35'	20'				
T	3	3				
R	6	16				
L	7	38				
MP	0.85	0.85				
G/C	0.55	0.45				
CSV_C	880	400				
fB	1.0	1.0				
ASVA	783	380				
fLS						
ASV						
	LT.&RT. Turns OK	LT.&RT. Turns OK				

INTERSECTION CAPACITY WORKSHEET

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS

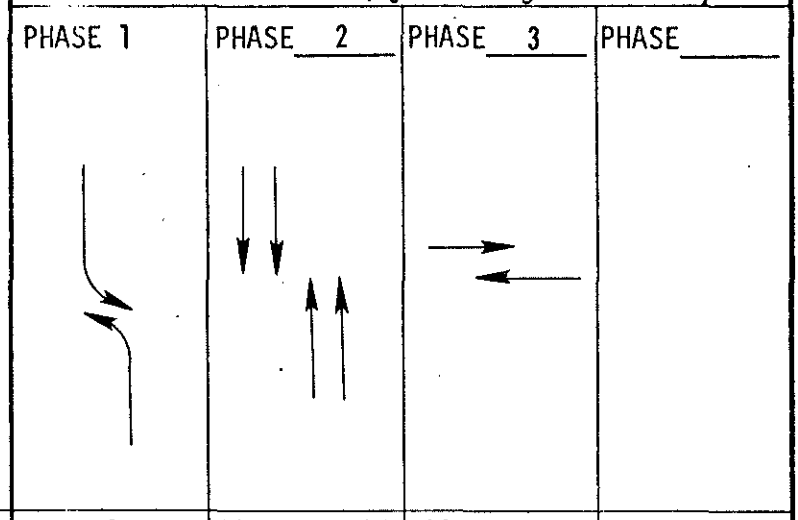
INTERSECTION: U.S. 218 Main Street & 7th Street — BY RLH — DATE: 11/5/75

INTERSECTION DIAGRAM: NORTH



1975 DHV

SIGNAL PHASING (Cycle Length 60)



Green Time	8	24 + 3 = 27	22 + 3 = 25	
G/C	.13	.45	.42	

GENERAL CONDITIONS:

Metro Area Population 15,000 — Type of Area CBD

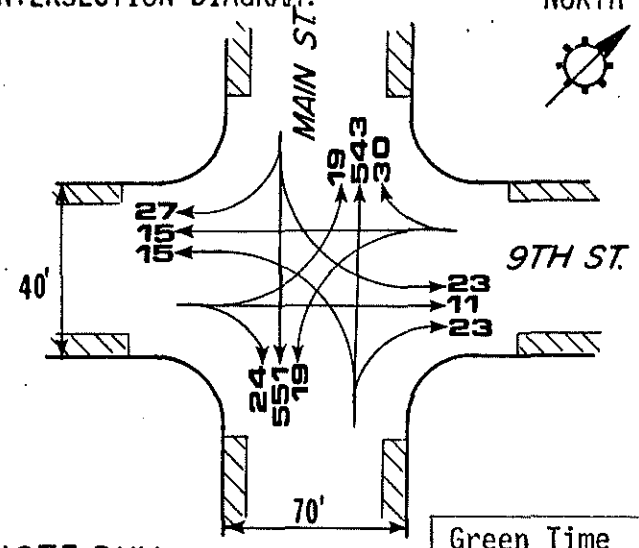
SPECIFIC CONDITIONS:						
Street	Main	7th Str.				
One- or Two Way	Two	Two				
Parking Condition	Parking	Parking				
Direction	N.B.	E.B.				
Movement	All	All				
Volume	587	276				
Peak Hour Factor	0.77	0.77				
Width (Approach)(Exit)	35'	20'				
Trucks (No.) (%)	3	3				
Right Turns (No.) (%)	4	40				
Left Turns (No.) (%)	17	54				
Local Buses (No. and Stops)	None	None				
Level of Service	(A)	(B)				
ANALYSIS:						
Charts/Tables Used	5	5				
WA	35'	20'				
T	3	3				
R	4	40				
L	17	54				
MP	0.85	0.85				
G/C	0.45	0.42				
CSVC	665	285				
f_{BA}	1.0	1.0				
ASVA	590					
f_{LSB}		.97				
ASVB		276				
	LT.&RT.OK	LT.&RT.OK				

