860.01 General

Intelligent Transportation Systems (ITS) apply advanced technologies in communications and computer science to optimize the safety and efficiency of the existing surface transportation network. In highway design, this goal is achieved by collecting and using traffic data to develop predictive models, regulating access to the freeway system, and providing timely information on traffic conditions to motorists. Previously, this technology was called Surveillance, Control, and Driver Information (SC&DI). In the context of highway design, ITS and SC&DI are synonymous.

The Transportation Equity Act (TEA-21) requires ITS projects to comply with the standards being developed in association with the federal government and private industry. These standards will be known as the National ITS Architecture. These standards are intended to ensure interoperability and efficiency to the maximum extent practicable for the many different types of ITS devices under development. The National ITS Architecture organizes a "system of subsystems" and makes managing ITS deployment easier. The Architecture helps agencies communicate complex ideas by providing a common language and definitions. One benefit of using the National ITS Architecture is that it helps identify all agencies and jurisdictions that should be included in ITS projects.

The ITS program in Washington State is known as "Venture Washington." It focuses on five areas within Washington State. These areas were chosen because they each have unique characteristics and problems associated with traffic. These five areas are:

- The Greater Puget Sound Region
- The Spokane Area
- The Vancouver Area
- Other Statewide Urban Areas
- Rural Areas and Intercity Corridors

An intelligent transportation system can be implemented in stages, starting with a small project for immediate benefit and then expanding the system as needed. Consider installing an ITS at any of the following locations:

- Where congestion frequently causes accidents.
- At freeway on-ramps where merging problems routinely occur.
- Where heavy traffic volumes occur between closely spaced on-ramps.
- Where the motorist would benefit from information on traffic conditions or alternative routes.

The initial stage of an intelligent transportation system can be as simple as installing a dynamic message sign that warns motorists of unusual driving conditions. Appropriate messages can be displayed on the sign using information obtained by direct observation of road conditions or by reports from law enforcement agencies.

Automated systems incorporate a traffic data collection system. The data collection system provides basic data to determine traffic volumes, vehicular speeds, and levels of congestion. The traffic data can be analyzed and used to verify the locations of traffic problems. This data can also be used in freeway computer models to predict the impacts of proposed improvements.

Design each stage of the system so that the associated technology can be used in subsequent, more sophisticated stages. For example, the stage following data collection could be the installation of closed circuit television cameras (CCTV) to monitor freeway locations where congestion is commonplace. The CCTV monitoring is used to detect or confirm incidents noted by other forms of data collection. The installation of motorist information devices such as dynamic message signs or highway advisory radio provides a means of transmitting this information to the motorist. Eventually, as traffic congestion increases, ramp meters are installed to control the traffic flow entering the facility.

When planning a staged system, attempt to determine the ultimate communication system to the degree that underground conduit size and quantity are known and can be installed in the initial construction. Consider long-term maintenance issues and component standardization.

The Northwest Region Traffic Systems Management Center (TSMC) is an example of a traffic operations center (TOC). Because a TOC usually works best with existing radio communication, it is located adjacent to or as part of a radio communication office. In addition to the location of a TOC, consider the work force and equipment costs required to operate and maintain the entire system. The size of a TOC is dependent on the complexity of the system and can vary from a single person at a desk to a large room with advanced equipment requiring continuous staffing.

860.02 References

Transportation Equity Act (TEA-21) of 1998

Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), USDOT,

SC&DI Design Guide, WSDOT Northwest Region

SC&DI Operations Guide, WSDOT Northwest Region

I-90 Seattle to Spokane, ITS Corridor Study, WSDOT Advanced Technology Branch

I-5 Seattle to Vancouver, BC, ITS Corridor Study, WSDOT Advanced Technology Branch

Portland/Vancouver to Boise, ITS Corridor Study Plan, WSDOT Advanced Technology Branch

Application of Advanced Transportation Technology Within Washington State: Discussion and Policy Recommendations, WSDOT Advanced Technology Branch

