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# TRANSPORTATION SYSTEM MANAGEMENT



Des Moines  
Urbanized Area

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APPENDIX



APPENDIX TO  
THE DES MOINES URBANIZED AREA  
TRANSPORTATION SYSTEM MANAGEMENT PLAN  
1977 - 78

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## INTRODUCTION

During the FY 1977-FY 1978 Unified Work Program of the Des Moines Urbanized Area, the Transportation Technical and Policy Committees developed a Transportation System Management Plan, which is published under a separate cover. This appendix provides back-up information to the TSM plan and can be used as a tool by local governments for future TSM planning. It outlines the objectives, actions and measures of effectiveness that were used in the plan. The charts which appear after the following definitions indicate the objectives, actions and measures of effectiveness that can be used to evaluate a TSM project.

### TSM OBJECTIVES

The following short range objectives were selected in August of 1977 by the Transportation Technical Sub-Committee to guide TSM planning efforts. These objectives are concerned with the safety of urban travel, the efficiency of the transportation system, the mobility of transportation disadvantaged groups and the environmental effects of transportation.

1. Reduction of injuries, deaths and property damage resulting from traffic accidents.
2. Improve level of service of urban travel.
3. Optimize the person and goods movement capacity of existing transportation facilities.
4. Reduce fuel consumed in urban travel.
5. Encourage alternatives to driving private automobiles.
6. Provide good quality, affordable transportation services to the elderly and handicapped.
7. Reduce automotive emissions and impacts.

## TSM ACTIONS

The Transportation Technical Sub-Committee has also selected a group of TSM actions for consideration in the study area. The selection was based upon funding constraints, technical feasibility, political acceptability and the ability of actions to meet the objectives identified above.

### DEFINITION OF TSM ACTIONS

#### 1. Variable Work Hours - Staggered Work Hours

Under this system the employee's starting and quitting times occur more frequently than usual (e.g. 10 min., 15 min., rather than 30 min. intervals) and either before or after the normal peak period. A staggered work hour program, however, does not change the hours or the number of days the employees work.

#### Flexible Work Hours

Employees adjust their working schedules to fit their preferences. The hours worked include a block of time within which all employees must be present. This core time would be, for example, from 10:00 A.M. - 12:00 P.M. and from 1:00 P.M. - 3:00 P.M. Under a flex time arrangement, the work week remains at 40 hours. (The State Department of Transportation is presently using this system.)

#### 2. 4-Day Work Week

4-day, ten hour schedule. Under this option all employees start work one hour earlier and leave one hour later.

4-day schedule in which less than 40 hours are worked per week. There are five scheduling options available under this type program. The options are as follows:

FOUR-DAY WORK SCHEDULE	PERCENT OF FOUR DAY EMPLOYEES WORKING ON A GIVEN DAY					
	M	TU	W	TH	F	S
1. Equally rotated M-F	80	80	80	80	80	-
2. 1/2 M-TH; 1/2 TU-F	50	100	100	100	50	-
3. Equally rotated M-S	67	67	67	67	67	67
4. 1/3 M-TH; 1/3 TU-F; 1/3 W-S	33	67	100	100	67	33
5. 1/2 M-TH; 1/2 W-S	50	50	100	100	50	50

### 3. Peak-Hour Restriction

Trucks are permitted to load and unload only during off-peak travel periods. This action applies only to trucks which provide pick-up and delivery services.

### 4. Higher Parking Cost

A change of the parking rate structure to discourage parking. The parking rates may be structured to discourage long-term parking and encourage short-term parking or vice versa. A parking rate increase can also be used to discourage the use of the private automobile and encourage the use of other means of transportation.

### 5. Reduced Parking Fee for Carpools or Vanpools

Reduction of parking fees for carpools and vanpools for the work trip.

### 6. Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders

Reduction of bus fares during all hours of bus operation for elderly and handicapped. Reduction of bus fares during off-peak periods for non-peak riders.

### 7. Transit Marketing

The direct transit marketing objectives are to increase transit patronage and to gain overall public support for the system. The marketing techniques range from public information service to advertising and promotional programs. The scale of programs depends upon the cost of implementation.

