

# TRANSPORTATION SYSTEM MANAGEMENT ELEMENT

Transportation system management (TSM) is a term used to describe a wide range of measures and techniques that attempt to both maximize the capacity of the street system and reduce the demand on it. Although some may be very expensive to implement, TSM measures are typically low cost localized improvements that attempt to take full advantage of the existing street infrastructure thereby increasing the efficiency of the street system. In recent years, the industry has folded travel demand management (TDM) measures into the TSM family of measures. TDM measures generally work to reduce the demand placed on the street system, particularly by SOVs. This element of the Salem Transportation System Plan will not address TDM measures as it is addressed in a separate element of the Plan starting on page 10-1. This element deals explicitly with supply side improvements.

TSM measures provide for better traffic movement and increased safety by managing the existing street system. TSM measures will generally not require midblock widening of the roadway system.<sup>1</sup> Because they typically are low-cost and low-impact (to surrounding land uses and neighborhoods) improvements, TSM measures are a significant resource to traffic engineers and planners. This is particularly true when existing traffic congestion requires street improvements in highly developed areas of the community or when finances dictate the need for an intermediate improvement.

While the spectrum of TSM measures is wide, the measures that are applicable to Salem will generally fall into one of five categories listed below:

- Traffic Management and Channelization;
- Intersection Modification and Widening;
- Access Management;
- Improved Traffic Control Devices; and
- On-street Parking Management.

This Element provides a summary of the TSM measures that may be carried out in Salem. We describe each measure along with a summary of its potential impact on traffic congestion, implementation issues, and its history in Salem—if any—and potential for future use.

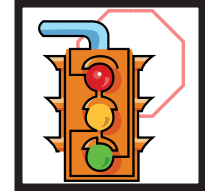
## Goal, Objectives, and Policies

The City of Salem has the following goal, objectives, and policies for utilizing transportation system management techniques:

**GOAL: To maximize the efficiency of the existing surface transportation system through management techniques and, facility improvements.**

### OBJECTIVE NO. 1

A system of traffic control devices maintained and operated at an optimal LOS and efficiency consistent with existing funding levels.



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### **Policy 1.1 Improve the Efficiency of the Signal System**

The City shall continue to modernize the signal system and improve its coordination and efficiency by ultimately connecting all of its signals to the centralized Traffic Control Center. The City shall increase its communication abilities with the traffic signals and cameras through installation of fiber optic communication network, or through the most cost-effective and reliable method available. The City shall employ traffic signal timing plans that maximize the efficiency of the system given the particular travel demand of that time of day. City traffic signals should be evaluated and retimed, as warranted, at least every three years to maximize the operational performance of the system.

### **Policy 1.2 Maintain Signal System Operations**

The City shall conduct regular and preventive maintenance on the signals within its inventory so as to prevent traffic delays and congestion due to avoidable malfunctions.

### **Policy 1.3 Maintain Clear and Effective Signs and Pavement Markings**

The City shall regularly maintain all of the traffic control devices (signs and markings) within its inventory so as to minimize congestion and driver delay due to confusion. While priority shall always be given to regulatory and warning signs, informational (street name and directional) signs shall also be given proper maintenance.

## **OBJECTIVE NO. 2**

To maximize the effective capacity of the street system through improvements in physical design and management of on-street parking.

### **Policy 2.1 Giving Intersection Improvements Priority**

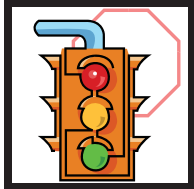
Consistent with adopted LOS standards, the City shall give the physical improvement of intersections a higher priority in the design process than general street corridor widenings when seeking ways to increase capacity and relieve congestion on a street.

### **Policy 2.2 On-street Parking Management**

Where on-street parking is permitted on a congested arterial street, the City shall give first priority to removing on-street parking as a means of enhancing the capacity of the facility. Depending upon the situation and proper analysis, the City may consider timed on-street parking prohibitions during peak travel periods in lieu of permanent removal.

### **Policy 2.3 Bus Bays on Arterial Streets**

The City shall consider installing bus bays on congested arterial streets as a means of facilitating traffic flow during peak travel periods. The feasibility, location, and design of bus bays shall be developed in consultation with the Salem Area Mass Transit District.



### **OBJECTIVE NO. 3**

To increase street system safety and capacity through the adoption and implementation of access management standards.