INTERSECTION CAPACITY WORKSHEET

KIRKHAM, MICHAEL AND ASSOCIATES — ARCHITECTS ENGINEERS PLANNERS

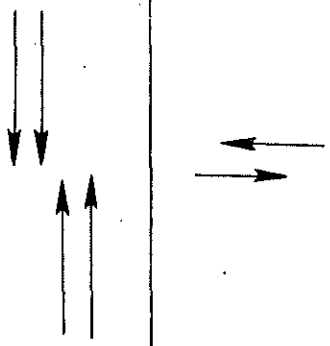
INTERSECTION: U.S. 218, Main Street & 9th Street BY RLH DATE: 11/7/75

INTERSECTION DIAGRAM:



1975 DHV

SIGNAL PHASING (Cycle Length 60)



	PHASE 1	PHASE 2	PHASE	PHASE
Green Time	30 + 3 = 33	24 + 3 = 27		
G/C	.55	.45		

GENERAL CONDITIONS:

Metro Area Population 15,000 Type of Area CBD

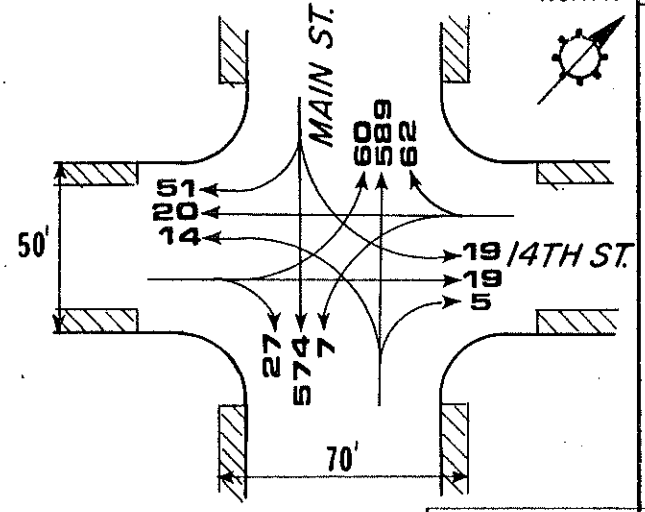
SPECIFIC CONDITIONS:						
Street	Main	9th Str.				
One- or Two Way	Two	Two				
Parking Condition	Parking	Parking				
Direction	S.B.	W.B.				
Movement	All	All				
Volume	601	64				
Peak Hour Factor	0.77	0.77				
Width (Approach)(Exit)	35'	20'				
Trucks (No.) (%)	3	3				
Right Turns (No.) (%)	5	47				
Left Turns (No.) (%)	4	30				
Local Buses (No. and Stops)	None	None				
Level of Service	(A)	(A)				
ANALYSIS:						
Charts/Tables Used						
WA	35'	20'				
T	3	3				
R	5	47				
L	4	30				
MP	0.85	0.85				
G/C	0.55	0.45				
CSVC	920	300				
f_{BA}	1.0	1.0				
ASVA	818	285				
f_{LS}						
ASV						
	LT.&RT.OK	LT.&RT.OK				

INTERSECTION CAPACITY WORKSHEET

KIRKHAM, MICHAEL AND ASSOCIATES
ARCHITECTS ENGINEERS PLANNERS

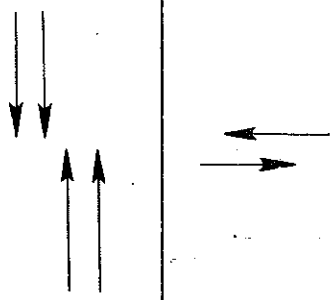
INTERSECTION: U.S. 218, Main Street & 14th Street BY RLH DATE: 11/5/75

INTERSECTION DIAGRAM:



1975 DHV

SIGNAL PHASING (Cycle Length 60)



	PHASE 1	PHASE 2	PHASE	PHASE
Green Time	30 + 3 =33	24 + 3 = 27		
G/C	0.55	0.45		

GENERAL CONDITIONS:

Metro Area Population 15,000 Type of Area CBD

SPECIFIC CONDITIONS:						
Street	Main	14th Str.				
One- or Two Way	Two	Two				
Parking Condition	Parking	Parking				
Direction	S.B.	E.B.				
Movement	All	All				
Volume	644	106				
Peak Hour Factor	0.77	0.77				
Width (Approach)(Exit)	35'	25'				
Trucks (No.) (%)	2	1				
Right Turns (No.) (%)	3	25				
Left Turns (No.) (%)	8	57				
Local Buses (No. and Stops)	None	None				
Level of Service	(A)	(A)				
ANALYSIS:						
Charts/Tables Used	5	5				
WA	35	25				
T	2	1				
R	3	25				
L	8	57				
MP	0.85	0.85				
G/C	0.55	0.45				
CSVC	900	400				
f_{BA}	1.0	1.0				
ASVA	801	372				
f_{LS}						
ASV						

