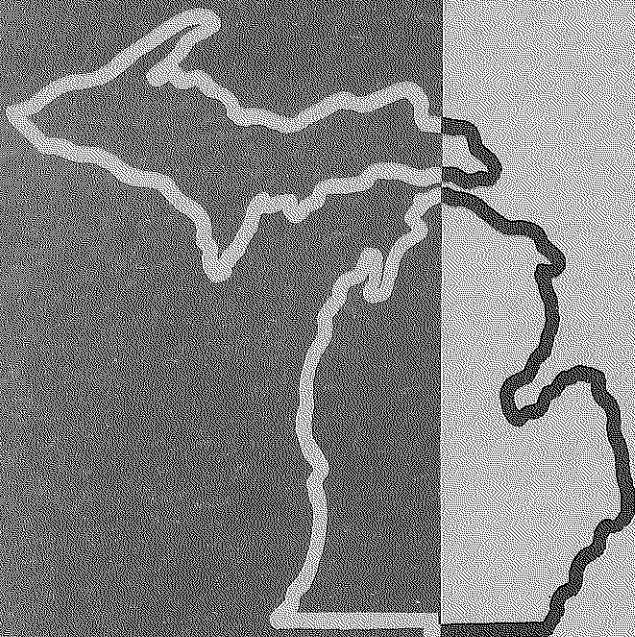


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THE MIDLAND METROPOLITAN AREA TRAFFIC STUDY

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MICHIGAN STATE HIGHWAY DEPARTMENT

CHARLES M. ZIEGLER, STATE HIGHWAY COMMISSIONER

MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

THE MIDLAND AREA TRAFFIC STUDY

STATE TRUNKLINE
and
ARTERIAL STREET SYSTEMS

Cooperating Agencies:

The City of Midland

U.S. Department of Commerce
Bureau of Public Roads

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Prepared by the
Planning and Traffic Division
July, 1953

FOREWORD

This report presents a selected state trunkline system in the Midland urban area which will be adequate to serve state trunkline traffic and which at the same time will be efficiently integrated with the arterial street system serving the local traffic of the city and its industry.

The selection of the Midland system is a step in the Department's policy of reviewing state trunkline routes in the principal cities of the state and revising them where necessary to meet current and estimated future traffic needs. Special conditions and requirements which have developed in Midland demanded that an early study be made of the trunkline situation in that area.

The analysis for this selection utilized the data obtained by an external Origin-Destination traffic survey made in the Midland area in 1946. The conclusions and recommendations presented herein are based on established principles of trunkline route location adapted to the special conditions and needs which the survey disclosed.

This report describes the steps in the selection of the urban trunkline system by means of a series of plates which present the pertinent data in graphic form and which are accompanied by ex-

planatory text. This series of plates shows:

1. The City of Midland and the state trunklines and traffic in its area, and the developments within the city which make it necessary to revise the urban trunkline system.
2. The arterial street plan adopted by the City of Midland and the usage that would be made of the different parts of that system by trunkline traffic in reaching destinations within the city area.
3. The streets selected from the revised arterial street plan that will best serve as an urban state trunkline system in the Midland area. Also shown is the way the selected trunkline system will integrate with both the established Midland arterial street plan and the projected revision of state trunkline routes in the Midland-Bay City-Saginaw area.

The final plan recommended by the report will provide efficient trunkline service in the Midland area and will contribute significantly to improving general traffic conditions there. Accomplishment of this plan will require the cooperation of the several governmental units and agencies whose interests or jurisdictions are involved.

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TERMINOLOGY AND DEFINITIONS

Central Business District:	The zones comprising the concentrated commercial and retail business center of the City.
Cordon Trip:	A trip with one terminal outside the Study Area and one terminal inside the Study Area.
Destination:	The place where a trip ends.
Downtown Area:	The zones comprising the central business district and its commercial-residential fringe.
External:	Outside the Study Area.
External Cordon:	The line connecting the external stations and outlining the Study Area.
External Station:	A point on a highway at the limits of the Study Area at which the drivers of vehicles were interviewed.
External Trip:	A trip with one or both of its terminals outside the Study Area.
Internal:	Within the Study Area.
Internal (Local) Trip:	A trip with both terminals inside the Study Area.
Non-Resident:	A person living outside the Study Area.
Origin:	The place where a trip begins.
Origin-Destination Zone; O-D Zone; Zone:	A basic subdivision of the Study Area having a single or dominant land use, designated for purposes of tabulation and analysis.
Resident:	A person living within the Study Area.
Study Area:	The area enclosed by the external cordon.
Through Trip:	A trip passing through the Study Area with both terminals outside the Study Area.
Trip:	One-way travel between an origin and a destination.
Trip Terminal:	A point where a trip begins or ends.

SUMMARY OF FACTS

- * Drivers of 15,077 vehicles were interviewed at the external cordon stations.
- * Of the 15,077 vehicles entering or leaving the area on an average weekday, 4,664 were reported as making through trips.
- * 85.5 percent of the traffic was made up of passenger cars.
- * 13.3 percent of the trips were made by trucks.
- * Busses and taxis accounted for 1.2 percent of all trips.
- * 76.6 percent of the traffic entering and leaving the area was carried on the state trunkline routes.
- * The peak hour on an average weekday was 4:00 PM to 5:00 PM when the bulk of the traffic was out-bound; 20 percent of the 24-hour total occurred in that peak hour.
- * The external cordon station counts showed 4,141 vehicles with destination at Dow Chemical Company plants; these trips made up 27 percent of all vehicles counted.
- * The study area included Midland and abutting territory totalling approximately nine square miles.

RECOMMENDATIONS

- * Adopt a revised trunkline system for the area with formal approval by the Midland City Planning Commission, the Midland City Council and the Michigan State Highway Department.
- * Construct a bridge at the foot of Jerome Street over the Tittabawassee River and the Chesapeake and Ohio Railroad.
- * Extend M-20 from the west approach of the Jerome Street Bridge to connect with the present M-20 west of the west city limits.
- * Relocate US-10 east and north of the city.
- * Reroute M-20 from Ellsworth Avenue over Second Street and East Second Street to connect with relocated US-10 and M-20 east of the city.
- * Extend Eastman Road north to connect US-10BR with relocated US-10 north of the city.

ECONOMY, GROWTH AND TRANSPORTATION

The need for a revision of the state trunkline system in Midland has been recognized and studied for a number of years by both the Department and the City. Midland's highway needs are serious

and growing more acute, but they are only one part of the general need for replanning and expanding public facilities which have been created by the phenomenal growth of the city's major industry.

MIDLAND AND THE DOW CHEMICAL COMPANY

Midland is the home of the Dow Chemical Company. When the original company was organized back in 1890, the town had only 2200 people and its sole importance was as the county seat and trading center of raw, sparsely settled Midland County. Growth was slow at first but during the last three decades, the company's operations, stimulated by two world wars and by remarkable developments in chemical engineering have transformed the former country town into the capital of a great and expanding industrial empire.

During the six years since World War II, the Dow Company has spent \$421 million in enlarging its productive plant. It recently announced plans for expanding in excess of \$100 million more for the same purpose during the next four years. Most of this plant expansion has taken or will take place in Midland. The company has been buying land by the square mile in and around the city to accommodate its growth.

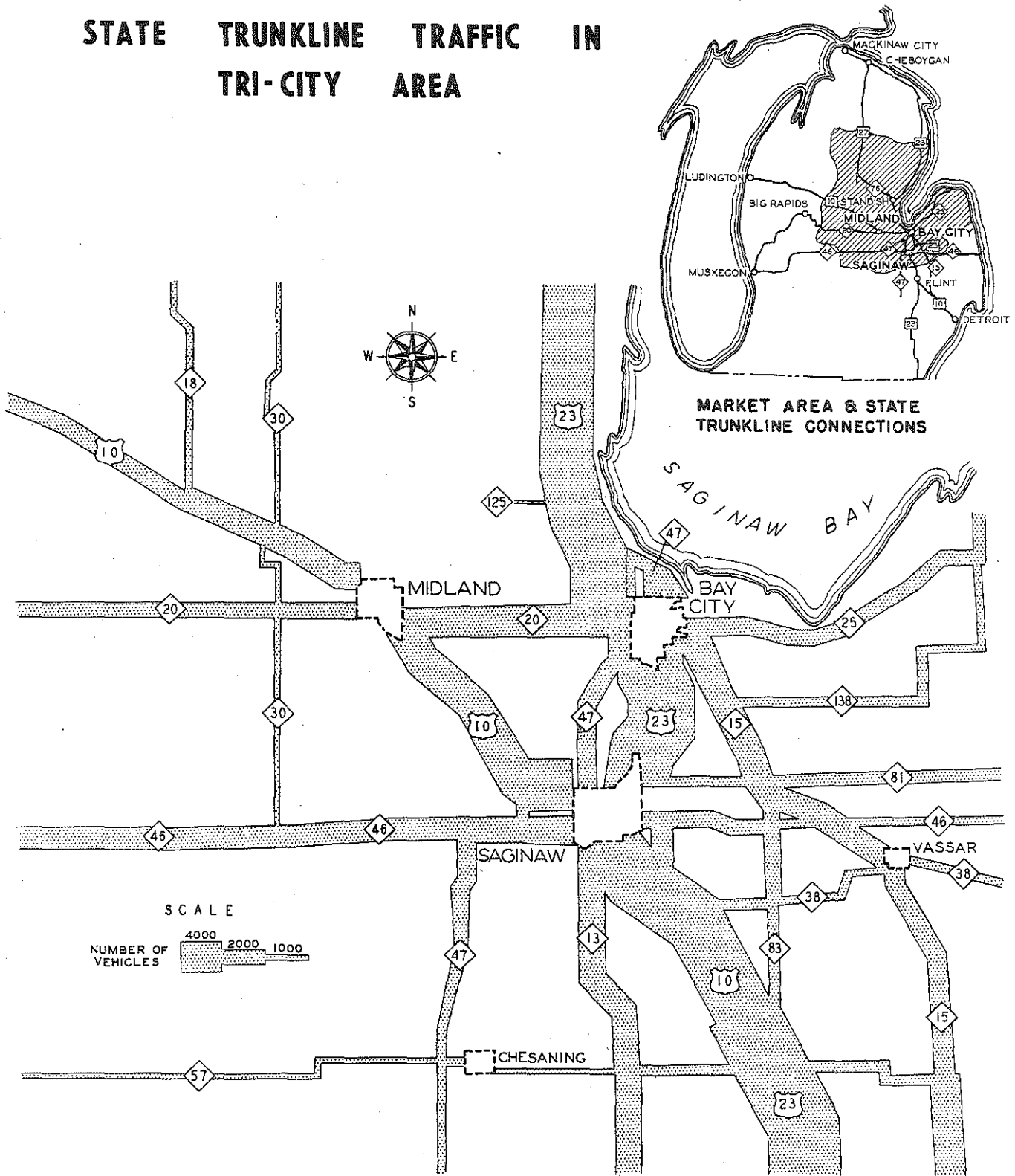
The company's development from a small local

plant to an immense industry whose operations and products are vital factors in the national economy and defense, is reflected in the record of the city's growth. Midland's population as shown in successive U.S. Census Reports is as follows:

		Percent Increase
1900	2,365	3.8
1910	2,527	6.9
1920	5,483	117.0
1930	8,038	46.6
1940	10,329	28.5
1950	14,285	38.3

In spite of the rapid increase shown above, Midland's corporate population does not meet the labor needs of the city's industry and business. Approximately 10,000 non-farming people live in suburban homes and settlements in surrounding townships, and there is a large daily movement of commuter employees from Bay City, Saginaw, and Mt. Pleasant.

STATE TRUNKLINE TRAFFIC IN TRI-CITY AREA



TRADE AREA, TRUNKLINE CONNECTIONS AND TRAFFIC

Midland is a market center of some importance although its trade area is restricted by the proximity of other active centers. Mt. Pleasant is 27 miles to the west, Bay City 17 miles to the east, Saginaw 21 miles to the southeast, and Alma about the same distance to the southwest. Because of this situation, Midland's immediate trade area is limited to the eastern half of Midland County.