#### **Policy 3.1 Development and Adoption of Access Management Standards**

The City shall develop and adopt specific access management standards to be contained in the Department of Public Works Design Standards, based on the following principles:

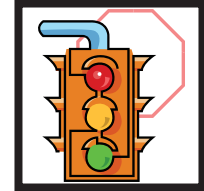
1. Properties with frontage along two streets shall take primary access from the street with the lower classification.
2. Any one development along the arterial street system shall be considered in its entirety, regardless of the number of individual parcels it contains. Individual driveways will not be considered for each parcel.
3. Access to the arterial street system shall be primarily limited to one point, provided adequate street frontage is available. Additional access may be permitted, provided adequate frontage and access spacing is available.
4. Signalized access for private streets and driveways onto the major street system shall not be permitted within 1,320 feet of any existing or planned future signal.
5. Shared mutual access easements shall be designed and provided along arterial street frontage for both existing and future development.
6. The spacing of access points shall be determined based on street classification. Generally, access spacing includes accesses along the same side of the street or on the opposite side of the street. Access points shall be located directly across from existing or future access, provided adequate spacing results.
7. All access to the public right-of-way shall be located, designed, and constructed to the approval of the Public Works Director or his designee. Likewise, variances to access management standards shall be granted at the discretion of the Public Works Director or his designees.

#### **Policy 3.2 Incorporate Access Management into Arterial Street Design**

The City shall incorporate access management plans into all of its arterial street design projects. Access management measures shall include, but not be limited to, construction of raised medians, driveway consolidation, driveway relocation, and closure of local street access to the arterial. Access onto State of Oregon Highways is regulated per OAR 734-051.

#### **Policy 3.3 Access Management Projects**

Consistent with the City's goal of improving mobility, the City shall consider developing access management projects for congested arterials to help improve safety and traffic flow. Access management projects shall include, but not be limited to, construction of raised medians, driveway consolidation, driveway relocation, and closure of local street access to the arterial.



## **OBJECTIVE NO. 4**

To actively manage the operation of the surface transportation system during peak travel periods.

### **Policy 4.1 Real-time System Management**

The City shall consider including funding for arterial surveillance and real-time management projects that will relieve or prevent arterial street congestion. These projects shall include, but not be limited to, real-time arterial surveillance, motorist information techniques, and incident response and clearance programs.

## **Traffic Management and Channelization**

Traffic management and channelization are those TSM measures that improve the operation of a significant length of street facility, not just the intersection. Many of these measures lead to a more intensive use of the existing street space.

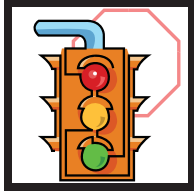
### **ONE-WAY STREETS**

Although most streets are designed for use by two-way traffic, high volumes of traffic and vehicle conflicts often lead to consideration of one-way traffic regulations. Cities have generally set up a one-way street system in major activity centers, such as downtowns, where high traffic volumes and signal timing considerations have required it. One-way streets provide increased traffic carrying capacity by:

- reducing intersection delays caused by vehicle turning movement conflicts;
- allowing a reduction in vehicle lane widths;
- reducing travel time;
- improving transit operations;
- permitting turns from more than one lane; and
- simplifying signal timing.

How much data to be collected and analyzed in planning for one-way streets depends largely on the size of the system being contemplated. Generally, two-way streets should be made one-way streets only when:

1. Analysis can show that a one-way system will alleviate a specific traffic problem or improve overall efficiency of the transportation system;
2. One-way operation is more desirable and cost-effective than alternative solutions;
3. Parallel streets of a suitable capacity, preferably not more than a block apart, are available or can be constructed;
4. Such streets provide adequate traffic service to the area traversed and carry traffic through and beyond the congested area;



5. The existing street system can provide safe transition to two-way operation at the ends of the one-way section;
6. The one-way system can maintain proper transit service; and
7. Such streets are consistent with the adopted Transportation Plan and compatible with abutting land uses.

The City of Salem has had much experience with the use of one-way streets, both in the downtown and Capitol Mall areas, and on the arterial approaches to these areas. Salem may develop additional one-way systems in the future if the need arises and if the conditions meet the application criteria described above. The Salem Transportation System Plan does not propose new one-way systems.

## REVERSIBLE TRAFFIC LANES

Arterial routes that normally operate as two-way streets, particularly those in urban areas, can experience greater peak hour traffic volumes in one direction than in the other. This results in an underutilization of one-half of the street width and overuse and congestion on the other half. The reversible lane system takes advantage of the total capacity of the street. Here, one or more lanes are designated for movement one way during part of the day and in the opposite direction during another part of the day. On a three-lane road, for example, the center lane might normally operate as a two-way, left-turn lane, but during the peak hour operate in the direction of greater flow.

A reversible lane system is one of the most efficient methods of increasing the peak hour capacity of an existing street. It takes advantage of the unused capacity in the off-peak direction of traffic by making the lane available to the heavier (or peak) flow of traffic. The result is that all of the lanes are used to their fullest capacity. Two key issues of concern in setting up a reversible lane operation are the potential for higher accidents given the dynamic nature of a reversible lane system, and the need to address the operational issues at the termini.