### 8. Transit Route Improvement

This action consists of both operational and physical improvements for the fixed route transit service. Operational improvements include but are not limited to

- (a) bus scheduling,
- (b) schedule reliability,
- (c) route plan and layout,
- (d) loading location.

Physical improvements include but are not limited to

- (a) turning radii at intersections,
- (b) radio service,
- (c) preferential treatment for traffic control purposes.

## 9. Integration of Transit Services

Three different types of integration are possible:

1) ~~Institutional integration-mergers of fixed route and paratransit services.~~

2) Operational integration:

- (a) a single transit network which avoids, as far as possible, duplication of service
- (b) a common fare structure
- (c) a schedule which ensures that patrons can transfer between vehicles with a minimum of waiting time, and
- (d) an areawide management information system.

3) Physical integration-this includes the standardization of vehicles, fare collection equipment and joint use of rolling stock.

## 10. Carpools, Vanpools

Carpools and vanpools organized by employers through matching programs.

## 11. Removal of On-Street Parking

This action usually is implemented in the CBD. It involves either permanent removal of on-street parking space or restriction of on-street parking during peak-periods.

## 12. One-Way Street System

On a one-way street, all lanes of traffic move in the same direction.

## 13. Traffic Control Improvement

Traffic control on urban or rural streets include the following types of improvements:

- (a) Lane markings
- (b) Lighting projects
- (c) Guardrails
- (d) 2-way stop sign
- (e) 4-way stop sign
- (f) Isolated intersection signal control
- (g) Open network control
- (h) Closed network control

The signal control concepts for (f), (g) and (h) fall into two basic categories:

- (1) pretimed control, and
- (2) traffic-actuated control.

#### 14. Unbalanced Flow

Reversible lanes are set up (during peak hours) to increase the capacity of the roadway in the direction of peak flow.

#### 15. Eliminating Unnecessary Traffic Control Devices

The elimination of traffic control devices, particularly traffic signals and stop signs, that do not meet the warrants for such devices adopted by Federal and State agencies. Frequently unwarranted traffic control devices result from changing traffic patterns.

#### 16. Signal Visibility Upgrading

The modernization of traffic signals by improving the visibility of the signals.

#### 17. Intersection Improvement (Channelization)

The establishment of exclusive right or left turn lanes through painted or physical barriers.

#### 18. Mid-block Improvement (2-way Left Turn Lanes)

Space is provided so that vehicles can pull out of through lanes and wait for an opportunity to turn left.

#### 19. Mid-block Improvement (Access Control)

Barrier type medians that prevent mid-block left turns can be used, although this is not practical where access has already been granted. Another option is to provide access through a street layout that allows drivers to make a right turn properly after circling the block. The most desirable alternative is to provide access from a side street after turning left at an intersection.

#### 20. Intersection Widening

Widening may be achieved by removal of parking, the addition of one or more lanes to provide additional lanes for left and/or right turns and the improvement of intersection geometrics.

#### 21. Pedestrian Walk and Pedestrian/Bicycle Safety Projects

Skywalks provide direct access between buildings, reducing pedestrian/vehicle conflict. The Des Moines Skywalk system will be located within the central business district, in an area bounded by 8th Street, 4th Street, Mulberry Avenue and Grand Avenue.

Bicycle safety projects consist of bikeways which are:

- (a) totally separated from pedestrian and vehicular traffic
- (b) on restricted rights-of-way, or
- (c) on shared rights-of-way with pedestrians and/or vehicles.



## THE TSM EVALUATION CHARTS

The following TSM evaluation charts may be used for:

1. determining which TSM actions can be implemented to achieve a given objective
2. indicating measures of effectiveness (MOE) which may be used to link an objective to related actions
3. determining an action's geographical area of influence
4. suggesting how actions may work to achieve objectives.

The first column of the charts indicate a specific objective. Once an objective has been selected several actions can be used to meet the objective. Actions which impact a particular objective are indicated in the second column of the chart.

The third column of the chart lists measures of effectiveness (MOEs). MOEs are defined as qualitative or quantitative indicators of the effect an action has on related objectives. The MOEs in the charts have been developed so that impacts (both positive and negative) of an action on one or more objectives can be determined.