The city is served by two railroads; the Saginaw-Ludington branch of the Chesapeake & Ohio Railroad, and a branch of the Michigan Central Railroad, extending to the city from Bay City.

Two state trunklines pass through Midland. US-10 is a major statewide route extending south-eastward to Saginaw, Flint and the Detroit metropolitan area, and northwestward to Clare and Ludington. M-20 runs west from Bay City, through Midland, to Mt. Pleasant, Big Rapids and Muskegon.

Midland has no north-south trunkline. It lies about midway between two main north-south arteries, US-23 and US-27; access to the northern and southern parts of its suburban and market area is afforded by connections with M-30 and by county roads.

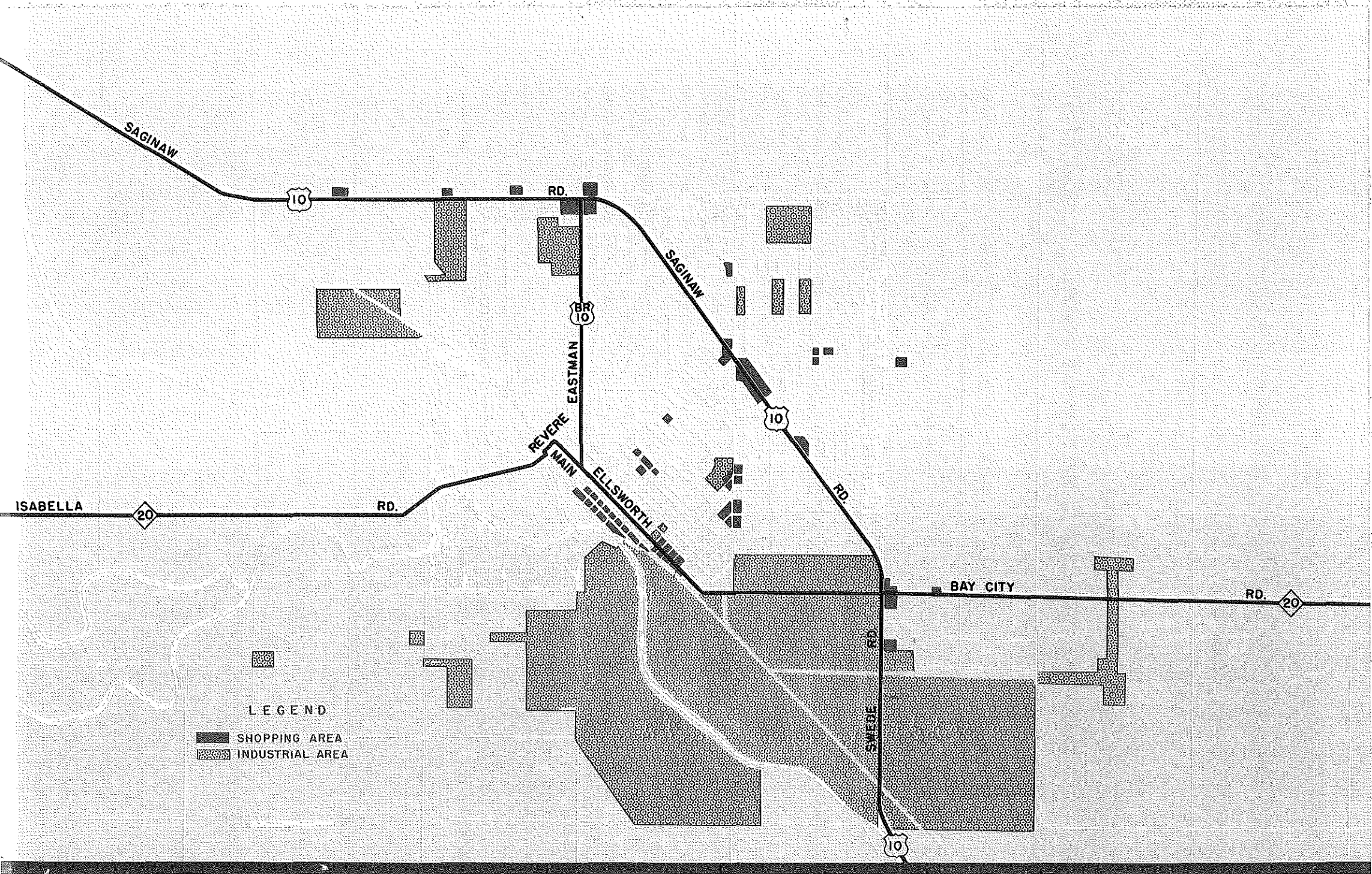
The traffic bands on Plate I indicate the close traffic relationship that exists between the cities

of Midland, Bay City, and Saginaw which comprise a rather closely knit tri-city area. Due to the location of this triangle of important cities on the routes of two major trunklines, a network of highways is needed to interconnect the cities and to by-pass the considerable quantities of through traffic around them.

A plan has been worked out and approved in principle by the Department and the planning authorities of the Bay City-Saginaw-Midland area for the improvement of state trunkline connections and service in that tri-city sector. The approved plan includes a projected route carrying US-10 and US-23 east of Saginaw, across the Saginaw River north of Saginaw and then north to join present US-23 northwest of Bay City. At a point west of Bay City, the route would intersect and join a projected highway located one-half mile south of the present line of M-20 which would carry US-10 and M-20 west to Midland. The plan contemplates continuance of a trunkline route between Saginaw and Midland and to the Tri-City Airport east of Freeland.

The selection of an urban trunkline system for Midland was aimed at obtaining satisfactory integration with this tri-city area plan.

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EXISTING TRUNKLINES AND LAND USES

EXISTING TRUNKLINES AND LAND USES

As shown on Plate II, state trunkline US-10 enters the Midland area at the southeast corner of the city on Swede Road, proceeds north on this road to a point just north of the Bay City Road (M-20), there it turns northwest onto Saginaw Road which it follows to the north city limits, where it turns west approximately two miles and then northwestward toward Clare.

M-20 enters the area from the east on Bay City Road and at East Ellsworth Street turns northwest through the central part of the city. The route turns southwest on Revere Street, crosses Main Street, and then proceeds across the Tittabawassee River and westward toward Mt. Pleasant on Isabella Road.

The business route of US-10 follows the route of M-20 westward from Swede Road to Eastman Road on which it goes north to rejoin US-10 at Saginaw Road.

At the time these routes were established, the city's business activities were almost entirely in the central district along East Main Street, and the Dow Chemical Company's operations were confined to the area southeast of the business district between the Chesapeake & Ohio Railroad and the Tittabawassee River.

The diagonal section of US-10 on Saginaw Road was designed and built in 1934 as a by-pass for through traffic around the central business and industrial districts. At the time of its construction, it traversed a very thinly developed suburban area. Since then the growth and expansion of the Dow

Chemical Company and its affiliated companies has been enormous. They have built and are building plants for the increased manufacture of drugs, chemicals, plastics, Dow Metal, and other related products. Further expansion is planned for the immediate future which will make this Midland industry one of the two or three largest chemical enterprises in the world.

Land has been bought by the companies east and north of the original plant site extending over a mile beyond the city limits. One and one-half miles east of the city, land served by a spur connection between the city's two railroad lines is being developed as a storage yard with tracks for shifting and loading materials and equipment. Other large parcels have been secured west of Midland and at several locations within the city.

These huge industrial developments and the consequent growth of population are making great changes in the pattern of the city and vastly increasing the load on the public facilities which serve it. The city, with the cooperation of the company, has been making every effort to keep pace with its expansion. In 1948 a master plan, including zoning ordinance, subdivision regulations, and an arterial street plan, was adopted. Following are some major projects included in the master plan, which have been completed since the plan was adopted:

Saginaw-Midland Water Supply Project	\$6,000,000
Storm Sewer Project	1,395,000
Street Maintenance and New Work	1,106,625

Highways have been particularly affected by the increased activity and changed pattern of the area, and their ability to provide adequate transportation is already seriously impaired. The following are among the conditions which have developed or are developing which make it essential that the state trunkline routes be relocated.

The expansion of the Dow industries has completely enveloped portions of all state trunklines, namely, the route of US-10 on its south approach to the city, the route of M-20 on the east, and the joint route of M-20 and US-10BR along Bay City Road to the central business district.

The tremendous expansion of plant facilities on both sides of US-10 at its south entrance to the city creates traffic problems in this area that even the most intelligent highway development and operation can no more than alleviate. To the east of the trunkline, the Dow-Corning Corporation and the Dow Chemical Company are making additions to existing buildings and erecting new facilities. To the west, the companies are constructing parking areas for employees and there is a service road leading to a truck terminal within the plant property.

M-20 in its east approach to the city divides an industrial area occupied by the Dow Chemical Company and its pilot plants which now extend 1.5 miles east of the east city limits. This development continues within the city throughout the section where M-20 and US-10BR share the same roadway. Here proposed plant expansion will utilize all available space along the route and as development proceeds it may be necessary to cross the right-of-way with the overhead piping and carriers which are essential in this type of industrial operation.

Parking facilities for over 2000 cars have been established near the intersection of US-10 and M-20, and parking areas are being developed all along the side of these trunklines throughout the section that traverses the plant area. As a result, the in-and-out movements of cars during shift changes cause congestion and increasing hazard and delay for both local and trunkline traffic. The State Highway Department has increased the pavement width of Bay City Road to 50 feet from Ellsworth Avenue to the intersection of US-10 to facilitate the movement of these heavy volumes.

The location of these trunklines involves another hazard which, while it at present is only potential, would be so serious that it deserves earnest consideration. Inasmuch as the Dow companies manufacture materials of prime and often secret importance to the nation's military forces, there is very real likelihood that in case of a war emergency these enveloped trunkline sections would be closed to all but plant traffic.

The effects of Midland's industrial expansion are evident well outside as well as within the immediate neighborhood of the plants.

Although the old central business district has expanded with Midland's growth, recent extensive housing developments in the northeast part of the city have led to the establishment of a new commercial district in that section. This busy shopping area is centered at the point where US-10 makes a complicated intersection with two major arteries, Ashman and Jefferson Streets. The building of new and modern business places is progressing rapidly in both directions along the trunkline route.

