City of Bellevue

ITS Master Plan
Executive Summary

“Enhancing Transportation Safety and Efficiency”

Prepared by
DKS Associates
TRANSPORTATION SOLUTIONS
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Acknowledgements

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The City of Bellevue is centrally located east of Seattle in the Puget Sound Region. The city has implemented some basic technology-based tools and intelligent transportation systems (ITS) strategies. However, until now there has not been a comprehensive, systematic look at future expansion and management of ITS. This plan represents a comprehensive evaluation of the city’s needs and opportunities for ITS applications over the next 20 years. The primary objective of the plan is to identify potential ITS solutions that will address specific transportation-related problems based on a set of clearly defined needs.

The City of Bellevue has had steady growth in both population and employment over the past thirty years. Since 1970, the population has almost doubled, and by the year 2020, the population is expected to grow another 24 percent. The significant growth, coupled with reliance on the automobile as the primary means of transportation, has placed a tremendous burden on the City’s transportation infrastructure. As the City continues to expand, a coordinated, systematic approach will be necessary to effectively manage the transportation infrastructure. By working efficiently and cooperating with other local agencies, the City can build and manage a smarter transportation system using ITS.

What is ITS?

ITS is the application of a range of advanced technologies and proven management techniques to enhance mobility and transportation productivity, enhance safety, conserve energy resources and reduce adverse environmental effects.

ITS uses real-time information to integrate and manage the components of a conventional transportation system (roads, transit, ramp meters, traffic signals, etc.). ITS can perform the following functions:

- Alert motorists, commercial vehicles, emergency response personnel and transit operators of congestion by collecting, processing and disseminating real-time information.
- Provide real-time transit arrival and departure information to passengers allowing them to time their departure from work or home to transit stops.
- Reduce corridor congestion by rapidly detecting and responding to traffic incidents.
- Reduce response times to incidents and emergencies for City maintenance staff and emergency services personnel through enhanced data and surveillance.
In the past, the common belief was that we could meet the demand for mobility by building and expanding highways and bridges. However, as many areas of the country have built out the roadway network, traffic congestion has increased to overfill the infrastructure and we must consider new ways of managing traffic. ITS provides new tools to compliment traditional transportation thinking and the approach is catching on worldwide.

Deployment of ITS tools and strategies, seen as the next major evolutionary stage of surface transportation, is expected to be the focus of implementation efforts early in this century, much like the highway system program was the focus of the last 60 years. ITS is no longer an alternative or option in dealing with congestion and increasing highway travel, but rather it is one of the most cost effective ways to obtain a more efficient transportation system.

What is the Bellevue ITS Plan?

The Bellevue ITS Plan is a road map to implement an integrated system of transportation strategies based on a set of identified opportunities. The plan’s purpose is to establish the need for ITS investments in the region, to identify relative priorities to direct ITS investment, and to identify specific projects to be deployed to address identified needs.

Why is the Plan Important?

An ITS plan:

- creates the framework from which ITS benefits can be realized;
- represents a comprehensive analysis of the City’s ITS goals;
- ensures that ITS projects in the City will be eligible for Federal ITS funding; and
- prioritizes financial resources for ITS opportunities.

This plan was coordinated with regional efforts, such as the Puget Sound Region ITS Architecture, to ensure ITS strategies throughout the region are integrated and complementary. In addition, this coordination helps assure that Bellevue is eligible for Federal ITS funding. During the development of the Regional ITS Architecture, the Puget Sound Regional Council (PSRC) created a document outlining procedures for local agencies to follow to comply with the regional ITS plan and Federal guidelines. The guidance document outlined a “System Engineering Analysis” that should be followed by local ITS projects. Table E-1 summarizes how the System Engineering Analysis was incorporated into the Bellevue ITS Master Plan.
How was the ITS Plan Developed?

The development of the ITS plan started with identifying the ITS Vision for Bellevue. This Vision maintains a consistent goal in the identification of future projects, and when coupled with the inventory of the existing ITS conditions, it helped determine the City’s ITS related needs.

The data from the needs assessment and the existing conditions inventory were used to develop the Bellevue Regional Architecture, which is a view of ITS in Bellevue displayed in a format developed by the United States Department of Transportation (U.S. DOT). The Regional Architecture helped identify where interagency arrangements will be needed. The interagency relationships are documented in the Concept of Operations. All of these steps help develop the final product, which is the deployment plan. This process is shown graphically in Figure E-1.

ITS Master Plan Vision

The City of Bellevue Transportation Department Executive Team developed the following four statements to capture the vision of ITS in Bellevue.

