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# CITY OF DES MOINES STREET SYSTEM STUDY

Prepared for
THE CITY OF DES MOINES



Prepared by
JACK E. LEISCH & ASSOCIATES

September 1989

# CITY OF DES MOINES

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1890 N. Maple Avenue, Suite 200
Evanston, Illinois 60201

September 1989

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## Executive Summary

The Iowa Department of Transportation (IaDOT) has undertaken a major, planning effort to identify long-term system needs for I-235 in Des Moines, Iowa. A consulting team headed by Jack E. Leisch & Associates (JEL) conducted a two-year study of the freeway from 1987 through early 1989.

As the study progressed, it became apparent that improvements to the freeway could have many potential impacts on the Des Moines street system. Also, development plans for the Des Moines CBD continued to surface, raising questions regarding local street traffic problems and impacts.

In the Spring of 1988, the city of Des Moines contracted with Jack E. Leisch & Associates to perform a parallel study of street system needs and impacts. This study, reported here, focused on problems and solutions associated with reconstruction of I-235, long-term growth in the CBD, and other major changes in the transportation network.

The following are significant findings of the study.

### Traffic forecasts

Population, and employment growth forecasets prepared by the DesMoines Area Transportation Planning Committee (DMATPC) would produce an increase in traffic by about 20 percent east and west of the central area, and over 40 percent within the central area. An analysis of travel patterns implied by this "year 2010" forecast shows that:

(1) Essentially all growth in travel demand east of the river and west of the Harding Road/Loop Arterial corridor is associated with I-235. If this demand is accommodated on the freeway, relatively stable traffic volumes should ensue in the residential areas of Des Moines.

(2) The loop arterial and associated land use development will significantly change travel patterns to the central area. Fully 33 percent of CBD-oriented traffic will approach from the south, with another 28 percent from the west.

(5) Traffic signals in the CBD core should be retimed as volumes and patterns evolve. Analyses of network traffic show significant potential for improved flow by retiming of signals.

(6) The intersection of Keo Way and 12th Street should be reconstructed to accommodate the relocation of 12th Street freeway ramps to Keo Way.

Implications of Freeway and Arterial Improvements

Street system improvement needs are closely tied to both freeway reconstruction and land use policy in the region. This study indicates that relatively modest, low impact improvements would be required outside the CBD to accommodate fairly substantial growth in traffic implied by the year 2010 forecasts. Even within the CBD, street system improvements are generally limited to minor intersection reconstruction, restriping, signal system improvements and alteration of one-way street patterns. These low cost, low impact solutions are contingent on the IaDOT's implementation of their long-range plan. Traffic growth is generally associated with longer distance trips which would use the freeway if sufficient capacity were provided.

If I-235 is not improved but development continues to occur within the city and the metropolitan area, substantial adverse traffic and other impacts would occur. Substitution of arterial street capacity for freeway capacity would mean widening east-west streets such as University, Grand, Ingersoll; and improving many intersections.

# I. INTRODUCTION

In the spring of 1987, the Iowa Department of Transportation initiated a comprehensive planning study of the problems and needs associated with Interstate Highway 235, which passes through the City of Des Moines. This study, completed during 1989, was performed by a consulting team headed by Jack E. Leisch & Associates.

As the study evolved, and findings in initial stages were presented, it was apparent that the problems and needs associated with the freeway would have significant impact on the Des Moines street system. Issues concerning the amount and pattern of freeway traffic, how it accesses and egresses the freeway, and how potential freeway improvements relate to the street system, all became issues of local concern.

In addition, plans for downtown redevelopment continued. As new office and other CBD developments were proposed, concerns were raised regarding their traffic impacts on the local street system.

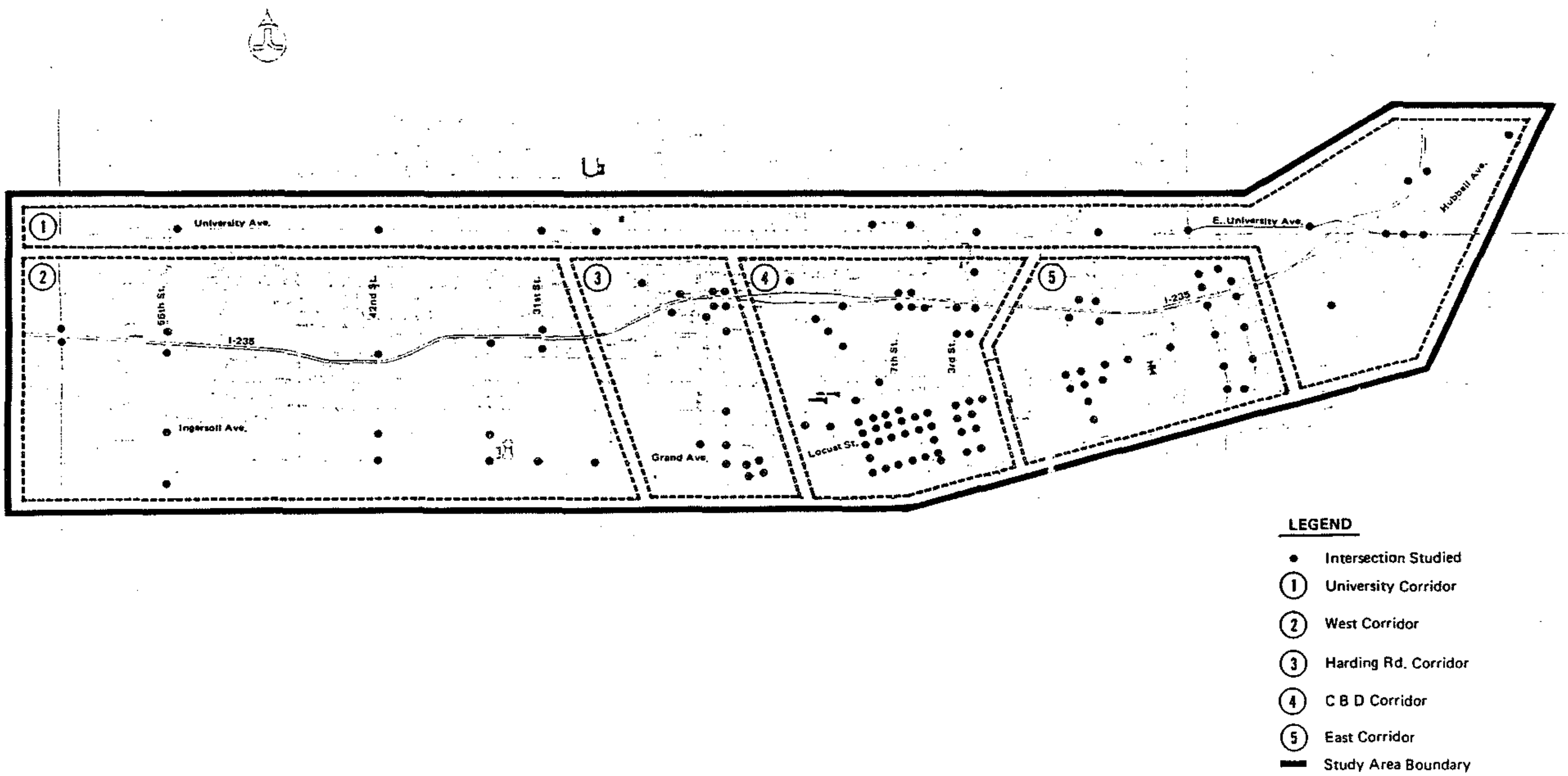
The above considerations led to a decision by the city to perform a parallel transportation study of street system needs and impacts. This study, begun in the spring of 1988 was conducted by Jack E. Leisch & Associates. The following are primary objectives of this second study, which is presented here:

1. To investigate changes in traffic volumes and patterns associated with reconstruction of I-235.

2. To identify future traffic and transportation problems associated with traffic volume increases.

3. To determine long range solutions to future problems.

4. To investigate the differences in traffic volumes and patterns associated with development with and without construction of the CBD Loop Arterial.

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I-235 TRAFFIC IMPACT STUDY

STUDY AREA

EXHIBIT 1

## II. SUMMARY OF EXISTING CONDITIONS

Determination of future needs requires an understanding of existing transportation facilities, their operational characteristics, and their relationship to existing as well as evolving land use activity.

### Highway Network

#### Freeway System

The study area is served by one major freeway, I-235. I-235 travels east-west through the city from the southwest system interchange with I-80 and I-35, to the University Avenue interchange where it turns, heading north-south to the northeast system interchange with I-80 and I-35. I-235 through Des Moines is a six basic lane freeway. Despite its through continuity, it primarily functions as a major access route into the central business district (CBD) of Des Moines.

The Iowa DOT study noted that I-235 currently carries 49,000 to 84,000 vehicles per day through Des Moines. During peak hours, the traffic demands of up to 5,100 vehicles per hour (vph) approach the practical capacity of the freeway within Des Moines. Table 1 summarizes existing volume to capacity relationships on the freeway.

#### Arterial Street System

The study area is also served by a system of east-west arterials. North of I-235, University Avenue, a 4-lane facility, is the only east-west arterial with system continuity. South of the freeway, only Grand Avenue maintains complete continuity from east to west. Other east-west arterials include Ingersoll Avenue. Focusing on the CBD, only Grand Avenue and Locust Street carry continuous east-west traffic into the CBD. Grand and Locust form a one-way pair through the center of the CBD.

The north-south system is limited in capacity. West of the downtown, 63rd, 56th, 42nd and 31st Streets are continuous, two-lane arterials that interchange with I-235. Through the CBD, north-south one-way pairs are formed by 8th Street and 9th Street, 6th Avenue and 7th Street and 2nd Avenue and 3rd Street. 5th Avenue is a southbound major feeder route into the downtown. Keo Way is a major arterial that interchanges with I-235 and penetrates 5th Avenue as a southbound feeder downtown.

East of the river, north-south streets include E. 6th Street and Pennslyvania Avenue, serving the capitol complex, and E. 14th and 15th Streets, which are designated as U.S. 65/69.

Street System Inventory. -- An early study task was assembling a complete inventory of the geometric and traffic operational conditions within the study area. The following data were collected from city files, field reviews and data files from the Iowa DOT study:

- Width of Streets
- Number and arrangement of lanes
- Type of traffic control at major intersections (including phasing and timing of signalized intersections)
- Configuration of street plan (i.e., one-way vs two-way)
- Parking regulations

Exhibit 2 illustrates existing street widths and operating configuration of the downtown street system. Appendix A summarizes lane arrangements at major intersections through the study area.

Traffic Control Inventory. -- This study focused on the type of traffic control at each key intersection, and the functional characteristics of that control. An in-depth inspection of hardware condition and characteristics was not performed. It should be noted, however, that the existing downtown traffic signal system was put in place in 1952. It is a simple 2-dial system. In addition to the maintenance problems associated with systems of that age, it lacks operational flexibility that is a characteristic of modern, computerized traffic signal systems.

Traffic Volume Inventory. -- The study team also compiled a complete database describing traffic volumes and patterns within the study area. Peak-hour traffic and average daily traffic (ADT) information was collected from the following sources:

- The City of Des Moines (peak hour turning movements), and
- The Iowa Department of Transportation (ADT, and peak hour traffic).

In addition, an extensive counting program to supplement the existing database was undertaken by the consultant team. In all, more than 125 a.m. and p.m. peak hour intersection counts were obtained. Exhibit 1, presented earlier, identifies the location of all intersections for which peak period traffic data were collected. All peak period traffic was posted and reviewed. Some adjustments were made to insure compatibility in data for adjacent intersections. Field checks were performed to note the location of special mid-block traffic generators such as parking garages.

Pedestrian Volume Inventory. -- Pedestrian counts were performed at select intersections to establish the extent of pedestrian activity. These counts, taken primarily at locations in the CBD, were used to determine the number of pedestrian conflicts with turning vehicles at signalized intersections.

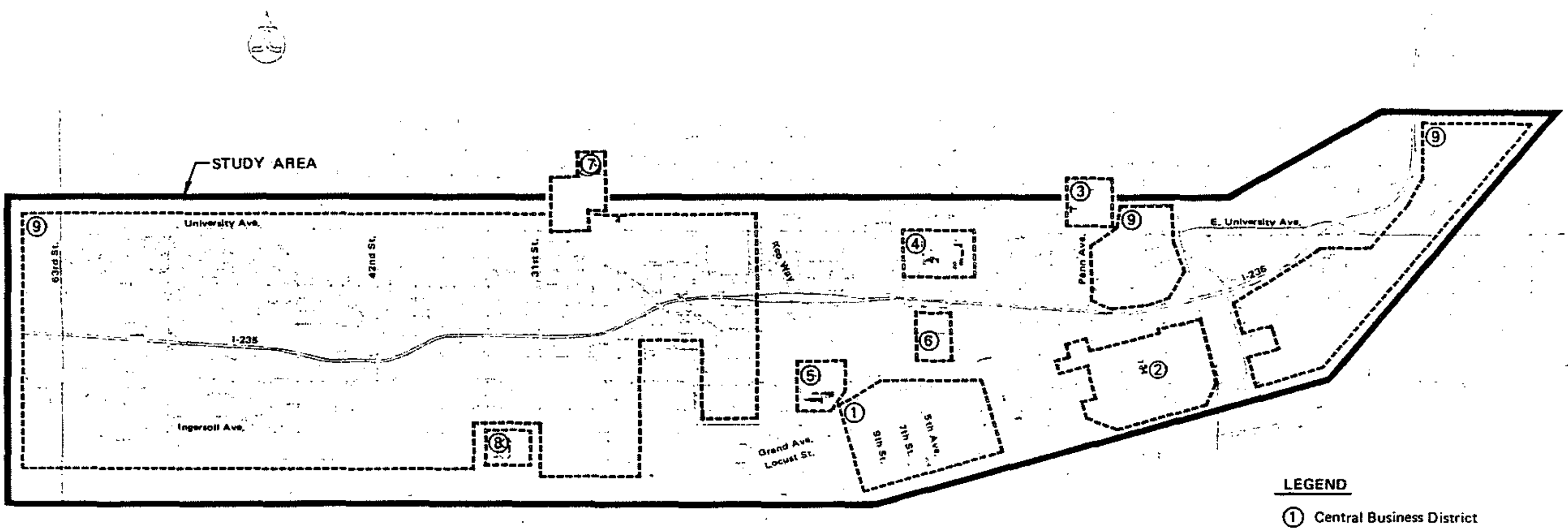
Accidents and Safety. -- Accident data were obtained from the City of Des Moines. Detailed traffic accident reports for the three-year period of 1985 through 1987 were reviewed to identify existing high accident locations. Table 2 lists high accident locations for the years 1985 through 1987. In addition to the high accident spot locations shown in Table 2, the accident history of key city streets was investigated. Review of recent accidents showed that University Avenue and Grand Avenue west of the CBD experience significant accident rates, as summarized below:

| | |
|---|---|
| University Avenue from Keo Way to west city limits | 15.02 acc/MVM |
| Grand Avenue from 18th Street to west city limits | 9.96 acc/MVM |

These rates compare with a state-wide rate for municipal city streets of 6.23 acc/MVM.

## Land Use

Exhibit 3 illustrates the significant land uses within the study area. Area 1, the CBD, generates the greatest amount of traffic demand. Stable residential areas (labeled as area 9) are on either end of the study area. Also noted on Exhibit 3 are special land uses, including the various hospital and medical complexes, Drake University, the State Capitol and Veterans Auditorium.




**LEGEND**

1. Central Business District
2. State Capitol Complex
3. Lutheran Hospital
4. Mercy Hospital
5. Methodist Hospital
6. Vets Auditorium
7. Drake University
8. College of Osteopathic Medicine
9. Residental

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SPECIAL STUDY AREA LAND USES

EXHIBIT 3

## TABLE 3

Existing Transit Ridership by Route

| Route No. and Description | Average Daily Ridership (5/88) | Headways (minutes) Peak | Off Peak |
|---|---|---|---|
| Route 1 -- Fairgrounds - West Des Moines<br>35th St. (West Des Moines) to Transit Mall via Ingersoll Ave.;<br>East to Fairgrounds via Grand Ave., Locust St., and Walnut Ave.<br>to E. 30th St., E. 38th St. and E. 42nd St. | 2,200 | W.15-20<br>E.15-20 | 30<br>60 |
| Route 2 -- Kingman - E. University Ave.<br>Kingman Ave. to Transit Mall via 31st St. to Ingersoll Ave.;<br>East to E. University Ave. via Walnut Ave., Locust St. and Grand Ave.<br>and Hubbell Ave.; E. University Ave. to SE 30th St. | 350 | 50 | --- |
| Route 3 -- Highland - Oak Park University<br>Westown Parkway to University Ave. to Transit Mall via Cottage Grove Ave.,<br>19th St. to Woodland Ave., 12th St. to Walnut Ave.; North to Park Fair via 6th Ave. | 2,050 | W. 15-20<br>N. 15-20 | 30<br>30-40 |
| Route 4 -- Urbandale - E. 14th St.<br>Urbandale Ave. to Transit Mall via 34th St., Hickman Rd., Harding Rd.,<br>Crocker to 9th St.; East to E. 14th St. via Locust St., Walnut Ave. and<br>Grand Ave. | 1,450 | W. 15-20<br>E. 15-20 | 60<br>60 |
| Route 5 -- East 6th and 9th - Clark<br>Merle Hay Mall to Transit Mall via Franklin Ave., Clark St., 13th St. and<br>9th St.; East to E 9th St. via Locust St., Grand Ave., and Walnut Ave. | 1,150 | 15-20 | 60 |
| Route 6 -- West 9th - Douglas - Indianola - Lacona<br>Douglas Ave. to Transit Mall via Harding Rd., Hickman Rd., 9th St.;<br>South to Southridge Mall via 7th St., Indianola, Watrous Ave. and SE 5th St. | 1,650 | 15-20 | 60 |

# III. TRAVEL FORECASTS

This section of the report describes the process of arriving at future traffic forecasts. The projections are used subsequently to test the adequacy of the existing street and highway system to accommodate future travel volumes and to arrive at plans for future improvements.

## Future Travel Demand

The amount and distribution of future traffic result from increased trip-making created by population growth and development. For this study, and the Iowa DOT study, the magnitude and location of land use development, population growth and employment growth within the study area were determined by local community planning officials in association with the Des Moines Area Transportation Planning Committee (DMATPC). The following is a brief description of the process, assumptions and methodology that were used in estimating future travel demands.

### Design Year 2010

The year 2010 was selected as a reasonable long range planning horizon for the Iowa DOT freeway study, and was considered reasonable for this study as well. This represents as long a planning horizon as is practical, in terms of forecasting land use and demographic trends. Note that previous planning efforts, including that which produced the "Year 2000 Street and Highway Plan for the Des Moines Urbanized Area," used Year 2000 as a target. It was therefore necessary to revise regional growth estimates for both studies to reflect a projected increment of growth beyond the year 2000 to 2010. Note, what is important when estimating future traffic demand is not necessarily the design year but the evolution of predicted development and growth.

### Land Use, Population and Employment

The year 2010 growth projections were approved by the DMATPC. They reflect an overall area-wide growth of 17% in the total population and 40% in employment over 1986. The distribution of this growth was approved by the DMATPC within the transportation planning area. Actual location of where development would take place within the study area was estimated on a zone by zone basis.

East and West Zone Travel Forecasts. -- The chart in Exhibit 4 depicts the process used to arrive at travel forecasts for the East and West Zones. The various steps involved in the process are described below:

(1) An existing (1987-1988) peak hour traffic assignment was developed from intersection counts.

(2)-(3) Using computer traffic assignments produced by the regional forecasting model, calculations were made of 1986 and 2010 daily vehicle miles of travel (VMT) for various types of highways in each the East and West Zone.

(4) Growth factors were calculated by dividing the year 2010 VMT by 1986 VMT for each category of street. Separate factors were determined for the total system of streets and highways; for arterials excluding I-235; and for arterials excluding both I-235 and the proposed CBD Loop Arterial.

Table 4 represents the results of this analysis for the East and West Zones, and for comparison, statistics for the Central Zone. (As described below, however, the travel forecasting process used for the Central Zone was somewhat more involved.)