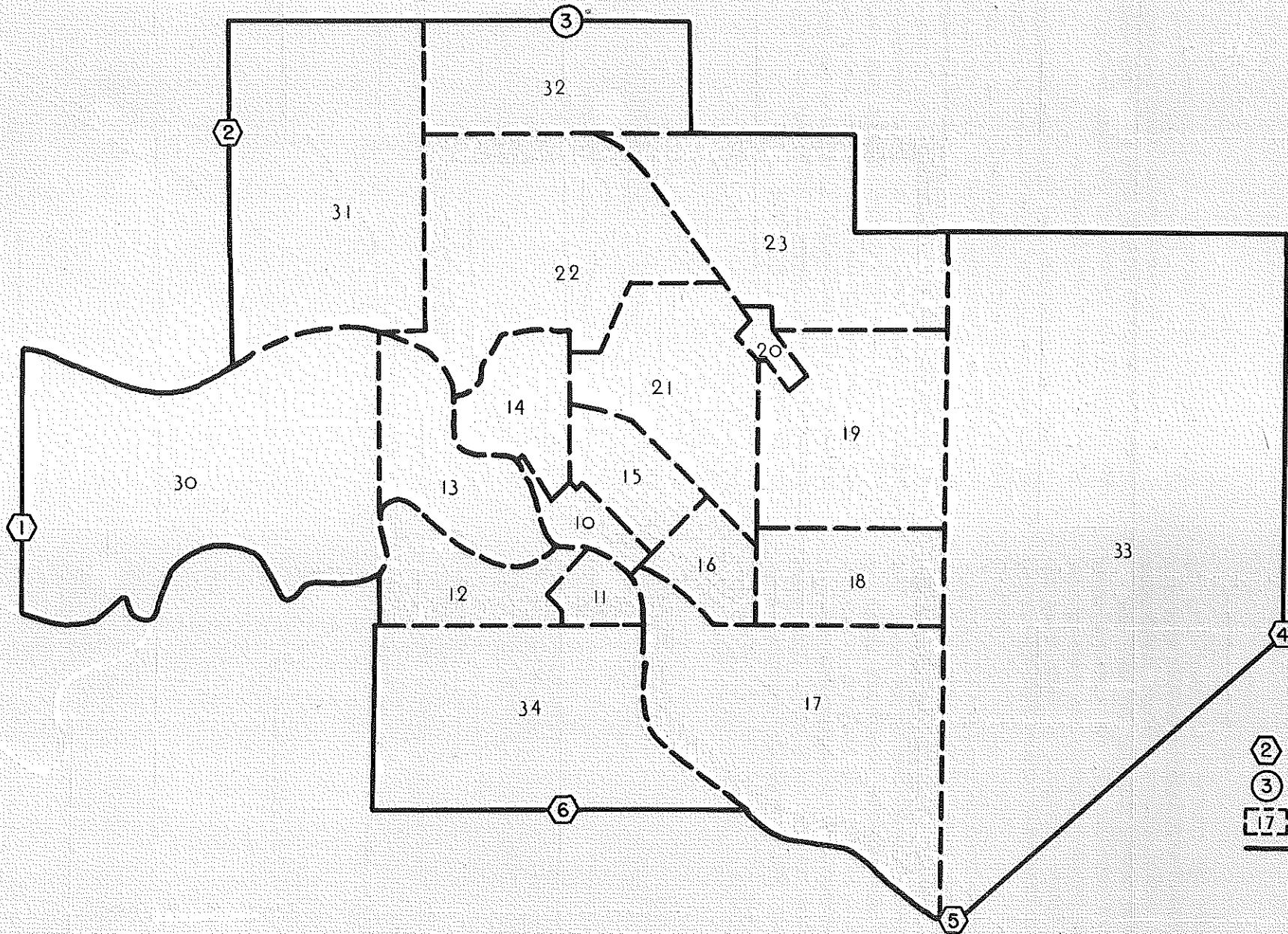
A few years ago service roads paralleling the trunkline pavement were built to provide access to the roadside establishments without interference with main road travel. But this measure has not worked out as intended and the combination of three parallel two-way roadways is causing congestion and danger especially at night when the cross-beams of headlights confuse both drivers and pedestrians.





Further northwest on the route of US-10, a fringe of business places is building up along the north side of the highway. This is just outside the north city limits where the land is not zoned. The result is that gas stations, stores and shops are going up without any planning and with no setback or other restrictions. This uncontrolled development is adding another section on this urban trunkline route where roadside exploitation is

destroying its usefulness for trunkline travel.

In addition to these unfavorable conditions created by the city's growth, there are others which are caused by the location of the route itself or by the obsolescence of key facilities.

There are inadequate and hazardous conditions on the western section of M-20 where it crosses the C. & O. Railroad to the bridge over the Tittabawassee River. The bridge, built in 1907, is an old high truss structure with a clear span of 136 feet. Its alignment with the highway is poor, it has a laminated plank floor, and the clear roadway is only 15 feet from curb to curb. During high water periods the area to the west of and around the bridge is frequently flooded; at times it has been necessary to ferry hundreds of commuters across the swollen stream to their jobs.



- LEGEND**
-  24 HOUR STATION
 -  16 HOUR STATION
 -  ORIGIN-DESTINATION ZONES
 -  AREA LIMITS

THE MIDLAND STUDY AREA

THE TRAFFIC STUDY

In October 1946 the Department conducted a traffic study in the Midland area. The study was made at that time to assist the Department and the City in the solution of the traffic problems created by the great expansion of the city's industrial activity which had resulted from the important war production in the Dow Chemical Company's plants. The City and the Bureau of Public Roads shared the costs of the study with the Department.

The Midland Study consisted of traffic observations made at six stations located in a cordon on four state trunkline and two county routes radiating from the city. Plate III shows the location of the external stations and the origin-destination zones enclosed by the cordon line. Each trip in and out was counted at these stations, the type of vehicle was noted, and the driver was interviewed to find out if he was passing through Midland or, if his trip had a terminal in the area, the locations of its local origin or destination in relation to the several characteristic zones into which the area was divided for study purposes.

The results of this traffic study were utilized by

the City and its planning consultant in formulating the arterial street system which was a part of the Midland master plan adopted in 1948. The same data were used as basic material in the analyses on which the present selection of urban state trunkline routes is founded. This information was also useful in establishing the need for relocating certain of the existing routes.

The quantities shown on the following charts and tables are those observed in October 1946. It has been estimated that statewide traffic has increased by 47 percent in 1952 over the 1946 level. In the Midland area a 1946 traffic count on M-20 just west of the city showed 2,315 trips per day. A recent count in the same location showed 5,200 trips. Part of this increase was caused by an influx of workers from as far west as Mt. Pleasant and by the expansion of a housing project at and beyond the west city limits. The balance is due to the general growth of traffic. It must be remembered that both local and general conditions have increased Midland's traffic significantly above the quantities shown in this report.

COMPOSITION OF TRAFFIC

The survey found that on an average weekday in October in 1946 there were 15,123 vehicular trips entering or leaving the Midland area on the routes counted; 11,558 of these trips were on the four state trunkline routes. Truck traffic made up 13.4

percent of the total in-and-out movement; on the state trunklines it amounts to 14.2 percent.

The following tabulation of average daily traffic volumes for a weekday in October, 1946 shows the routes on which the trips were counted.

<u>Station Number</u>	<u>Route</u>	<u>All Trips</u>	<u>Truck Trips</u>	<u>Percentage of Truck Trips</u>
1	M-20 West	2,315	320	13.9
2	US-10 Northwest	3,100	426	13.7
3	County Road North	1,249	212	17.0
4	M-20 East	3,005	414	13.8
5	US-10 Southeast	3,138	459	14.6
6	County Road South	2,316	201	8.7
	Totals	15,123	2,032	13.5
	State Trunklines	11,558	1,619	14.0

The most significant results of analyses of traffic entering and leaving Midland are presented

on the following four plates.

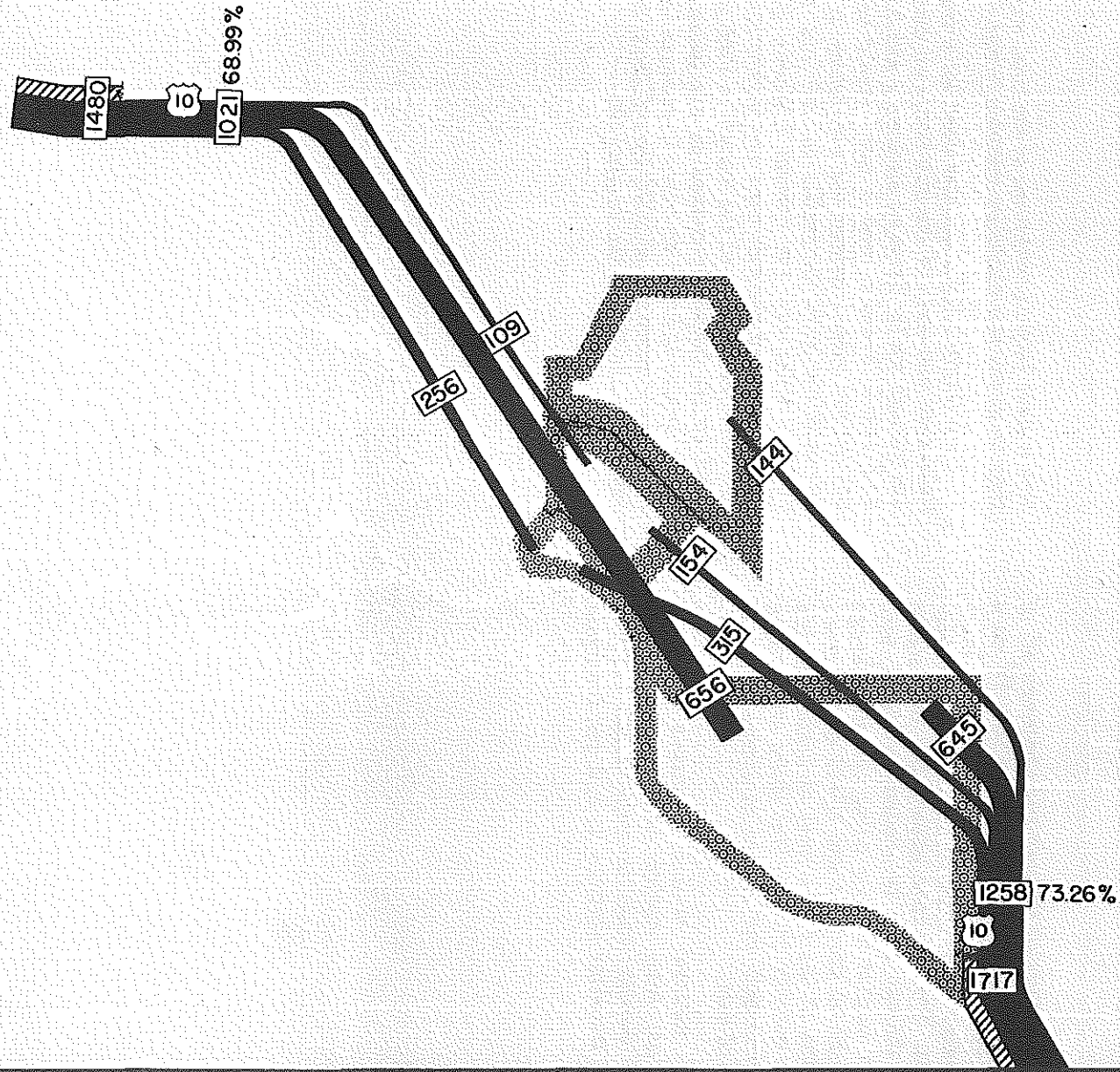
INTERCHANGE OF THROUGH TRIPS ON STATE TRUNKLINES AND MAJOR COUNTY ROADS

The interchange of through trips between all of the external stations is shown on Plate IV on a straight, desire line basis with no attempt being made to assign these trips to the designated trunkline streets. This diagram shows that the largest volume of through trips is carried on US-10, with the second largest volume being the interchange between M-20 on the east and US-10 on the west. In the course of the day a total of 2,332 vehicles made trips entirely through the study area, being interviewed at both the station of entrance and at the station of exit.




At each external station is shown the total through trips, total cordon trips, and the percentage of through trips to total trips. Through trips at the trunkline stations 1, 2, 4 and 5 consti-

tute a much larger percentage of the total trips than they do at the non-trunkline stations, 3 and 6.

This diagram indicates the need for a trunkline route east and north of the city limits so that all of the through traffic between stations 2 and 3, 2 and 4, 2 and 5, 3 and 4, and 3 and 5 would be intercepted and routed around the city where it would not interfere with the traffic to and from the industrial areas and the central business district. The volumes of through trips are higher now than they were at the time of the survey in 1946 and the trend is for further increases in the future. More recent counts indicate an over-all increase in daily traffic with increases of 300% for holidays, summer week-ends and during the hunting season.



LEGEND

 TRIPS TO PRINCIPAL ZONES OF TRAFFIC ATTRACTION
 TRIPS TO ALL OTHER ZONES
 TRAFFIC VOLUMES ARE FOR AN AVERAGE 24 HOUR WEEKDAY IN OCTOBER 1946

TRAFFIC BETWEEN U.S.-10 AND THE PRINCIPAL ZONES OF ATTRACTION

LOCAL ORIGINS AND DESTINATIONS OF CORDON TRIPS

The external trips which have an origin or destination within the city area are called "cordon" trips because they are bound to or from terminal points inside the cordon of stations which were established to count and study Midland's traffic. Certain business and industrial sections of the city are especially important in generating the traffic movement. Because such districts are centers where many people have jobs or where they go for goods or services, they attract many trips to them. They are called objective destinations of traffic.