The fourth column shows an action's geographical area of influence. This area of influence may be confined to a project site or it may extend to the entire study area.

The last column suggests means by which a TSM action possibly affects an objective. This column can be used to determine which action or actions best achieve the objective. A further analysis of a project needs to be made to

determine which of the available action(s) will have the greatest impact on an objective.

~~These charts were used to evaluate FY 1978 TSM actions (projects)~~  
submitted by local governments, the MTA and the Iowa DOT. Future TSM actions of the Des Moines Urbanized Area will be evaluated by using similar charts.

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduction of injuries, deaths and property damage resulting from traffic accidents	Variable Work Hours 4-Day Work Week	Number of accidents occurring during peak hours	CBD and/or major job centers	These actions may disperse the peak hour travel, decreasing traffic accidents as peak hour congestion is reduced.
	Peak Hour Truck Restrictions	Difficult to quantify	CBD	It is difficult to determine the number of accidents that may result from the presence of trucks in the CBD during peak hours of travel.
	Higher Parking Cost	Number of accidents	CBD	For a sizeable increase in parking cost, the number of CBD oriented automobile trips may be reduced. Such a decrease in trip making may reduce the number of accidents.
	Reduced Parking Fee for Carpools/Vanpools	Number of accidents	Routes traveled from residences to major job centers	This action may be an incentive for the lone automobile driver to shift to carpools, vanpools or transit. The number of accidents may be reduced as less vehicles are on the highways during peak hour (work trip) commuting periods.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Not applicable	----	This action has no affect on accident reduction since most of these individuals are now captive transit riders.
	Transit Marketing	Number of accidents	Transit Routes	Transit marketing could increase transit ridership by automobile users, thus reducing vehicle miles of travel. As vehicle miles of travel is reduced accidents may also be decreased.
	Transit Route Improvements	Number of bus-auto accidents	Transit Routes	The proper location of bus stops and the upgrading of turning radii may reduce the number of bus/automobile conflicts.
	Integration of Transit Service	Difficult to quantify	Areawide	It is difficult to relate accident reductions to coordinated transit service.
	Carpools, Vanpools	Difficult to quantify	Areawide	It is difficult to relate accident statistics to carpool/vanpool programs.

### TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduction of injuries, deaths and property damage resulting from traffic accidents	Removal of On-Street Parking	Number of accidents	Arterials	This action may reduce the risk of accidents due to the presence of parked cars.
	One-Way Street System	Number of Accidents	Major arterials	This action would improve safety by reducing the conflicts between turning vehicles.
	Traffic Control Improvements	Number of accidents	Intersection	Depending upon the type of traffic control improvement, the number of traffic accidents may be reduced.
	Unbalanced Flow	Number of accidents	Major arterials	Unbalanced flow decreases lane density. Therefore safety may be improved.
	Elimination of unnecessary traffic control devices	Number of accidents	Intersections	There may be a negative impact as more accidents may result from the implementation of this action.
	Signal visibility upgrading	Number of accidents	Intersection	This action may improve stopping sight distance and therefore improve safety.
	Intersection improvements (channelization)	Number or percent of left turn and/or right turn accidents	Intersection	This action eliminates the conflict between stopped vehicles desiring to turn left or right and those vehicles moving through the intersection.
	Mid-block Improvement (2-Way Left Turn Lanes)	Number of accidents	Arterial or Collector Streets	This action may improve safety by removing the left turning vehicles from the flow of traffic.
	Mid-block Improvement (access control)	Number of accidents	Arterial or Collector Streets	This action reduces the number of rear end collisions due to mid-block left turns.
	Intersection Widening	Number of accidents	Intersection	Intersection widening permits separate left and/or right turn lanes which may reduce accidents.
Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Number of accidents	Areawide	Pedestrian and bicycle projects may reduce the conflict between bicycles, pedestrians and automobiles.	