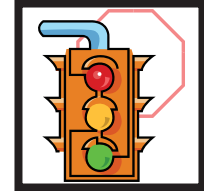
Several factors need to be considered before setting up a reversible lane operation:

1. Traffic congestion should be to the point where demand is greater than the street's actual capacity;
2. The congestion is occurring during predictable and periodic times of the day, such that the traffic lanes may be reversed during certain times of the day;
3. The off-peak, or lighter flow direction, may be easily satisfied within the capacity remaining after the lanes are reversed for use in the peak direction; and
4. Adequate capacity exists at the ends of the reversible lane system, with an easy transition from the reversed operation to the normal operation.

The City of Salem does not have experience with reversible lane operations. This makes this type of operation especially difficult, due to driver expectation and performance. While this is an acceptable measure to consider in the proper circumstance, we should apply it with care and plenty of advance public notification and education.

## HIGH OCCUPANCY LANES ON ARTERIALS

Priority treatments for high occupancy vehicles (HOVs)—such as buses and carpools—provide for more effective use of street space during peak periods of traffic. Moving more people in fewer vehicles accomplishes this. HOV



facilities in the United States, for the most part, are in use on freeways. Surface street applications are not as prevalent, but do exist. It is the latter type of HOV facility that would be applicable for use in Salem.

Two types of surface street HOV facilities are available: concurrent flow and contraflow. Other HOV treatments, usually used in downtown areas, include:

- Exclusive transit streets, such as the transit mall in downtown Portland; and
- Priority signals for HOVs and buses.

These two types of HOV treatments are further described below.

Concurrent flow HOV lanes on surface streets are found in more than 30 cities throughout the United States. Most applications use the curb lanes of downtown streets with minimal signing and marking. Concurrent flow HOV lanes in downtown areas are carried out either by taking an existing lane of traffic, removing on-street parking, or by narrowing existing lanes to achieve an extra lane. Restricted right-of-way, and the potential for significantly impacting adjoining land uses, usually prohibits the construction of a full added lane. Concurrent flow lanes usually operate during either one, or both, of the peak hours, or during other specified periods of the day. Twenty-four-hour restrictions are rare for this type of treatment due to enforcement problems, lack of physical separation, and low HOV demand during off-peak hours.

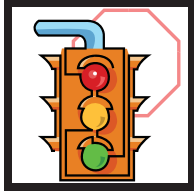
Contraflow applications have generally been used on one-way streets although a few projects have applied the concept to two-way streets, either on the opposite side of a median or on a two-way, left-turn lane. These latter applications are most prevalent on arterial routes outside the downtown area. Because a contraflow lane is taken from the off-peak direction, there are usually no major physical changes required for the roadway. To date, all contraflow operations in downtown areas have been limited to buses due to the typically high bus volumes and the safety concerns associated with contraflow movements. Most downtown contraflow lanes operate on a permanent basis. The special signing and signalization required for this type of operation dictate 24-hour restrictions.

If properly set up, HOV facilities can accomplish the following:

- Induce commuters to shift to HOV travel modes due to the faster travel times associated with the exclusive facilities;
- Increase the person-carrying capacity of critically congested arterial corridors and provide increased accessibility to major activity centers such as downtown;
- Optimize the travel times for the maximum number of people, but not necessarily vehicles;
- Reduce or defer the need to construct additional highway capacity for general purpose traffic; and
- Improve the efficiency and economy of public transit operations.

Although every HOV treatment is unique to its setting, several guidelines are common to most projects. These are:

- Advance planning and inclusion of all stakeholders, governmental and private, is critical to the eventual success of the HOV treatment;



- Flexibility to meet the changing conditions in the area where the treatment is carried out;
- Enforcement of the restrictions put in place;
- Public education and marketing before the program's start-up; and
- Clear signing and marking.

A limited example of an HOV treatment is present in downtown Salem at the High Street bus terminal. The extensive network of one-way streets may someday form the basis of an HOV network to and from Salem's central core. Other possible locations for this type of measure are along some east-west arterials, particularly if implemented along with park-and-ride lots. Any future development of HOV treatments must be done in coordination and cooperation with the Salem Area Mass Transit District and the Salem Rideshare Program.

## **BUS BAYS**

Bus bays provide areas separated from the flow of traffic for boarding and alighting bus passengers. As such, they are generally designed as safety facilities on streets with posted speeds greater than 40 mph. By having the bus pull out of the flow of traffic, it reduces the disruption to through traffic. However, delays can result from the bus merging back into the travel lanes. Bus bays generally require additional right-of-way to fit them. Another effective way of creating bus bays is to eliminate curbside parking for a length of several hundred feet at a bus stop location.

Bus bays are generally inexpensive measures that are typically installed as part of street modernization projects. On existing streets in Salem, bus bays have generally been created by removing parking. Coordinating the location of bus bays with the Salem Area Mass Transit District is important to confirm its location and to ensure that the bus drivers will use them.