Plates V, VI, and VII show graphically the distribution of the origins and destinations of cordon trips on US-10, M-20, and the principal county roads, to the most important zones of traffic attraction. In the case of each of these highways, the graph shows the distribution of well over half

of its total cordon trips.

These three plates reflect the character and operation of Midland's economic life. They show that in Midland the primary focus of traffic attraction is the major industrial district and that the central business district is second in importance. This reverses the usual order of traffic attraction found in most of Michigan's industrial cities. The plates also reflect the wide distribution of the homes of Midland's plant employes in suburban areas and in cities as far distant as Bay City, Saginaw, and Mt. Pleasant.

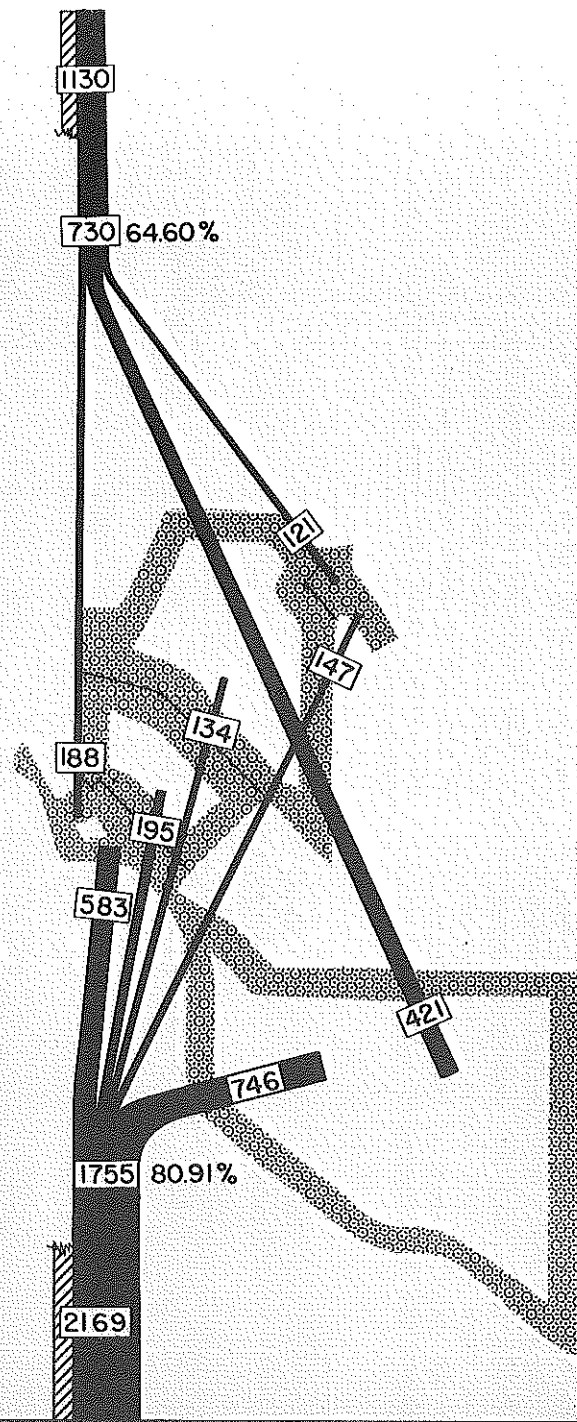
The following table summarizes the data presented in the three plates. It shows the distribution of the cordon trips on the several state trunkline and county road routes to the principal zones of traffic attraction.

Route	Total Cordon Trips	Dow Industries		Central Bus. Dist.		Other Major Zones	
		Number	%	Number	%	Number	%
US-10 NW	1,480	656	44.3	256	17.3	109	7.4
SE	1,717	645	37.6	315	18.3	298	17.4
M-20 W	1,773	696	39.3	407	23.0	125	7.0
E	2,190	977	44.6	285	13.0	365	16.7
Co. Rd. N	1,130	421	37.3	188	16.6	121	10.7
S	2,169	746	39.4	583	26.9	476	17.3
Total	10,459	4,141	39.6	2,034	19.4	1,494	13.3

These figures show that nearly 40 percent of all the cordon trips go to the Dow plant area, nearly 20 percent to the central business district, and the remaining 40 percent to various parts of the area but particularly to the residential sections and the new shopping district lying northeast of the central business district.

The external counts revealed that traffic on

major radiating highways is concentrated to an unusual degree in peak hours. On an average week-day, it was found that as much as 20 percent of the day's total traffic movement occurred in the single hour from 4:00 PM to 5:00 PM. These traffic surges are found on the major streets within the city where they include the local trips as well as those which were counted at the cordon stations.



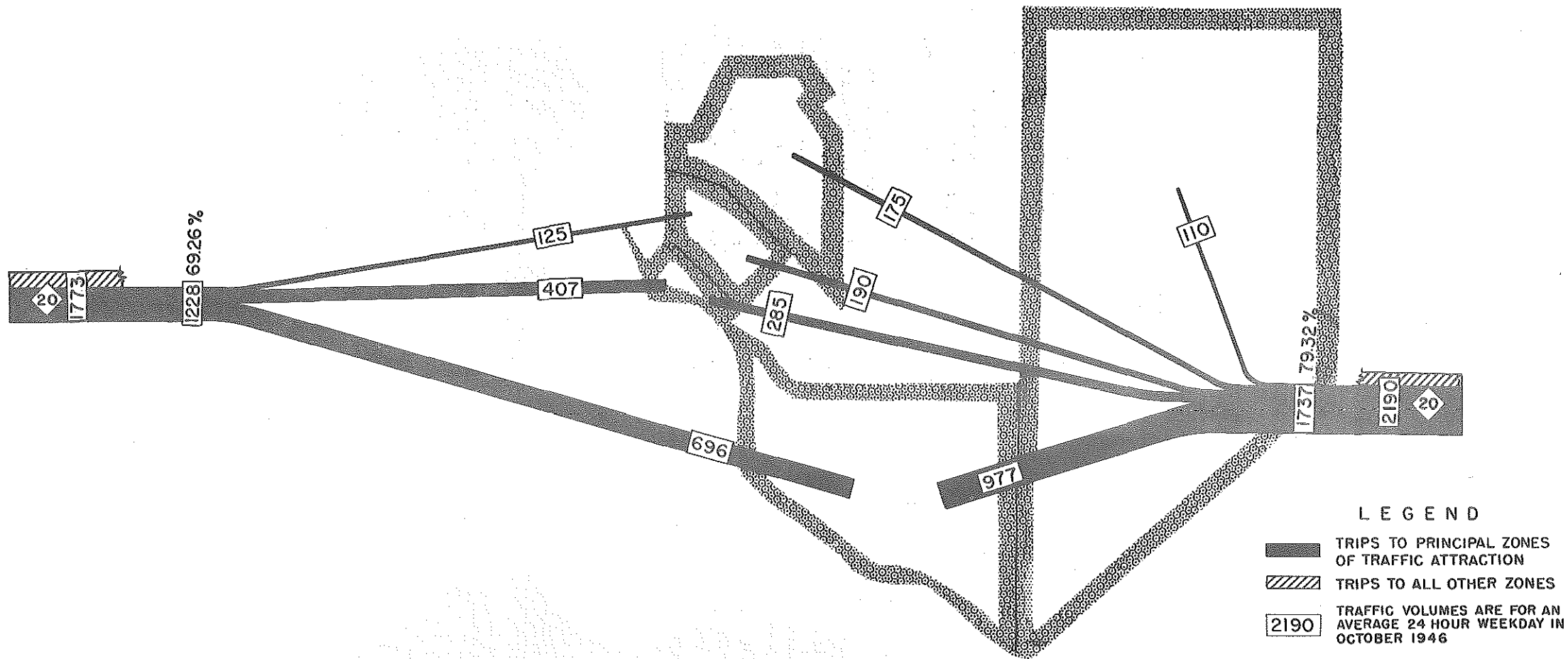
LEGEND

TRIPS TO PRINCIPAL ZONES OF TRAFFIC ATTRACTION

TRIPS TO ALL OTHER ZONES

TRAFFIC VOLUMES ARE FOR AN AVERAGE 24 HOUR WEEKDAY IN OCTOBER 1946

TRAFFIC BETWEEN THE MAIN COUNTY ROADS AND THE PRINCIPAL ZONES OF ATTRACTION



TRAFFIC BETWEEN M-20 AND THE PRINCIPAL ZONES OF ATTRACTION

CONCLUSIONS INDICATED BY THE TRAFFIC STUDY

The Department's study of external traffic in the Midland area makes it clear that the existing state trunkline system in most respects is well designed as to location and connections to serve trunkline traffic to and through the city. The causes of today's difficulties on some parts of this urban system were created by developments along these trunkline routes and by the increased movements of local traffic on them.

Although no counts were made of internal traffic, it is certain, on the basis of studies made in other cities, that local trips have much the same objective destinations as trips from outside the study area. For that reason the existing state trunkline routes which give direct access to the most important destinations must carry heavy loads of local trips as well as the traffic coming into the city on the rural state trunklines and county roads.

These factors have so seriously impaired the adequacy of certain routes that improvements to present facilities could not permanently remedy conditions. In view of the probability of extensive further industrial developments, it is doubted if any additional construction would be warranted on these trunkline sections in their present location.

These facts point to the conclusion that those portions of the state trunkline system which have been adversely affected by local developments and traffic, should be relocated. The traffic analyses indicated that the new locations should parallel the present routes as closely as possible while being well outside the area of present development and congestion. The experience of the Department proves that the new locations should be protected against future roadside encroachments.

PRINCIPLES OF URBAN TRUNKLINE SELECTION

The selected trunkline system in Midland will give efficient and convenient service to the traffic of the area and the state highway traffic passing through the area. This improved service will be provided because the system has been revised to fit the special needs of the city and its economy, and also because routes in the system were selected in conformity with certain basic principles of urban trunkline planning. These principles have been established as the result of many studies of metropolitan traffic in this and other states.

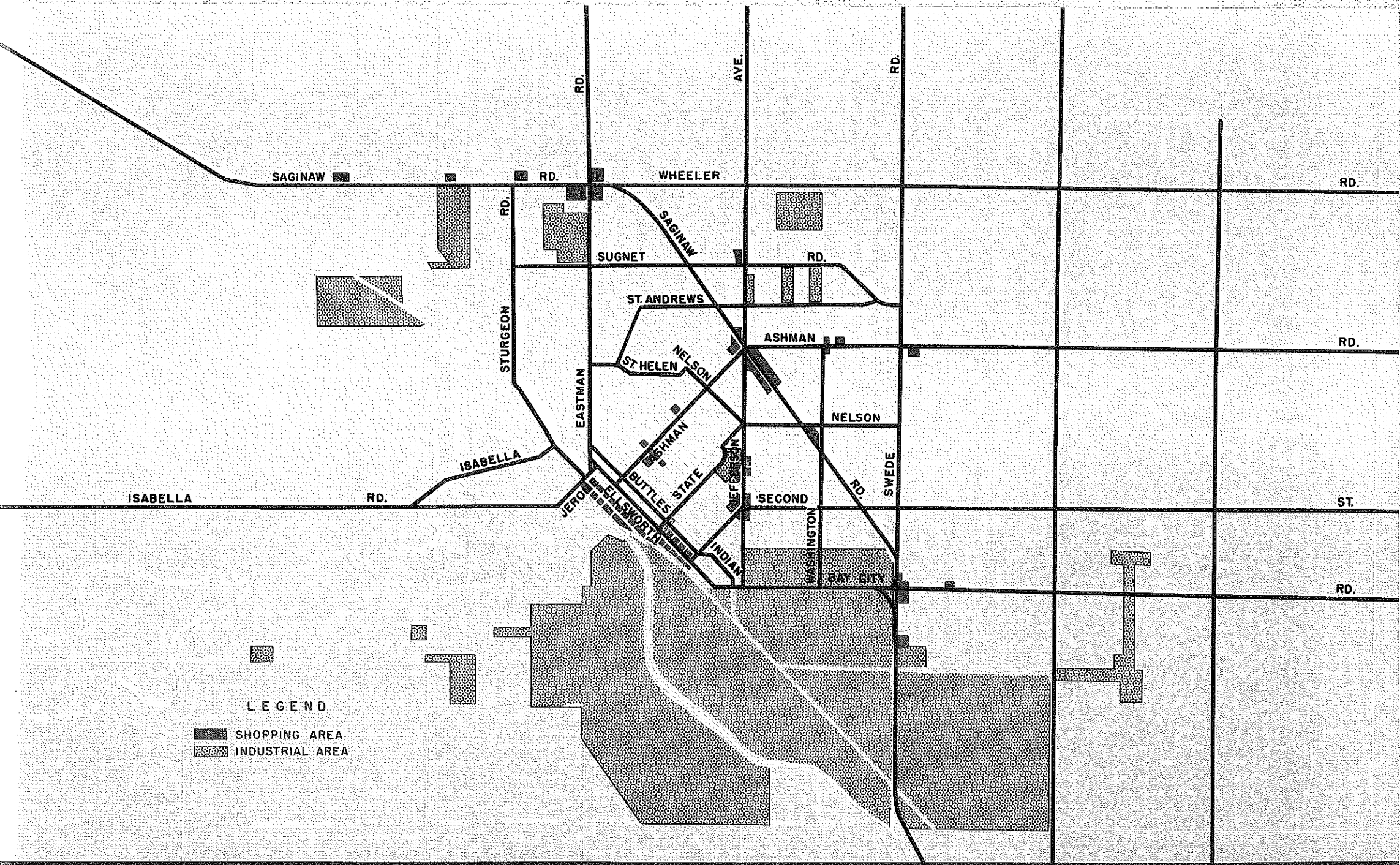
In brief, these principles require that:

1. The urban state trunkline routes should connect the rural state trunklines with the central business district;
2. They should serve the principal industrial areas of the city;
3. They should interconnect within the city;
4. They should be reasonably direct, and free

from numerous turns in their approach to the principal areas of objective destinations;

5. They should avoid as far as possible the existing handicaps and hazards of commercial developments at the roadside, and should be safeguarded by location or design against the development of such handicaps and hazards in the future;
6. Since the central business district's functional traffic is primarily pedestrian, state trunklines should provide a channel to and around its periphery, but not through it; and,
7. In cases where new urban trunklines are constructed, they should be so located that they will not disturb existing land uses and values; ordinarily locations on diagonal routes should be avoided, as these create additional and difficult intersections and greatly increase right-of-way costs.

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LEGEND
 ■ SHOPPING AREA
 ▨ INDUSTRIAL AREA

ARTERIAL STREET SYSTEM AND PRINCIPAL LAND USES

ARTERIAL STREET SYSTEM

An early result of the 1946 Midland external traffic survey was the formulation of the city's arterial street plan. The plan was drawn up by the Midland City Planning Commission's consultant on the basis of early survey data and was approved by the Commission in December 1946. After certain revisions made in consultation with the Department, the plan was adopted in 1948 by the City of Midland as a part of the city's master plan.

The city's arterial street plan is of primary importance in the selection of state trunkline routes in the area. The proper operation of and service to both trunkline and local traffic require that the selected trunkline system be selected as an integral part of the planned arterial system. For that reason, an analysis of the arterial street plan to establish its efficiency is the first step in trunkline selection.

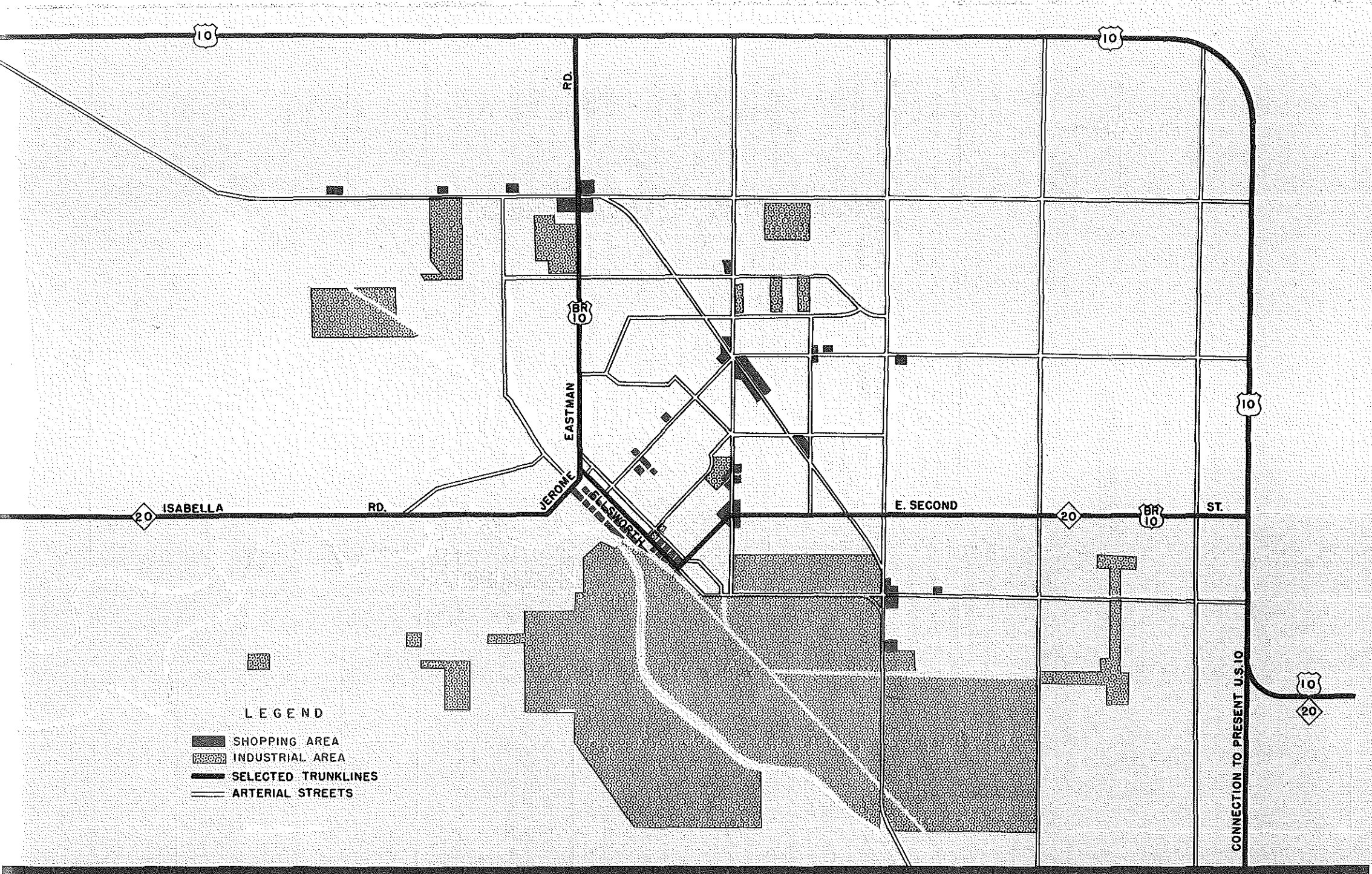
In Midland the location and expansion of industry is the predominating factor making necessary the revision of the state trunkline system within and beyond the city limits. As in other cities, land uses and particularly commercial and industrial uses are the primary forces in generating and shaping the movements of both trunkline and local traffic. For these reasons it was possible to make an effective analysis of the arterial street plan by studying it in relation to land uses even though no

specific data regarding internal traffic were available.

It is the function of an arterial street system to provide access to the areas of the city which have high attraction for traffic. It should provide this access from one area to another by the shortest, easiest, and least time-consuming routes which are practical without basic changes in the existing street pattern. Rural state trunkline routes and certain primary county roads are very important origins and destinations of trips on the city's streets.

Plate VIII shows the arterial street plan, the existing commercial districts, and the industrial areas as indicated by existing plants and by the planned expansion of the Dow plants. Within the city area, the plan utilizes existing streets with some street openings to improve arterial connections and proposes that certain inadequate streets be widened. In the outskirts of the city, several street and road extensions are proposed.

Examination of this arterial street plan in relation to the commercial, industrial, and residential districts, and to the principal trunkline and rural road entrances to the area, indicates that it will provide for efficient circulation of traffic within the city and that it includes routes conveniently connecting it with the rural trunklines.



STATE TRUNKLINE SYSTEM SELECTED FOR ULTIMATE DEVELOPMENT

SELECTION OF STATE TRUNKLINE ROUTES RECOMMENDED FOR DEVELOPMENT

The routes selected for the state trunkline system in the Midland area are shown on Plate IX. Considerable portions of the selected system represent changes of location due to unsatisfactory conditions which have developed along the existing routes. In the following paragraphs the reasons for such changes are summarized and the entire routes are described.

US-10

The tremendous expansion of the Dow Chemical Company's plants along both sides of US-10 where it enters the area from the southeast, and the development of roadside business on the section that goes diagonally across the city and along its northwest limits, necessitate a relocation of this state trunkline. Other factors supporting a route revision are the anticipated heavier traffic demands on the existing route, the probability that the route would be closed to general traffic in a national emergency, and the requirement to provide a convenient dependable artery for US-10's heavy movement of through trips.

In selecting a new route for US-10, consideration had to be given to completed and planned developments of the Dow companies extending two miles east of the southeast city limits. These developments required an eastward revision of plans for all state trunklines approaching the city from the east and southeast. It also was necessary to orient the new route location to the projected revision of state trunklines in the tri-city area. In addition, account had to be taken in selecting both location and design, of the potential northward expansion of the city of Midland.

The recommended location of US-10, selected with due regard for all of these factors, is described as follows:

The route selected for US-10 approaches Midland from the east on a line about one-half mile south of the present location of M-20. M-20 will also be routed over this new location. Approximately 2 miles east of the east city limits the route turns north for about 4 miles and then west for about 7 miles to connect with the present US-10.

This location puts the trunkline well beyond the area of dense industrial and suburban development and leaves considerable room for future expansion of the city. However, to guard against such expansion again involving the trunkline's roadside, it is recommended that this relocated section of US-10 be designed and constructed as a full limited access highway.

M-20

Two sections of M-20 require relocation. The present east entrance section has been enveloped by Dow plant expansion projects and its operation is handicapped by abutting plant parking lots. The west entrance section is unsatisfactory because of a hazardous railroad crossing, because the bridge on which it crosses the Tittabawassee River is inadequate and badly aligned with the road, and because the highway west of the bridge is subject to flooding.

The central section of this route on Ellsworth Street between Second and Jerome Streets was widened and a 46 foot pavement constructed in 1949. This section is believed to be adequate for present traffic and estimated future needs. In the event additional capacity is needed in the future, Buttles Street can be added and used with Ellsworth Street as a pair of one-way streets.

The recommended location of M-20 is described as follows: Starting at a point on the projected Bay City-Midland route of US-10 and M-20 two miles east of the east city limits and one-half mile south of the present line of M-20, the route runs north approximately one mile to East Second Street Road, then west 2 miles to the east city limits, and continuing west on East Second Street to Jefferson Street, then southwest on Second Street to Ellsworth Street, and northwest on Ellsworth Street to Jerome Street on which it turns southwest across the C&O Railroad tracks and the Tittabawassee River to a point on the projected east-west line of Isabella Road, and then west to join the existing route of M-20 on Isabella Road.

The recommended relocation of the western section of M-20 involves the construction of a combined railroad grade separation and bridge across the Tittabawassee River and a revision of the channel of the Chippewa River. Army engineers have made a study of flood control measures in this vicinity and have reviewed the relocation of the highway bridge and the required revision of the river channel. It is contemplated that the highway grade from the southwest bridge approach west to its junction

with Isabella Road would be incorporated into the river control works.