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Improve level of service of urban travel	Variable Work Hours 4-Day Work Week	Volume/capacity ratio during peak periods	CBD and/or major job centers	These actions may disperse peak hour travel and thus relieve peak hour congestion.
	Peak Hour Truck Restrictions	Street and intersection delay in seconds per vehicle	CBD	Truck parking maneuvers tend to cause travel time delays in the CBD. Traffic flow may therefore be improved if trucks are restricted from peak period loading and unloading.
	Higher Parking Cost	Volume/capacity ratio	CBD	Sizeable increases in parking cost may decrease traffic volumes (and decrease the volume/capacity ratio) in the CBD.
	Reduced Parking Fee for Carpools/Vanpools	Volume/capacity ratio on work trip routes	Routes traveled from residences to major job centers	The employer's policy on parking cost may encourage more carpool/vanpool use. Since the formation of carpool/vanpools increases auto occupancy the volume/capacity ratio should decrease.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Percent of transit vehicle capacity used during non-peak periods	Transit Routes	This action may shift peak-period demand to off-peak periods.
	Transit Marketing	Difficult to quantify	Transit Routes	The affects of marketing (i.e. information and promotion) are difficult to separate from those of service changes.
	Transit Route Improvements	Waiting time, operating speed and schedule reliability	Transit Routes	Bus route scheduling, frequency changes and route coverage modifications may improve the level of service.
	Integration of Transit Service	Difficult to quantify	Areawide	It is difficult to determine the affect this action has on the objective since the integration of transit services is a relatively new concept. Therefore, the level of service variables are now hard to specify.
	Carpools, Vanpools	Volume/Capacity ratios	Routes traveled from residences to major job centers	Carpools and vanpools may reduce the number of automobiles used for work trips thus reducing congestion.
Removal of On-Street Parking	Volume/Capacity Ratio	Arterials	This action would increase street capacity.	

### TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Improve level of service of urban travel	One-Way Street System	Delay time in seconds, volume/capacity ratio	Major arterials	This action would reduce the delay time for left turning vehicles at signalized intersections. A one-way street would also increase street capacity. However, additional traffic may be attracted due to better driving conditions.
	Traffic Control Improvements	Delay time in seconds per vehicle; volume/capacity ratio	Intersection	Traffic control improvements (i.e. changes in cycle length, phases and offsets) can minimize the delay time and increase the capacity of an intersection.
	Unbalanced Flow	Volume/Capacity ratio	Major arterials	This action increases the capacity of the roadway in the direction of peak flow. However, additional traffic may be attracted to the facility offsetting the increase in capacity.
	Elimination of unnecessary traffic control devices	Delay time in seconds per vehicle	Intersection	This action may reduce the stops per mile needed when traveling on a given route.
	Signal visibility upgrading	Not applicable	----	This action has no affect on the objective.
	Intersection improvements (channelization)	Delay in seconds per vehicle	Intersection	This action segregates the traffic flow and, when combined with separate signal phasing, reduces left turn delay.
	Mid-block Improvements (2-Way Left Turn Lanes)	Volume/Capacity ratio	Arterial or Collector Streets	This action may improve the level of service by removing left turning vehicles from the flow of traffic.
	Mid-block Improvements (access control)	Volume/Capacity ratio	Arterial and Collector Streets	Access control of the entrance to and exit from driveways at mid-block may improve the vehicle capacity of streets between signalized intersections.
	Intersection Widening	Delay time in seconds per vehicle; intersection capacity	Intersection	The capacity of an intersection would be increased through widening. Separate left turn lanes could also reduce delay time, resulting in greater vehicle flow per cycle.
Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Difficult to quantify	Areawide	Given the present state of knowledge on bikeway-pedestrian planning, it is difficult to determine the affect which the presence of bikeways and walkways may have on the level of service.	