The "growth factors" verify a generally understood sense of the magnitude and location of traffic change. In the western part of Des Moines, essentially all traffic growth would be on the freeways. This would be composed predominantly of longer distance traffic on I-235. Internal growth in land activity would be slight, resulting in little traffic change on the local street system.

In the East Zone, basically all of the projected traffic growth would be attributable to the CBD Loop Arterial. The resulting growth factor of 0.98 for local arterial street traffic is probably low, however, and deserves to be adjusted upward to the "breakeven" point in recognition of an almost assured nominal growth in street system traffic.

**TABLE 4**

Traffic Growth for City of Des Moines
Street System -- Year 2010 to Base Year

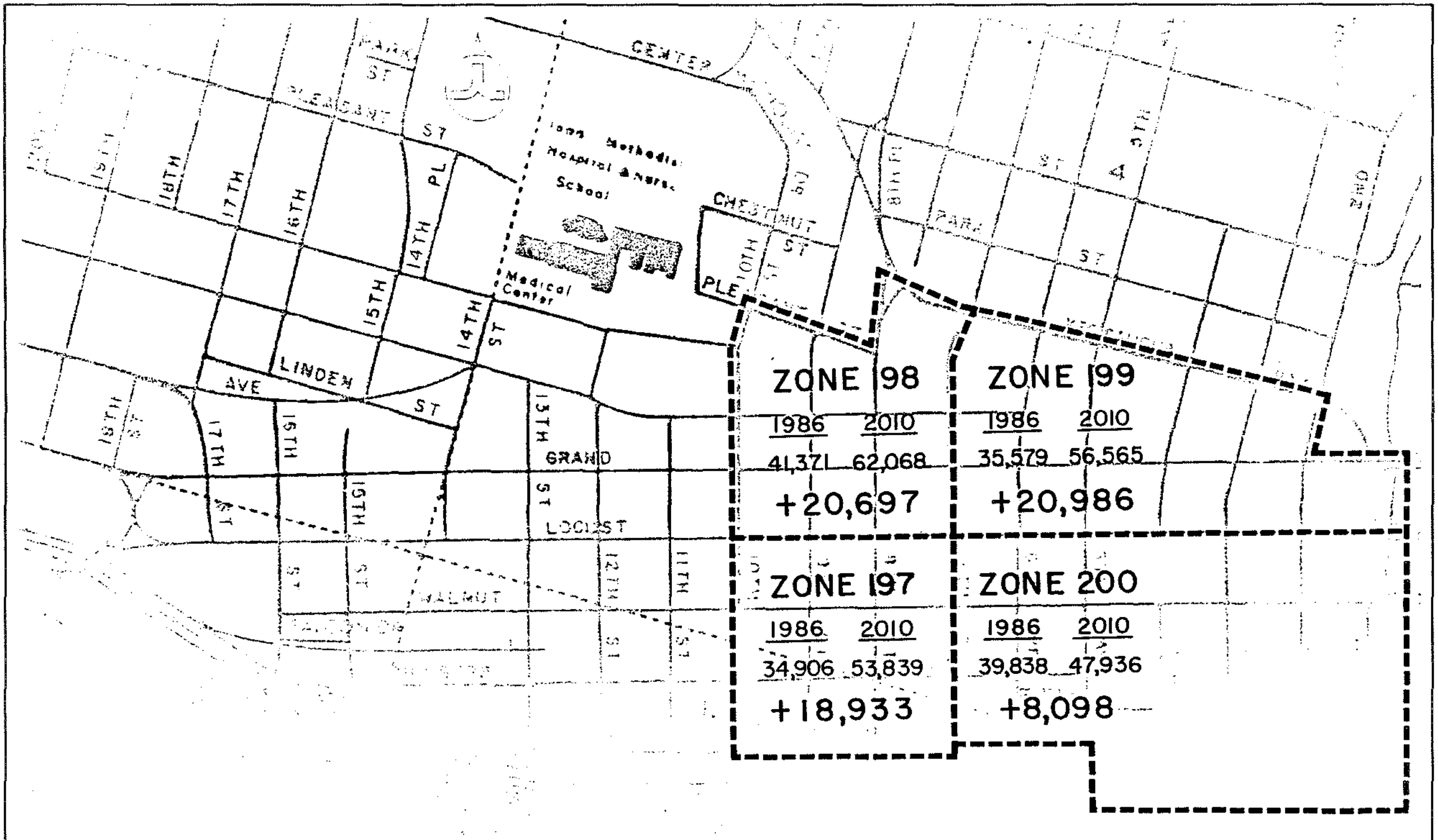
| Analysis Area | Factor [1] |
|---|---|
| Complete Highway Network Included (Arterials and Freeway) | |
| West | 1.19 |
| Central | 1.44 |
| East | 1.17 |
| Arterial System Only (Including CBD Loop) | |
| West | 1.02 |
| Central | 1.62 |
| East | 1.20 |
| Local Arterial System Only (Excluding CBD Loop) | |
| West | 1.02 |
| Central | 1.31 |
| East | 0.98 |

1 Factor represents ratio of system-wide VMT for Year 2010 trip table to 1986 (base year) trip table.

## TABLE 5

Des Moines CBD Trip End Growth

| Zone | Total Trip Ends 1986 | Total Trip Ends 2010 | Decrease or Increase 1986 - 2010 | Growth Factor |
|---|---|---|---|---|
| 165 | 12,826 | 12,685 | - 141 | - 1.1 |
| 166 | 6,402 | 7,746 | 1,344 | 21.0 |
| 169 | 6,842 | 7,133 | 1,315 | 13.6 |
| 192 | 9,712 | 10,944 | 1,232 | 12.7 |
| 193 | 5,373 | 6,365 | 992 | 18.5 |
| 194 | 12,482 | 14,698 | 2,216 | 17.8 |
| 195 | 11,250 | 14,247 | 2,997 | 26.6 |
| 196 | 11,445 | 14,439 | 2,994 | 26.2 |
| 197 | 34,906 | 53,839 | 18,933 | 54.2 |
| 198 | 41,371 | 62,068 | 20,697 | 50.0 |
| 199 | 35,579 | 56,565 | 20,986 | 59.0 |
| 200 | 39,838 | 47,936 | 8,098 | 20.3 |
| 201 | 11,111 | 23,079 | 11,968 | 107.7 |
| 202 | 5,132 | 11,314 | 6,182 | 120.5 |
| TOTAL | 244,269 | 343,058 | 98,789 | 40.4 |
| AREA TOTAL | 2,094,350 | 2,733,882 | 739,345 | 30.5% |
| %CBD | 11.7% | 12.5% | 13.5% | |

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I-235 TRAFFIC IMPACT STUDY

CBD TRIP GROWTH ANALYSIS

EXHIBIT 6

(7) Using outputs of Steps 5 and 6, an assignment was made of new CBD trips (growth from 1986 to 2010) to the Central Zone street system. Note: when new trips were assigned to the existing network, trips were not assigned along Walnut Street through the Transit Mall.

(8) A calculation was made of the VMT of forecast CBD travel growth generated by new development, or trip ends, within the CBD.

(9) VMT of projected travel growth from new development within the CBD was subtracted from the total VMT increase found in Step 3. The resulting growth factor would be representative of "background" traffic, or Central Zone travel growth generated by new development occurring outside of the CBD.

(10) The growth factor derived in Step 9 was applied to the 1987-1988 traffic assignment (Step 1) to produce a forecast of 2010 background peak hour traffic.

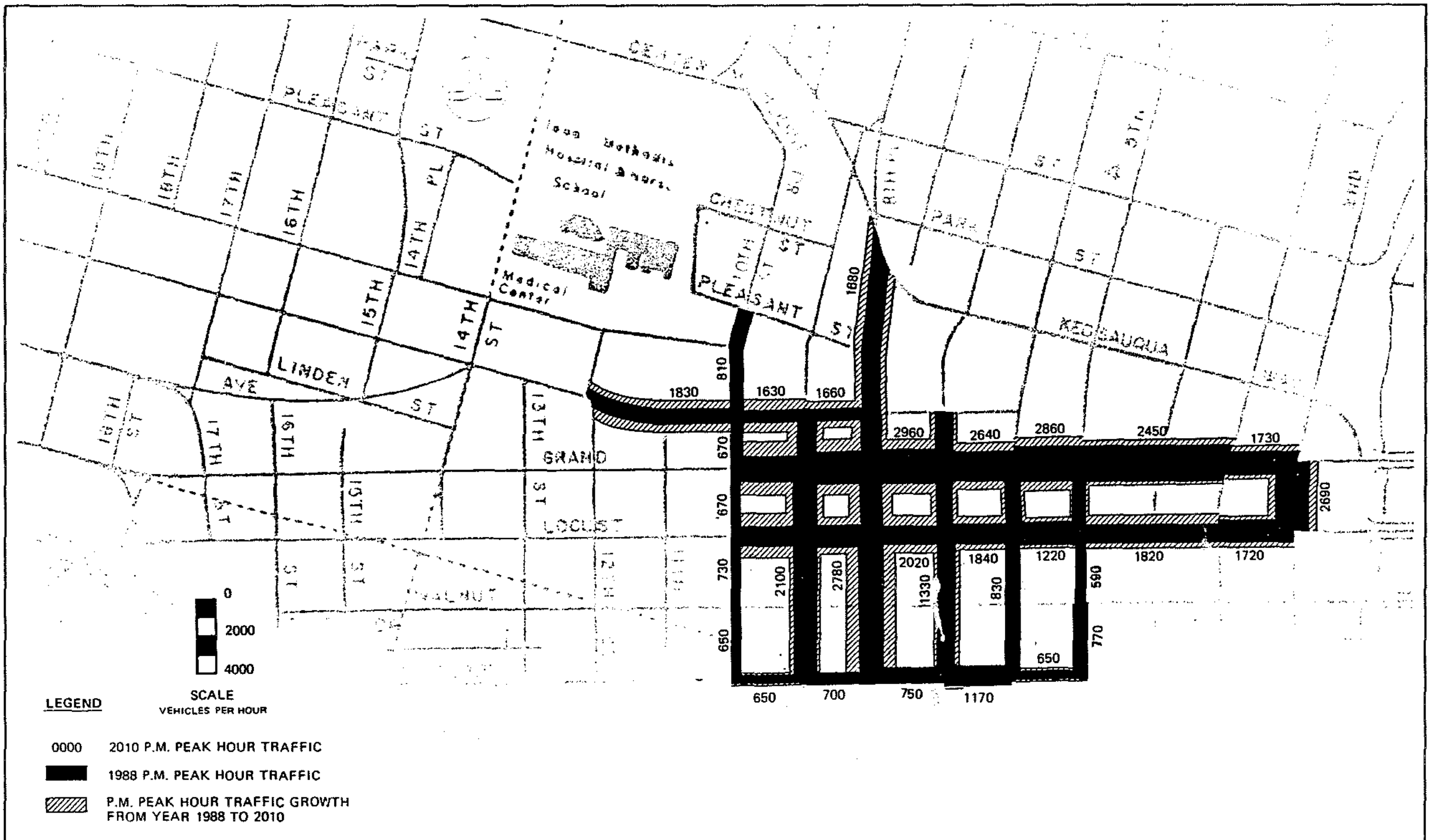
(11) A compilation was made of 1986 and 2010 socioeconomic regional model inputs (i.e., population, employment by type) by zone.

(12) The types of land activity increases forecast for CBD zones were used to develop factors to convert average daily travel (ADT) to peak hour volumes.

(13) The peak hour conversion factors were applied to ADT travel growth forecasts (Step 7) to arrive at a projection of 2010 a.m. and p.m. peak hours trips generated by new development occurring within the CBD during this time period.

(14) The travel forecast from Step 13 was assigned to the CBD street system.

(15) The results of Step 10 (Expanded Background Traffic) and Step 14 (Travel Growth from New CBD Development) were combined to produce a 2010 forecast peak hour traffic assignment.

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P.M. PEAK HOUR TRAFFIC GROWTH FROM YEAR 1988 TO 2010

EXHIBIT 8

## IV. OPERATIONAL AND DESIGN CRITERIA

Future transportation needs are based on forecast traffic volumes and patterns. These are translated to street system and/or operational improvements, based on established design guidelines and operational criteria. Such criteria are developed to represent a reasonable balance between the costs and impacts of highway improvements, and acceptable levels of safe transportation.

### General Planning Criteria

A number of key planning concepts should be understood in translating traffic volumes to design needs. These include the difference in highway functional classes, relationships between demand and capacity, the importance of developing an operationally "balanced" system, and a sensitivity to differences in needs and constraints in different parts of the city.

Functional classification. -- Higher volume, longer distance trips should desirably be provided for on higher type facilities such as I-235. Off the freeway, similar types of trips should use arterial streets for as much of the trip as possible. Sufficient capacity should be provided on the freeway and arterial street system to insure that diversion of long, through trips to local streets does not occur.

Demand vs. Capacity. -- A typical weekday commuting work peak is the basis for system planning. In small cities such as Des Moines, traffic demand is generally unrestrained. Businesses do not operate flexible work hours or staggered schedules because of traffic congestion. Individuals for the most part leave for work and return home at a time convenient to them and are not significantly influenced by traffic congestion in arranging their daily schedules. An operational criterion implicitly assumed in both this study as well as the Iowa DOT freeway study is that this "small city" characteristic should be retained if at all possible when meeting future traffic projections.

Operationally Balanced System. -- Efficient use of resources demands that a balance be struck in planning for all highway improvements. It does little good to plan for a high level of service on I-235, for example, but accept or plan for widespread congestion off the freeway.

For peak hour operations in smaller cities such as Des Moines, LOS D is considered a desirable objective. However, LOS E often occurs at complex intersections requiring long cycle lengths to provide phases for all movements including separate left turns.

The operation of a signalized intersection is also measured in terms of its volume to capacity ratio, (v/c). The v/c ratio compares the demand flow of traffic approaching an intersection to its practical capacity. Intersections approaching or exceeding 1.00 represent potential problems. Slight increases in traffic or periodic volume surges will result in degradation of level of service and rapid increases in overall delay.

For planning purposes, v/c ratios of 0.90 or more were identified as being potentially critical, i.e. capacity improvements were investigated at these locations.

Through Arterial Capacity. -- Guidelines for an appropriate number of continuous through lanes are as follows:

| Street or Highway Type | Peak Period Volume per lane (vph) (one direction) |
|---|---|
| 2-lane undivided | 500 - 600 |
| 4-lane undivided | 600* - 1000 |
| 5-lane (median channelization) | 1000 or more |

* Lower volume appropriate in CBD or other areas with closely spaced signalized intersections.

Intersection Channelization. -- The use of turn lanes and their appropriate design at signalized intersections can significantly affect operations. Many geometric and operational factors play a role in decisions to implement left-turn lanes, including prevailing speeds, traffic control, left-turn volumes and overall intersection capacity.

moving traffic, progressing major flows, and operating a coordinated signal system. Much CBD planning, including the layout of the transit mall, and location and design of the central city parking garages is directly tied to the current one-way configuration of streets. Finally, with respect to ramp improvements to I-235, the long range reconstruction plan was designed to be compatible with, and indeed complementary to, the CBD street plan.

Another given condition was the transit mall. For the purposes of this study, it was assumed that this mall would remain in place. A final important "constraint" applied to both this study and the Iowa DOT freeway study were the conclusions and recommedations of the current year 2000 Des Moines Area Street and Highway Plan, shown in Exhibit 9. While the current plan is being updated, there is no indication at this time of significant change in the Des Moines highway network.

## V. DETERMINATION OF FUTURE STREET SYSTEM PROBLEMS

This section of the report documents the analyses that led to identification of potential future problems, and recommendations for mitigating those problems. As explained earlier, the analysis is based on traffic volumes produced by a level of development associated with the latest year 2010 forecast of land use in Des Moines.

### Outside CBD (sub areas 1-3 and 5)

A two-step approach was used to identify year 2010 traffic impacts. 1985 Highway Capacity Manual (HCM) techniques were employed, with assumptions regarding peaking, saturation flow rates, geometric effects, etc. reflective of local conditions. The first step was a simplified planning level analysis. More detailed operational analyses were performed only at locations where the planning level analysis resulted in volume to capacity ratios greater than 0.90.

#### Intersection Analyses

Planning level analyses performed for year 2010 traffic on the existing network are summarized for intersections outside the CBD in Table 8. (The reader is referred to Appendix A and Appendix B for summaries of traffic volume and existing lane arrangements at each intersection.) Table 8 indicates that most intersections would exhibit a v/c ratio less than 0.90. This is not surprising, given that the traffic forecasts for areas outside the CBD and off the freeway show little if any growth in traffic over existing levels.

#### Evaluation of East-West Corridors

A general evaluation was also performed of the major east-west arterials outside the CBD. These include University Avenue, Grand Avenue and Ingersoll Avenue west of the CBD, and E. University, Grand and Locust to the east of the CBD.

University Avenue (West). -- University Avenue west of the CBD is a 4-lane arterial street with no median channelization for left turns midblock or at local intersections. Forecast traffic volumes are only slightly higher than existing volumes, indicating peak direction, peak period demand of about 800 to 1,700 vph. Strictly in terms of capacity, this future volume can be

**TABLE 8 (concluded)**

Year 2010 P.M. Peak Hour Traffic

Planning Method Capacity Analysis for Signalized Intersections

(Outside CBD Corridor)

| Intersection | Capacity Level (Sum of CLV) | v/c Ratio ** |
|---|---|---|
| Grand Ave./56th St. | 515 | 0.37 |
| Grand Ave./42nd St. | 930 | 0.66 |
| Grand Ave./35th St. | 870 | 0.62 |
| Grand Ave./31st St. | 885 | 0.63 |
| Grand Ave./28th St. | 960 | 0.69 |
| Grand Ave./E. 5th St. | 570 | 0.41 |
| Grand Ave./E. 6th St. | 525 | 0.38 |
| Grand Ave./Pennsylvania Ave. | 750 | 0.54 |
| Grand Ave./E. 9th St. | 730 | 0.52 |
| Grand Ave./E. 12th St. | 800 | 0.57 |
| Grand Ave./E. 14th St. | 940 | 0.67 |
| Grand Ave./E. 15th St. | 955 | 0.68 |
| Grand Ave./Hubbell Ave.& E. 18th St. | 740 | 0.53 |
| Locust St./E. 7th St. | 660 | 0.47 |
| Locust St./E. 5th St. | 1,000 | 0.71 |
| Locust St./E. 6th St. | 665 | 0.48 |
| Walnut St./E. 14th St. | 770 | 0.55 |
| Walnut St./E. 15th St. | 755 | 0.54 |
| Court Ave./E. 5th St. | 525 | 0.38 |
| Court Ave./E. 14th St. | 985 | 0.70 |
| Court Ave./E. 15th St. | 825 | 0.59 |
| Walker St./E. 14th St. | 500 | 0.36 |
| Walker St./E. 15th St. | 285 | 0.20 |

** v/c Ratio Based on 1400 vphpl representing typical capacity of the sum of critical lane volumes at signalized intersections.

CLV: Critical Lane Volume

## North-South Streets and Arterials

Future traffic volumes forecast for the freeway and arterial streets can be accommodated on the planned network. North of I-235, the year 2000 plan calls for widening of both 56th and 63rd Streets to 4 lanes. South of I-235, traffic increases are minor on the north-south system, and can be accommodated within their existing 2-lane widths.

Two special locations outside the CBD were identified as requiring in-depth analysis. These are the intersection complex of Grand Avenue, Locust Street and Fleur Drive, and the intersection area of E. University Avenue and Hubbell Avenue.

## Grand/Locust/Fleur

The Grand/Locust/Fleur intersection poses a unique situation. It represents the entrance to downtown Des Moines from the west via Grand Avenue and southwest via Fleur Drive. It is the beginning of the one-way pair of Grand Avenue and Locust Street, but it is also currently part of the major north-south connection between the airport and I-235.

Current operation is characterized by complex signalization, heavy turning movements and difficult geometrics for north-south movements. Under existing traffic volumes, level of service is low, with long delays during peak hours of operation.

The long range plan for the loop arterial will somewhat mitigate problems by removing north-south through traffic from this area via an interchange between Fleur Drive and the Loop Arterial. Exhibit 10 documents the forecast effect of the interchange on traffic movements through this area.