**Vision Statement #1**
Maximize the safety and efficiency of the City’s transportation system for residents, business owners, and visitors to the City of Bellevue.

**Vision Statement #2**
Support Emergency Services in their efforts in saving lives and protecting the City’s transportation infrastructure.

**Vision Statement #3**
Maximize the quality of transportation service provided by the City of Bellevue to residents, business owners, and visitors.

**Vision Statement #4**
Be active in and support regional ITS initiatives.
Existing Conditions

The existing conditions analysis describes the City’s ITS infrastructure as well as planned ITS elements included in other local planning efforts. The benefits of ITS to the City are quite broad, so the implementation of ITS is recommended in a variety of reports including the Bellevue Transit Plan, the Bellevue-Redmond Overlake Transportation Study, the 148th Avenue Mobility Improvements, the Bellevue Capital Investment Program, the Downtown Implementation Plan, the PSRC Regional Architecture, and the Bellevue Emergency Operations Plan.

The ITS related equipment operated by the City includes:

- Traffic signals at 170 intersections (See Figure E-2)
- Approximately 500 system detectors (See Figure E-3)
- Computran central signal system
- Copper traffic signal interconnect (See Figure E-4)
- Traffic management center (TMC)
- Closed Circuit Television (CCTV) cameras at 20 locations
- Fiber optics for communications between the TMC and CCTV cameras (See Figure E-4)
- Portable message signs and highway advisory radio
- Emergency vehicle pre-emption at nearly all signalized intersections
- Transit Signal Priority (TSP) at two signalized intersections
- Driver feedback signs for traffic calming
- Variable speed limit signs at school zones
- 911 and emergency operation centers

The Washington State Department of Transportation (WSDOT) also operates ITS equipment within City boundaries, including:

- CCTV cameras at 31 locations
- Metering at 24 ramps
- Variable message signs at six locations
- Highway Advisory Radio (HAR) at two locations
- Data stations throughout the Bellevue area freeways
Figure E-2. Existing Traffic Signal Locations

Legend

Signal System
- Prot/Perm with Interconnect
- Prot/Perm with No Interconnect
- Signal with Interconnect
- Signal with No Interconnect
- City of Redmond Signal
- WSDOT Signal
- King County Signal
Figure E-3. Existing Data Station Locations

Legend
- System Loops
- Traffic Signals
- Bellevue Signal
- Other Signal
Figure E-4. Existing Communications Infrastructure

Legend
- Existing Traffic Copper
- Existing Traffic Fiber
- Existing Conduit

Existing Conditions
The Vision statements developed for the Bellevue ITS plan provided a high-level view of the ITS goals in the region, however a more detailed view is needed to determine the specific elements for deployment in the future. Through an interview process with a variety of City departments, the needs assessment identified many potential uses for ITS technology in the City. The groups interviewed included: Traffic Management, Information Technology, Right-of-Way, Planning, Modeling and Forecasting, Maintenance, Fire, Police, Emergency Management and the Transportation Commission.

Table E-2 summarizes the Bellevue ITS needs. These needs are categorized into the five functional areas used throughout this report to manage needs and future projects.

<table>
<thead>
<tr>
<th>Table E-2. Summary of Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Travel and Traffic Management</strong></td>
</tr>
<tr>
<td><strong>Communications</strong></td>
</tr>
<tr>
<td>1 Utilize City's existing communications infrastructure</td>
</tr>
<tr>
<td>2 Expand existing traffic operations communications</td>
</tr>
<tr>
<td>3 Upgrade communications (multi-mode to single-mode fiber)</td>
</tr>
<tr>
<td><strong>Traffic Operations and Management</strong></td>
</tr>
<tr>
<td>4 Pedestrian and bicycle treatment (detection)</td>
</tr>
<tr>
<td>5 Expanded video surveillance</td>
</tr>
<tr>
<td>6 Enhanced traffic control capabilities</td>
</tr>
<tr>
<td>7 Expanded use of driver feedback signs</td>
</tr>
<tr>
<td>8 Probe vehicle data</td>
</tr>
<tr>
<td>9 Signal pre-empt for police vehicles</td>
</tr>
<tr>
<td>10 Center-to-center link to neighboring agencies</td>
</tr>
<tr>
<td>11 Red light and speed photo enforcement</td>
</tr>
<tr>
<td>12 Procurement of standards based equipment</td>
</tr>
<tr>
<td>13 Automatic detection of traffic equipment malfunctions</td>
</tr>
<tr>
<td>14 Improved vehicle classification system</td>
</tr>
<tr>
<td>15 Expand system detection</td>
</tr>
<tr>
<td>16 Traffic management center equipment upgrade</td>
</tr>
<tr>
<td>17 Heavy-rail crossing advanced preemption</td>
</tr>
<tr>
<td><strong>Traveler Information</strong></td>
</tr>
<tr>
<td>18 Expanded use of VMS (includes additional installation)</td>
</tr>
<tr>
<td>19 Dynamic detour route development and management</td>
</tr>
<tr>
<td>20 Real-time construction information</td>
</tr>
<tr>
<td>21 Web-based traveler information</td>
</tr>
<tr>
<td>22 Automated commuter alerts</td>
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<tr>
<td>23 Parking management system</td>
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</tbody>
</table>
The U.S. DOT defines a Regional ITS Architecture as a specific, tailored framework for ensuring institutional agreement and technical integration for the implementation of ITS projects in a particular region. Simply stated, the Regional Architecture helps define the elements of the ITS system and the standard information that is exchanged between these elements. The guidelines for developing a Regional Architecture are defined in the National ITS Architecture.