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Optimize the person and goods movement capacity of existing transportation facilities	Variable Work Hours 4-Day Work Week	Frequency of person trips	Areawide	These actions may have a temporary negative effect on carpool programs due to schedule changes. A more flexible work schedule may also encourage more leisure travel, thereby increasing trips per capita.
	Peak Hour Truck Restrictions	Difficult to quantify	CBD	It is difficult to determine the affect peak hour truck restrictions would have on the goods movement capacity without an extensive study of commodity flows in the CBD.
	Higher Parking Cost	Transit ridership, auto occupancy	CBD	Sizeable increases in parking cost may encourage carpool/vanpool and transit usage which in turn will increase the vehicle occupancy rate for the work trip.
	Reduced Parking Fee for Carpools/Vanpools	Number of former automobile drivers participating in carpool/vanpool program(s)	Routes traveled from residences to major job centers	This action may be an incentive for the lone automobile driver to shift to carpools or vanpools.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Percent of transit vehicle capacity used during peak and non-peak periods	Transit Routes	This action may shift peak-period demand to off-peak periods.
	Transit Marketing	Increase in transit ridership (Passengers per trips)	Transit Routes	Transit marketing could encourage increased transit use.
	Transit Route Improvements	Passengers per trip	Transit Routes	Transit route service improvements may attract additional ridership.
	Integration of Transit Service	Passengers per trip	Areawide	Improved service may attract additional ridership
	Carpools, Vanpools	Auto occupancy	Areawide	Carpools and vanpools may increase average auto occupancy.
	Removal of On-Street Parking	Traffic volumes on street before and after removal of parking	Arterials	This action may attract additional traffic volumes from parallel routes.
One-Way Street System	Vehicle mix (buses-cars using the street before and after the removal of parking)	Major arterials	One-way streets may change the mix of vehicles on the street in question. They could also generate more traffic by shifting automobiles from adjacent streets.	

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Optimize the person and goods movement capacity of existing transportation facilities	Traffic Control Improvements	Service volume	Intersection	Traffic control improvements (i.e. changes in cycle length, phases and offsets) may increase the service volume at affected intersections.
	Unbalanced Flow	Volume/Capacity ratio	Major arterial	This action may increase the vehicular capacity of the roadway thus enabling more individuals and goods to be moved, especially during peak periods of travel.
	Elimination of unnecessary traffic control devices	Service volume	Intersection	This action may increase the capacity of intersections affected.
	Signal visibility upgrading	Not applicable	----	This action has no affect on the objective.
	Intersection improvements (channelization)	Service volume	Intersection	This action, when combined with signal phasing modifications, may allow more vehicles to make left turn movements in a given period of time - one hour, for example.
	Mid-block Improvement (2-Way Left Turn Lanes)	Flow rate in person or tonage units per hour	Arterials or Collector Streets	This action may increase the number of vehicles that can make left turns in a given time period. Thus, the flow rate may be increased.
	Mic-block Improvements (access control)	Flow rate in person or tonage units per hour	Arterial and Collector Streets	This action may increase the flow rate by reducing delay time and increasing the overall travel speed between intersections.
	Intersection Widening	Service volume	Intersection	Widening may reduce average lane density and thus permit a higher service volume to be handled by an intersection.
	Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Difficult to quantify	Areawide	The use of bikeways and walkways for purposeful trip making has just begun in the Des Moines Urban Area. Therefore, it is hard to determine what improvement bikeways and walkways can have on the person movement capacity of the local transportation system.



TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduce fuel consumed in urban travel	Variable Work Hours 4-Day Work Week	Reduction of Vehicle Miles of Travel	Routes from residential areas to major job centers	These actions may decrease vehicle miles of travel during peak periods by diverting peak trips to non-peak hours. However, a potential negative effect may result as leisure travel may increase.
	Peak Hour Truck Restrictions	Overall travel speed	CBD	This action may reduce idling time, increase overall travel speed and thus improve fuel economy.
	Higher Parking Cost	Vehicle miles of travel	Routes traveled from residences to CBD job centers	Sizeable increases in parking cost may encourage changes in mode of travel, decreasing the vehicle miles of travel. This implies a reduction in fuel consumed.
	Reduced Parking Fee for Carpools/Vanpools	Vehicle miles of travel	Routes traveled from residences to major job centers	As lone automobile drivers shift to carpools or vanpools, vehicle miles of travel should be reduced. A decrease in vehicle miles of travel will produce a reduction in fuel consumption.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Not applicable	----	This action will have no affect on fuel consumption, since most of the Elderly, Handicapped and off-peak Riders are not automobile drivers.
	Transit Marketing	Passenger miles of travel per gallon of fuel consumed	Transit Routes	This action may shift automobile drivers to transit. Such an increase in passenger loads will reduce the fuel consumed per passenger carried.
	Transit Route Improvements	Passenger miles of travel per gallon of fuel consumed	Transit Routes	As service improvements attract more riders less fuel is consumed per passenger mile of travel.
	Integration of Transit Service	Vehicle miles of travel	Areawide	Improved service may attract automobile drivers to integrated transit service, thus reducing the vehicle miles of travel.
	Carpools, Vanpools	Vehicle miles of travel	Areawide	Carpool/vanpool programs may decrease the number of vehicles on the road. Therefore, the amount of fuel consumed for the work trip may be reduced
Removal of On-Street Parking	Overall travel speed	Arterials	This action may improve the level of service, thereby increasing overall travel speed.	

### TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduce fuel consumed in urban travel	One-Way Street System	Overall travel speed	Major arterials	This action may increase fuel economy by increasing overall travel speed. However, the additional vehicle miles of travel generated can offset the fuel conserved through improvements in automobile fuel efficiency.
	Traffic Control Improvements	Delay in seconds per vehicle	Intersection	Traffic control improvements (i.e. changes in cycle length, phases and offsets) may reduce delay time. As delay is reduced fuel efficiency is improved.
	Unbalanced Flow	Overall travel speed	Major arterial	This action may increase overall travel speed, resulting in better fuel economy.
	Elimination of unnecessary traffic control devices	Delay time in seconds per vehicle	Intersection	This action may conserve fuel by reducing the number of stops per mile.
	Signal visibility upgrading	Difficult to quantify	Intersection	This action could improve fuel efficiency by reducing acceleration and deceleration time. However, the direct measurement of acceleration and deceleration time requires the use of sophisticated equipment.
	Intersection improvements (channelization)	Delay time in seconds per vehicle	Intersection	The amount of energy saved depends on the extent to which delay is reduced. And the extent to which delay is reduced depends, in turn, on the existing degree of congestion.
	Mid-block Improvements (2-Way Left Turn Lanes)	Delay time in seconds per vehicle	Arterials or Collector Streets	This action may increase the number of vehicles that can make left turns in a given time period. Delay will therefore be reduced and fuel consumption decreased.
	Mid-block Improvements (access control)	Delay time in seconds per vehicle	Arterial and Collector Streets	This action may reduce delay time and thereby improve fuel economy.
	Intersection Widening	Delay time in seconds per vehicle, overall travel speed	Intersection	Intersection widening may reduce delay time and improve overall travel speed, both of which would improve fuel economy.
Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Vehicle miles of travel	Areawide	The reduction of vehicle miles of travel may be achieved by shifting lone automobile drivers to bicycling or walking.	

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Encourage alternatives to driving private automobiles	Variable Work Hours 4-Day Work Week	Difficult to quantify	Areawide	These actions may not encourage the use of alternative modes of travel due to reduced congestion during peak periods.
	Peak Hour Truck Restrictions	Not applicable	----	This action has no affect on the objective.
	Higher Parking Cost	Transit ridership auto occupancy	Routes traveled from residences to CBD job centers	Sizeable increases in parking cost may induce auto drivers to change their mode of travel or to form carpools/vanpools.
	Reduced Parking Fee for Carpools/Vanpools	Number of former automobile drivers participating in carpool/vanpool program(s)	Routes traveled from residences to major job centers	This action may be an incentive for the lone automobile driver to shift to carpools or vanpools.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Not applicable	----	In general, the Elderly, Handicapped and Non-Peak Riders are not automobile drivers.
	Transit Marketing	Number of automobile drivers shifted to transit	Transit Routes	Transit marketing may inform automobile drivers of the transit services available. This could encourage some automobile drivers to ride transit if it fits their needs.
	Transit Route Improvements	Number of automobile drivers shifted to transit	Transit Routes	Transit route improvements may induce automobile drivers to use transit.
	Integration of Transit Service	Automobile drivers shifted to integrated transit	Areawide	Improved levels of service may tend to attract automobile drivers.
	Carpools, Vanpools	Number of lone automobile drivers shifting to carpool/vanpool use	Areawide	Carpool/vanpool programs may reduce the cost of the work trip. This may attract automobile users to ridesharing modes.
	Removal of On-Street Parking	Vehicle Miles of Travel Transit Ridership by Route	Arterials	This action may attract more automobile traffic from other routes as the street capacity is increased, thus increasing vehicle miles of travel. Also, the transit level of service may be increased (due to reduced delay) thus attracting increased ridership.