## Hubbell Avenue and Easton Boulevard

The Iowa DOT I-235 freeway study proposed a reconstruction alternative that would significantly affect traffic patterns along E. University in the vicinity of Easton Boulevard and Hubbell Avenue. Under this alternative (Alternative I), the existing ramp connections between Easton and the west would be eliminated.

A second alternative (Alternative II) retained the eastbound exit to Easton. Also, under both alternatives considered for the freeway, traffic movements between E. 14th and E. 15th Streets and E. University Avenue could not be made on the freeway, but instead must take place on the street system.

A separate traffic analysis of the effects of these changes is shown on Exhibit 11. This exhibit depicts local street connections proposed in the freeway study.

Table 9 summarizes operational analyses of the three intersections in the area under both freeway alternatives. For Alternative I, in which Easton Boulevard ramp connections are removed, the existing channelization of the E. University Avenue and Hubbell Avenue intersection is not sufficient. The primary capacity problem would be the existing single eastbound left turn lane.

**TABLE 9**

Year 2010 P.M. Peak Hour

Detailed Signalized Intersection Level of Service

(E. University Ave./Hubbell Ave./Easton Blvd.)

| Location | Level of Service | Average Stopped Delay per vehicle (sec) | v/c Ratio |
|---|---|---|---|
| Freeway Alternative I (No eastbound exit ramp from I-235 to Easton and no westbound entrance ramp from Easton to I-235) | | | |
| E. University Ave./E. 21st St. | B | 12 | 0.62 |
| E. University Ave./Hubbell Ave. | F | 60+ | 1.20 |
| Easton Blvd./Hubbell Ave. | B | 14 | 0.67 |
| Freeway Alternative II (Eastbound ramp provided from I-235 to Easton) | | | |
| E. University Ave./E.21st St. | B | 8 | 0.62 |
| E. University Ave./Hubbell Ave. | D | 31 | 0.95 |
| Easton Blvd./Hubbell Ave. | B | 9 | 0.60 |

Under Alternative II, the existing channelization and street configuration would provide sufficient intersection capacity.

An additional consideration is the effect of the existing at-grade railroad crossing at Hubbell Avenue south of the intersection of Hubbell Avenue and E. University Avenue. Changes in freeway ramp connections that increase traffic on Grand Avenue will increase exposure to this at-grade crossing.

## Evaluation of CBD Traffic Impacts

Most of the year 2010 increases in traffic are forecast to occur in the CBD. Routes of access to the CBD are primarily I-235 and the loop arterial. Traffic leaving these corridors will have to be accommodated on the major north-south arterials that penetrate the CBD.

HCM intersection analyses were performed for year 2010 traffic on the existing system.

### Intersection Analysis

The HCM planning method of capacity analysis, performed on intersections in the CBD, was used to uncover potential problems at CBD locations. Problem areas are focused along the High Street, Grand Avenue and Locust Street corridors between 10th Street and 8th Street, in addition to a few spot locations. Exhibit 12 shows the location and extent of intersection capacity concerns in the CBD, and Table 10 provides a summary of all CBD intersections analyzed.

HCM operational intersection analyses were performed on CBD intersections where the above analysis indicated v/c ratios exceeding 0.90. These more detailed level of service analyses for the critical CBD intersections are summarized in Table 11. Traffic increases projected in the downtown produce low levels of service and significant v/c ratios at many intersections, including those along High Street, Grand Avenue and Locust Street.

The analyses shown in Table 11 do not reflect the effects of the closely spaced intersections. Long delays and queues at one intersection may create back-ups into adjacent intersections. Also, the effects of signal progression schemes such as are used for Grand Avenue and Locust Street are not fully reflected in the analysis.

## TABLE 10

For Year 2010 P.M. Peak Hour Traffic
Planning Method Capacity Analyses for Signalized Intersections
(CBD Corridor)

| Location | Capacity Level (Sum of CLV) | v/c Ratio** |
|---|---|---|
| Keo Way/12th St. | 1,470 | 1.05* |
| Keo Way/9th St. | 1,192 | 0.85 |
| Keo Way/8th St. | 880 | 0.59 |
| High St./12th St. | 615 | 0.44 |
| High St./10th St. | 1,075 | 0.77 |
| High St./9th St. | 1,110 | 0.79 |
| High St./8th St. | 1,276 | 0.91* |
| Grand Ave./17th St. | 1,210 | 0.86 |
| Grand Ave./10th St. | 928 | 0.66 |
| Grand Ave./9th St. | 1,100 | 0.93* |
| Grand Ave./8th St. | 1,536 | 1.10* |
| Grand Ave./7th St. | 1,255 | 0.90* |
| Grand Ave./6th Ave. | 1,080 | 0.77 |
| Grand Ave./5th Ave. | 765 | 0.55 |
| Grand Ave./3rd St. | 1,005 | 0.72 |
| Grand Ave./2nd Ave. | 1,147 | 0.82 |
| Locust St./17th St. | 510 | 0.36 |
| Locust St./10th St. | 852 | 0.61 |
| Locust St./9th St. | 1,261 | 0.90* |
| Locust St./8th St. | 1,190 | 0.85 |
| Locust St./7th St. | 860 | 0.61 |
| Locust St./6th Ave. | 893 | 0.65 |
| Locust St./5th Ave. | 909 | 0.65 |
| Locust St./2nd Ave. | 953 | 0.68 |
| Mulberry St./10th St. | 950 | 0.68 |
| Mulberry St./9th St. | 835 | 0.60 |
| Mulberry St./8th St. | 698 | 0.50 |
| Mulberry St./7th St. | 1,416 | 1.01 |
| Mulberry St./6th Ave. | 772 | 0.55 |
| Mulberry St./5th Ave. | 399 | 0.29 |
| Court Ave./3rd St. | 903 | 0.65 |
| Court Ave./2nd Ave. | 783 | 0.56 |

* Based on v/c ratio greater than 0.90 further analysis is required.

** v/c Ratio Based on 1400 vphpl representing typical capacity of the sum of critical lane volumes at signalized intersections

CLV: Critical Lane Volume

TRANSYT-7F Analysis

A more sophisticated operational analysis was undertaken to ensure full understanding of the consequences of year 2010 traffic in the CBD. TRANSYT-7F (T-7F) is a comprehensive, computerized signal system management program. It is regarded as a "State of the Art" computer model. T-7F has two major functions:

1. Signal System Simulation -- T-7F can simulate the operation of traffic flow through a network of signalized intersections.

2. Signal System Optimization -- T-7F can optimize cycle length and signal timing for a network of signalized intersections to provide optimal operation of traffic flow.

Data input requirements for T-7F include:

- o Distance between adjacent intersections
- o Total Link Volume (vph)
- o Source of flow for subject link (vph)
- o Adjusted saturation flow rates for each lane group (vphg)
- o Number of signal phases/phasing configuration
- o Average cruise speed (mph)

The outputs of T-7F include the measurement of degree of saturation by lane group, maximum number of queued vehicles for each intersection, as well as average stopped delay, total delay and total fuel consumption subtotaled by intersection and aggregated for the network.

To perform a T-7F analysis it was necessary to develop an arithmetically balanced peak-hour traffic assignment. The travel forecasts were used as a base and then adjusted to reflect a balanced assignment. Mid-block generators such as parking garages are reflected in the assignment. Exhibit 13 displays 2010 p.m. peak-hour traffic volumes used in the T-7F analyses.

T-7F network analyses were performed along High Street from 10th Street to 8th Street; and Grand Avenue and Locust Street from 10th Street to 5th Avenue. A discussion of the results follows:

High Street Corridor.--T-7F simulation runs along High Street yielded the following results summarized in Table 12.

**TABLE 12**

Summary of TRANSYT-7F Analyses of Year 2010 p.m. Peak Hour Traffic on Existing Street System (Key Intersections Along High Street)

| Intersection | Level of Service | Average Stopped Delay per vehicle (sec) |
|---|---|---|
| High St./10th St. | F | 60+ |
| High St./9th St. | B | 13 |
| High St./8th St. | D | 30 |

The analysis identifies specific problems at High Street intersections with 10th Street and 8th Street. At 10th Street the northbound and southbound movements are oversaturated, resulting in significant delays. At the intersection with 8th Street, significant delay for the eastbound left turn is reported. These areas of congestion affect overall intersection delay as well as system wide delay.

Grand Avenue and Locust Street Corridors.--The T-7F simulation analysis along Grand Avenue and Locust Street extends from 10th Street to 5th Avenue, encompassing 12 intersections. As the following table indicates, poor levels of service would occur at Grand Avenue and 8th Street and the Locust Street intersections with 6th Avenue, 8th Street, 9th Street and 10th Street.

## Summary of Traffic Impacts of Year 2010 Forecast

Year 2010 traffic forecasts for the study area have the following implications:

### Outside CBD

Relatively minor impacts at a few isolated intersections would occur (with two exceptions noted below). This is because most of the forecast traffic increase would use the freeway, as it is associated with longer distance trip making to the CBD. The two areas outside the CBD that would require capacity or other improvements to accommodate future traffic are discussed below.

Grand/Locust/Fleur. -- The Grand/Locust/Fleur intersection complex will experience serious operational problems as traffic in the area increases. The existing configuration of one-way movements and coordinated signals is presently operating at its capacity.

E. University/Hubbell/Easton/Grand -- Changes in traffic patterns due to revisions in I-235 ramp arrangements will affect traffic flow in the vicinity of

E. University Avenue, Hubbell Avenue and Easton Boulevard. Channelization and new signalization schemes will be required.

### Within The CBD

Most of the traffic growth forecast for I-235 is destined to the CBD. With no improvements to the existing downtown street system, poor levels of service and significant delays would be encountered at the following locations:

Keo Way and 12th Street
Locust Street and 2nd Avenue
High Street and 10th Street
Grand Avenue and 8th Street
Locust Street and 9th Street
Locust Street and 8th Street

# VI. 2010 RECOMMENDATIONS

Certain improvements to the existing roadway network would be required to accommodate forecast year 2010 peak hour traffic at a reasonable level of service. The improvements outlined here are the result of analyses of the impacts of future traffic performed in Chapter V and the design guidelines and constraints documented earlier in Chapter IV. In general, the improvements had the following objectives:

- Provide acceptable operations at signalized intersections.
- Improve arterial operations.
- Mitigate accident experience and improve safety.

## Recommendations Outside The CBD

The recommendations made for locations outside the CBD are described below.

E. University Avenue/Hubbell Avenue/Easton Boulevard

Recommended improvements for the area encompassing E. University Avenue, Hubbell Avenue and Easton Boulevard are based on changes in traffic patterns associated with the Alternative I -- Freeway Reconstruction Plan. (In this alternative the ramps from I-235 west to Easton Boulevard are removed.) Traffic diversion to the street system results in geometric improvements shown schematically in Exhibit 14.

At E. University Avenue and Hubbell Avenue geometric changes consist of converting the existing eastbound left turn lane to a dual left turn lane while maintaining two through lanes. The operational effect of the proposed changes is summarized in the operational analysis below.

Year 2010 p.m. Peak Hour Signalized Intersection Analysis

| Existing Conditions | | | With Proposed Improvements | | |
|---|---|---|---|---|---|
| LOS | Average Stopped Delay per vehicle (sec) | v/c | LOS | Average Stopped Delay per vehicle (sec) | v/c |
| F | 60+ | 1.2 | B | 31 | 0.95 |

Modifications to the intersection at E. University Avenue and E. 21st Street include adding an eastbound lane. Adding a lane eastbound provides three continuous through lanes and a separate left-turn bay. This eliminates the existing undesirable left turn treatment, where a through lane is trapped at the intersection in a left turn lane.

Signal phasing and signal timing should be coordinated with the signal at E. University Avenue and Hubbell Avenue to provide favorable progression and to promote the use of certain movements such as the eastbound and westbound left turns as alternatives to the left turns at University Avenue and Hubbell Avenue.

The estimated construction cost of these improvements is $450,000.

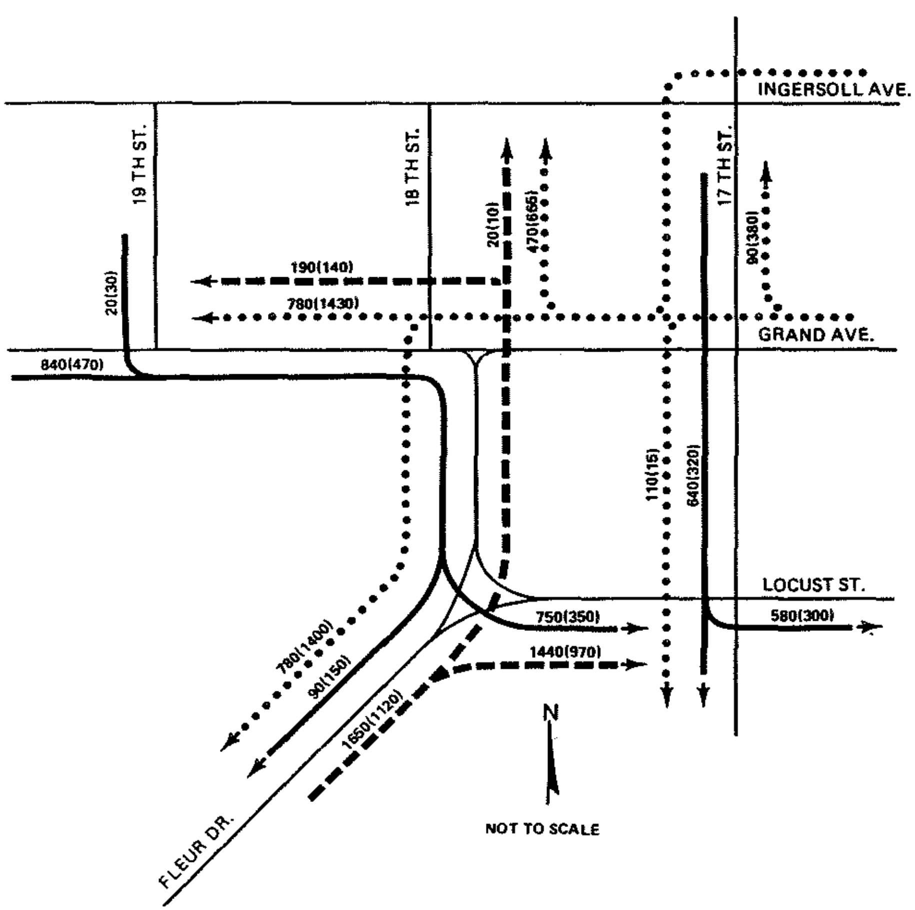
For Alternative II of the Iowa DOT I-235 reconstruction plan, the Easton Boulevard ramp movements remain in place. The existing street configuration would operate at a reasonable level of service, with only adjustments in signal timing required to accommodate future traffic.

<u>Grand/Locust/Fleur</u>

Improvements at the Grand Avenue/Locust Street/Fleur Drive intersection were designed to accommodate 2010 traffic with minimal encroachment to the existing right-of-way. To improve the operation and better utilize existing street capacity of the area, a plan was developed which would provide a more conventional signal phasing plan and minimize the number of conflicting intersection movements, while maintaining movements in all directions. A key consideration of this plan is the construction of the CBD loop arterial, with an interchange at Fleur Drive. The alternative which is recommended is shown schematically in Exhibit 15. Redistribution/reassignment of peak hour traffic in this area is shown in Exhibit 16.

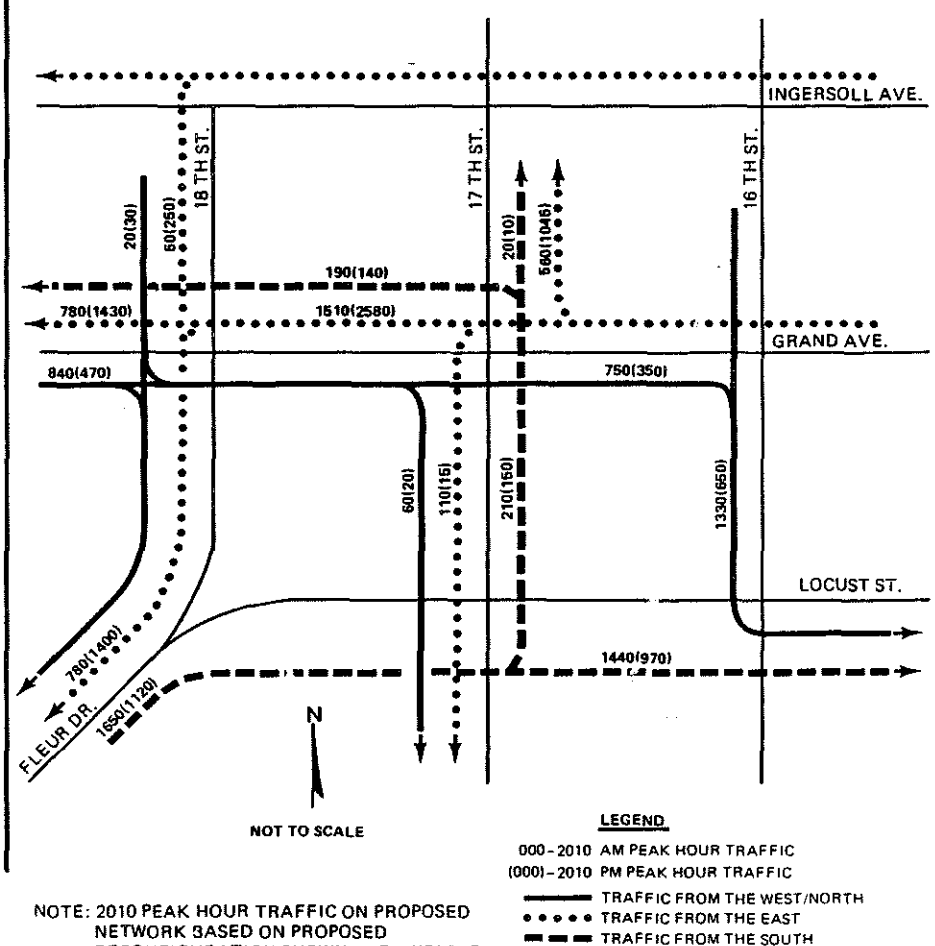
<u>Traffic Circulation</u>. -- Under the proposed plan, the existing north/south one-way pair at 19th and 18th Streets is shifted to 18th and 17th Streets. Traffic from the north and west proceeds eastbound along Grand Avenue to 16th Street, where the traffic is routed to Locust Street. Grand Avenue thus becomes two-way as far east as 16th Street. Traffic from the east proceeds along Grand Avenue

## YEAR 2010 PEAK HOUR TRAFFIC ON DMATPC NETWORK




NOTE: DMATPC PLAN INCLUDES THE PRESENCE OF THE LOOP ARTERIAL WHICH INCLUDES AN INTERCHANGE AT FLEUR DR.

## YEAR 2010 PEAK HOUR TRAFFIC ON PROPOSED NETWORK




NOTE: 2010 PEAK HOUR TRAFFIC ON PROPOSED NETWORK BASED ON PROPOSED RECONFIGURATION SHOWN IN EXHIBIT 15

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YEAR 2010 PEAK HOUR TRAFFIC AT GRAND AVE./LOCUST AVE./FLUER DR. ON PROPOSED NETWORK

EXHIBIT 16

Compatibility with Long Range Plan. -- The proposed reconfiguration of this area would serve to promote Ingersoll Avenue as a major east-west penetrator to the CBD. This is a desirable feature in that, as was previously noted, the Grand and Locust one-way pair will operate at or near capacity for year 2010 traffic. It is compatible with the plan for the CBD loop arterial, which includes an intersection at Ingersoll Avenue, but excludes intersections or interchanging at Grand Avenue.