## **IMPROVED SIGNS AND MARKINGS**

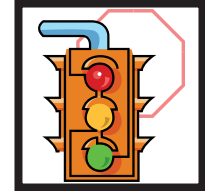
Improvements in street signing and markings, with the intent to provide better information to the driver, are beneficial in reducing congestion and increasing the efficiency of the roadway system. Improved directional signs, route markers, large (easy to read) street signs, signs on mast arms, cross street signs ahead of major intersections, etc., all provide a means of reducing the uncertainty of drivers. In addition, they also tend to increase safety, which further increases the efficiency of the street system.

## **Intersection Widening and Modification**

These techniques relate to geometric improvements at intersections.

## **ROADWAY ALIGNMENT AT INTERSECTION**

Possibly one of the simplest of the TSM measures is roadway alignment at intersections. At intersections where a roadway's centerline is offset on opposite sides of the cross street, reductions in traffic flow can result. Reduced traffic flow can cause significant congestion, particularly during peak hours. Correcting the offset problem may require acquisition of additional right-of-way for moving curbs and sidewalks, but can result in substantial increases in operational efficiency.



The City of Salem has many locations where a roadway centerline does not match up across the intersecting street. The cause of these offsets is typically interspersed development of parcels. While the City does not have a program to correct these misalignments, many of these problems are corrected when reconstruction of the street is undertaken. Other locations are corrected ad hoc, as funding allows.

## INTERSECTION WIDENING

Widening intersection approaches to provide left- and right-turn lanes can increase the approach capacity by up to 25 percent. This increase allows for a better balance between intersections and midblock capacities. Turn lanes also allow for simplified, and often more efficient, signal timing.

Another possibility is to increase the corner radii at intersections. Larger radii provide smoother right turns and reduce the negative effects right turns have on the capacity of through traffic at intersections. However, increasing a turn radius can also negatively impact pedestrian activity. Usually, corner radii of 25 to 35 feet are adequate for smooth turns.

Intersection widening is a cost-effective technique for improving capacity that is widely used throughout Salem. Understanding the impacts to pedestrian safety, however, these are done with advanced planning and caution to not create a hazard at locations heavily traveled by pedestrians.

## TURN CONTROLS

Turn controls at intersections include prohibitions, limitations, and channelization. We discuss each of these measures in greater detail below.

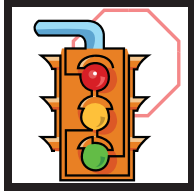
Turn prohibitions can increase intersection capacity by eliminating delays due to pedestrian conflict and left turns. Turns can be prohibited during certain parts of the day, particularly during the peak periods. Signs, signals, and pavement markings are used to control the movement. Where painted or channelized turn bays are provided, extra attention must be given to signing and marking for turn prohibitions at specific hours.

Alternatives should be carefully examined before banning turns from an arterial street due to other problems that these measures sometimes create. These problems include an overall increase in system travel and new traffic patterns that may result in new problem locations upstream or downstream from the subject intersection. Special signing may be used to help drivers find an alternative method for making a left turn that has been prohibited.

Right-turn lanes may be installed independent of signal control by using channelization, or they may be given a signal phase free of opposing left turns or pedestrians. Right-turn-on-red ordinances and one-way street patterns are considerations in developing right-turn lanes. Continuous right-turn channels may create some problem with safe pedestrian crossing of the channel, although placement of the crosswalk near the entry end of the channel will improve visibility for driver and pedestrian alike.

A modest planning effort is required to identify arterial locations where turn controls should be considered and installed. These should include:

- Amount of congestion and delay caused by turning movements;
- Number of accidents caused by turning vehicles;



- Availability of suitable alternative routes for the restricted turns;
- Impacts of the traffic diversion on congestion and accidents at other locations;
- Feasibility of alternative solutions.

Turn controls are cost-effective measures that are in widespread use throughout Salem. The need for these is evaluated based upon the five issues discussed above and done on a case-by-case basis.

## **GRADE SEPARATION AT MAJOR INTERSECTIONS**

This technique is costly and requires major reconstruction of existing at-grade intersections. Typical costs are two to three million dollars for reconstruction. Additionally, it may require acquisition of costly right-of-way. Maintenance of traffic during construction activities is also a major consideration. Grade separation, however, may be required at intersections of major arterials serving a corridor with increasingly dense population or major trip generators/ attractors such as large shopping centers. It should also be considered where at-grade arterial street and railroad crossings currently exist.