The National ITS Architecture is a tool used to create a common framework for planning, defining, and integrating intelligent transportation systems. The architecture was developed to define the following ITS features:

- Functional area of ITS
- The physical entities or subsystems where the functions reside (e.g. roadside or vehicle)
- The information flows that connect the functional areas and subsystems

The creation of a Regional Architecture provides the following benefits:

- Displays a high-level view of the integration of ITS systems within the City of Bellevue.
- Creates a common platform to compare architectures with neighboring regions.
- Permits the identification of jurisdictional and system interconnections that will ultimately be referenced when designing Elements of the ITS Plan.
- Serves as a focal point for discussions among the Stakeholders concerning respective roles and responsibilities.

In addition to these benefits, a Regional Architecture must be created to meet the requirements to obtain Federal ITS funding. The Federal Highway Administration (FHWA) Federal-Aid Policy Guide, Title 23, Part 940 states that a Regional Architecture must be developed to show conformance of the region’s ITS projects to the National ITS Architecture.
Regional Architecture

A list of the complete inventory of all existing and planned ITS elements was developed. This included their relationship with associated Stakeholders as well as their relationship with the appropriate National ITS Architecture defined subsystem. The subsystems applied to this project are shown in the National ITS Architecture standard “Sausage Diagram” in Figure E-5.

The process of developing a Regional Architecture also helps identify the Market Packages needed in the ITS Plan. A Market Package is a categorization of ITS technologies into individual packages for guiding the design and deployment of ITS. The Market Packages are used in the ITS Plan to organize the interagency ITS concepts of operations and to define projects in the Deployment Plan. Selecting Market Packages also helps identify the ITS standards that should be applied to future projects.

Concept of Operations

ITS strategies often require a high level of coordination and cooperation among multiple agencies in order to realize their maximum benefits. The concept of operations provides an outline of the roles and responsibilities of the many agencies that are Stakeholders in ITS projects within Bellevue.

From the Market Packages identified in the Regional Architecture process, the following packages were recognized as potentially needing interagency cooperation:

- ITS Data Warehouse,
- Multi-modal Coordination,
- Interactive Traveler Information,
- Network Surveillance,
- Traffic Information Dissemination,
- Regional Traffic Control,
- Traffic Incident Management System,
- Regional Parking Management,
- Emergency Management and
- Construction Management.

For each interagency Market Package identified, both the agency-to-agency relationship and the information exchange is determined. Agency-to-agency relationships range from a one-time consultation to operations and maintenance of another agency’s equipment. Information exchange includes video, data, command, data requests and status updates.

Interagency coordination is nothing new to the City as it already has agreements with other cities, counties and the state to share resources such as video feeds, signal equipment and emergency response personnel.

Figure E-6 provides an example of the interagency relationships for the Regional Traffic Control Market Package.
This section summarizes all of the components of the Deployment Plan, which is broken out into three phases: 0 - 5 Year Plan, 6 - 10 Year Plan, and 11 - 20 Year Plan. The capital costs and operations and maintenance costs for each phase are listed in Table E-3. All identified projects and their estimated deployment timeframe are listed in Table E-4 and are described in detail in Table E-5 at the end of this section. The high priority projects scheduled for the 0 - 5 Year Plan are highlighted following Table E-4. Figures E-7 through E-14 illustrate proposed locations for ITS equipment including variable speed limit signs, proposed weather stations, CCTV cameras, dynamic message signs, fiber optic communications, transit signal priority, flood warning sensors and real time transit arrival signs, respectively.