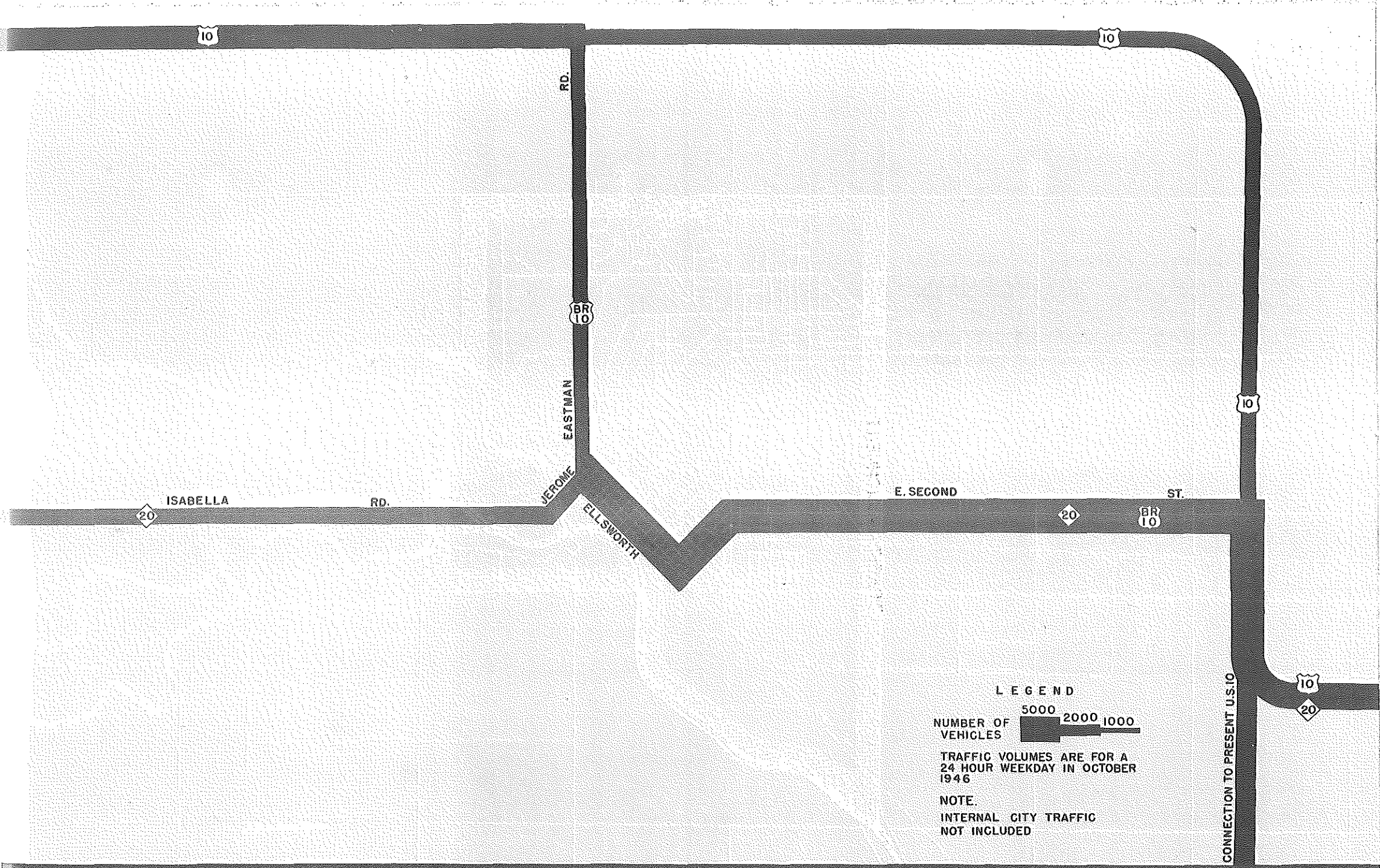
US-10 BUSINESS ROUTE

Since US-10BR now follows the same route as existing M-20 on the eastern entrance to the city, it is affected by the same conditions which make this section unsatisfactory. Sections of the existing route on Ellsworth and Eastman Streets are believed to be adequately served in their present location.

It is recommended, therefore, that US-10BR follow the above described selected route of M-20 from the intersection of the selected route of US-10 and East Second Street Road, to the intersection of Ellsworth Street and Eastman Street, and then follow Eastman Street north to a junction with the selected route of US-10 approximately one mile north of the north city limits.

To provide access for traffic originating along US-10 between Midland and Saginaw, a connection is proposed, joining the north-south segment of new US-10, located approximately 2 miles east of the east city limits, to the present US-10 to the south.

TRAFFIC ASSIGNMENT



LEGEND
 NUMBER OF VEHICLES 5000 2000 1000
 TRAFFIC VOLUMES ARE FOR A 24 HOUR WEEKDAY IN OCTOBER 1946
 NOTE:
 INTERNAL CITY TRAFFIC NOT INCLUDED

TRAFFIC ASSIGNED TO THE SELECTED TRUNKLINE SYSTEM

TRAFFIC ASSIGNED TO THE SELECTED TRUNKLINE SYSTEM

The flow bands on Plate X demonstrate the usage of the selected routes by through trips and cordon traffic. The flow bands were constructed by assigning the trips observed in the October 1946 survey to the various routes in accordance with three accepted rules of driving habit:

1. The driver picks the shortest route;
2. He uses the route with the least number of turns; and,
3. He avoids the central business district and other congested areas, if routes are available which do not involve adverse distance or conditions.

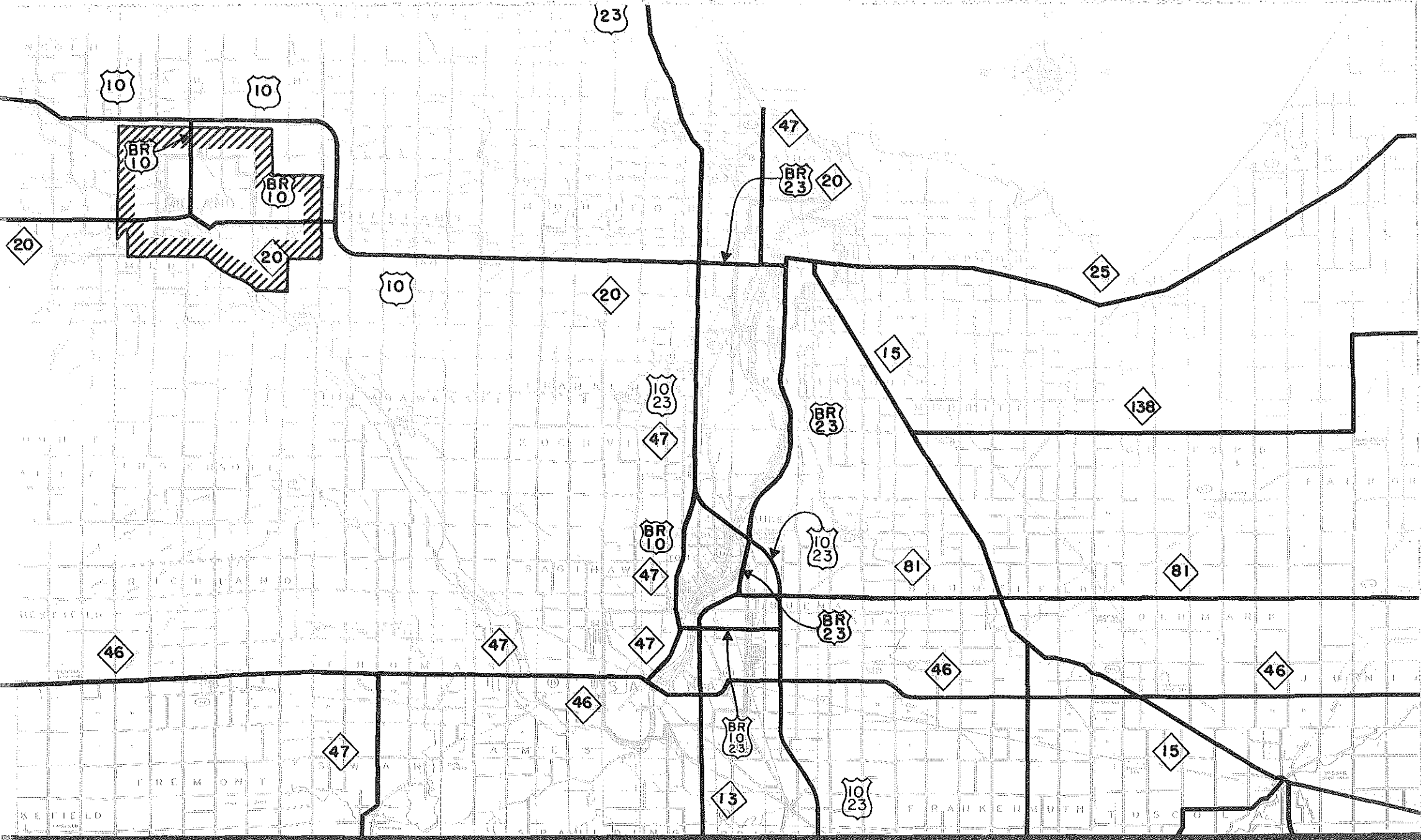
It should be repeated, in respect of all traffic quantities quoted or represented in this report, that in 1952 total motor vehicle traffic in Michigan was 47 percent above the 1946 total while the increase in the Midland area probably was even greater, and that no data regarding internal traffic were available or used -- only the external traffic is shown. However, on the basis of observed conditions and of experience in other city areas where both external and internal traffic counts were made, it is concluded that the system as selected provides ample capacity for present and future traffic.

The route of US-10 to the east and north of the city would assure uninterrupted travel to the through trips amounting to at least 45 percent of the traffic on that trunkline. It would likewise afford drivers entering or leaving the city a wide choice of routes by which they could reach their local destinations or their rural trunkline.

Through trips on M-20 would be carried on a route which is comparatively free from the roadside developments which now hinder their progress. At the same time, trips on this trunkline with destinations in the city would be served by the convenient grid of arterial streets.

The recommended changes in the trunkline system should do much to relieve congestion and serve traffic on the two major north and south county roads.