State-Wide Communications Strategic Plan, WSDOT Advanced Technology Branch

Seattle to Portland Inter-City ITS Corridor Study and Communications Plan, WSDOT Advanced Technology Branch

Venture Washington, WSDOT Advanced Technology Branch

860.03 Traffic Data Collection

Loop detectors, placed in traffic lanes, are the most common devices used to collect traffic data. In general, data stations are spaced at $^1/_2$ mile intervals between interchanges. Alternative methods of detection include video detection cameras, microwave detectors, and other newer technologies. This information can be augmented with cellular phone calls from motorists, Washington State Patrol (WSP) reports, and commercial traffic reporters.

The loops sense the amount of time a vehicle is over them. This is called *occupancy* and is recorded by a data station in a nearby roadside cabinet. The data station periodically transmits the data to a central computer. The information from the detection system is transmitted over leased phone lines, WSDOT phone lines, fiber optic lines, or microwave transmitters to a traffic operations center. A spread spectrum radio is another method of transmitting data. The central computer translates these data into an indication of traffic congestion for incident detection and traffic flow information.

A single loop provides traffic volumes and lane occupancy from which, given some basic assumptions, speeds can be computed. Two loops spaced a known distance apart, longitudinally, provide better determinations of traffic speeds.

CCTV is used by the department to manage the freeway system. It is not usually used as a traffic law enforcement tool. The primary function of CCTV is to confirm or detect incidents. As a secondary function, this information can be provided to the WSP, incident response teams, maintenance forces, and the local media.

860.04 Traffic Flow Control

During peak traffic volume periods, freeway on-ramps are metered with either roadside or overhead traffic signals. These ramp meters control or regulate the flow of traffic entering the freeway. The metering prevents the entering traffic from exceeding freeway capacity by limiting the number of vehicles that enter within a specific time period. The meters also keep long platoons of cars from merging onto the freeway. This process makes on-ramp merges safer and allows freeway traffic to move at a more efficient speed.

Ramp meters are traffic control signals and an approved traffic signal permit is required. The approval procedures for traffic signal permits are noted in Chapter 850.

Consider the available area for vehicle storage on the ramp when locating a ramp meter. If the arrival rate of the entering traffic exceeds the metered flow rate, traffic queues will develop. A common concern is that this queue might extend onto the crossroads and interfere with local traffic. Chapter 1050 provides guidance on the placement of the ramp meter. This guidance, however, only addresses the required acceleration needed to merge onto the freeway. The storage area needed at the meter varies at each location and is determined separately. If it is not possible to provide an adequate storage length on the ramp, consider alternate methods of addressing the problem.

(1) Adjust the ramp metering rate to temporarily increase the rate.

(2) Allow two vehicles to pass the meter at a time.

(3) Widen to two metered lanes.

(4) Provide storage lanes on the crossroad.

(5) Provide alternate routes for local traffic.

(6) Provide HOV bypass lanes.

(1) **Adjust Rate.** Ramp metering uses information from the detection loops to determine freeway congestion adjacent to and downstream from the ramps. Data from the loops are sent to a central computer or a local computer that adjusts the metering rate for the traffic congestion and transmits this rate to the ramp meter controllers. The ramp controllers implement the metering rate and control the signal. A ramp metering rate can be determined in two ways: remote metering and standby metering.

For remote metering, the metering rates of all ramp meter locations are determined by the local controller and adjusted by the central computer at the TOC. This is the normal mode of operation for the Seattle system. The central computer is capable of adjusting upstream metering rates on the basis of downstream conditions. A metering rate at an upstream location is decreased if traffic congestion develops downstream. Metering start and end times, as well as metering rates, can be remotely adjusted from the TOC with an override function.

Standby metering, also called local control, is used when communications with the central computer are interrupted or when that computer is not in service. In these cases, each ramp meter determines a metering rate for its on-ramp according to local traffic conditions or by a pre-determined rate based on a time of day table. These time of day tables are developed to predict averages of the actual traffic volume peaking characteristics of the on-ramp. In standby metering, each ramp meter operates independently without coordinating with other controllers.