Table E-4. Deployment Schedule

<table>
<thead>
<tr>
<th>Project ID</th>
<th>Project Title</th>
<th>Years</th>
<th>5-Year Plan</th>
<th>10-Year Plan</th>
<th>20-Year Plan</th>
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<td>Bicycle Detection</td>
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<td>911 Computer Aided Dispatch Interface</td>
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<td>TM_03</td>
<td>Photo Enforcement</td>
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<td>TM_04</td>
<td>Traffic Management Center Build-out</td>
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<td>TM_05</td>
<td>Dynamic Route Guidance</td>
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<tr>
<td>TM_06</td>
<td>Automated Commuter Alert System</td>
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<td>TM_07</td>
<td>Downtown Parking Management System</td>
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<td>TM_08</td>
<td>Permanent Highway Advisory Radio (HAR)</td>
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<td>TM_09</td>
<td>Vehicle Classification Detection</td>
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<td>TM_10</td>
<td>Driver Feedback Signs</td>
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<td>TM_11</td>
<td>Rail Crossing Interconnect</td>
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<td>Traveler Information Kiosks</td>
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<td>TM_13</td>
<td>Variable Speed Limit Signs</td>
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<td>City-Wide CCTV Deployment</td>
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<td>Dynamic Message Signs</td>
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<td>TM_16</td>
<td>City-Wide Communications</td>
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<td>Communications to Isolated Signalized Intersections</td>
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<td>TM_18</td>
<td>Arterial Congestion Map</td>
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<td>Central Signal System Replacement</td>
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<td>Center to Center Integration - Redmond and WSDOT</td>
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<td>TM_21</td>
<td>Signal System Upgrade for TSP and TRPS</td>
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<td>Public Transportation</td>
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<td>Transit Signal Priority</td>
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<td>Smart-Bus TSP Enhancements</td>
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<td>PT_03</td>
<td>Real-Time Transit Arrival Signage</td>
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<td>Emergency Management</td>
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<td>Remote Monitoring of City Facilities</td>
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<td>Maintenance and Construction</td>
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<td>MC_01</td>
<td>Roadway Weather Information System</td>
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<td>MC_02</td>
<td>Portable Work Zone ITS Equipment</td>
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<td>MC_03</td>
<td>Maintenance Vehicle AVL Tracking System</td>
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Table E-3. Deployment Cost Summary

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<tr>
<th>Deployment</th>
<th>Capital Cost</th>
<th>Operations and Maintenance</th>
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<tr>
<td>0 - 5 Years</td>
<td>$4,500,000</td>
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<td>6 - 10 Years</td>
<td>$4,600,000</td>
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<tr>
<td>11 - 20 Years</td>
<td>$4,600,000</td>
<td>$419,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$13,700,000</td>
<td>$761,000</td>
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High Priority Projects

High priority projects are identified for deployment within the first five-year timeframe. This section describes each high priority project.

TMC Build Out

This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall.

City-Wide CCTV Deployment

CCTV cameras will be used to monitor traffic conditions, monitor emergency events, optimize signal timing, view high accident locations, and monitor flooding and weather.

Driver Feedback Signs

The City would like to expand the use of Driver Feedback signs in Bellevue as a means of traffic calming. These signs notify the driver of their current speed and flash the speed when they are traveling over the speed limit. The City currently has approximately 20 signs and would like to deploy an additional 10 signs.

Variable Speed Limit Signs

This project will deploy approximately 72 variable speed limit signs in school speed zones on Bellevue streets. These signs will adjust the posted speed by time of day with respect to school schedule. The City deployed their first set of time of day signs at Lake Hills Elementary. The City would like to have the ability in the future to communicate to the signs directly from the TMC.

Dynamic Message Signs

Full function VMS signs and limited state wayfinding signs will be deployed to manage traffic during incidents such as flooding, large freeway accidents and special events in downtown Bellevue. The need for six full function VMS signs and three wayfinding signs has been identified.

Communications to Isolated Signalized Intersections

This project will provide communications to all the signalized intersections in the City that are currently isolated from the signal interconnect network.

City-Wide Communications

This project will phase in new fiber optic cables throughout the City to communicate to the new field devices and to upgrade communications to existing field devices.