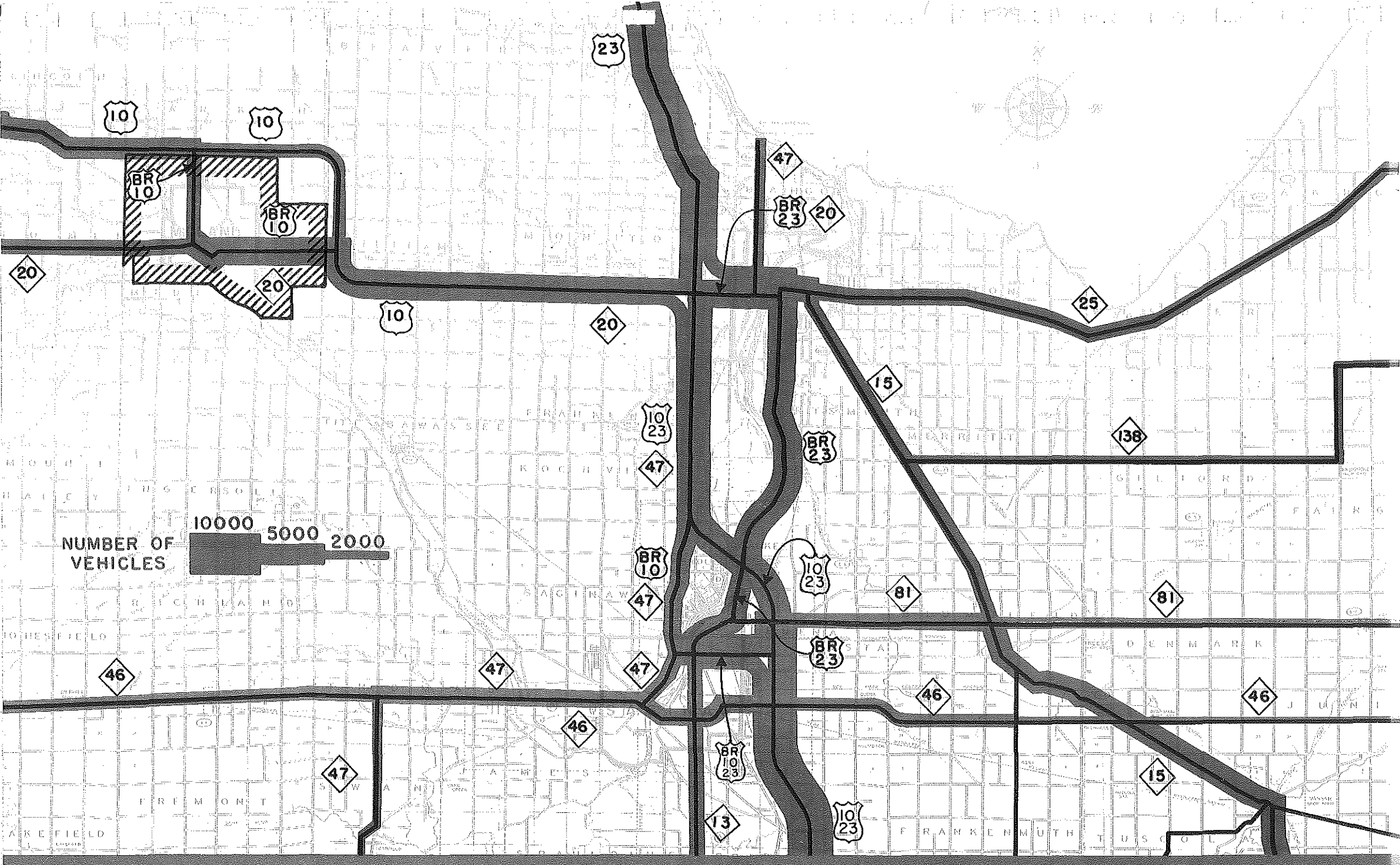
Although the population, business, and industry of Midland are expanding and shifting, it is believed that with intelligent zoning control and the sound arterial street plan, the urban trunkline system here selected and recommended will give traffic the service needed during the life expectancy of the highway facilities involved.



TRI-CITY AREA TRUNKLINE SYSTEM SELECTED FOR ULTIMATE DEVELOPMENT

NOTE: - CITY LIMITS EXTENDED-1953

PLATE XI



TRAFFIC ASSIGNED TO THE SELECTED TRI-CITY AREA TRUNKLINE SYSTEM

NOTE:- CITY LIMITS EXTENDED-1953

TRI-CITY AREA TRAFFIC STUDY

Plates XI and XII are included in this report for two purposes. First, to show the planned revision of the state trunklines in the tri-city area which was a determining factor in some phases of urban trunkline selection; and second, to show how well the Midland selected system is integrated with the tri-city traffic pattern as it would be under the projected revision.

The system shown on Plate XI has been approved in principle by the Michigan State Highway Department and the planning authorities of the Bay City - Saginaw - Midland area for the improvements of state trunkline connections and service in this tri-city area. This system includes a projected route for US-10 and US-23 east of Saginaw, across the Saginaw river north of Saginaw, and then north

to join present US-23 northwest of Bay City. At a point west of Bay City the route intersects and joins a projected highway, located one-half mile south of the present location of M-20, over which is routed US-10 and M-20 west to Midland.

Traffic flow bands on the three county map on Plate XII indicate the close traffic relationship that exists between Bay City, Saginaw and Midland. Due to the location of this triangle of important cities on the routes of two major trunklines, a network of highways is needed to interconnect the cities and to by-pass the considerable quantities of through trips around them.

Selection of an urban trunkline system in Midland was aimed at obtaining satisfactory integration with the Tri-City area system.

EXTERNAL SURVEY
AND
TABULATIONS

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P. O. DRAWER "K" 48906

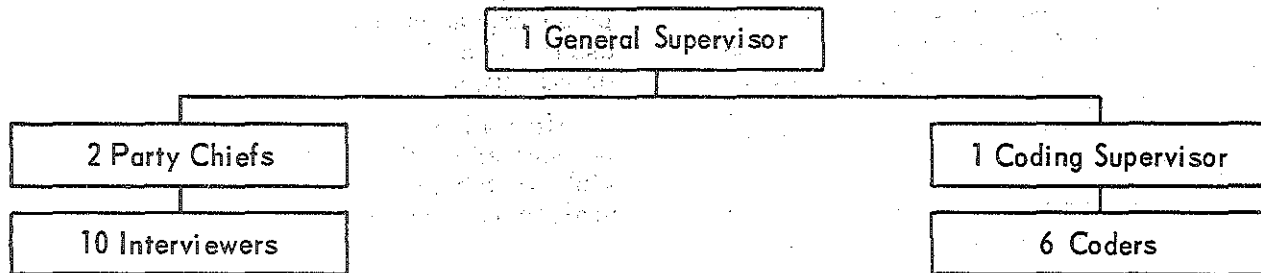
FIELD PROCEDURE

The Midland External Traffic Study field work was started on October 14, 1946 and was completed on October 25. In this twelve day period five external stations were operated for three eight hour shifts each, and one station was operated for two eight hour shifts. Part of the vehicles were stopped and the drivers interviewed and all of the traffic was counted and classified at each of the stations when they were in operation.

The study area enclosed by the external cordon was divided into zones according to the land use

of each group of blocks. Each of the zones was numbered using a two digit code for identification. Contrary to the other studies made in Michigan, the individual blocks were not numbered. All origin or destination codes were on a six digit code using the first two digits for the zone and the last four digits in every case XXXX in place of the block code.

Operational field work was conducted by the Traffic Survey Section of the Planning and Traffic Division using the following organizations:



The coding was not started on this study until December 17, after all of the field work was completed on the Lansing Metropolitan Area Traffic

Study. All of the coding was done in the State Office of the Planning and Traffic Division, by the personnel that made the interviews in the field.

OFFICE PROCEDURE

When the field survey data is submitted to the Urban Planning Section it is grouped and coded by zone number only, and it is on this basis that all tabulations are made. All of the data was transferred from Form OD-5, External Interview, to International Business Machine Tabulating Cards, one card for each interview. Each of these forms is shown in Appendix B. The original data from the interview forms was keypunched into the cards, the punching verified and the data machine-checked prior to the expansion factors being entered by additional gang punching.

To prepare the interview data for usage, it was first expanded by vehicle type, by direction of travel, by interview period, by station. This expansion is made by dividing the number of interviews into the number of vehicles counted, according to the type of vehicle, direction and station, and entering the factor into the cards affected for each interview period.

Station No. 3 was operated for only 16 hours, so it was necessary to compute a second factor for

this station that would give the 16 hour cards a 24-hour representation. This was done by dividing the 16 hour manual count into the sum of the 16 hour manual count plus the 8 hour machine count, and entering the resultant factor on the cards for this station.

Due to the survey methods used, the tabulating cards for through trips contained a duplication of data because these trips were recorded inbound by interviewers at one external station and the same, or similar, trips were recorded outbound by interviewers at some other external station. This duplication was eliminated by punching into the through trip cards a factor equal to one-half of the computed expansion factor. Therefore, it is not necessary to divide by two the tabulated figures for through trips.

After all of the expansion and adjustment data is recorded on the tabulating cards, it is then possible to tabulate the various tables necessary to analyze and use the interview data.

TRIP TABLES

Four tables comprise the group of tables that show the vehicle trips into, out-of, and through the study area. Appendix C contains these four tables which are titled as follows:

- Cordon Trips by All Vehicles for a Weekday in October, 1946
- Cordon Trips by Passenger Cars for a Weekday in October, 1946
- Cordon Trips by Single Unit Trucks for a Weekday in October, 1946
- Cordon Trips by Trailer-Combinations for a Weekday in October, 1946

These trip tables are made up by sections showing the various types of trips that it was possible to tabulate from the data collected at the cordon line. The Through Trips that pass through the area and have both their origin and destination outside of the area are in the upper left corner of the table. Outbound Cordon Trips that have their origins in one of the zones inside the area limits and their destinations outside of the cordon line are in the two sections of the table below the through trips. Inbound Cordon Trips that have their origin outside of the cordon line and their destination inside of the study area are in the three sections on the right hand side of the table. As this was a purely Ex-

ternal Survey there can be no internal trips shown on the trip tables.

It should also be noted that the tables are assembled by through trips, trips with either origin or destination in the City of Midland, and trips with either origin or destination in the rural area between the city limits and the cordon line limits.

The Table "Cordon Trips by all Vehicles for a Weekday in October 1946" is the recapitulation of the other three tables.

None of the "C" and "D" tables specified by the Bureau of Public Roads can be prepared because there are no internal trips recorded in the survey.

In using these tables it must be borne in mind that the data set forth is determined by the expansion of a sample and that it is representative of weekday travel during October of 1946. The data must be regarded as relative rather than absolute and it serves to establish general traffic flow patterns which are reliable within the limits of error of the sampling procedure. Seasonal variations and anticipated future increases in traffic volumes may be estimated by applying appropriate multipliers to the basic data contained in the tables.

TABLE 1
 TRAFFIC VOLUMES FOR TWENTY-FOUR HOURS
 SHOWING PERCENTAGES FOR EACH VEHICLE TYPE
 AT EXTERNAL STATIONS

External Station	Passenger Cars	Percent	Trucks	Percent	Busses	Percent	Total
1	1980	85.6	320	13.9	12	0.5	2312
2	2642	85.3	426	13.8	29	0.9	3097
3	1092	83.7	212	16.2	1	0.1	1305
4	2641	86.0	414	13.5	15	0.5	3070
5	2540	84.4	459	15.2	13	0.4	3012
6	2199	90.5	201	8.3	28	1.2	2428
Totals	13094	86.0	2032	13.4	98	0.6	15224

TABLE 2
 TRAFFIC VOLUMES AND PERCENTAGES OF TWENTY-FOUR HOUR TRAFFIC
 FOR HIGH ONE-HOUR, TWO-HOUR, AND THREE-HOUR PERIODS
 AT EXTERNAL STATIONS

External Station	High One-Hour			High Two-Hour			High Three-Hour		
	Time	Volume	Per-cent	Time	Volume	Per-cent	Time	Volume	Per-cent
1	5-6P	273	11.8	4-6P	497	21.5	4-7P	646	27.9
2	4-5P	306	9.9	4-6P	561	18.1	3-6P	774	25.0
3	7-8A	165	12.6	4-6P	295	22.6	3-6P	364	27.9
4	4-5P	426	10.5	4-6P	741	18.2	3-6P	923	22.7
5	5-6P	312	10.4	4-6P	612	20.3	3-6P	815	27.1
6	7-8A	339	14.0	4-6P	548	22.6	4-7P	709	29.2

TRAFFIC VOLUME SUMMARIES

Tables of hourly traffic volumes by vehicle type were compiled from data gathered at the six interview stations on the cordon around the study area. A summary of the counts is shown in Table 1 on page 44, but the individual station counts are not reproduced in this report. In addition to the twenty-four hour count a summary of the peak one-hour, peak two-hour, and peak three-hour traffic volumes

is shown in Table 2 on page 44, with the percentage of each peak to aid in the analysis of travel habits for this area. In these summaries the column "Passenger Cars" includes Taxis, the column "Trucks" includes trailer combinations, and the column "Busses" includes common-carrier busses.