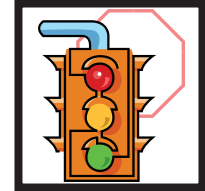
In urban areas that continue to develop, intersections serving these areas may no longer provide the capacity necessary to provide for safe and efficient traffic movement. These intersections often form bottlenecks during both peak periods, backing up traffic, and retarding traffic movement at upstream intersections. The design engineer can expect that when total entering daily volumes exceed 60,000 or 70,000, an at-grade intersection will become saturated no matter the efficiency of control applied. For safety and operational reasons, local access is not desirable in the immediate area of interchanges. These access points reduce the effectiveness of providing separation of flows.

The City of Salem has one grade-separated intersection (Mission Street SE at 12th Street SE/13th Street SE). There is a strong possibility that they will develop additional grade-separated intersections as increased densities lead to greater traffic congestion. Primary candidates for this type of treatment are the two signalized intersections along Salem Parkway NE and the Kuebler Boulevard SE/Commercial Street SE intersection. None, however, are planned at this time.

## **Access Management**

Access management can improve the operation of an arterial street by reducing the number of traffic conflicts. Studies have shown that access management can both increase the average travel speeds and the carrying capacity of arterials while reducing accident rates. Without an access management program for arterial streets, capital investment for roadway improvements is required at periodic intervals. This cycle is a result of continually trying to satisfy traffic demands that are often a result of increased business activity that improved traffic conditions influence leading to further traffic demands. The number of conflict points among vehicles rises because of an increased number of driveways, causing the capacity of a specific LOS to diminish. Access management strategies typically include one or more of the following:

- physical restriction of left turns;
- restriction of direct access driveways;



- separation of obvious conflict points;
- placement of intersections and driveways at no less than minimum intervals; and
- development of frontage roads to collect local traffic and funnel to selected intersections.

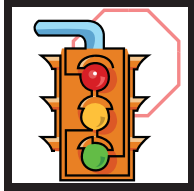
Effective management of the location and number of access points can result in the following:

- Improved safety. Over 50 percent of arterial accidents are access related.
- Increased capacity and reduced congestion. Controlling turning movements and eliminating conflicting movements, while controlling speed and ease of ingress and egress, can increase street capacity by as much as 35 percent.
- Increased functional life of the existing roadway by increased or preserved capacity. This reduces the need for new capital construction to meet increased traffic demands.
- Assures equitable and consistent treatment for all.
- Protects the economic vitality of the abutting properties. Inadequate access management will drive potential customers to other less congested locations.
- Reduced travel time and delay. Up to a 60 percent reduction can be achieved due to fewer stops, less vehicle deceleration and acceleration.
- Decreased energy consumption. Up to a 50 percent reduction can result due to fewer stops, less vehicle deceleration and acceleration. This has a positive effect on air quality.
- Reduced costs to customers, commercial shipments, and services.

## **ARTERIAL ACCESS MANAGEMENT**

Controlling or managing access along arterial highways is perhaps one of the most difficult tasks facing local officials and transportation engineers. This difficulty comes from a time-honored tradition and, occasionally, a legal right for land owners abutting a road to have access to their land. In addition, the process for land development decisions is often very different from that for transportation system planning.

One approach for providing proper coordination for access management plans and programs is to undertake corridor level planning studies. Corridor analyses that assess future demands and capacity of freeway and parallel arterials and evaluate major development proposals provide essential information to decision makers. Successful arterial access management relies on the adoption of effective access management standards and adequate site analysis by the developer and City staff.



## Improved Traffic Control Devices

### TRAFFIC SIGNAL IMPROVEMENTS

Traffic signal improvements generally provide the greatest payoffs for reducing congestion on surface streets. Some basic improvements can and should be made to improve traffic flow on arterials. These actions are:

- Updating old signals with modern equipment having greater capabilities for complex timings and connections between signals;
- Updating and improving the signal timing plans and retiming the signals, as needed;
- Interconnect signals along key arterial routes;
- Remove traffic signals that are no longer justified; and
- Maintain signals, both through periodic preventive maintenance and immediate response to signal malfunctions.

When these efforts are combined with an advanced, computer-based signal control system, traffic flow on arterials can be increased by up to 25 percent.

This is a TSM measure that the City of Salem is actively using. About half of the Salem traffic signals are under the control of a computer-based system.

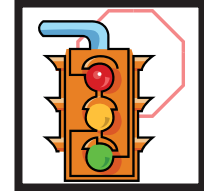
Ultimately, all of the signals within the Salem-Keizer area will be under City jurisdiction and under the control of the City's central system. In addition, many signals along major arterial routes either have been or will be interconnected. Both actions will allow for greater progression of vehicular traffic during peak travel times.

### IMPROVED SIGNS AND MARKINGS

Improvements in street signing and markings, with the intent to provide better information to the driver, are beneficial in reducing congestion and increasing the efficiency of the roadway system. Improved directional signs, route markers, large (easy to read) street signs, signs on mast arms, cross street signs ahead of major intersections, etc., all provide a means of reducing the uncertainty of drivers. In addition, they also tend to increase safety, which further increases the efficiency of the street system.