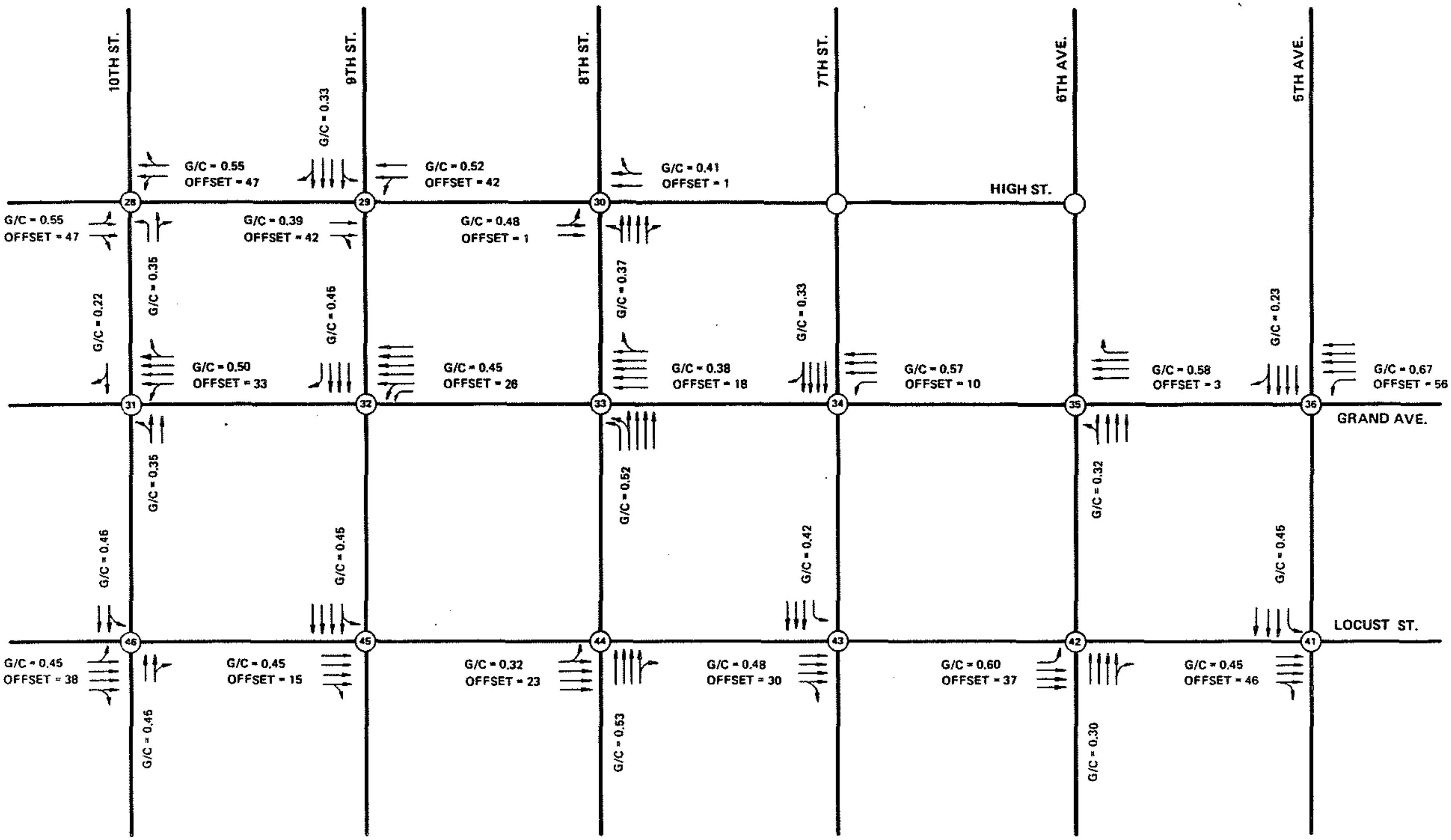
Access to Local Land Uses. -- Implementation of the new routing scheme requires consideration of local access changes and needs. Two areas were specifically considered: The Des Moines Independent School District Central Campus at the southwest quadrant of the Grand Avenue and Fleur Drive intersection and the Meredith Corporation parking garage south of the Locust Street and 17th Street intersection.

Access to the school along 18th Street will be maintained. The traffic control at the driveway should be stop controlled. Access into the site would be right-turn only from 18th Street. Egress could be made either with a right turn to southbound Fleur Drive or with an eastbound through movement to Locust Street.

The location and operation of driveways serving the parking garage would also remain the same. To enable service to the garage, one southbound lane along 17th Street between Grand Avenue and Locust Street could be provided.

Costs and Impacts. -- Reconstruction of 18th Street and the Grand/Locust intersection would be required to accomplish this plan. Some additional right-of-way would be necessary along the south side of Grand. The extent of encroachment on right-of-way to the west of 18th Street should be established. Other necessary improvements would be limited to removal of on-street parking, restriping, re-signing and signalization. The relatively low cost of improving the area is due to the already available width on 18th, 17th and 16th Streets, as well as on Grand Avenue.

Appendix E. contains a functional geometric plan of the proposed scheme. Construction costs for the improvement are estimated to be between $1.1 and $1.6 million. The higher value would include full replacement of pavement on

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PROPOSED LANE ARRANGEMENTS AND SIGNAL TIMING ALONG HIGH STREET, GRAND AVENUE AND LOCUST STREET

SCALE

EXHIBIT 17

(2) Re-timing of traffic signals along Grand Avenue and Locust Street should be implemented to minimize average stopped delay per vehicle and maximize progression along Grand Avenue and Locust Street. Among the recommended signal timing changes is the conversion at the 10th Street and Grand Avenue intersection from 2-phase signal to 3-phase signal providing a leading phase for northbound left-turning traffic.

Moreover, indications are that the existing 2-phase operation (at all other intersections) and 60-second cycle provides optimal results with respect to individual intersection operation as well as overall network operations. Analysis results of 2010 peak hour traffic on the proposed system are summarized in Table 14. Exhibit 17 documents proposed signal timing and lane arrangements within the CBD core.

<u>9th Street</u>. -- The potential exists for an adverse effect on capacity and operations of the 9th Street bridge southbound from the CBD. At present there are two lanes of capacity for southbound traffic. Restriping and other street system improvements along 9th Street may have limited effect due to the capacity constraint represented by the bridge.

To test this constraint, a series of T-7F runs was performed. Review of the output focused on the delay, saturation flow rates, and queue lengths associated with operation of the 9th Street/Mulberry Street intersection. Four separate runs were made, covering all combinations of the following variables:

(1) Through discharge capacity on 9th Street southbound (2 lanes, 3 lanes)
(2) Assumed saturation flow rate (1600 vphpl, 1500 vphpl)

T-7F Test Runs of Southbound Through Traffic
on 9th Street at Mulberry Street

| T-7F Test Runs | v/c | Average Delay (Sec./veh.) | Queue length (vehicles) Maximum | Queue length (vehicles) Capacity |
|---|---|---|---|---|
| 3 lanes SB @ 1600 vphpl | 0.69 | 3.1 | 5 | 42 |
| 2 lanes SB @ 1600 vphpl | 0.88 | 5.2 | 16 | 28 |
| 3 lanes SB @ 1500 vphpl | 0.74 | 3.4 | 5 | 42 |
| 2 lanes SB @ 1600 vphpl | 0.90 | 5.8 | 26 | 28 |

## TABLE 14

CBD Corridor

Detailed Year 2010 P.M. Peak Hour Signalized Intersection Analysis

(Analysis With Recommended Improvements)

| Intersection | LOS | Average Stopped Delay per vehicle (sec.) |
|---|---|---|
| **TRANSYT-7F Analysis** | | |
| High St./10th St.* | C | 16 |
| High St./9th St. | C | 16 |
| High St./8th St. | B | 13 |
| Grand Ave./10th St. | B | 12 |
| Grand Ave./9th St. | B | 12 |
| Grand Ave./8th St. | B | 11 |
| Grand Ave./7th St. | B | 8 |
| Grand Ave./6th Ave. | B | 12 |
| Grand Ave./5th Ave. | B | 11 |
| Locust St./10th St. | B | 13 |
| Locust St./9th St. | B-C | 15 |
| Locust St./8th St. | B | 9 |
| Locust St./7th St. | B | 8 |
| Locust St./6th Ave. | B | 7 |
| Locust St./5th Ave. | B | 11 |
| **HCM ANALYSIS** | | |
| Keo Way/12th St. | C | 19 |

* Analysis reflects two-way traffic on 10th Street through the intersection with High Street.

## VII. INTERIM YEAR IMRPROVEMENTS

The CBD Loop Arterial will play a major role in providing access to developing areas of Des Moines, particularly to the south of the CBD. At the present time it is uncertain when complete funding will be available to construct the loop arterial.

An evaluation was made of potential traffic impacts associated with employment and population growth as planned, without a completed loop arterial. This section of the report addresses the impacts of "interim year" traffic on the Des Moines CBD.

### Interim Year Forecast

Iowa DOT computer assignments of the year 2010 trip table to networks that included and excluded the loop arterial were used to forecast traffic for the interim year. The following is a brief summary of the process:

1) All Year 2010 development was assumed to occur by the "interim year."

2) Assignments performed on two networks were evaluated in the area around the CBD. Cordon lines were drawn and ADT volumes from the assignments added across the cordons.

3) Cordon totals were compared for the two cases (final year 2010 and interim year) as shown in Exhibit 18.

4) Final year 2010 peak period traffic forecasts in the CBD were factored based on the ratio of cordon counts to simulate differences in travel patterns in the interim year. Factors were applied to through volumes at each intersection.

The above procedure produces a rough estimate of potential changes in traffic patterns. More involved or sophisticated modeling, beyond the scope of this project, would be necessary to fully document the effects of no loop arterial on ramp and through volumes along I-235. The results of the analysis should be used with caution, in that they probably overestimate traffic impacts for two major reasons:

1) Increased traffic on all approaches to every intersection would not occur. The cordon increases reflect the less efficient network that may tend to increase total travel on the edges of the cordon. This effect would actually diminish toward the CBD core.

2) The interim year forecast assumes all year 2010 development would occur without the loop arterial. This is unlikely, given that much of the expected development south of the CBD is directly tied to the increased accessibility provided by the loop arterial. Hence, overall trip activity in the interim year is probably less than estimated here.

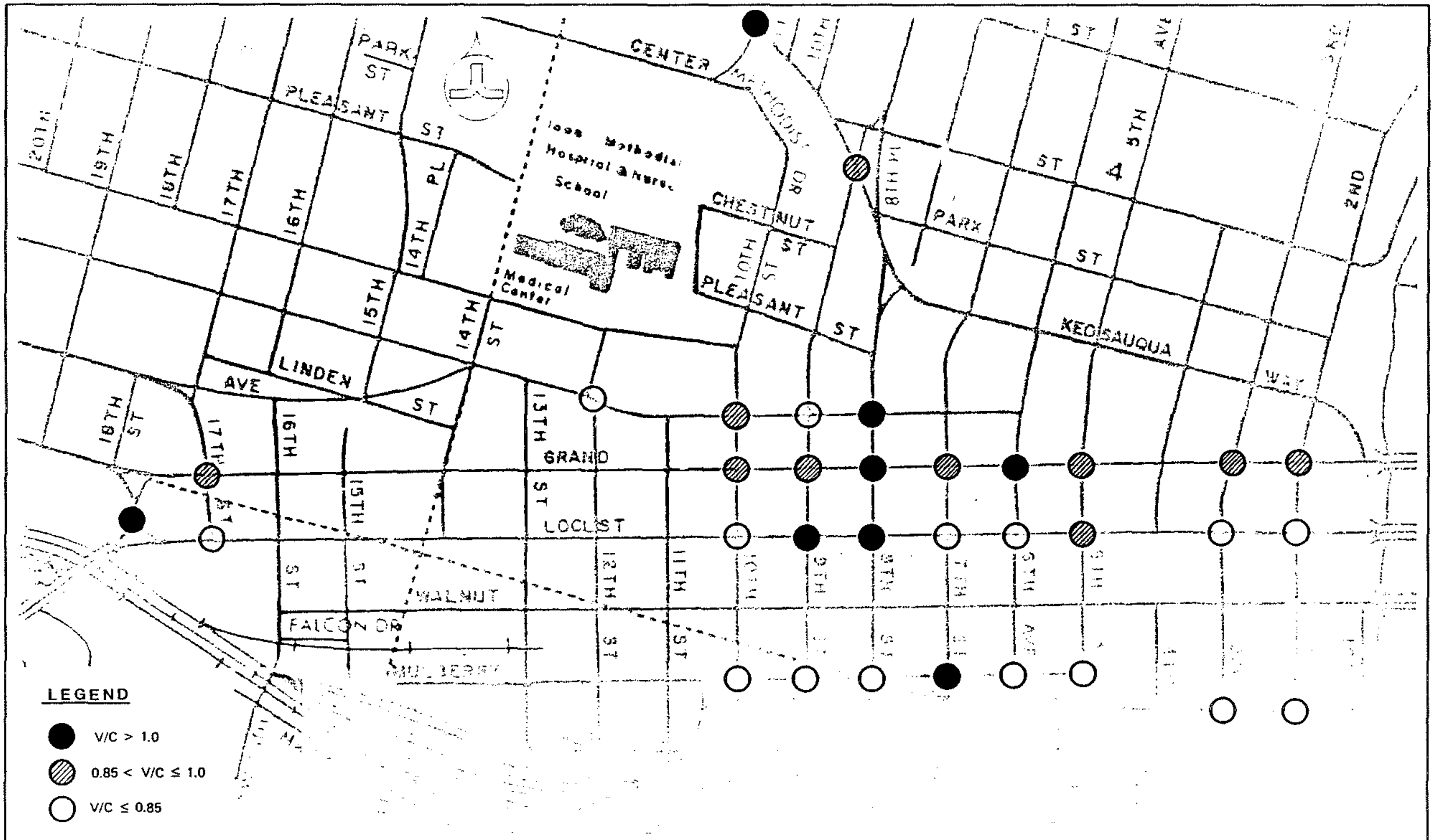
With the above caveats in mind, the interim year assignment was used to identify potential problems in the CBD. The results of the assignment are shown on Exhibit 19 and Table 15.

## Evaluation of Interim Year Traffic

Procedures used in evaluating interim year traffic impacts are the same as those used in evaluating 2010 traffic. The planning method of capacity analysis was performed on CBD intersections to determine intersections which require further analysis as a result of interim traffic. Table 15 lists results of this analysis. Exhibit 19, graphically summarizes the analysis.

### Interim Year, Level of Service Analysis--CBD Corridor

Signalized intersection level of service was performed on intersections which produced v/c ratios greater than 0.90. TRANSYT-7F (T-7F) was again employed to identify problem areas along High Street, Grand Avenue and Locust Street, while HCM analyses were performed outside the T-7F analysis corridor. The interim year peak hour traffic assignment used in the T-7F analysis is documented in Exhibit 20. Table 16 lists p.m. peak hour results for interim traffic on the existing system.

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INTERIM YEAR LEVEL OF
SERVICE ANALYSIS -- PM PEAK HOUR

EXHIBIT 19

## TABLE 16

CBD Corridor

Detailed Interim Year P.M. Peak Hour Signalized Intersection Analysis
(On Existing Network)

| Intersection | LOS | Average Stopped Delay per vehicle (sec) |
|---|---|---|
| **TRANSYT-7F** | | |
| High St./10th St. | F | 60+ |
| High St./9th St. | B | 13 |
| High St./8th St. | D | 28 |
| Grand Ave./10th St. | F | 60+ |
| Grand Ave./9th St. | F | 60+ |
| Grand Ave./8th St. | E | 52 |
| Grand Ave./7th St. | F | 60+ |
| Grand Ave./6th Ave. | F | 60+ |
| Grand Ave./5th Ave. | C | 16 |
| Locust St./10th St. | F | 60+ |
| Locust St./9th St. | F | 60+ |
| Locust St./8th St. | F | 60+ |
| Locust St./7th St. | E | 52 |
| Locust St./6th Ave. | F | 60+ |
| Locust St./5th Ave. | A | 4 |
| **HCM ANALYSIS** | | |
| Keo Way/12th St. | F | 60+ |
| Locust St./Grand Ave./Fleur Dr. | F | 60+ |
| Grand Ave./2nd Ave. | F | 60+ |
| Mulberry Ave./7th St. | F | 60+ |

The following improvements should also be implemented as part of the interim year program.

- o Grand Ave./10th St. -- Add southbound through lane at 10.5 feet.
- o Grand Ave./7th St. -- Add westbound through lane at 10.5 feet.
- o Grand Ave./6th Ave. -- Add westbound through lane at 10.5 feet.
- o Locust St./9th St. -- Add southbound through lane at 10 feet.

Implementation of the above additional improvements can be accomplished within the existing right-of-way through restriping. Operational benefits realized through these recommended improvements are shown in Table 17.

As traffic growth evolves and traffic patterns change, signal timing and signal phasing should be adjusted to provide optimal operation with respect to individual signal operation as well as system wide operation.

Although analysis of some intersections indicates levels of service lower than and delay greater than design criteria established earlier, no other improvements to approach capacity can be made without significant right-of-way impacts. However, due to the conservating approach taken in developing the interim assignment, the magnitude of traffic volumes used in the analysis, and the eventual implementation of the CBD Loop Arterial, additional improvement are not considered warranted.

# VIII. STUDY CONCLUSIONS

This study of traffic impacts in the City of Des Moines was performed in parallel with a major planning effort concerning future improvements to I-235 in Polk County. Both studies are intended to provide technical background to assist in decision making on future transportation needs in the region.

Both studies employed the same basic assumptions:

1) A "year 2010" demographic forecast was used as the basis for estimating future traffic volumes and patterns. The forecast, prepared by the Des Moines Transportation Planning Committee and refined for use in this study by City of Des Moines staff, predicts growth in population within Des Moines itself of 17 percent over 1986 levels. Growth in employment is predicted to be 40 percent. Trip making in Des Moines will increase by 30 percent by the year 2010 as a result of this growth.

2) The basic planning criteria used to size transportation facilities and determine street system improvments are compatible with the small city character of Des Moines. This means that every effort is made to accommodate traffic demand where and when it occurs.

3) The year 2000 approved transportation plan for the Des Moines area was assumed as a point of reference for all transportation issues. This includes approved widening of arterials, and new facilities such as the CBD Loop Arterial. It also includes planning assumptions regarding auto occupancy and transit.

With respect to Des Moines itself, traffic demand is largely focused on the CBD, and in particular, zones 197 through 202. The types and lengths of trips result in an increase in demand on I-235 of 26 to 32 percent west of the CBD, and 8 to 25 percent east of the CBD, as shown in Exhibit 21. Assuming this demand is accommodated on the freeway, traffic growth on the local street system both west and east of the CBD will be nominal.

Nominal increases in traffic translate to few, minor improvements on the street system outside the CBD to accommodate year 2010 traffic. Those improvements that are recommended for the most part would involve minimal reconstruction.

Within the CBD, substantial traffic growth will occur. Because of the extreme constraints common to central areas, improvements to accommodate this growth are primarily low-cost and operational in nature. These include restriping to add lanes, changes in parking regualtions and retiming of signals.

The following is a summary of all improvements required to accommodate traffic forecast for the year 2010:

| Location | Improvement | Estimated Cost of Construction |
|---|---|---|
| Grand/Locust/ Fleur | Reconstruct Intersection to provide conventional operation (see Exhibit 15) | $1.1 to 1.6 million |
| E. University Ave./ Hubbell Ave. | Add additional left turn lane at eastbound approach | $450,000 |
| E. University Ave./ E. 21st St. | Add additional through lane eastbound to provide three continuous through lanes | Included in cost of E. University Ave./ Hubbell Ave. construction |
| Keo Way/12th St. | Add dual left turn lane at northbound approach | Nominal-accomplished through restriping |
| Grand Ave./8th St. | Add left turn lane at northbound approach | Nominal-accomplished through restriping |
| Grand Ave./9th St. | Add left turn lane westbound | Nominal |
| Grand Ave./10th St. | Change signal operation to 3-phase | Nominal |
| Locust St./8th St. | Add additional through lane at northbound approach | Nominal-accomplished through peak-hour parking restrictions |
| Locust St./9th St. | Add additional through lane at southbound approach | Nominal-accomplished through peak-hour parking restrictions |

traffic away from the congested freeway. Bus transit service, while important to maintain and improve will not in all probability attract sufficient ridership to reduce highway system needs for the year 2010. HOV or other similar strategies have not proven to be viable options for the type of travel on I-235 in other locations. Furthermore, even if they were viable, their target market would not be Des Moines, but rather the western and northern suburbs. A successful HOV facility implies congested conditions for non HOV users. Such congestion would naturally result in diversion onto the Des Moines street system.