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Encourage alternatives to driving private automobiles	One-Way Street System	Vehicle Miles of Travel Transit Ridership by Route	Major arterials	This action may increase street capacity and thus improve the transit level of service which may attract increased ridership. More automobile traffic may also be attracted after a one-way street is implemented.
	Traffic Control Improvements	Not applicable	----	Traffic control improvements will not encourage mode shifts. In fact, the effect of such improvements may be increased vehicle miles of travel by automobile.
	Unbalanced Flow	Vehicle Miles of Travel Transit Ridership by Route	Major arterial	This action may increase the capacity of the roadway and thus may improve the transit level of service. Therefore transit ridership may be increased. However, due to better driving conditions increased trip making by automobile drivers may result.
	Elimination of unnecessary traffic control devices	Vehicle Miles of Travel	Intersection	This action may reduce delay and thus attract more automobile traffic from other routes. In effect, it may have a negative impact on the objective.
	Signal visibility upgrading	Not applicable	----	This action has no affect on the objective.
	Intersection improvements (channelization)	Not applicable	----	This action has no affect on the objective.
	Mid-block Improvements (2-Way Left Turn Lanes)	Not applicable	----	This action has no affect on the objective.
	Mid-block Improvements (access control)	Not applicable	----	This action has no affect on the objective.
	Intersection Widening	Vehicle Miles of Travel	Intersection	This action may encourage increased trip making by automobile due to an increased level of service.
	Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	The number of bicycle riders and walkers (for other than recreational trips) who previously used automobiles	Areawide	By connecting residential areas with activity (i.e. work shopping) centers some automobile drivers may use bicycle paths and walkways for utility trip making.

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Provide good quality, affordable transportation services for the elderly and handicapped	Variable Work Hours 4-Day Work Week	Not applicable	----	Neither of the TSM actions will have an affect on this objective.
	Peak Hour Truck Restrictions	Not applicable	----	This action has no affect on the objective.
	Higher Parking Cost	Not applicable	----	This action has no affect on the objectives.
	Reduced Parking Fee for Carpools/Vanpools	Not applicable	----	This action has no affect on the objective.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Elderly and Handicapped Ridership	Transit Routes	The reduced bus fares may make it possible for more elderly and handicapped to ride transit.
	Transit Marketing	Elderly and Handicapped Ridership	Transit Routes	Promotion and information campaigns may make it easier for the elderly and handicapped to use the transit system.
	Transit Route Improvements	Additional elderly and handicapped riders using the the bus system	Transit Routes	Transit service improvements (i.e. bus stop relocation, improved schedule frequency, etc.) may attract more elderly and handicapped riders.
	Integration of Transit Service	Elderly and Handicapped Ridership	Areawide	Integration of services (i.e. increases in service area, for example) may increase the availability of transportation services to the elderly and handicapped.
	Carpools, Vanpools	Not applicable	----	This action would have no affect on the objective
Removal of On-Street Parking	Not applicable	----	This action has no affect on the objective.	

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Provide good quality, affordable transportation service to elderly and handicapped	One-Way Street System	Not applicable	----	A one-way street has no affect on the objective.
	Traffic Control Improvements	Not applicable	----	Traffic control improvements have no affect on the objective.
	Unbalanced Flow	Not applicable	----	This action has no affect on the objective.
	Elimination of unnecessary traffic control devices	Not applicable	----	This action has no affect on the objective.
	Signal visibility upgrading	Not applicable	----	This action has no affect on the objective.
	Mid-block Improvements (2-Way Left Turn Lanes)	Not applicable	----	This action has no affect on the objective.
	Mid-block Improvements (access control)	Not applicable	----	This action has no affect on the objective.
	Intersection improvements (channelization)	Not applicable	----	This action has no affect on the objective.
	Intersection Widening	Not applicable	----	This action has no affect on the objective.
	Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Not applicable	----	This action has no affect on the objective.