Five basic factors must be employed in designing and maintaining an improved signing and marking system:

1. Design. The combination of physical features such as size, colors, and shape needed to command attention and convey a message;
2. Placement. The installation of devices so that they are within the lines of vision of the users and thus able to command attention and allow time for response;
3. Operation. The application of devices so that they meet traffic requirements in a uniform and consistent manner, fulfill a need, command respect, and allow time for response;



4. Maintenance. The upkeep of devices to retain legibility and visibility or the removal of devices if not needed; and
5. Uniformity. The uniform application of similar devices for similar situations.

The City of Salem observes all of the factors listed above in the design and maintenance of the street signs and markings.

## **ARTERIAL SURVEILLANCE AND MANAGEMENT**

Although not traffic control devices in and of themselves, the measures included in this section work in concert with traffic control devices—specifically, computerized signal systems—to further increase the efficiency of arterials.

- Incident detection, citizen alert of the incident, and follow-up action to remove it from the travel lanes;
- Intersection surveillance and monitoring using loop detectors, interconnected signal systems, and video monitoring;
- Use of variable message signs to convey real-time information to motorists on the street; and
- Use of parking and access management techniques (as described in other parts of this element).

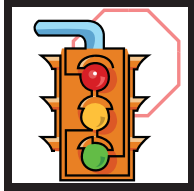
These measures may be carried out at discrete locations or as a system on key arterials. At discrete locations, these measures may be relatively simple, albeit costly, to implement. On a systemwide level, the planning and implementation of an arterial surveillance and management system is a major undertaking. The Traffic Control Center at City Hall that houses the central signal computer forms the backbone for implementation of arterial surveillance and management in Salem. Once all of the signals are connected to the computer, the logical next step will be to initiate these types of measures to further the efficiency of the arterial system.

## **On-street Parking Management**

### **REMOVAL OF PARKING**

Removal of on-street parking can be considered on a systemwide basis for arterials and collectors for increasing through-traffic capacity. It requires thorough study involving operational and capacity benefits, availability of off-street parking facilities, loss of parking revenue, and commercial truck loading requirements. Removal of on-street parking should be done consistent with a community's parking needs, providing sufficient parking spaces to serve residential, commercial, and retail activities. Any change in on-street parking supply requires a thorough public education, notification, and involvement process to address possible resistance from citizens and merchants.

Curb parking, particularly angle parking, reduces the street width available for the through movement of traffic. Parking maneuvers at on-street spaces further decrease the capacity of the street by producing interruptions in the traffic flow. Capacity can be reduced by 25 to 35 percent. On-street parking is also considered a frictional factor to the street's capacity. Thus, where capacity deficiencies exist, removal of the on-street parking is an effective first consideration for increasing capacity.



The City of Salem has a successful history of removing on-street parking to enhance the capacity of the street system. Parking removal has provided for increased carrying capacity, with the least impacts to adjoining properties. Recently, we have removed on-street parking in some locations in favor of providing on-street bicycle lanes.<sup>1</sup>

## Recommended TSM Improvements

It is anticipated that about 40 new traffic signals will be needed in the City of Salem over the next 20 years. Currently (in 2006) the average cost for a traffic signal is about \$330,000. These costs are shown in the Street System Element. A number of traffic signal interconnect projects will be completed over the next 20 years as well. These, along with various other ITS projects, are recommended for implementation and funding as part of an overall strategy to maximize the capacity of the existing arterial and collector street system within the Salem Urban Area (see Table 4-1).

The City also supports implementation of other ITS strategies (see Table 4-2) but does not anticipate programming significant capital funds toward these within the 25-year planning period. These strategies build on ITS infrastructure shown in Table 4-1 and/or involve one or more of the following:

- A Management and/or Coordination Strategy.
- Another Agency Taking the Lead.
- A Maintenance-related Strategy.

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<sup>1</sup> See Bicycle System Element of Salem Transportation System plan for a more detailed discussion on this topic and the City Council-adopted policies that govern its implementation.