1069:1171RV:173RP:873RP

3441

KEOKUK MUNICIPAL BRDIGE

* CLOSING TIME THURSDAY, MARCH 28, 1974 - MONDAY, APRIL 15, 1974

DATE	DRAW GATE DOWN	DRAW GATE UP	Traffic Delay Minutes
3/28/74	1:11 A.M.	1:20 A.M.	9
	2:50 A.M.	2:57 A.M.	7
	4:34 A.M.	4:46 A.M.	12
	1:35 P.M.	1:46 P.M.	11
	8:40 P.M.	8:55 P.M.	15
3/29/74	NONE		
3/30/74	11:50 A.M.	12:20 A.M.	30
	2:13 A.M.	2:23 A.M.	10
	3:37 A.M.	4:00 A.M.	23
	5:10 A.M.	5:25 A.M.	15
	2:44 P.M.	2:53 P.M.	9
	6:25 P.M.	6:34 P.M.	9
	7:42 P.M.	7:56 P.M.	14
	8:58 P.M.	9.09 P.M.	11
	10:04 P.M.	10:27 P.M.	23
3/31/74	12:25 P.M.	12:35 P.M.	10
	1:27 P.M.	1:37 P.M.	10
	1:42 P.M.	1:57 P.M.	15
	3:13 P.M.	3:45 P.M.	32
	3:56 P.M.	4:04 P.M.	8
	4:41 P.M.	4:50 P.M.	9
	6:45 P.M.	6:52 P.M.	7
	8:22 P.M.	8:30 P.M.	8
	10:37 P.M.	10:57 P.M.	20
	12:42 A.M.	12:55 A.M.	13
	5:35 A.M.	5:49 A.M.	14
	9:59 A.M.	10:09 A.M.	10
4/1/74	12:10 A.M.	1:05 A.M.	55
	2:00 A.M.	2:19 A.M.	19
	4:01 A.M.	4:12 A.M.	11
	6:24 A.M.	6:33 A.M.	9
	8:48 A.M.	8:57 A.M.	9
	1:10 P.M.	1:21 P.M.	11
	6:02 P.M.	6:13 P.M.	11
	11:00 P.M.	11:15 P.M.	15
4/2/74	5:41 A.M.	6:03 A.M.	22
	8:02 A.M.	8:08 A.M.	6
	9:51 A.M.	10:05 A.M.	14
	11:43 A.M.	11:54 A.M.	11

* Furnished by the Municipal Bridge Commission.

DATE	DRAW GATE DOWN	DRAW GATE UP	Traffic Delay Minutes
4/2/74	12:35 P.M.	12:44 P.M.	9
	1:00 P.M.	1:21 P.M.	21
	2:30 P.M.	2:37 P.M.	7
	6:58 P.M.	7:04 P.M.	6
	11:16 P.M.	11:45 P.M.	29
4/3/74	1:42 A.M.	1:57 A.M.	15
	2:10 A.M.	2:28 A.M.	18
	6:22 A.M.	6:29 A.M.	7
	9:34 A.M.	9:41 A.M.	7
	10:43 A.M.	10:52 A.M.	9
	12:34 P.M.	12:41 P.M.	7
	6:47 P.M.	6:57 P.M.	10
	7:43 P.M.	7:53 P.M.	10
	9:17 P.M.	9:27 P.M.	10
4/4/74	12:28 A.M.	12:47 A.M.	19
	4:18 A.M.	4:33 A.M.	15
	10:16 A.M.	10:31 A.M.	15
	11:54 P.M.	12:06 P.M.	12
	12:30 P.M.	12:41 P.M.	11
	1:26 P.M.	1:36 P.M.	10
	5:06 P.M.	5:24 P.M.	18
	6:12 P.M.	6:22 P.M.	10
	9:44 P.M.	9:53 P.M.	9
	11:15 P.M.	11:25 P.M.	10
4/5/74	12:46 A.M.	1:00 A.M.	14
	5:36 A.M.	5:48 A.M.	12
	8:49 A.M.	8:58 A.M.	9
	10:04 A.M.	10:10 A.M.	6
	2:54 P.M.	3:05 P.M.	11
	9:16 P.M.	9:31 P.M.	15
	10:12 P.M.	10:27 P.M.	15
4/6/74	3:04 A.M.	3:15 A.M.	11
	5:47 A.M.	5:58 A.M.	11
	3:40 P.M.	3:50 P.M.	10
	4:33 P.M.	4:46 P.M.	13
	5:40 P.M.	5:55 P.M.	15
4/7/74	1:10 A.M.	1:24 A.M.	14
	2:03 A.M.	2:16 A.M.	13
	2:20 A.M.	2:44 A.M.	24
	3:51 A.M.	3:59 A.M.	8
	8:25 A.M.	8:37 A.M.	12
	9:14 A.M.	9:24 A.M.	10
	2:10 P.M.	2:23 P.M.	13
	3:34 P.M.	3:43 P.M.	9