TSM EVALUATION CHARTS

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduce automotive emissions	Variable Work Hours 4-Day Work Week	Hourly concentration of pollutants (parts per million)	Areawide	These actions may reduce traffic volumes and increase average travel speeds during peak periods. Thus air pollution concentrations during peak periods may be reduced.
	Peak Hour Truck Restrictions	Hourly pollution concentration (in parts per million)	CBD	This action may reduce automobile idling time and therefore decrease air pollution concentrations during peak periods of travel.
	Higher Parking Cost	Pollution emitted (in parts per million)	CBD	The total amount of pollutants emitted may tend to decrease as vehicle miles of travel are reduced.
	Reduced Parking Fee for Carpools/Vanpools	Vehicle miles of travel	Routes traveled from residences to major job centers	Vehicle miles of travel may be reduced as lone automobile drivers shift to carpools or vanpools.
	Reduced Bus Fares for Elderly and Handicapped and for Non-Peak Riders	Not applicable	----	Because few of the elderly and handicapped are currently automobile drivers their increased use of transit can have little or no affect on automotive emissions.
	Transit Marketing	Pollution in grams	Areawide	Transit marketing could induce automobile drivers to use transit. As a result, vehicle miles of travel may be reduced which implies a reduction of automotive emissions.
	Transit Route Improvements	Number of automobile drivers attracted to transit	Areawide	Service improvements may induce some automobile drivers to leave their cars at home. If, however, these automobiles are driven by household members during the working hours the same amount of, or even more, pollution may result.
	Integration of Transit Service	Vehicle miles of travel	Areawide	This action may improve the level of service of transit and attract automobile drivers out of their cars.
	Carpools, Vanpools	Vehicle Miles of Travel	Areawide	Carpools and vanpools may reduce the number of cars used for the work trip. As a result, the amount of pollution emitted may also be reduced.
Removal of On-Street Parking	Overall Travel Speed	Arterials	This action may increase the overall travel speed on the street in question - a result which improves automobile fuel economy.	

TSM OBJECTIVE	TSM ACTION	MEASURE OF EFFECTIVENESS	GEOGRAPHIC AREA OF INFLUENCE	HOW THE TSM ACTION POSSIBLY AFFECTS THE OBJECTIVE
Reduce automotive emissions	One-Way Street System	Overall travel speed	Major arterials	A one-way street system increases fuel economy by improving overall travel speed. This increased fuel economy may be offset, however, by the additional traffic attracted from parallel streets.
	Traffic Control Improvements	Overall travel speed	Intersection	Traffic control improvements may increase overall travel speed, thereby reducing automobile emissions. However, this reduction in pollution may be offset by the additional traffic attracted to the intersection.
	Unbalanced Flow	Overall travel speed	Major arterial	An increase in overall speed may reduce emissions, but in the long run more pollution may result from the additional traffic volumes that may be attracted to arterial streets.
	Elimination of unnecessary traffic control devices	Delay time in seconds per vehicle	Intersection	This action may decrease delay, thus increasing overall travel speed. As speed increases the pollution emitted decreases.
	Signal visibility upgrading	Difficult to quantify	Intersection	This action could reduce pollution by lowering acceleration and deceleration rates. But the sophisticated equipment needed to measure it is not readily available in the study area.
	Intersection improvements (channelization)	Delay time in seconds per vehicle	Intersection	A reduction in delay time may improve overall travel speed, which in turn reduces the pollution emitted by automobiles.
	Mid-block Improvements (2-Way Left Turn Lanes)	Delay time in seconds per vehicle	Arterial or Collector Streets	By reducing delay time automotive emissions should also be reduced.
	Mid-block Improvements (access control)	Overall travel speed	Arterial and Collector Streets	This action may reduce overall travel speed and in turn reduce auto emission rates.
	Intersection Widening	Delay time in seconds per vehicle	Intersection and Surrounding Streets	Street widening may decrease the delay time per vehicle, which would also reduce automobile emissions.
	Pedestrian-Walk and Pedestrian-Bicycle Safety Projects	Vehicle miles of travel	Areawide	By reducing the vehicle miles of travel, the amount of pollution emitted may also be reduced.



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