There is clearly a need for the city to address in a comprehensive, orderly manner transportation policy. Accessibility to each part of the city, land use control, transit. parking availability and cost are all factors that should be considered.

Regardless of the results of such policy review, the implications of the traffic forecast used for both this study and the Iowa DOT freeway study are clear. A forecast of nominal traffic increases on the local street system would not be valid if freeway reconstruction choices were made that relied on the above diversion techniques. Even small amounts of diverted traffic would have a significant impact on parallel east-west streets such as University, Grand and Ingersoll. Increased traffic on north-south streets would also occur south of I-235.

Accommodating the diverted traffic at a reasonable level of service would mean as a minimum the widening of University Avenue to a 5 to 7 lane arterial west of Keo Way; widening of Grand Avenue to a 5-lane arterial, west of Keo Way and probable widening of 63rd Ave. and 56th Streets south of I-235 and 42nd Street north of I-235. The costs of most of these improvements would be the responsibility of the city.

In conclusion, the extent of highway and street improvements required for year 2010 traffic projections is closely tied to the Iowa DOT's commitment to reconstruction of I-235.

## APPENDICES

APPENDIX A - Existing Intersection Channelization at select Intersections

APPENDIX B - Existing and Year 2010 Turning Movements at Select Intersections

APPENDIX C - TRANSYT-7F Operational Summary for Year 2010

APPENDIX D - Access to Local Land Uses During I-235 Reconstruction

APPENDIX E - Functional Plans

APPENDIX F - Investigation of One-Way Operation of 10th Street North of High Street

APPENDIX G - Glossary

## APPENDIX A

### Table A-1

Existing Intersection Lane Arrangements
(CBD Corridor)

| Node No. | Intersection | Intersection Approach | L | LT | LR | LTR | T | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| | | | Existing Lane Arrangements | | | | | | |
| 16 | 12th St./Keo Way | NB | | 1 | | | | 1 | |
| | | SB | | | | | | | |
| | | EB | | 1 | | | 1 | 1 | |
| | | WB | | 1 | | | 1 | 1 | |
| 17 | 9th St./Keo Way | NB | | | | | | | |
| | | SB | 1 | 1 | | | | 1 | |
| | | EB | | 1 | | | 1 | | 1 |
| | | WB | | 1 | | | 2 | | |
| 20 | 12th St./High St. | NB | | 1 | | | | | 1 |
| | | SB | | | | 1 | | | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 25 | 17th St./Grand Ave. | NB | | | | | | | |
| | | SB | | | | | 1 | 1 | |
| | | EB | | | | | | | |
| | | WB | | 1 | | | 2 | 1 | |
| 27 | 17th St./Locust St. | NB | | | | | | | |
| | | SB | 3 | | | | | | |
| | | EB | | | | | 4 | | |
| | | WB | | | | | | | |
| 28 | 10th St./High St. | NB | | 1 | | | | 1 | |
| | | SB | | | | 1 | | | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |

Table A-1 (Continued)

Existing Intersection Lane Arrangements
(CBD Corridor)

| Node No. | Intersection | Intersection Approach | Existing Lane Arrangements L | LT | LR | LTR | T | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| 35 | 6th Ave./Grand Ave. | NB | | 1 | | | 3 | | |
| | | SB | | | | | | | |
| | | EB | | | | | | | |
| | | WB | | | | | 3 | | 1 |
| 36 | 5th Ave./Grand Ave. | NB | | | | | | | |
| | | SB | | | | | 3 | 1 | |
| | | EB | | | | | | | |
| | | WB | 1 | | | | 4 | | |
| 37 | 3rd St./Grand Ave. | NB | | | | | | | |
| | | SB | | 1 | | | 1 | 1 | 1 |
| | | EB | | | | | | | |
| | | WB | | 1 | | | 2 | | |
| 38 | 2nd Ave./Grand Ave. | NB | 1 | 1 | | | 1 | 1 | |
| | | SB | | | | | | | |
| | | EB | | 1 | | | | | |
| | | WB | | | | | 2 | 1 | |
| 39 | 2nd Ave./Locust St. | NB | | | | | 3 | 1 | |
| | | SB | | | | | | | |
| | | EB | 1 | 1 | | | 2 | | |
| | | WB | | | | | | | |
| 40 | 3rd St./Locust St. | NB | | | | | | | |
| | | SB | | 1 | | | 2 | | |
| | | EB | | | | | 2 | 1 | |
| | | WB | | | | | | | |

**Table A-1** (Continued)

Existing Intersection Lane Arrangements
(CBD Corridor)

| Node No. | Intersection | Intersection Approach | Existing Lane Arrangements | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L | LT | LR | LTR | T | TR | R |
| 48 | 10th St./Mulberry St. | NB | | | | 1 | | | |
| | | SB | 1 | | | | | 1 | |
| | | EB | | | | 1 | | | |
| | | WB | | | | 1 | | | |
| 49 | 9th St./Mulberry St. | NB | | | | | | | |
| | | SB | | | | | 2 | 1 | |
| | | EB | | | | | 1 | 1 | |
| | | WB | | 1 | | | 1 | | |
| 50 | 8th St./Mulberry St. | NB | | 1 | | 1 | 1 | | 1 |
| | | SB | | | | | | | |
| | | EB | | 1 | | | 1 | | |
| | | WB | | | | | 1 | 1 | |
| 51 | 7th St./Mulberry St. | NB | | | 1 | | | | 1 |
| | | SB | 2 | | | | | 1 | |
| | | EB | | | | | 1 | 1 | |
| | | WB | | | | | | | |
| 52 | 6th St./Mulberry St. | NB | | 1 | | | 1 | 1 | |
| | | SB | | | | | | | |
| | | EB | 1 | 1 | | | 1 | 1 | |
| | | WB | | | | | | | |
| 53 | 5th St./Mulberry St. | NB | | | | | | | |
| | | SB | | | | | 3 | | |
| | | EB | | | | | | | 3 |
| | | WB | | | | | | | |

Table A-2

Existing Intersection Lane Arrangements
(Outside CBD Corridor)

| Node No. | Intersection | Intersection Approach | Existing Lane Arrangements L | LT | LR | LTR | T | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 25th St./University Ave. | NB | | | | 1 | | | |
| | | SB | | | | 1 | | | |
| | | EB | 1 | | | | | 1 | |
| | | WB | 1 | | | | 1 | 1 | |
| 2 | 24th St./University Ave. | NB | | | | 1 | | | |
| | | SB | | | | 1 | | | |
| | | EB | 1 | | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 3 | Harding Rd./Carpenter Ave. | NB | | | | | | | |
| | | SB | 1 | 1 | | | | 1 | |
| | | EB | | | | | 1 | 1 | |
| | | WB | | 1 | | | 1 | | |
| 4 | 19th St./Carpenter Ave.. | NB | | 1 | | | 1 | 1 | |
| | | SB | | | | | | | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | | 2 |
| 5 | Harding Rd./University Ave. | NB | | | | | | | |
| | | SB | | 1 | | | 1 | | 1 |
| | | EB | | | | | 1 | 1 | |
| | | WB | 1 | | | | 2 | | |
| 6 | 19th St./University Ave. | NB | | 1 | | | | 1 | |
| | | SB | | | | | | | |
| | | EB | 1 | | | | 2 | | |
| | | WB | | | | | 1 | 1 | |

**Table A-2** (Continued)

Existing Intersection Lane Arrangements
(Outside CBD Corridor)

| Node No. | Intersection | Intersection Approach | Existing Lane Arrangements L | LT | LR | LTR | T | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| 59 | E. 7th St./Locust Ave. | NB | | | | | | 1 | |
| | | SB | | | | | | | |
| | | EB | 2 | | | | | 1 | |
| | | WB | | | | | | | |
| 61 | 56th St./University Ave. | NB | 1 | | | | | 1 | |
| | | SB | 1 | | | | | 1 | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 63 | 42nd St./University Ave. | NB | 1 | | | | | 1 | |
| | | SB | 1 | | | | | 1 | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 65 | 31st St./University Ave. | NB | | | | 1 | | | |
| | | SB | | | | | | | |
| | | EB | | | | | 1 | 1 | |
| | | WB | 1 | | | | 2 | | |
| 66 | 30th St./University Ave. | NB | | | | | | | |
| | | SB | | | 1 | | | | |
| | | EB | 1 | | | | 2 | | |
| | | WB | | | | | 1 | 1 | |
| 67 | 28th St./University Ave. | NB | | | 1 | | | | |
| | | SB | | | | | 1 | 1 | |
| | | EB | | | | | | | |
| | | WB | 1 | | | | 1 | 1 | |

**Table A-2** (Continued)

Existing Intersection Lane Arrangements
(Outside CBD Corridor)

| Node No. | Intersection | Intersection Approach | Existing Lane Arrangements L | LT | LR | LTR | R | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| 92 | 42nd St./Grand Ave. | NB | 1 | | | | | 1 | |
| | | SB | 1 | | | | | 1 | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 93 | 35th St./Grand Ave. | NB | | | | | | | |
| | | SB | | | 1 | | | | |
| | | EB | | 1 | | | 1 | | |
| | | WB | | | | | 1 | 1 | |
| 94 | 31st St./Grand Ave. | NB | | | | 1 | | | |
| | | SB | | | | 1 | | | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 95 | 28th St./Grand Ave. | NB | | | | 1 | | | |
| | | SB | | | | 1 | | | |
| | | EB | | 1 | | | | 1 | |
| | | WB | | 1 | | | | 1 | |
| 96 | E. 5th St./Grand Ave. | NB | | | | 1 | | | |
| | | SB | | | | 1 | | | |
| | | EB | | | | 1 | | | |
| | | WB | | 1 | | | | 1 | |
| 97 | E. 6th St./Grand Ave. | NB | | 1 | | | | 1 | |
| | | SB | | 1 | | | | 1 | |
| | | EB | | | | 1 | | | |
| | | WB | | 1 | | | | 1 | |

**Table A-2** (Continued)

Existing Intersection Lane Arrangements
(Outside CBD Corridor)

| Node No. | Intersection | Intersection Approach | L | LT | LR | LTR | T | TR | R |
|---|---|---|---|---|---|---|---|---|---|
| 109 | E. 14th St./Walker St. | NB | | | | | | | |
| | | SB | 1 | | | | 2 | 1 | |
| | | EB | | | | | 1 | | |
| | | WB | | | | | 1 | | |
| 115 | E. 14th St./Grand Ave. | NB | | | | | | | |
| | | SB | 1 | | | | 2 | 1 | |
| | | EB | | | | | 1 | 1 | |
| | | WB | 1 | | | | 2 | | |
| 116 | E. 15th St./Grand Ave. | NB | 1 | | | | 2 | 1 | |
| | | SB | | | | | | | |
| | | EB | 1 | | | | 2 | | |
| | | WB | | | | | 1 | 1 | |
| 117 | E. 14th St./Walnut St. | NB | | | | | | | |
| | | SB | 1 | | | | 2 | 1 | |
| | | EB | | | | | 1 | | 1 |
| | | WB | 1 | | | | | 1 | |
| 118 | E. 15th St./Walnut St. | NB | | 1 | | | 1 | 1 | |
| | | SB | | | | | | | |
| | | EB | 1 | | | | 1 | | |
| | | WB | | | | | 1 | | 1 |
| 119 | E. 14th St./Court Ave. | NB | | | | | | | |
| | | SB | 1 | | | | 2 | 1 | |
| | | EB | | | | | 1 | 1 | |
| | | WB | 1 | | | | 2 | | |

# APPENDIX B

EXISTING TRIPS-AM

| NODE NO. | NORTHBOUND LEFT | NORTHBOUND THRU | NORTHBOUND RIGHT | SOUTHBOUND LEFT | SOUTHBOUND THRU | SOUTHBOUND RIGHT | EASTBOUND LEFT | EASTBOUND THRU | EASTBOUND RIGHT | WESTBOUND LEFT | WESTBOUND THRU | WESTBOUND RIGHT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 0 | 0 | 0 | 190 | 809 | 76 | 0 | 394 | 540 | 0 | 206 | 0 |
| 15 | 127 | 301 | 8 | 0 | 0 | 0 | 4 | 675 | 0 | 0 | 137 | 59 |
| 16 | 37 | 134 | 38 | 0 | 0 | 0 | 438 | 1817 | 428 | 47 | 176 | 7 |
| 17 | 0 | 0 | 0 | 32 | 533 | 25 | 0 | 591 | 1201 | 19 | 467 | 0 |
| 18 | 451 | 265 | 1 | 0 | 0 | 0 | 6 | 602 | 0 | 0 | 0 | 0 |
| 19 | 40 | 80 | 45 | 0 | 0 | 0 | 2 | 29 | 18 | 156 | 260 | 62 |
| 20 | 21 | 239 | 26 | 16 | 0 | 32 | 23 | 169 | 0 | 0 | 229 | 34 |
| 21 | 1 | 14 | 6 | 1 | 72 | 175 | 2 | 280 | 4 | 3 | 68 | 0 |
| 22 | 0 | 0 | 0 | 614 | 0 | 124 | 155 | 430 | 0 | 0 | 730 | 613 |
| 23 | 0 | 0 | 0 | 453 | 0 | 8 | 0 | 986 | 0 | 0 | 462 | 0 |
| 24 | 327 | 729 | 0 | 0 | 0 | 0 | 61 | 0 | 1223 | 341 | 409 | 479 |
| 25 | 0 | 0 | 0 | 0 | 601 | 45 | 0 | 0 | 0 | 104 | 1214 | 29 |
| 26 | 0 | 0 | 0 | 613 | 0 | 985 | 681 | 1088 | 0 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 | 542 | 156 | 0 | 0 | 1718 | 0 | 0 | 0 | 0 |
| 28 | 30 | 200 | 25 | 47 | 193 | 27 | 33 | 307 | 25 | 37 | 224 | 111 |
| 29 | 0 | 0 | 0 | 48 | 1329 | 160 | 0 | 279 | 51 | 45 | 303 | 0 |
| 30 | 120 | 836 | 77 | 0 | 0 | 0 | 54 | 240 | 0 | 0 | 488 | 55 |
| 31 | 54 | 137 | 0 | 0 | 170 | 31 | 0 | 0 | 0 | 228 | 1109 | 118 |
| 32 | 0 | 0 | 0 | 0 | 1063 | 300 | 0 | 0 | 0 | 336 | 1106 | 0 |
| 33 | 235 | 974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1264 | 105 |
| 34 | 0 | 0 | 0 | 0 | 953 | 378 | 0 | 0 | 0 | 229 | 1056 | 0 |
| 35 | 95 | 440 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1070 | 115 |
| 36 | 0 | 0 | 0 | 0 | 959 | 203 | 0 | 0 | 0 | 222 | 1100 | 0 |
| 37 | 0 | 0 | 0 | 47 | 834 | 690 | 0 | 0 | 0 | 47 | 924 | 0 |
| 38 | 287 | 725 | 0 | 0 | 0 | 0 | 0 | 88 | 0 | 0 | 701 | 75 |
| 39 | 0 | 764 | 59 | 0 | 0 | 0 | 343 | 593 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 86 | 440 | 0 | 0 | 515 | 56 | 0 | 0 | 0 |
| 41 | 0 | 0 | 0 | 162 | 851 | 0 | 0 | 936 | 148 | 0 | 0 | 0 |
| 42 | 0 | 526 | 65 | 0 | 0 | 0 | 276 | 747 | 0 | 0 | 0 | 0 |
| 43 | 0 | 0 | 0 | 349 | 877 | 0 | 0 | 967 | 137 | 0 | 0 | 0 |
| 44 | 0 | 1073 | 279 | 0 | 0 | 0 | 262 | 1090 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 0 | 262 | 1073 | 0 | 0 | 878 | 128 | 0 | 0 | 0 |
| 46 | 0 | 111 | 31 | 68 | 295 | 0 | 53 | 1125 | 79 | 0 | 0 | 0 |
| 47 | 16 | 117 | 0 | 0 | 316 | 50 | 0 | 0 | 8 | 0 | 10 | 0 |
| 48 | 6 | 78 | 30 | 83 | 158 | 27 | 4 | 63 | 8 | 40 | 155 | 122 |
| 49 | 0 | 0 | 0 | 194 | 836 | 121 | 0 | 146 | 36 | 52 | 215 | 0 |
| 50 | 174 | 1204 | 252 | 0 | 0 | 0 | 45 | 303 | 0 | 0 | 144 | 96 |
| 51 | 0 | 0 | 0 | 321 | 298 | 174 | 0 | 346 | 24 | 0 | 0 | 0 |
| 52 | 0 | 133 | 24 | 0 | 0 | 0 | 522 | 408 | 128 | 0 | 0 | 0 |
| 53 | 0 | 0 | 0 | 0 | 1011 | 0 | 0 | 0 | 405 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 5 | 760 | 8 | 0 | 26 | 0 | 165 | 39 | 227 |
| 55 | | | | | | | | | | | | |
| 56 | 0 | 0 | 14 | 508 | 147 | 0 | 0 | 515 | 16 | 0 | 0 | 0 |
| 57 | 0 | 102 | 25 | 0 | 0 | 0 | 194 | 565 | 180 | 0 | 0 | 0 |
| 58 | | | | | | | | | | | | |
| 132 | 0 | 0 | 0 | 10 | 590 | 0 | 0 | 290 | 20 | 0 | 0 | 0 |
| 133 | 0 | 0 | 0 | 380 | 1420 | 0 | 0 | 180 | 950 | 0 | 0 | 0 |
| 134 | 0 | 640 | 180 | 0 | 0 | 0 | 560 | 210 | 0 | 0 | 0 | 0 |
| 135 | | | | | | | | | | | | |
| 136 | | | | | | | | | | | | |
| 137 | | | | | | | | | | | | |