DATE	DRAW GATE DOWN	DRAW GATE UP	Traffic Delay Minutes
4/8/74	7:59 A.M.	8:10 A.M.	11
	8:58 A.M.	9:10 A.M.	12
	9:29 A.M.	9:59 A.M.	30
	4:28 P.M.	4:38 P.M.	10
	7:12 P.M.	7:19 P.M.	7
	8:37 P.M.	8:46 P.M.	9
	8:58 P.M.	9:07 P.M.	9
4/9/74	4:49 A.M.	5:00 A.M.	11
	7:20 A.M.	7:32 A.M.	12
	8:08 A.M.	8:28 A.M.	20
	1:45 P.M.	1:58 P.M.	13
	2:14 P.M.	3:26 P.M.	72
	4:13 P.M.	4:26 P.M.	13
	6:16 P.M.	6:30 P.M.	14
4/10/74	12:14 A.M.	12:27 A.M.	13
	2:59 A.M.	3:11 A.M.	12
	4:05 A.M.	4:30 A.M.	25
	7:30 A.M.	7:48 A.M.	18
	10:34 A.M.	10:48 A.M.	14
	11:21 A.M.	11:32 A.M.	11
	12:12 P.M.	12:24 P.M.	12
	4:09 P.M.	4:19 P.M.	10
	5:17 P.M.	5:28 P.M.	11
	5:45 P.M.	6:05 P.M.	40
	9:36 P.M.	9:46 P.M.	10
	10:38 P.M.	10:58 P.M.	20
4/11/74	12:45 A.M.	12:58 A.M.	13
	5:30 A.M.	5:51 A.M.	21
	4:35 P.M.	5:02 P.M.	27
	6:37 P.M.	6:51 P.M.	14
	9:21 P.M.	9:31 P.M.	10
4/12/74	4:30 A.M.	5:07 A.M.	37
	5:50 A.M.	6:03 A.M.	13
	7:34 A.M.	7:46 A.M.	12
	8:36 A.M.	8:51 A.M.	15
	9:40 A.M.	10:06 A.M.	26
	12:17 P.M.	12:26 P.M.	9
	3:58 P.M.	4:19 P.M.	21
	11:15 P.M.	11:25 P.M.	10
	11:34 P.M.	11:53 P.M.	19
4/13/74	7:10 A.M.	7:22 A.M.	12
	9:42 A.M.	9:56 A.M.	14
	5:39 P.M.	6:02 P.M.	23
	6:41 P.M.	6:52 P.M.	11
	8:13 P.M.	8:27 P.M.	14
	10:31 P.M.	10:50 P.M.	19
	11:32 P.M.	11:58 P.M.	26

DATE	DRAW GATE DOWN	DRAW GATE UP	Traffic Delay Minutes
4/14/74	7:20 A.M.	7:35 A.M.	15
	9:11 A.M.	9:32 A.M.	21
	2:43 P.M.	2:53 P.M.	10
	10:04 P.M.	10:14 P.M.	10
	10:23 P.M.	10:38 P.M.	15
	11:33 P.M.	11:41 P.M.	8
4/15/74	3:12 A.M.	3:38 A.M.	26
	4:20 A.M.	4:29 A.M.	9
	6:54 A.M.	7:03 A.M.	9
	7:46 A.M.	8:00 A.M.	14
	8:09 A.M.	8:19 A.M.	10
	9:08 A.M.	9:14 A.M.	6
	10:59 A.M.	11:14 A.M.	15
	11:50 P.M.	12:08 P.M.	18
	12:44 P.M.	12:55 P.M.	11
	3:00 P.M.	3:15 P.M.	15
	4:25 P.M.	4:38 P.M.	13
	4:51 P.M.	5:11 P.M.	40
	8:01 P.M.	8:14 P.M.	13

Average Delay Time = 14.7 min.

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