Single lane metering rates normally vary between 4 and 15 vehicles per minute (240 and 900 vehicles per hour). If a ramp has heavier traffic volumes and queue storage is not adequate, several actions can be taken.

(2) **Two Vehicles**. The metering capacity can be increased by allowing two vehicles to enter during each green cycle. This can increase a single lane ramp meter maximum capacity to about 1,100 vehicles per hour. This procedure is a temporary, operational solution and is not a recommended design practice.

(3) **Widen**. The metering capacity can be increased by widening the ramp to install additional lanes. Widening a single-lane on-ramp to create two lanes can double the metered traffic volume to 1,800 vehicles per hour, provided no downstream traffic congestion develops. Changes in ramp access to the freeway might require an access point decision report. (See Chapter 1425.)

(4) **Storage Lanes**. If adequate storage length cannot be provided on the ramp, it might be possible to provide storage as turn lanes on the crossroad and adjust the ramp terminal traffic signal timing to limit freeway access movements.

(5) **Diversion**. Diversion of some ramp traffic to local arterial streets might can be desirable, assuming a suitable alternate route is available. When diversion occurs, modification of traffic signal timing and coordination plans on the alternative routes might be necessary. Coordinate efforts with the local agency and, if appropriate, initiate public meetings to identify needs and impacts.

(6) **HOV Bypass.** Wherever possible, provide bypass lanes for high occupancy vehicles (HOV) around the traffic queue at the ramp meter. The HOV bypass allows transit vehicles to maintain schedules and indirectly provides an incentive for carpooling. (See Chapter 1050.)

860.05 Motorist Information

Motorist information includes dynamic message signs, highway advisory radio, telephone traffic information lines, commercial radio and television messages, and Internet access for personal computers. These are all used to transmit traffic conditions to freeway users. The motorist information system is also used to alert drivers to short term construction and maintenance activities that might affect normal travel patterns. It can also be used to suggest alternative travel routes.

(1) Dynamic Message Signs

Dynamic message signs (DMS) are used to provide motorists with current road and traffic conditions. Accidents, incidents, construction and maintenance activities, reversible lane status, traffic congestion, and traction device requirements are examples of this information. Because motorists receive many distractions while driving, consider the location of the DMS. The best location for a DMS is on a tangent section of roadway with few roadside distractions. Overhead installations have more visual impact. When possible, use sign bridges, cantilever sign structures, or bridge mounts on existing overcrossings for DMSs. Use the message displays and sign location requirements contained in the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) and Chapter 820.

(2) Highway Advisory Radio

The highway advisory radio (HAR) system uses car radios to provide information to motorists. Warning signs, usually with flashing beacons, direct motorists to select a specific AM radio station for information. HAR has an advantage over DMS because longer messages with more detailed information can be relayed to the motorist. The major disadvantages are that not all vehicles have radios that can receive HAR frequencies, and some motorists might not use the radio for this information. HAR works best when used in conjunction with DMS.

HAR locations and assigned radio frequencies are restricted to prevent interference with other frequencies in use. HAR message content is restricted by federal regulations and WSDOT restricts HAR messages to noncommercial voice information pertaining to roadway and mountain pass conditions, major incidents, traffic hazards, and travel advisories.

(3) Additional Public Information Components

A telephone number can be provided to give the same prerecorded messages as the HAR and can also include transit and carpool information. A computer generated flow map can be developed, using the data collection system, to graphically depict actual traffic flows within a geographical area. The flow map can be made accessible to the public by providing links to a WSDOT web site.

860.06 Documentation

Preserve the following documents in the project file: See Chapter 330.

- ☐ Justification for the installation of ramp meters.
- ☐ Approved traffic signal permit for ramp meters.
- ☐ All correspondence and coordination with local agencies.
- ☐ Designs for the ultimate system when staged implementation is used.

P65:DP/DMM