EXISTING TRIPS (PM)

| | NORTHBOUND | | | SOUTHBOUND | | | EASTBOUND | | | WESTBOUND | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NODE No. | LEFT | THRU | RIGHT | LEFT | THRU | RIGHT | LEFT | THRU | RIGHT | LEFT | THRU | RIGHT |
| 14 | 0 | 0 | 0 | 62 | 545 | 88 | 0 | 187 | 290 | 12 | 774 | 0 |
| 15 | 331 | 649 | 5 | 0 | 0 | 0 | 18 | 193 | 0 | 0 | 343 | 372 |
| 16 | 135 | 827 | 49 | 0 | 0 | 0 | 1552 | 555 | 87 | 50 | 557 | 40 |
| 17 | 0 | 0 | 0 | 36 | 367 | 124 | 0 | 223 | 495 | 62 | 1554 | 0 |
| 18 | 655 | 268 | 1 | 0 | 0 | 0 | 5 | 264 | 0 | 0 | 0 | 0 |
| 19 | 25 | 325 | 132 | 0 | 0 | 0 | 150 | 126 | 70 | 27 | 43 | 35 |
| 20 | 145 | 122 | 64 | 31 | 0 | 50 | 11 | 283 | 0 | 0 | 307 | 30 |
| 21 | 9 | 93 | 43 | 1 | 45 | 98 | 7 | 155 | 2 | 5 | 133 | 0 |
| 22 | 0 | 0 | 0 | 809 | 0 | 112 | 109 | 734 | 0 | 0 | 254 | 235 |
| 23 | 0 | 0 | 0 | 623 | 0 | 0 | 0 | 452 | 0 | 0 | 1212 | 0 |
| 24 | 203 | 824 | 0 | 0 | 0 | 0 | 141 | 0 | 1189 | 392 | 337 | 623 |
| 25 | 0 | 0 | 0 | 0 | 235 | 132 | 0 | 0 | 0 | 14 | 2293 | 289 |
| 26 | 0 | 0 | 0 | 353 | 0 | 1836 | 788 | 453 | 0 | 0 | 0 | 0 |
| 27 | 0 | 0 | 0 | 258 | 19 | 0 | 0 | 830 | 0 | 0 | 0 | 0 |
| 28 | 31 | 272 | 65 | 64 | 215 | 33 | 61 | 395 | 35 | 14 | 227 | 64 |
| 29 | 0 | 0 | 0 | 123 | 905 | 59 | 0 | 406 | 93 | 39 | 235 | 0 |
| 30 | 64 | 1167 | 115 | 0 | 0 | 0 | 116 | 332 | 0 | 0 | 530 | 203 |
| 31 | 150 | 280 | 0 | 0 | 106 | 32 | 0 | 0 | 0 | 81 | 1391 | 92 |
| 32 | 0 | 0 | 0 | 0 | 893 | 212 | 0 | 0 | 0 | 580 | 1410 | 0 |
| 33 | 238 | 1071 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1577 | 328 |
| 34 | 0 | 0 | 0 | 0 | 620 | 352 | 0 | 0 | 0 | 281 | 1526 | 0 |
| 35 | 68 | 738 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1597 | 420 |
| 36 | 0 | 0 | 0 | 0 | 295 | 205 | 0 | 0 | 0 | 147 | 1616 | 0 |
| 37 | 0 | 0 | 0 | 101 | 562 | 451 | 0 | 0 | 0 | 76 | 1075 | 0 |
| 38 | 321 | 1690 | 25 | 0 | 0 | 0 | 0 | 87 | 10 | 0 | 760 | 359 |
| 39 | 0 | 1585 | 88 | 0 | 0 | 0 | 772 | 615 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 121 | 411 | 0 | 0 | 1005 | 128 | 0 | 0 | 0 |
| 41 | 0 | 0 | 0 | 260 | 342 | 0 | 0 | 1139 | 171 | 0 | 0 | 0 |
| 42 | 0 | 752 | 63 | 0 | 0 | 0 | 420 | 641 | 0 | 0 | 0 | 0 |
| 43 | 0 | 0 | 0 | 349 | 734 | 0 | 0 | 879 | 222 | 0 | 0 | 0 |
| 44 | 0 | 1058 | 263 | 0 | 0 | 0 | 271 | 1091 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 0 | 215 | 1129 | 0 | 0 | 1022 | 162 | 0 | 0 | 0 |
| 46 | 0 | 358 | 110 | 67 | 157 | 0 | 35 | 1003 | 61 | 0 | 0 | 0 |
| 47 | 29 | 338 | 0 | 0 | 193 | 42 | 18 | 0 | 28 | 0 | 0 | 0 |
| 48 | 6 | 195 | 63 | 191 | 53 | 13 | 21 | 285 | 7 | 7 | 40 | 37 |
| 49 | 0 | 0 | 0 | 205 | 1123 | 19 | 0 | 209 | 259 | 33 | 70 | 0 |
| 50 | 44 | 837 | 138 | 0 | 0 | 0 | 122 | 383 | 0 | 0 | 91 | 105 |
| 51 | 0 | 0 | 0 | 234 | 487 | 126 | 0 | 376 | 107 | 0 | 0 | 0 |
| 52 | 0 | 443 | 94 | 0 | 0 | 0 | 530 | 444 | 128 | 0 | 0 | 0 |
| 53 | 0 | 0 | 0 | 0 | 732 | 0 | 0 | 0 | 593 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 12 | 505 | 18 | 0 | 17 | 2 | 204 | 43 | 170 |
| 55 | | | | | | | | | | | | |
| 56 | 0 | 0 | 37 | 366 | 118 | 0 | 0 | 1215 | 32 | 0 | 0 | 0 |
| 57 | 0 | 267 | 16 | 0 | 0 | 0 | 491 | 933 | 36 | 0 | 0 | 0 |
| 58 | | | | | | | | | | | | |
| 59 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |
| 132 | 0 | 0 | 0 | 10 | 160 | 0 | 0 | 790 | 10 | 0 | 0 | 0 |
| 133 | 0 | 0 | 0 | 430 | 510 | 0 | 0 | 250 | 170 | 0 | 0 | 0 |
| 134 | 0 | 1915 | 575 | 0 | 0 | 0 | 490 | 225 | 0 | 0 | 0 | 0 |

# --> 19-091.01
ILE --> DES MOINES CBD
AM FUTURE TRAFFIC - REVISED AS OF 1/5/89

NODE VOLUMES

| | NORTHBOUND | | | | | SOUTHBOUND | | | | | EASTBOUND | | | | | WESTBOUND | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (02) | (01) | (09) | --TOTAL-- | | (04) | (03) | (10) | --TOTAL-- | | (06) | (05) | (11) | --TOTAL-- | | (08) | (07) | (12) | --TOTAL-- | |
| NODE | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY |
| 14 | 0 | 0 | 0 | 0 | 0 | 226 | 848 | 78 | 1153 | 1408 | 0 | 407 | 561 | 968 | 535 | 0 | 217 | 0 | 217 | 295 |
| 15 | 137 | 340 | 8 | 485 | 427 | 0 | 0 | 0 | 0 | 3 | 4 | 728 | 3 | 735 | 735 | 0 | 143 | 83 | 226 | 290 |
| 16 | 55 | 137 | 39 | 231 | 591 | 0 | 0 | 0 | 0 | 489 | 447 | 2138 | 441 | 3025 | 2176 | 48 | 461 | 7 | 516 | 517 |
| 17 | 0 | 0 | 0 | 0 | 0 | 79 | 659 | 26 | 763 | 2091 | 0 | 699 | 1413 | 2112 | 776 | 19 | 758 | 0 | 777 | 793 |
| 18 | 722 | 385 | 1 | 1108 | 391 | 0 | 0 | 0 | 0 | 0 | 6 | 757 | 0 | 763 | 758 | 0 | 0 | 0 | 0 | 722 |
| 19 | 45 | 82 | 46 | 173 | 147 | 0 | 0 | 0 | 0 | 183 | 2 | 30 | 24 | 56 | 75 | 159 | 274 | 63 | 496 | 319 |
| 20 | 42 | 244 | 27 | 312 | 302 | 16 | 0 | 33 | 49 | 0 | 23 | 470 | 0 | 494 | 513 | 0 | 572 | 35 | 606 | 646 |
| 21 | 1 | 14 | 6 | 21 | 281 | 169 | 73 | 179 | 421 | 81 | 2 | 416 | 4 | 422 | 590 | 3 | 169 | 264 | 437 | 349 |
| 22 | 0 | 19 | 12 | 31 | 806 | 632 | 16 | 126 | 774 | 26 | 158 | 694 | 0 | 852 | 1338 | 11 | 850 | 629 | 1490 | 975 |
| 23 | 0 | 0 | 0 | 0 | 0 | 462 | 0 | 15 | 477 | 0 | 0 | 1292 | 0 | 1292 | 1754 | 0 | 851 | 0 | 851 | 867 |
| 24 | 291 | 660 | 0 | 950 | 1134 | 0 | 0 | 0 | 0 | 1658 | 5 | 638 | 873 | 1515 | 638 | 755 | 778 | 469 | 2033 | 1069 |
| 25 | 0 | 0 | 0 | 0 | 92 | 0 | 697 | 56 | 753 | 804 | 0 | 0 | 0 | 0 | 0 | 105 | 2006 | 92 | 2204 | 2062 |
| 26 | 0 | 5 | 0 | 5 | 955 | 919 | 0 | 1372 | 2291 | 0 | 950 | 1440 | 0 | 2390 | 2358 | 0 | 0 | 0 | 0 | 1372 |
| 27 | 0 | 0 | 0 | 0 | 0 | 620 | 159 | 0 | 779 | 159 | 0 | 2351 | 0 | 2351 | 2971 | 0 | 0 | 0 | 0 | 0 |
| 28 | 131 | 206 | 26 | 362 | 353 | 48 | 200 | 28 | 275 | 263 | 34 | 640 | 25 | 699 | 714 | 38 | 455 | 113 | 606 | 613 |
| 29 | 0 | 0 | 0 | 0 | 0 | 49 | 1642 | 183 | 1874 | 1825 | 0 | 550 | 93 | 643 | 599 | 90 | 517 | 0 | 607 | 699 |
| 30 | 129 | 1105 | 152 | 1386 | 1358 | 0 | 0 | 0 | 0 | 0 | 77 | 648 | 0 | 725 | 800 | 0 | 697 | 176 | 872 | 625 |
| 31 | 55 | 140 | 0 | 195 | 339 | 0 | 173 | 32 | 205 | 411 | 0 | 0 | 0 | 0 | 0 | 238 | 1889 | 200 | 2326 | 1976 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 1386 | 563 | 1950 | 1892 | 0 | 0 | 0 | 0 | 0 | 505 | 1713 | 0 | 2218 | 2276 |
| 33 | 686 | 1207 | 0 | 1893 | 1316 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1895 | 109 | 2004 | 2591 |
| 34 | 0 | 0 | 0 | 0 | 0 | 0 | 1114 | 457 | 1571 | 1348 | 0 | 0 | 0 | 0 | 0 | 234 | 1613 | 0 | 1847 | 2070 |
| 35 | 97 | 644 | 0 | 741 | 761 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1627 | 117 | 1745 | 1724 |
| 36 | 0 | 0 | 0 | 0 | 0 | 0 | 1175 | 402 | 1577 | 1402 | 0 | 0 | 0 | 0 | 0 | 226 | 1395 | 0 | 1621 | 1797 |
| 37 | 0 | 0 | 0 | 0 | 0 | 48 | 914 | 704 | 1666 | 971 | 0 | 0 | 0 | 0 | 48 | 56 | 1215 | 0 | 1272 | 1919 |
| 38 | 525 | 912 | 0 | 1436 | 988 | 0 | 0 | 0 | 0 | 0 | 0 | 90 | 0 | 90 | 90 | 0 | 855 | 77 | 932 | 1380 |
| 39 | 0 | 1023 | 68 | 1030 | 1445 | 0 | 0 | 0 | 0 | 0 | 422 | 761 | 0 | 1183 | 829 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 0 | 0 | 88 | 521 | 0 | 609 | 826 | 0 | 757 | 305 | 1062 | 845 | 0 | 0 | 0 | 0 | 0 |
| 41 | 0 | 0 | 0 | 0 | 0 | 341 | 889 | 0 | 1231 | 1040 | 0 | 1194 | 151 | 1345 | 1535 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 537 | 66 | 603 | 1013 | 0 | 0 | 0 | 0 | 0 | 477 | 934 | 0 | 1461 | 1050 | 0 | 0 | 0 | 0 | 0 |
| 43 | 0 | 0 | 0 | 0 | 0 | 356 | 1037 | 0 | 1393 | 1312 | 0 | 1507 | 275 | 1782 | 1863 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 1733 | 552 | 2285 | 2026 | 0 | 0 | 0 | 0 | 0 | 293 | 1535 | 0 | 1828 | 2087 | 0 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 0 | 0 | 0 | 276 | 1551 | 0 | 1827 | 1775 | 0 | 1579 | 224 | 1804 | 1855 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 113 | 41 | 154 | 167 | 69 | 301 | 0 | 370 | 361 | 54 | 1878 | 81 | 2013 | 1988 | 0 | 58 | 0 | 58 | 58 |
| 47 | 16 | 128 | 0 | 145 | 128 | 0 | 327 | 51 | 378 | 335 | 0 | 0 | 8 | 8 | 0 | 0 | 10 | 0 | 10 | 78 |
| 48 | 6 | 80 | 31 | 116 | 208 | 85 | 161 | 28 | 273 | 210 | 4 | 109 | 8 | 122 | 225 | 41 | 185 | 124 | 350 | 219 |
| 49 | 0 | 0 | 0 | 0 | 0 | 198 | 1127 | 123 | 1448 | 1246 | 0 | 171 | 59 | 231 | 369 | 60 | 246 | 0 | 307 | 370 |
| 50 | 204 | 1688 | 269 | 2162 | 1832 | 0 | 0 | 0 | 0 | 0 | 46 | 332 | 0 | 377 | 601 | 0 | 154 | 98 | 252 | 359 |
| 51 | 0 | 0 | 0 | 0 | 0 | 327 | 582 | 177 | 1086 | 636 | 0 | 365 | 47 | 412 | 693 | 7 | 7 | 0 | 15 | 185 |
| 52 | 0 | 136 | 24 | 160 | 668 | 0 | 0 | 0 | 0 | 131 | 532 | 429 | 131 | 1092 | 453 | 0 | 15 | 0 | 15 | 15 |
| 53 | 0 | 0 | 0 | 0 | 0 | 0 | 1031 | 15 | 1046 | 1457 | 0 | 0 | 425 | 425 | 0 | 0 | 0 | 0 | 0 | 15 |

E --> 01-07-1989
# --> 19-091.01
LE --> DES MOINES CBD
PM FUTURE TRAFFIC - REVISED AS OF 1/6/89

NODE VOLUMES

| | NORTHBOUND | | | | | SOUTHBOUND | | | | | EASTBOUND | | | | | WESTBOUND | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (02) | (01) | (09) | --TOTAL-- | | (04) | (03) | (10) | --TOTAL-- | | (06) | (05) | (11) | --TOTAL-- | | (08) | (07) | (12) | --TOTAL-- | |
| NODE | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY | LEFT | THRU | RGHT | APPR | AWAY |
| 14 | 0 | 0 | 0 | 0 | 0 | 85 | 593 | 90 | 769 | 910 | 0 | 195 | 304 | 500 | 283 | 12 | 798 | 0 | 810 | 858 |
| 15 | 345 | 693 | 5 | 1043 | 1128 | 0 | 0 | 0 | 0 | 2 | 18 | 225 | 2 | 245 | 231 | 0 | 660 | 416 | 1077 | 1005 |
| 16 | 155 | 844 | 50 | 1048 | 2467 | 0 | 0 | 0 | 0 | 156 | 41 | 1031 | 57 | 1129 | 1081 | 89 | 1045 | 1583 | 2717 | 1200 |
| 17 | 0 | 0 | 0 | 0 | 0 | 117 | 520 | 126 | 764 | 1390 | 0 | 389 | 806 | 1195 | 506 | 63 | 1655 | 0 | 1720 | 1763 |
| 18 | 1231 | 448 | 1 | 1680 | 453 | 0 | 0 | 0 | 0 | 0 | 5 | 511 | 0 | 516 | 512 | 0 | 0 | 0 | 0 | 1231 |
| 19 | 35 | 332 | 135 | 501 | 521 | 0 | 0 | 0 | 0 | 115 | 153 | 129 | 77 | 359 | 263 | 38 | 56 | 37 | 130 | 90 |
| 20 | 166 | 124 | 65 | 355 | 166 | 32 | 0 | 51 | 83 | 0 | 11 | 786 | 0 | 797 | 983 | 0 | 751 | 31 | 782 | 968 |
| 21 | 9 | 95 | 44 | 148 | 413 | 280 | 46 | 100 | 426 | 53 | 7 | 408 | 2 | 417 | 732 | 5 | 336 | 311 | 652 | 445 |
| 22 | 0 | 18 | 12 | 30 | 373 | 834 | 22 | 114 | 970 | 35 | 111 | 1149 | 0 | 1260 | 1935 | 15 | 431 | 244 | 690 | 545 |
| 23 | 0 | 0 | 0 | 0 | 0 | 635 | 0 | 8 | 643 | 0 | 0 | 351 | 0 | 351 | 1565 | 0 | 1689 | 0 | 1689 | 1697 |
| 24 | 209 | 740 | 0 | 949 | 1412 | 0 | 0 | 0 | 0 | 2759 | 8 | 337 | 1353 | 1598 | 337 | 1405 | 1432 | 663 | 3501 | 1641 |
| 25 | 0 | 0 | 0 | 0 | 385 | 0 | 375 | 148 | 523 | 390 | 0 | 0 | 0 | 0 | 0 | 14 | 3420 | 385 | 3819 | 3568 |
| 26 | 0 | 5 | 0 | 5 | 954 | 818 | 0 | 2364 | 3182 | 0 | 949 | 972 | 0 | 1921 | 1789 | 0 | 0 | 0 | 0 | 2364 |
| 27 | 0 | 0 | 0 | 0 | 0 | 367 | 19 | 0 | 386 | 19 | 0 | 1840 | 0 | 1840 | 2207 | 0 | 0 | 0 | 0 | 0 |
| 28 | 180 | 280 | 66 | 527 | 428 | 55 | 222 | 34 | 311 | 272 | 62 | 887 | 35 | 985 | 1019 | 14 | 528 | 86 | 628 | 743 |
| 29 | 0 | 0 | 0 | 0 | 0 | 125 | 1344 | 86 | 1556 | 1603 | 0 | 810 | 163 | 973 | 935 | 55 | 511 | 0 | 608 | 598 |
| 30 | 70 | 1551 | 238 | 1859 | 2059 | 0 | 0 | 0 | 0 | 0 | 146 | 882 | 0 | 1029 | 1120 | 0 | 818 | 361 | 1179 | 688 |
| 31 | 153 | 286 | 0 | 439 | 498 | 0 | 108 | 33 | 141 | 201 | 0 | 0 | 0 | 0 | 0 | 53 | 2492 | 213 | 2757 | 2679 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 1329 | 553 | 1882 | 2148 | 0 | 0 | 0 | 0 | 0 | 819 | 2304 | 0 | 3123 | 2856 |
| 33 | 946 | 1421 | 0 | 2367 | 1761 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2217 | 340 | 2557 | 3553 |
| 34 | 0 | 0 | 0 | 0 | 0 | 0 | 812 | 471 | 1283 | 1099 | 0 | 0 | 0 | 0 | 0 | 287 | 2356 | 0 | 2642 | 2827 |
| 35 | 69 | 1011 | 0 | 1080 | 1439 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2428 | 428 | 2857 | 2498 |
| 36 | 0 | 0 | 0 | 0 | 0 | 0 | 568 | 524 | 1092 | 718 | 0 | 0 | 0 | 0 | 0 | 150 | 2302 | 0 | 2452 | 2825 |
| 37 | 0 | 0 | 0 | 0 | 0 | 103 | 690 | 460 | 1253 | 781 | 0 | 0 | 0 | 0 | 103 | 91 | 1545 | 0 | 1635 | 2005 |
| 38 | 690 | 1977 | 26 | 2693 | 2343 | 0 | 0 | 0 | 0 | 10 | 0 | 89 | 10 | 99 | 114 | 0 | 1004 | 366 | 1370 | 1695 |
| 39 | 0 | 1975 | 100 | 2075 | 2871 | 0 | 0 | 0 | 0 | 0 | 896 | 825 | 0 | 1721 | 926 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 0 | 0 | 123 | 552 | 0 | 676 | 1041 | 0 | 1334 | 489 | 1823 | 1458 | 0 | 0 | 0 | 0 | 0 |
| 41 | 0 | 0 | 0 | 0 | 0 | 492 | 388 | 0 | 880 | 562 | 0 | 1492 | 174 | 1666 | 1984 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 767 | 64 | 831 | 1454 | 0 | 0 | 0 | 0 | 0 | 687 | 1155 | 0 | 1842 | 1220 | 0 | 0 | 0 | 0 | 0 |
| 43 | 0 | 0 | 0 | 0 | 0 | 356 | 928 | 0 | 1284 | 1327 | 0 | 1621 | 399 | 2020 | 1977 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 2087 | 670 | 2757 | 2400 | 0 | 0 | 0 | 0 | 0 | 313 | 1672 | 0 | 1985 | 2342 | 0 | 0 | 0 | 0 | 0 |
| 45 | 0 | 0 | 0 | 0 | 0 | 228 | 1805 | 0 | 2032 | 2088 | 0 | 2026 | 283 | 2309 | 2253 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 365 | 120 | 485 | 401 | 68 | 160 | 0 | 228 | 222 | 36 | 2066 | 62 | 2164 | 2254 | 0 | 88 | 0 | 88 | 89 |
| 47 | 30 | 353 | 0 | 382 | 371 | 0 | 207 | 43 | 250 | 235 | 18 | 0 | 29 | 47 | 0 | 0 | 0 | 0 | 0 | 72 |
| 48 | 6 | 199 | 64 | 269 | 258 | 195 | 54 | 19 | 268 | 68 | 21 | 329 | 7 | 357 | 598 | 7 | 89 | 38 | 134 | 114 |
| 49 | 0 | 0 | 0 | 0 | 0 | 209 | 1495 | 19 | 1723 | 1822 | 0 | 232 | 283 | 515 | 441 | 44 | 119 | 0 | 164 | 139 |
| 50 | 93 | 1597 | 164 | 1854 | 1829 | 0 | 0 | 0 | 0 | 0 | 124 | 410 | 0 | 534 | 573 | 0 | 104 | 107 | 211 | 196 |
| 51 | 0 | 0 | 0 | 0 | 0 | 239 | 849 | 129 | 1216 | 988 | 0 | 407 | 128 | 535 | 645 | 11 | 11 | 0 | 21 | 139 |
| 52 | 0 | 452 | 96 | 548 | 992 | 0 | 0 | 0 | 0 | 131 | 541 | 476 | 131 | 1147 | 572 | 0 | 21 | 0 | 21 | 21 |
| 53 | 0 | 0 | 0 | 0 | 0 | 0 | 747 | 21 | 768 | 1375 | 0 | 0 | 628 | 628 | 0 | 0 | 0 | 0 | 0 | 21 |