**Table 4-1 Intelligent Transportation Systems (ITS) Projects**

Street	Location	Full Project Description	ID	Priority	Cost Estimate	Wards	Neighborhoods	Lead Agency
12th and 13th Streets SE	Mission Street SE to Hoyt Street SE	Install fiber optic cable and Interconnect Signals along 12th Street SE and upgrade signals at 12th and 13th Streets.	254	Committed	\$167,000	2	SESNA	Salem
17th Street NE and Center Street NE	State Street to Market Street NE and 17th Street NE to 24th Street NE	Install fiber optic cable and Interconnect Signals along these two corridors.	220	Committed	\$329,000	1, 2, 6	NEN	Salem
25th Street SE	Mission Street SE to McGilchrist Street SE	Install fiber optic cable and Interconnect Signals along 25th Street SE.	211	Committed	\$150,000	2	SESNA, SEMCA	Salem
Edgewater Street NW	Wallace Road NW to Eola Drive NW	Install fiber optic cable and Interconnect Signals along Edgewater Street NW	207	Committed	\$375,000	8	West Salem	Salem
Lancaster Drive NE	Hayesville Drive NE to Silverton Road NE	Install fiber optic cable and Interconnect Signals along Lancaster Drive NE.	215	Committed	\$125,000			Marion County
Lancaster Drive SE	Act 3 Theater to Rickey Street SE	Install fiber optic cable and Interconnect Signals along Lancaster Drive SE.	214	Committed	\$75,000			Marion County
Lancaster Drive SE	Hagers Road SE to Cordon Road SE	Install fiber optic cable and Interconnect Signals along Lancaster Drive SE.	212	Committed	\$200,000	2	SEMCA	Salem
Madrona Avenue SE	Pringle Road SE to Fairview Industrial Drive SE	Install fiber optic cable and Interconnect Signals along Madrona Avenue SE.	213	Committed	\$100,000	3	Morningside	Salem
Marion Street Bridge	Wallace Road NE to Front Street NE	Install fiber optic cable over the bridge in order to interconnect traffic signals in West Salem to Downtown and to the Salem Traffic Control Center.	219	Committed	\$100,000	8, 1	West Salem, CAN-DO	Salem
Portland Road NE	Lana Avenue NE to Hyacinth Street NE	Install fiber optic cable and Interconnect Signals along Portland Road NE	208	Committed	\$375,000	5	Northgate	Salem
Sunnyview Road NE	Lancaster Drive NE to 45th Av NE	Install fiber optic cable, interconnect signals, and install new signal at 45th Avenue NE. Extend interconnect project to Cordon Road NE if resources allow.	209	Committed	\$290,000	1, 6	NOLA, ELNA, NESCA	Salem
Cordon Road NE	State Street to Silverton Road NE	Install fiber optic cable and Interconnect Signals along Cordon Road NE.	218	High	\$400,000	1, 6	ELNA, NOLA	Salem
Fiber Optic Communications	Citywide	Install fiber optic cable to provide high speed communication among traffic management centers and field devices.	231	High	\$462,000	All	All	Salem

**Table 4-1 Intelligent Transportation Systems (ITS) Projects (Continued)**

Street	Location	Full Project Description	ID	Priority	Cost Estimate	Wards	Neighborhoods	Lead Agency
Silverton Road NE	Lancaster Drive NE to Cordon Road	Install fiber optic cable and Interconnect Signals along Silverton Road NE.	216	High	\$150,000			Marion County
Video Deployment	Citywide	Deploy pan-tilt-zoom cameras to monitor roadway conditions, trouble spots, incidents, equipment failures, traffic signal operations, and to provide real-time roadway condition information to travelers.	221	High	\$2,100,000	All	All	Salem
Center to Center Integration	Citywide	Implement communications links among the Salem Traffic Control Center, ODOT's Northwest Traffic Operations Center, and other transp. operations centers in the area.	226	Medium	\$205,000	All	All	Salem
Central Signal System Upgrade	Downtown Salem	Upgrade the Salem Traffic Control Center's computer and other equipment to maximize ITS systems capabilities.	229	Medium	\$600,000	All	CAN-DO	Salem
Communications to Isolated Signals	Citywide	Connect all remaining isolated signals to the central signal system computer.	234	Medium	\$445,000	All	All	Salem
Computer Aided Dispatch Interface	Citywide	This project will provide traffic related information and video directly to the 911 Computer Aided Dispatch system.	236	Medium	\$83,000	All	All	Salem
Downtown Salem Parking Management	Downtown Salem	Deploy dynamic message signs and HAR radio messages to direct motorists to available parking facilities in downtown Salem.	228	Medium	\$448,000	1, 2	CAN-DO	Salem
Fiber Optic Communications	Citywide	Install fiber optic cable to provide high speed communication among traffic management centers and field devices.	232	Medium	\$385,000	All	All	Salem
Intra-Agency Information Sharing	Citywide	This project will provide for information flow (traffic data and video) among the various traffic management and emergency operations centers.	235	Medium	\$79,000	All	All	Salem
Traffic Data Collection System	Citywide	Deploy equipment to automate traffic data collection and link it directly to the Salem Traffic Control Center.	224	Medium	\$210,000	All	All	Salem