APPENDIX

APPENDIX A STATISTICS OF OPERATION

For recording, tabulation, and analysis of data, the survey area was divided into nineteen origin-destination zones as shown on the Study Area map on page 18. The division of the area into O-D

zones was made to outline areas of a particular type of land use wherever possible, as listed in the following tabulation:

O-D Zone Number	Type of Land Use	Area in Acres
10	Central Business District	82
11	Industrial	79
12	Residential	279
13	Residential	350
14	Residential	231
15	Residential	189
16	Residential and commercial	150
17	Industrial	1,054
18	Residential and light industry	313
19	Residential - Commercial	596
20	Commercial	46
21	Residential	489
22	Recreation	838
23	Residential	699
30	Rural	1,333
31	Rural	1,174
32	Residential	645
33	Residential and industry	3,097
34	Industrial	751
Total		12,395

For the average weekday travel data, traffic was stopped and the drivers interviewed at six external stations on the cordon line surrounding the study area. The following table shows the number

of interviews, number of vehicles passing through the station and the percentage of vehicles stopped for interviewing:

External Station	Total Interviews	Total Count	Percent of Drivers Interviewed
1	1,759	2,300	76.5
2	2,373	3,073	77.2
3	1,026	1,305	78.6
4	1,985	3,055	65.0
5	2,222	3,000	74.1
6	1,622	2,401	67.6
Total	10,987	15,134	72.6

A total of 10,987 tabulating cards were punched for this study, one card for each interview made at

the external stations.

APPENDIX B
TABULATING CARD
INTERVIEW FORM

MICHIGAN STATE HIGHWAY DEPARTMENT
 Charles M. Ziegler, State Highway Commissioner
 Planning & Traffic Division

METROPOLITAN AREA TRAFFIC STUDY

EXTERNAL INTERVIEW

Date Hour Period _____ to _____ A.M. P.M.			City	Station	Day of Travel	Hour Period Ending	Inbound Outbound	Direction of Travel													
			2	3 4	5	6 7	1 2	8													
1	2	3	4	5			6	7	8	9	10	11	12	13							
Interview Number	State of Registration	Vehicle Type	No. in Vehicle	Where did this trip begin? Origin			Where will this trip end? Destination			Trip Purpose	Where is this vehicle garaged?		Screen	Route of Exit or Ent.	Stops in area		Check	Purpose	Intermediate Stop Location		
	1 Michigan 2 Other (write in)										5 Other 6			1 Yes 2 No X Not Stated							
										X							Y				
										X							Y				
										X							Y				
										X							Y				
										X							Y				
										X							Y				

INTERVIEW FORM
OD 5

- 1. Passenger Car
- 2. Pick-up or Panel
- 3. Single Unit - Single Rear Tire
- 4. Single Unit - Dual Rear Tire
- 5. TT-ST Combination
- 6. TT-ST-TR or TK-TR
- 7. Bus Not C.C.
- 8. Taxi
- 9. Single Unit - 3 Axle

- 1. Work
- 2. Transact Business
- 3. Medical - Dental
- 4. School
- 5. Social, Recreation
- 6. Change Mode of Travel
- 7. Eat Meal
- 8. Shopping
- 9. Serve Passenger

- 1. Course of Work
- 2. Transact Business
- 3. Social - Recreation
- 4. Eating
- 5. Gas-Oil Service
- 6. Serve Passenger
- 7. Secure Lodging
- 8. Shopping

APPENDIX C
TRIP TABLES

		DESTINATIONS - EXTERNAL STATIONS									DESTINATIONS - CITY ZONES							
		1	2	3	4	5	6	Sub-Total	10	11	12	13	14	15	16	17		
Ext. Sta.	1		12	9	151	94	21	287	ORIGINS Ext. Sta.	1		14	14	4	65	38	329	
	2	5		10	171	559	20	765		2		9	14	7	51	22	396	
	3	9	8		13	23	7	60		3	85	1	6	2	2	45	25	220
	4	129	244	17		20	23	433		4	126	2	8	4	18	102	36	515
	5	100	563	18		30	9	720		5	142	7	16	7	13	90	42	301
	6	12	28	5		17	5	67		6	249	8	49	9	12	91	35	378
	Stations	255	855	59	382	701	80	2332		Total	937	18	102	50	56	444	198	2139
ORIGINS City Zones	10	200	128	103	159	173	284	1047	ORIGINS Ext. Sta.	DESTINATIONS - CITY ZONES						Sub-		
	11	3			6	3	6	18		18	19	20	21	22	23	Total		
	12	27	13	9	11	10	45	115		1	14	12	41	39	11	11	799	
	13	24	10	5	4	4	7	54		2	13	22	37	46	19	13	777	
	14	12	8	4	11	14	8	57		3	10	16	84	28	8	5	537	
	15	60	58	43	88	64	104	417		4	18	40	49	80	11	26	1035	
	16	31	27	16	48	27	49	198		5	18	28	19	75	20	37	815	
	17	367	260	201	462	344	368	2002		6	16	23	80	72	14	19	1055	
	18	11	13	9	21	26	20	100		Total	89	141	310	340	83	111	5018	
	19	31	15	12	43	31	22	154		DESTINATIONS - RURAL ZONES						Sub-Total	Total	
	20	33	43	37	48	38	67	266		1	31		1	13	2		47	1133
	21	57	51	30	95	69	62	364		2		1	9	12	2		24	1566
	22	5	15	9	10	20	12	71		3		38	6	5	1		50	647
	23	24	7	9	29	36	24	129		4	5			71			76	1544
City	885	648	487	1035	859	1078	4992	5	1		1	13			15	1550		
ORIGINS Rural Zones	30	29		2	1		32	6	2	1	2	11	5		21	1143		
	31			45	1		46	Total	39	40	19	125	10	233	7583			
	32	1	7	10	2		20	MIDLAND AREA TRAFFIC STUDY										
	33	11	24	1	39	26	10	CORDON TRIPS BY ALL VEHICLES FOR A WEEKDAY IN OCTOBER 1946										
	34	1			1	5	7	(The data derived from interviews conducted at six cordon line stations)										
Rural	42	31	56	44	28	15	216											
Total	1182	1534	602	1461	1588	1173	7540											

MIDLAND AREA TRAFFIC STUDY
CORDON TRIPS BY ALL VEHICLES FOR A WEEKDAY IN OCTOBER 1946

(The data derived from interviews conducted at six cordon line stations)

		DESTINATIONS - EXTERNAL STATIONS							DESTINATIONS - CITY ZONES										
		1	2	3	4	5	6	Sub-Total	10	11	12	13	14	15	16	17			
Ext. Sta.	1		10	8	117	73	16	224	ORIGINS Ext. Sta.	1	191	12	13	3	48	25	305		
	2	5		9	130	457	18	619		2	112	8	14	7	41	17	382		
	3	7	7		9	19	7	49		3	73	1	1	2	35	23	214		
	4	94	199	12		16	20	341		4	104	1	6	4	18	89	32	464	
	5	83	441	15	27		6	572		5	122	1	9	4	12	81	35	270	
	6	10	22	5	16	4		57		6	223	7	40	6	11	79	29	367	
Stations		199	679	49	299	569	67	1862	Total	825	9	76	42	53	373	161	2002		
ORIGINS City Zones	10	156	113	92	140	145	261	907	ORIGINS Ext. Sta.	DESTINATIONS - CITY ZONES							Sub- Total		
	11	2			6	2	3	13		18	19	20	21	22	23				
	12	18	7	4	6	8	39	82		1	11	12	39	36	11	11		717	
	13	16	10	5	4	4	7	46		2	12	20	33	41	17	12		716	
	14	12	7	4	11	13	7	54		3	9	13	79	24	8	4		486	
	15	48	46	31	77	58	91	351		4	17	38	38	78	7	23		919	
	16	23	18	12	48	24	43	168		5	13	24	18	73	20	37		719	
	17	355	252	196	420	307	355	1885		6	15	21	80	70	14	17		979	
	18	10	11	8	19	23	15	86		Total	77	128	287	322	77	104		4536	
	19	29	13	8	34	27	21	132		DESTINATIONS - RURAL ZONES								Total	
	20	33	38	37	44	33	67	252		30	31	32	33	34	Sub-Total				
	21	55	45	26	92	68	61	347		ORIGINS Ext. Sta.	1	23	1	11	2	37			978
	22	4	15	9	8	20	12	68		2		9	12	2	23	1358			
23	24	6	9	27	34	22	122	3	2	6	5	1	14	549					
City	785	581	441	936	766	1004	4513	4	4		61		65	1325					
30	26			2	1		29	5	1	1	12		14	1305					
Rural Zones	31		1		1		2	6	1	1	2	10	4	18	1054				
	32	1	7	9	2		19	Total	29	3	19	111	9	171	6569				
	33	9	23	1	34	23	9	99											
	34					5		5											
Rural	36	30	11	38	25	14	154												
Total	1020	1290	501	1273	1360	1085	6529												

MIDLAND AREA TRAFFIC STUDY

CORDON TRIPS BY PASSENGER CARS FOR A WEEKDAY IN OCTOBER 1946

(The data derived from interviews conducted at six cordon line stations)

		DESTINATIONS - EXTERNAL STATIONS									DESTINATIONS - CITY ZONES						
		1	2	3	4	5	6	Sub-Total	10	11	12	13	14	15	16	17	
Ext. Sta.	1		2	1	25	13	5	46			2	1	1	17	13	20	
	2			1	29	64	2	96			1			10	5	13	
	3	2	1		3	4		10			5	1		10	2	6	
	4	23	31	4		3	3	64		1	2			11	4	34	
	5	11	88	3		3	3	108		3		3		6	7	18	
	6	2	5		1	1		9		1	8	3		1	12	6	10
Stations		38	127	9	61	85	13	333	Total	109	6	18	8	3	66	37	101
ORIGINS City Zones	10	38	15	11	18	25	23	130									
	11	1					3	4									
	12	7	6	5	5		3	26	18	19	20	21	22	23			Sub-Total
	13	8						8	3		2	3					78
	14		1			1	1	3		2	4	5	2				58
	15	10	12	12	10	6	13	63	1	3	5	4		1			51
	16	8	9	4		3	6	30	1	2	11	2	4	3			95
	17	11	8	5	21	18	13	76	5	4	1	2					69
	18	1	2	1	2	3	3	12	1	2		2					74
	19	2	2	4	9	4	1	18									
	20		3		4	4		13	Total	11	13	23	18	6	6		425
	21	2	6	4	3	1	1	17									
	22	1			2	2		3									
23		1		2	2	2	7										
City		89	67	46	76	63	69	410	30	31	32	33	34	Sub-Total	Total		
Rural Zones	30	3						3						9		133	
	31			38				38	7			2		1		155	
	32									1				31		92	
	33	2	1		5	3	1	12	1		10			11		170	
	34	1			1			2	1		1	1		3		178	
Rural		6	1	38	6	3	1	55	Total	9	32	14	1	56		814	
Total		133	195	93	143	151	83	798									

MIDLAND AREA TRAFFIC STUDY

CORDON TRIPS BY SINGLE UNIT TRUCKS FOR A WEEKDAY IN OCTOBER 1946

(The data derived from interviews conducted at six cordon line stations)

		DESTINATIONS - EXTERNAL STATIONS						DESTINATIONS - CITY ZONES									
		1	2	3	4	5	6	Sub-Total	10	11	12	13	14	15	16	17	
Ext. Sta.	1				9	8		17								4	
	2				12	38		50								1	
	3				1			1									
	4	12	14	1		1		28	2					2		17	
	5	6	34					40	1	3	7			3		13	
	6		1					1			1						1
Stations		18	49	1	22	47		137	Total	3	3	8		5		36	
CITY ZONES	10	6			1	3		10									
	11					1		1									
	12	2				2	3	7	18	19							
	13																
	14															4	
	15	2			1			3						1		3	
	16																
	17	1			21	19		41									21
	18						2	2									27
	19					4		4									2
	20					1		1									
	21																
	22																
23																	
City		11			23	30	5	69									
RURAL ZONES	30																
	31			6				6	1					1		22	
	32			1				1								53	
	33									5				5		6	
	34															49	
Rural			7				7									67	
Total	29	49	8	45	77	5	213	Total	1	5			6			200	

MIDLAND AREA TRAFFIC STUDY

GORDON TRIPS BY TRAILER COMBINATIONS FOR A WEEKDAY IN OCTOBER 1946

(The Data derived from interviews conducted at six cordon line stations)