## APPENDIX C

DES MOINES: 2010 TRAFFIC W/FINAL RECOMMENDATIONS INCLUDES MULBERRY (SIMUL)     CYCLE: 60 SECONDS,     60 STEPS   PAGE 10

(PERFORMANCE WITH INITIAL SETTINGS)

| NODE NO | LINK NO | FLOW (VEH/H) | SAT FLOW (VEH/H) | DEGREE OF SAT (%) | TOTAL TRAVEL (VEH-MI/H) | TOTAL TIME (VEH-H/H) | DELAY UNIFORM (VEH-H/H) | DELAY RANDOM (VEH-H/H) | DELAY TOTAL (VEH-H/H) | AVERAGE DELAY (SEC/VEH) | UNIFORM STOPS (VEH/H;%) | MAX BACK OF QUEUE (VEH/LN) | QUEUE CAPACITY (VEH/LN) | FUEL CONSUM (GA/H) | PHASE LENGTH (SEC) | LINK NO |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 3101 | 290 | 3209P | 22 | 16.40 | 1.66 | 1.10 | .02 | 1.12 | 13.9 | 238.0( 82%) | 4 | 24 | 2.84 | 27 | 3101 |
| 31 | 3102 | 150 | 3101S | 22 | 8.48 | .83 | .54 | .02 | .55 | 13.2 | 126.4( 84%) | 3101 | 3101S | 1.47 | 27 | 3102 |
| 31 | 3103 | 270 | 1400 | 83 | 12.75 | 3.01 | 1.64 | .94 | 2.58 | 34.4 | 240.3( 89%) | 4 | 10 | 3.73 | 16 | 3103 |
| 31 | 3107 | 2805 | 6344P | 88 | 186.50 | 13.48 | 5.73 | 1.62 | 7.35 | 9.4 | 2209.6( 79%) | 47 | 56 | 25.53 | 33 | 3107 |
| 31 | 3108 | 95 | 3107S | 88 | 6.32 | .46 | .19 | .06 | .25 | 9.4 | 73.6( 77%) | 3107 | 3107S | .86 | 33 | 3108 |
| 31 : | | 3610 | MAX = | 88 | 230.44 | 19.42 | 9.20 | 2.65 | 11.85 | 11.8 | 2887.9( 80%) | | | 34.48 | PI = | 35.1 |
| 32 | 3203 | 1300 | 4811 | 58 | 61.39 | 6.48 | 4.22 | .20 | 4.42 | 12.2 | 866.4( 67%) | 16 | 30 | 10.51 | 30 | 3203 |
| 32 | 3207 | 2350 | 6763 | 74 | 156.24 | 10.55 | 4.88 | .54 | 5.42 | 8.3 | 1504.8( 64%) | 33 | 55 | 18.92 | 30 | 3207 |
| 32 | 3208 | 850 | 2077 | 88 | 56.51 | 5.50 | 2.13 | 1.51 | 3.64 | 15.4 | 666.4( 81%) | 13 | 14 | 8.53 | 30 | 3208 |
| 32 | 3210 | 550 | 1400 | 84 | 25.97 | 4.11 | 2.15 | 1.09 | 3.24 | 21.2 | 440.3( 80%) | 8 | 10 | 5.85 | 30 | 3210 |
| 32 : | | 5050 | MAX = | 88 | 300.12 | 26.64 | 13.38 | 3.34 | 16.72 | 11.9 | 3497.9( 69%) | | | 44.16 | PI = | 31.5 |
| 33 | 3301 | 1450 | 5080 | 54 | 81.99 | 5.46 | 2.61 | .15 | 2.77 | 6.9 | 469.9( 32%) | 8 | 35 | 8.05 | 34 | 3301 |
| 33 | 3302 | 950 | 2200 | 81 | 53.72 | 4.47 | 1.85 | .85 | 2.70 | 10.2 | 322.5( 34%) | 6 | 12 | 6.01 | 34 | 3302 |
| 33 | 3307 | 2640 | 7881 | 84 | 172.20 | 15.39 | 8.66 | 1.07 | 9.73 | 13.3 | 1724.4( 65%) | 35 | 70 | 23.98 | 26 | 3307 |
| 33 : | | 5040 | MAX = | 84 | 307.91 | 25.32 | 13.12 | 2.08 | 15.20 | 10.9 | 2516.8( 50%) | | | 38.04 | PI = | 25.2 |
| 34 | 3403 | 1375 | 6065 | 65 | 64.93 | 8.74 | 6.26 | .30 | 6.56 | 17.2 | 1072.3( 78%) | 19 | 40 | 13.34 | 23 | 3403 |
| 34 | 3407 | 2190 | 4669 | 80 | 123.83 | 5.69 | .80 | .82 | 1.62 | 2.7 | 210.9( 10%) | 9 | 36 | 7.45 | 27 | 3407 |
| 34 | 3408 | 330 | 1478 | 38 | 18.66 | .78 | .11 | .06 | .17 | 1.8 | 22.2( 7%) | 0 | 12 | 1.01 | 37 | 3408 |
| 34 : | | 3895 | MAX = | 80 | 207.43 | 15.20 | 7.17 | 1.18 | 8.35 | 7.7 | 1305.4( 34%) | | | 21.80 | PI = | 13.2 |
| 35 | 3501 | 1370 | 6417P | 68 | 77.47 | 9.43 | 6.54 | .34 | 6.89 | 18.1 | 1111.4( 81%) | 21 | 48 | 14.54 | 22 | 3501 |
| 35 | 3502 | 90 | 3501S | 68 | 5.09 | .62 | .43 | .02 | .45 | 18.1 | 72.8( 81%) | 3501 | 3501S | .95 | 22 | 3502 |
| 35 | 3507 | 2430 | 4667 | 87 | 161.56 | 12.59 | 5.87 | 1.41 | 7.28 | 10.8 | 1928.4( 79%) | 35 | 42 | 22.91 | 38 | 3507 |
| 35 | 3512 | 430 | 1322 | 54 | 28.59 | 1.73 | .63 | .16 | .79 | 6.7 | 202.0( 47%) | 5 | 14 | 2.90 | 38 | 3512 |
| 35 : | | 4320 | MAX = | 87 | 272.71 | 24.37 | 13.48 | 1.94 | 15.41 | 12.8 | 3314.5( 77%) | | | 41.30 | PI = | 30.2 |
| 36 | 3603 | 1120 | 5954 | 75 | .00 | 7.04 | 6.47 | .57 | 7.04 | 22.6 | 970.8( 87%) | 17 ) | 0 | 10.52 | 17 | 3603 |
| 36 | 3607 | 2340 | 5954 | 58 | .00 | 3.42 | 3.22 | .19 | 3.42 | 5.3 | 1040.1( 44%) | 20 ) | 0 | 8.25 | 43 | 3607 |
| 36 | 3608 | 180 | 1478 | 18 | .00 | .18 | .17 | .00 | .18 | 3.6 | 55.4( 31%) | 1 ) | 0 | .44 | 43 | 3608 |
| 36 : | | 3640 | MAX = | 75 | .00 | 10.64 | 9.86 | .77 | 10.64 | 10.5 | 2066.4( 57%) | | | 19.21 | PI = | 19.2 |
| 41 | 4103 | 390 | 4251 | 20 | 20.81 | 2.86 | 2.17 | .01 | 2.18 | 20.1 | 336.5( 86%) | 6 | 36 | 4.36 | 30 | 4103 |
| 41 | 4104 | 490 | 1447 | 73 | 26.12 | 4.89 | 3.56 | .48 | 4.04 | 29.7 | 460.1( 94%) | 8 | 12 | 6.64 | 30 | 4104 |
| 41 | 4105 | 1680 | 6314 | 57 | 95.00 | 4.85 | 1.54 | .19 | 1.73 | 3.7 | 440.4( 26%) | 13 | 48 | 7.66 | 30 | 4105 |
| 41 : | | 2560 | MAX = | 73 | 141.93 | 12.61 | 7.27 | .68 | 7.95 | 11.2 | 1237.0( 48%) | | | 18.66 | PI = | 12.5 |

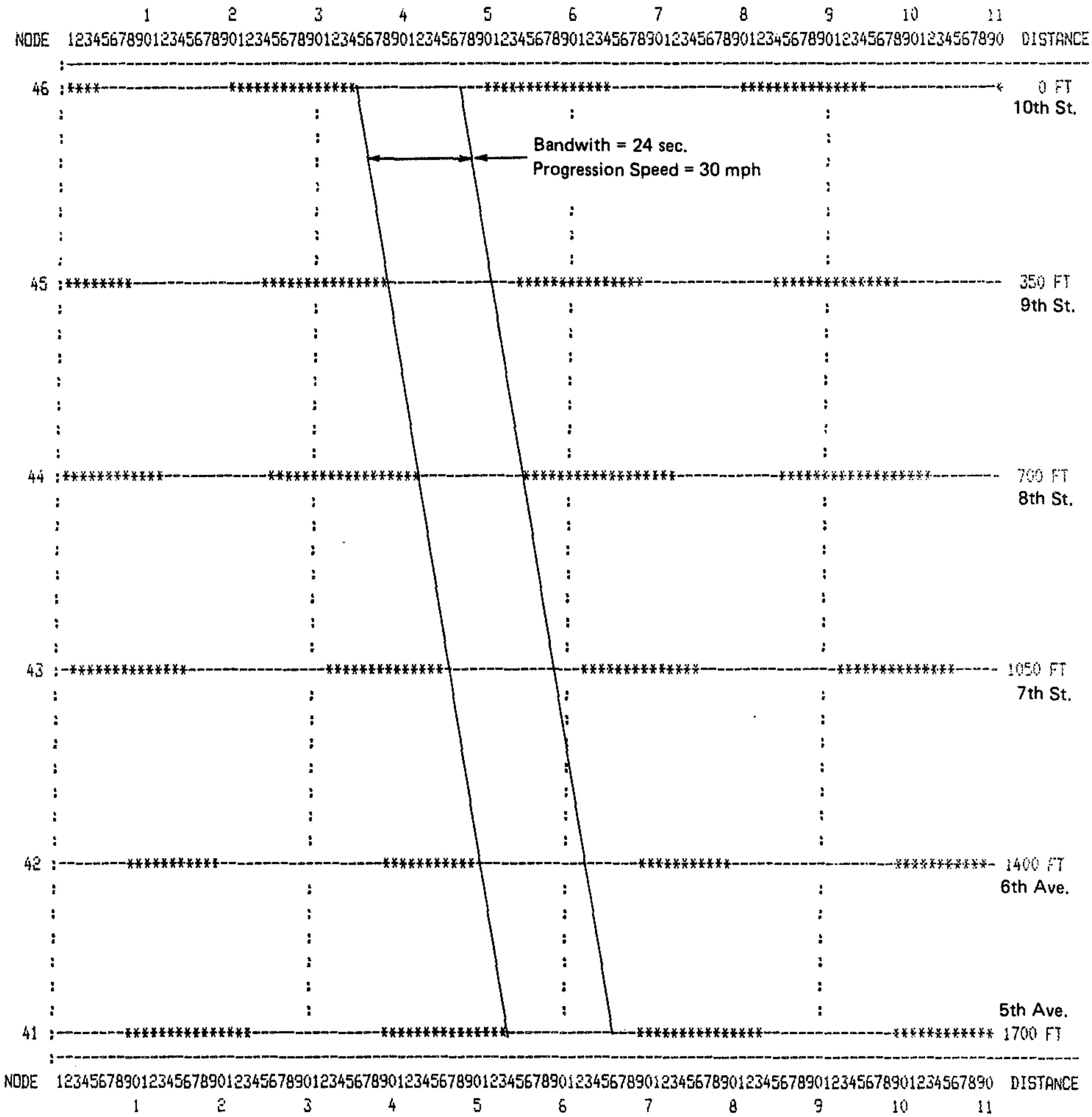
(SYSTEM WIDE TOTALS INCLUDING ALL LINKS)

| TOTAL DISTANCE TRAVELED (VEH-MI/H) | TOTAL TRAVEL TIME (VEH-H/H) | TOTAL UNIFORM DELAY (VEH-H/H) | TOTAL RANDOM DELAY (VEH-H/H) | TOTAL DELAY (VEH-H/H) | AVERAGE DELAY (SEC/VEH) | TOTAL UNIFORM STOPS (VEH/H-%) | TOTAL FUEL CONSUM (GA/H) | PERFORMANCE INDEX | SPEED (MI/H) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3044.32 | 255.19 | 127.18 | 27.63 | 154.81 | 10.60 | 30244.0( 58%) | 408.42 | 283.59 | 12.45 | (TOTALS) |

(TRANSYT-7F TIME-SPACE DIAGRAM)

PLOT NO. 2 PLOT TITLE: LOCUST AVENUE PROGRESSION

TIME AXIS IS IN: SEC TIME SCALE = 2 SEC/CHAR, DIST. SCALE = 40 FT/LINE




SCALE CONVERSIONS:
TIME/INCH = 2 * 10 (AT 10 CHAR/INCH)
DIST/INCH = 40 * 6 (AT 6 LINES/INCH)

+++ GREEN IN DOWN DIRECTION
GREEN IN BOTH DIRECTIONS
--- GREEN IN UP DIRECTION
*** RED IN BOTH DIRECTIONS

AVG. TIME DISPLACEMENT:
579.55 / SPEED

# APPENDIX D

## ACCESS TO LOCAL LAND USES DURING I-235 RECONSTRUCTION

An important task in the study, which was performed concurrently with the Iowa DOT I-235 freeway study was to evaluate the effects of access to hospitals and other specific study area land uses. Focus was placed on changes in access patterns created by the revised I-235 Interchanges and the temporary impacts during staged reconstruction. Exhibit 3 presented earlier identifies specific land uses investigated.

### Hospitals

Specific importance was placed on the ability of emergency vehicles to access hospitals along the corridor. Three hospitals were identified, Mercy Hospital, Methodist Hospital and Lutheran Hospital. Table D-1 summarizes existing access via I-235. Table D-1 describes access during I-235 reconstruction and access upon implementation of the year 2010 plan. Access to Lutheran Hospital will not be critical at any time during reconstruction and will not change in the year 2010 plan. The location of access to Methodist Hospital will remain on Keo Way in a slightly different interchange configuration. However, during phased reconstruction exiting traffic from both eastbound and westbound I-235 will temporarily have to use the exits at 19th Street. This would result in some increase in travel time for emergency vehicles. Similarly, for Mercy Hospital, westbound I-235 traffic will be detoured temporarily to University Avenue via the Pennslyvania Avenue interchange.

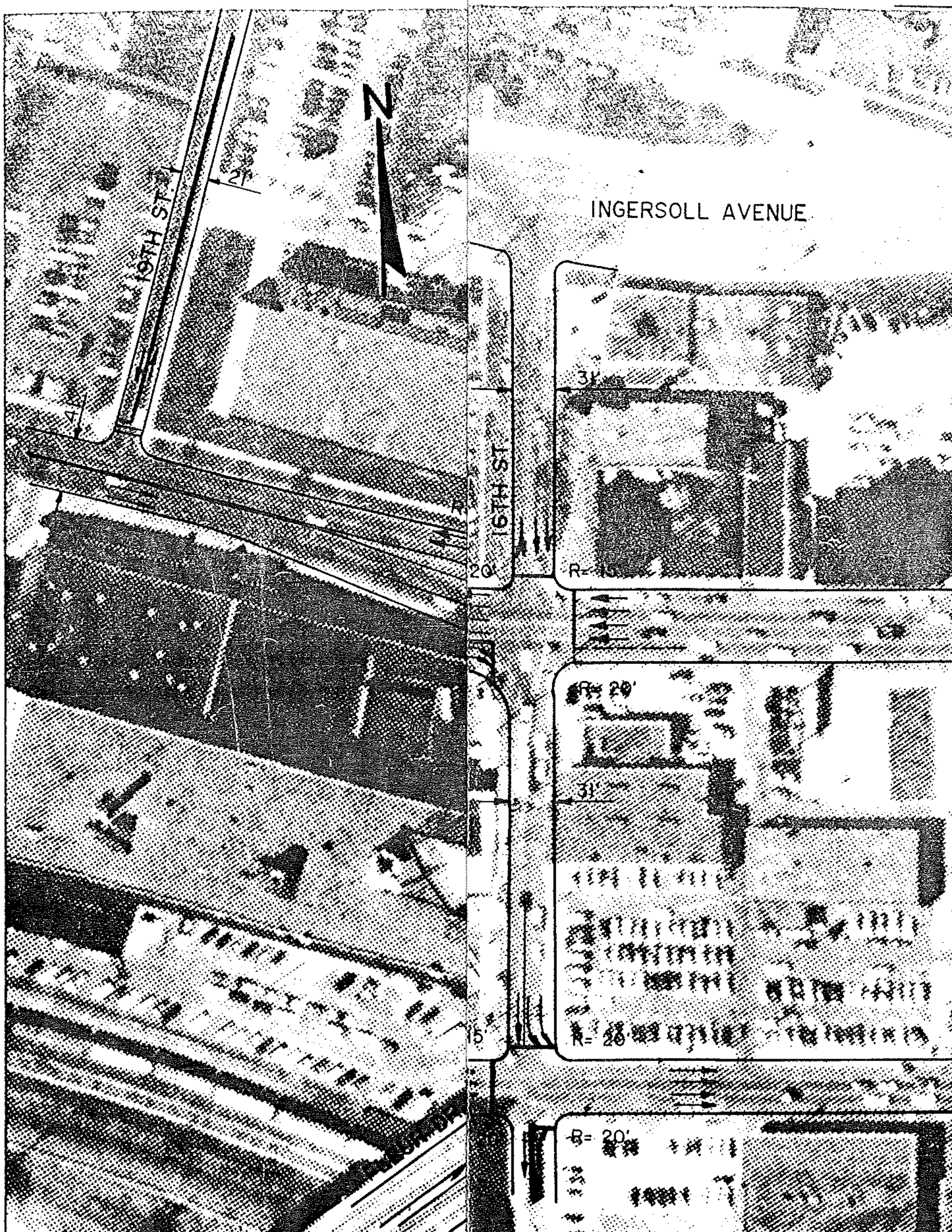
### Other Special Land Uses

Table D-1 summarizes future access via I-235 to other specifically recognized study area land uses. As Table D-1 indicates, access and egress to these land uses will be provided either directly or through minor detours during various construction phases. The only change in future access to a land use is associated with Drake University. Reconstruction of the 31st Street interchange to a full diamond interchange will provide full access and egress at this interchange for traffic oriented to the west. However, access can still be accommodated to Drake via Cottage Grove Avenue through the interchange along 19th Street.