**Table 4-1 Intelligent Transportation Systems (ITS) Projects (Continued)**

Street	Location	Full Project Description	ID	Priority	Cost Estimate	Wards	Neighborhoods	Lead Agency
Video Deployment	Citywide	Deploy pan-tilt-zoom cameras to monitor roadway conditions, trouble spots, incidents, equipment failures, traffic signal operations, and to provide real-time roadway condition information to travelers.	222	Medium	\$1,470,000	All	All	Salem
Adaptive Signal Timing	Citywide	Deploy adaptive signal timing on selected signalized corridors in the region with the highest levels of congestion and the most fluctuation in volumes.	230	Low	\$1,400,000	All	All	Salem
Fiber Optic Communications	Citywide	Install fiber optic cable to provide high speed communication among traffic management centers and field devices.	233	Low	\$539,000	All	All	Salem
Traffic Control Center Upgrade	Downtown Salem	Upgrade the existing Salem Traffic Control Center to provide additional space for equipment and for Salem-Keizer metropolitan area traffic management activities.	227	Low	\$351,000	All	All	Salem
Traffic Data Collection System	Citywide	Deploy equipment to automate traffic data collection and link it directly to the Salem Traffic Control Center.	225	Low	\$210,000	All	All	Salem
Video Deployment	Citywide	Deploy pan-tilt-zoom cameras to monitor roadway conditions, trouble spots, incidents, equipment failures, traffic signal operations, and to provide real-time roadway condition information to travelers.	223	Low	\$1,554,000	All	All	Salem

**Table 4-2 Additional ITS Projects & Strategies Supported by the City of Salem**

Project/Strategy Title	Project/Strategy Description
Incident Management Plan for West Salem Bridges	Provide traffic management and traveler information tools (cameras, advisory radio (HAR), moveable barriers, transit vehicles) and specific plan outlining roles, responsibilities and procedures for handling an emergency bridge closure.
Incident Response	Build on current ODOT incident response program to support incident management on state, county and city roadways. Equip incident response vehicles with GPS to enhance dispatch. Provide additional incident response vehicles and personnel.
Detour Route Management	Includes the mapping of detour route plans in GIS, incident signal timing plans, electronic message signs, and congestion monitoring to support incident responders and management of the roadway network during incidents. This includes improving communications to field devices (traffic signals, vehicle detectors, message signs and cameras). High priority will be given to Kuebler Boulevard S/Cordon Road, and Salem Parkway/Commercial Street/Liberty Road corridors.
Arterial Congestion Map	Create a congestion map that shows actual travel speeds on roadways throughout the region.
Advanced Rail Warning System	Deploy railroad crossing detection to determine rail crossing occupation and duration at crossings. This information can be used by emergency service providers and motorists to avoid those crossings and use an alternative route.
Central Signal System Upgrade	Upgrade the central computer control to provide additional functionality including advanced signal control, camera control, automated incident response timing plans and arterial congestion mapping.
Flood Warning System	This project will monitor rising water on roadways and alert transportation managers of high water.
Advanced Vehicle System	Deploy Mayday system information from vehicle to Traffic Control Center (e.g. air bag deployment) and from roadside to vehicle (e.g. transmit traveler information).
Isolated Intersection Safety Warning System	Deploy devices at high crash locations that warn drivers of changing conditions (e.g. tee intersections or sharp curves).
En-route Traveler Information	Dynamic message signs, websites and HAR would notify motorists of incidents, detour routes, construction, and other traveler information.
Cable TV Traveler Information Channel	Provide camera images and other traveler information to cable TV companies to display on a channel.
Broadcast Traveler Information	A dedicated traffic condition radio channel will be provided.
Interactive Traveler Information	Allow the motorist to request specific traveler information, utilize dynamic ridesharing and provide yellow page and reservation services prior to a trip or en-route using wide-area wireless connections
Transit Signal Priority	This project will install transit priority emitters and upgrade traffic signal controllers along selected routes.
Dynamic Routing of Emergency Vehicles	This project would automatically calculate the ideal route between two points based on real-time roadway congestion, construction, and incident information.
Traffic Signal Preemption by Vehicle ID	Implement preemption equipment to provide traffic signal preemption by specific vehicle ID.
Work Zone Safety Systems and Monitoring	This project would provide portable cameras, variable speed limit signs and speed detection devices to monitor and control traffic conditions in work zones. It also would utilize technology within work zones to reduce motor vehicle conflicts with workers by warning workers of vehicles entering work zones.
Maintenance and Construction Coordination System	Deploy a construction activity information site that contains regional and state-wide maintenance and construction activities, including active and planned construction sites, weight and width restrictions, and travel times through work zones.
Work Zone Traveler Information	This project will provide travel time information through work zones using electronic message signs, the internet, and HAR.
Roadway Weather Information System	Install weather stations with roadway temperature, wind speed, humidity, and precipitation sensors.
Maintenance Vehicle Tracking	Track maintenance vehicles to enhance dispatch of personnel and equipment to daily events and for management of the transportation network during events.
Maintenance Event Logging System	Log maintenance requirements through an automated system to record items that require maintenance as personnel identify them daily.