**Table D-1 (Continued)**

Access to Special Land Uses During I-235 Reconstruction

| | | FUTURE ACCESS VIA I-235 | |
|---|---|---|---|
| SPECIAL LAND USE | EXISTING ACCESS VIA I-235 | ACCESS DURING I-235 RECONSTRUCTION PHASES | ACCESS IN YEAR 2010 |
| State Capitol | EB: Exit at E. 6th St.<br>Enter at E. 15th St. | EB: No Change, Temporary Connection during Phase III<br>No Change, Temporary Connection during Phase III | EB: No Change<br>No Change |
| | WB: Exit at E. 14th St.<br>Enter at E. 6th St. | WB: No Change, Temporary Connection during Phase III<br>No Change, Temporary Connection during Phase III | WB: No Cnange<br>No Change |
| Veterans Memorial Auditorium | EB: Exit at 5th Ave. or 3rd St.<br>Enter at 2nd Ave. | EB: No Change, Temporary Connection during Phase II<br>During Phase III, use Penn. Ave. | EB: No Change<br>No Change |
| | WB: Exit at 3rd St. or 5th Ave.<br>Enter at 7th St. or 2nd Ave. | WB: During Phase III, use E. 6th St.<br>During Phase III, use 7th St. Exclusively | WB: No Change<br>No Change |
| Sec. Taylor Stadium | EB: Exit at 3rd St.<br>Enter at 2nd Ave. | EB: No Change, Temporary Connection during Phase II<br>During Phase III, use Penn. Ave. | EB: No Change<br>No Change |
| | WB: Exit at 3rd St.<br>Enter at 2nd Ave. | WB: During Phase III, use 6th St.<br>During Phase III, use 7th St. | WB: No Change<br>No Change |
| Convention Center | EB: Exit at 5th Ave.<br>Enter at 5th Ave. | EB: No Change, Temporary Connection during Phase II<br>During Phase III, use Penn. Ave. | EB: No Change<br>No Change |
| | WB: Exit at 5th Ave.<br>Enter at 7th St. | WB: During Phase III, use E. 6th St.<br>No Change, Temporary Connection during Phase II | WB: No Change<br>No Change |
| State Fairgrounds | EB: Exit at University Ave.<br>Enter at Easton Blvd. | EB: No Change<br>No Change | EB: No Change<br>No Change |
| | WB: Exit at Easton Blvd.<br>Enter at University Ave. | WB: No Change<br>No Change | WB: No Change<br>No Change |




JACK E. LEISCH & ASS

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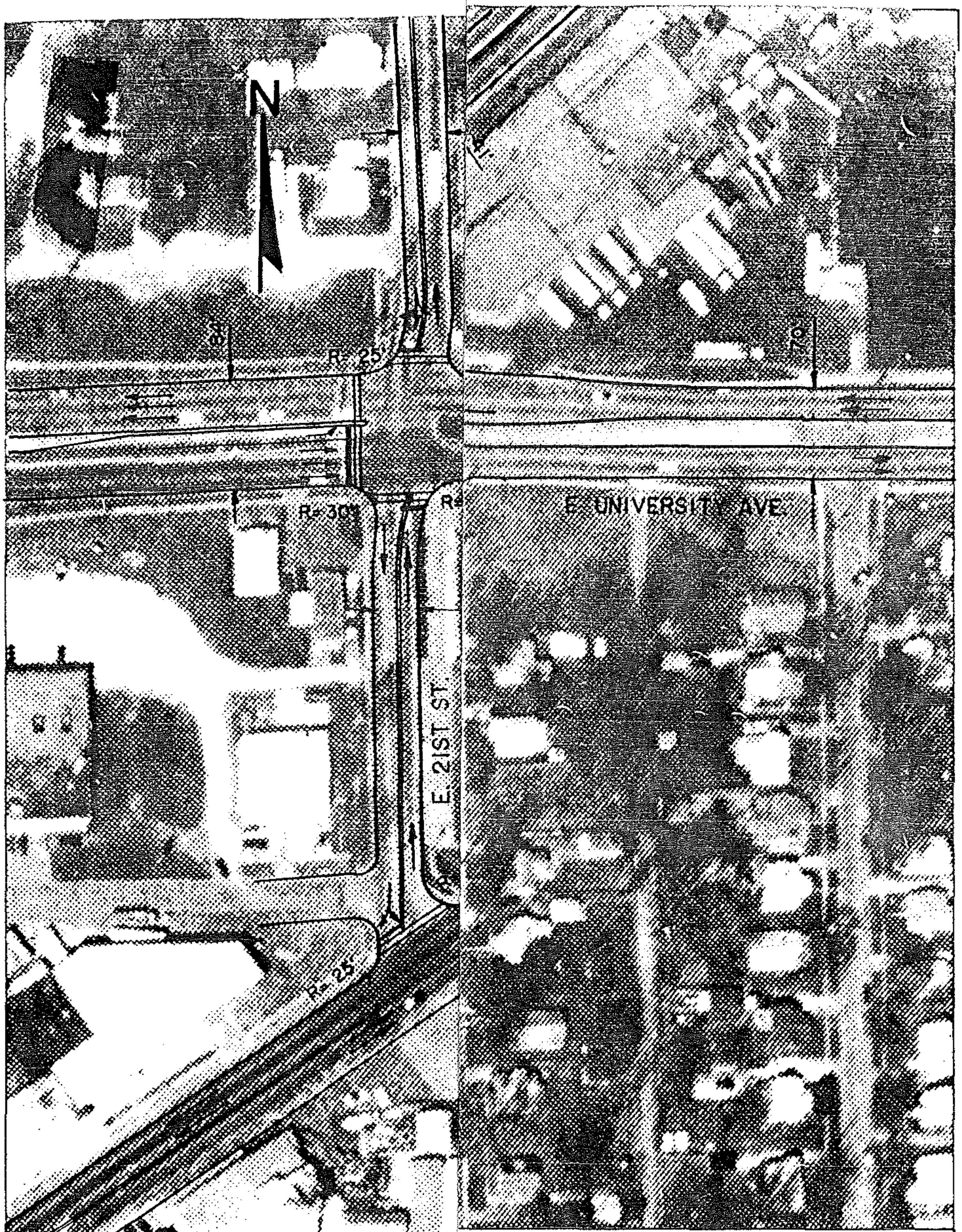
HORIZONTAL PLAN

RAND AVE./LOCUST ST./FLEUR DR.

EXHIBIT E1

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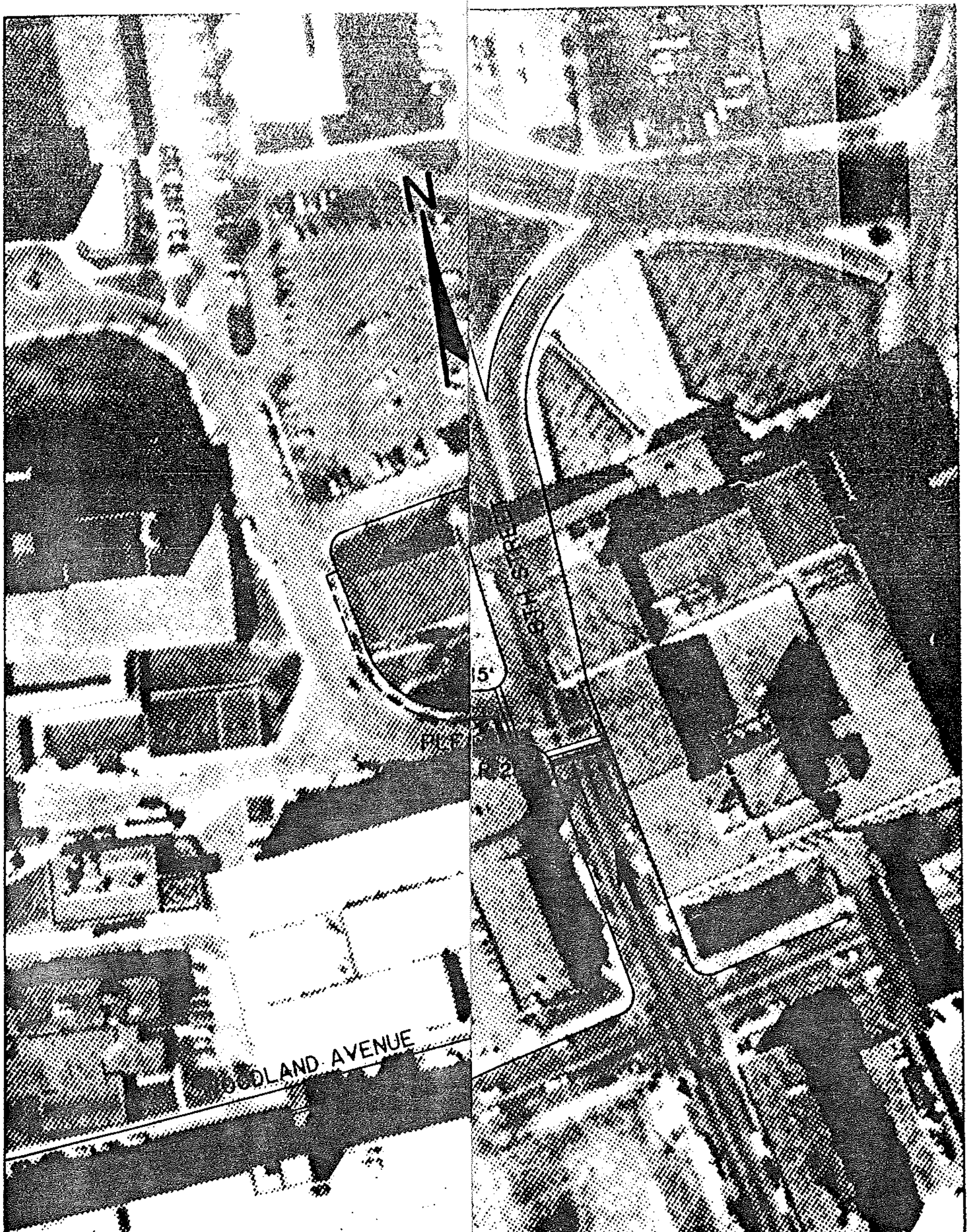
HORIZONTAL PLAN

VERSITY AVE./E. 21ST ST./HUBBELL AVE.

EXHIBIT E2

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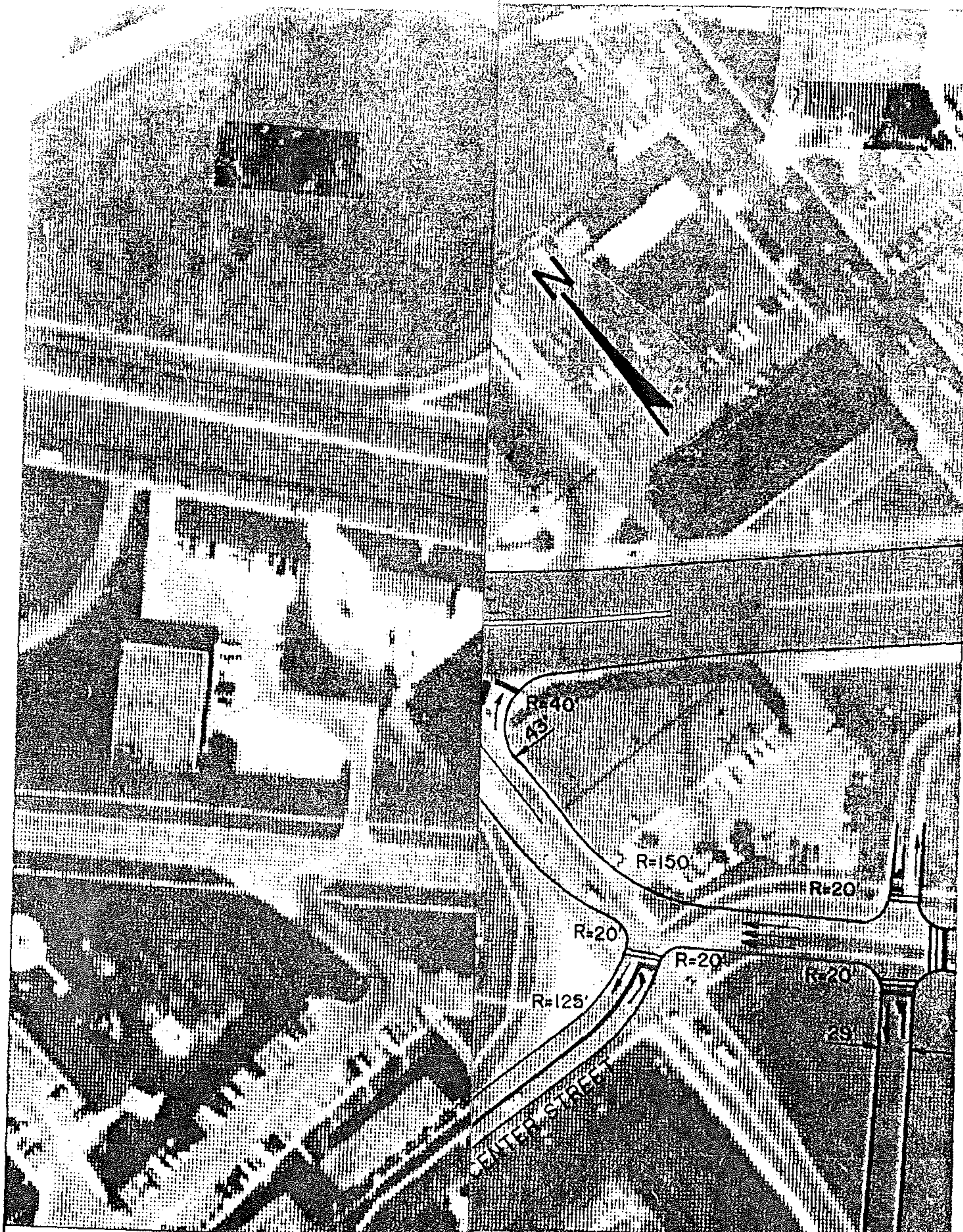
HORIZONTAL PLAN
WOODLAND AVE. EXTENSION

EXHIBIT E3

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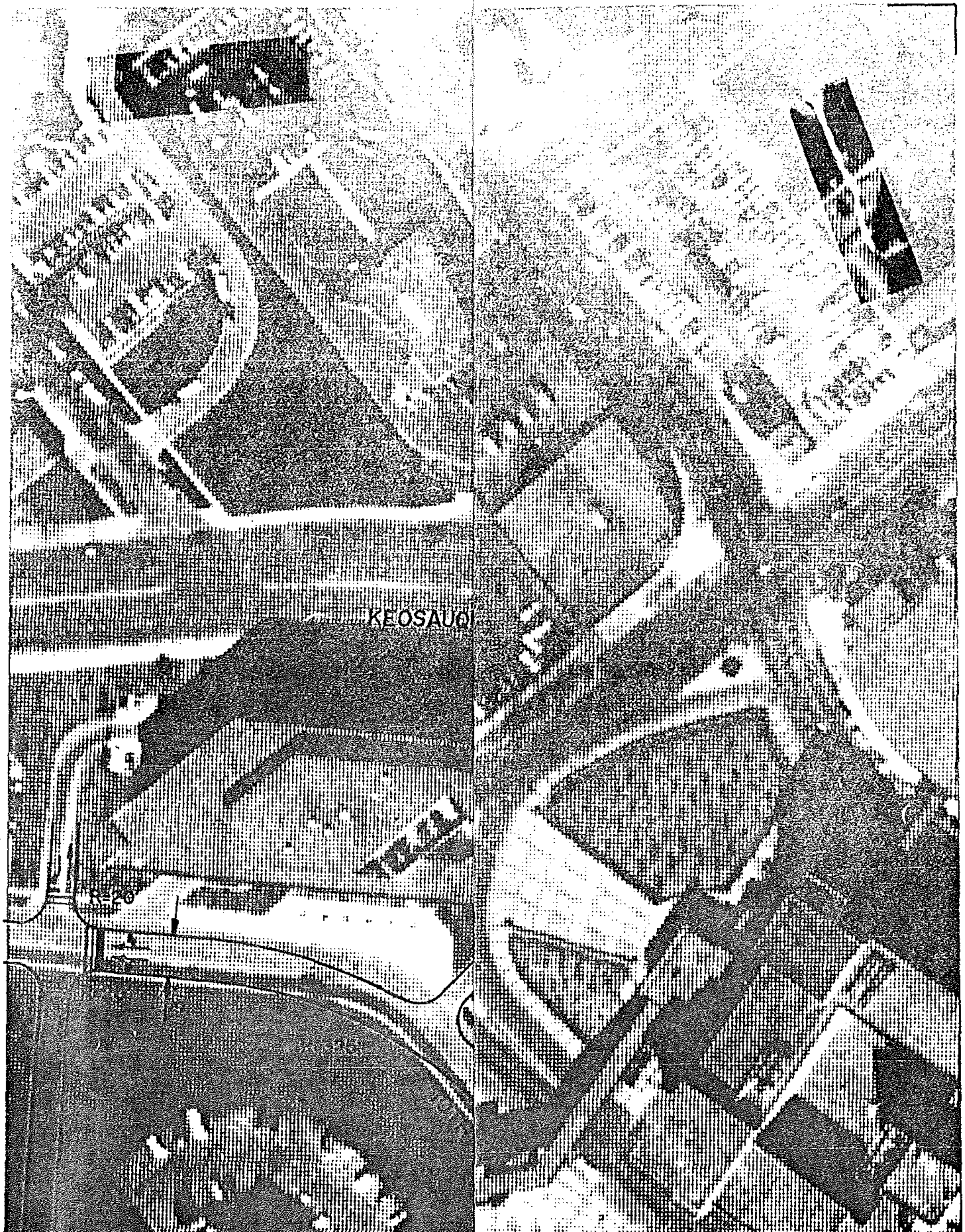
HORIZONTAL PLAN

2TH ST. AND 10TH ST. RECONSTRUCTION

EXHIBIT E4

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HORIZONTAL PLAN
10TH ST. RECONSTRUCTION

EXHIBIT E5

## APPENDIX F

### Investigation of One-way Operation of 10th Street North of High Street

Recommendations to accommodate year 2010 traffic impacts consist primarily of geometric improvements (within available right-of-way) and signal timing modifications. A particular constraint identified previously in Chapter IV was the existing configuration of arterial street operations (i.e., one-way vs. two-way) would be desirable to retain. However, consideration was given to converting 10th Street to one-way operation northbound north of High Street.

To identify the operational effects of the conversion, local traffic was rerouted and analyses performed at affected intersections. Table F-1, below, summarizes and compares signalized level of service analysis on the existing network and the ntework with 10th Street converted to one-way.

**TABLE F-1**

Operational Analysis* at Key Intersections

Assuming One-Way Operations of 10th Street North of High Street

| | Existing Network | | | Proposed Network (10th St. One-Way) | | |
|---|---|---|---|---|---|---|
| Intersection | LOS | Delay** | v/c | LOS | Delay** | v/c |
| High St. & 10th St. | D | 29.4 | 1.02 | B | 9.2 | 0.72 |
| High St. & 9th St. | B | 12.0 | 0.74 | B | 12.0 | 0.77 |
| Grand Ave. & 10th St. | B | 12.4 | 0.79 | B | 13.6 | 0.80 |
| Grand Ave. & 9th St. | D | 29.9 | 1.08 | D | 39.8 | 1.12 |

* All analyses reflect existing geometry and lane arrangements, except High St./10th St. where 10th St. is converted to one-way northbound.
** Average Stopped Delay per Vehicle (sec)

Southbound traffic on 10th Street would be diverted to either 8th Street or other parallel streets to the east and west. Consequently, traffic operations improve significantly at the intersection of High Street and 10th Street, but deteriorate slightly at High Street and 9th Street, and the already congested intersection of Grand Avenue and 9th Street The greatest benefit in this rerouting scheme as identified in Chapter VI, would be providing an alternative route for outbound CBD traffic during the evening peak period.

APPENDIX G

## Glossary of Transportation Terms

**AASHTO -** American Association of State Highway and Transportation Officials

**AVERAGE DAILY TRAFFIC (ADT) -**

The average 24-hour volume, being the total volume during a stated period divided by the number of days in that period. Unless otherwise stated, the period is one year.

**CAPACITY -** The maximum number of vehicles that can pass over a given section of a lane or roadway in one direction (or in both directions for a two-lane highway) during a given time period under prevailing roadway and traffic conditions. It is the maximum rate of flow that can occur.

**CBD -** Central Business District, generally an area of intense commercial development in the center of a region. The CBD defined in a transportation study may differ from the census definition.

**CYCLE LENGTH -** Cycle Length refers to the total time for all traffic movements or signal phases to be accommodated, after which the signal recycles.

**D -** Directional Distribution. The directional split of total two-way traffic during the peak or design hour, commonly expressed as percent in the peak and off-peak flow directions.

**DHV -** Design Hour Volume

**DMATPC -** Des Moines Area Transportation Planning Committee

**DOT -** Department of Transportation

**G/C -** The ratio of effective green time to the total cycle length for a specific movement at a signalized intersection.

**HCM -** Highway Capacity Manual (Transportation Research Board Special Report 209).

**LEVEL OF SERVICE (LOS) -**

Level of Service is a description of the quality of traffic flow. For signalized intersections LOS is defined in terms of average stopped delay per vehicle in seconds. Table 6 lists the range of delay for LOS A through LOS F.