Arterial Congestion Map

This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has an extensive deployment of system detectors that can initially be used for measuring congestion in the region. It is assumed that GPS data will provide a more accurate measurement in the future, so it is anticipated that the system will eventually migrate to a GPS system.
Center-to-Center Integration
This project will implement center-to-center communications with Redmond’s future central signal system and will re-establish the connection to WSDOT. The center-to-center communications to WSDOT requires software upgrades on the interface servers.

Signal System Upgrade for TSP and TRPS
This project will upgrade the City’s Computran system to improve traffic responsive pattern selection (TRPS) and TSP operations.

Transit Signal Priority
In a joint effort with King County Metro and Sound Transit, The City of Bellevue will deploy new TSP sites near the Bellevue Transit Center as part of the Downtown Access Project. In addition, the City is starting a project to evaluate TSP along the corridor of six of the most heavily traveled transit routes in Bellevue. This project involves a joint effort with King County Metro and Sound Transit to install TSP at up to 120 sites in the next twenty years.

Real-Time Transit Arrival Signage
This project will be a joint effort with King County Metro and Sound Transit to deploy signage at major transit hubs and transfer points to notify travelers of the estimated arrival and departure time for specific transit routes. The high priority locations include the Bellevue Transit Center, Eastgate, South Bellevue, Wilburton and Newport Hill Park and Rides, Factoria Mall, Bellevue Square and the Crossroads Shopping Center.

Intra-Agency Video Sharing
This project will provide video to the Police, Fire, the 911 center, the Emergency Operations Center and the Bellevue Service Center.

Remote Monitoring of City Facilities
This project will monitor City facilities such as Downtown Park or water reservoirs. The monitoring may be via CCTV or other technologies.

Flood Warning System
This project will deploy flood monitoring equipment at six critical locations in Bellevue.

Traffic Data Query System
This project will enhance the loop data management program in the Computran system to improve access to historic system detector data and provide access to automated traffic count information.

Roadway Weather Information System
Weather stations with roadway temperature monitoring will be included at six critical locations.
<table>
<thead>
<tr>
<th>Project ID</th>
<th>Project Title</th>
<th>Description</th>
<th>Priority</th>
<th>Capital Cost</th>
<th>O&amp;M Cost</th>
<th>Stakeholders</th>
<th>Relationship to Other Projects</th>
<th>Other Considerations</th>
<th>Expected Benefits</th>
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</thead>
</table>
| TM_01     | Bicycle Detection                     | This project will install permanent bicycle detection throughout the City on arterials designated as bike routes and on bike trails. This project does not include bicycle detection at signalized intersections. A total of 10 locations are assumed. | M        | $50,000      | $2,000    | Primary: Bellevue | Requires communications through the City-Wide Communications Project (TM_16). | The communication requirements for the bike detectors is minimal so it may be possible to use existing signal interconnect. A larger issue will be bringing power to detector sites on bike trails away from existing lighting or traffic signal circuits. | ● Reduce staff time needed to set detectors in the field  
● Increase available data for evaluating bicycle usage in Bellevue  
● Better meet the needs of the Bellevue biking community |
| TM_02     | 911 Computer Aided Dispatch Interface| This project will provide a direct interface with the Bellevue 911 Computer Aided Dispatch system to automatically post incidents related to traffic in the Commuter Alert System. | M        | $150,000     | $10,000   | Primary: Bellevue | Feeds incident data to the Automated Commuter Alert System in TM_06. | The incident reporting system could be a stand alone program. The platform for this program will be evaluated further when the project is in design. | ● Increase driver awareness of traffic conditions  
● Decrease traffic operations staff time  
● Reduce congestion |
| TM_03     | Photo Enforcement                     | This project will deploy photo enforcement for speeding and red light running. For this project, it is assumed Bellevue will deploy this equipment at 5 sites. | L        | $375,000     | $300,000  | Primary: Bellevue | None | The City is interested in deploying photo enforcement equipment, but its use will depend on photo enforcement lawmaking in the state. The O&M cost for this project could be significantly reduced if Bellevue contracts with a vendor that installs, operates and maintains the equipment for a percentage of the fines paid by violators. | ● Reduce red light running and speeding in the City  
● Improve driver safety  
● Reduce accidents at high accident locations |
| TM_04     | Traffic Management Center Build-out   | This project will provide new video displays, switching equipment and consoles for the designated TMC space at the new City Hall. | H        | $300,000     | $10,000   | Primary: Bellevue | None | Although this is a high priority project, the TMC is functional with the existing equipment leaving the option open for a phased deployment and build out of equipment. | Replacement of antiquated/failing equipment  
● Increased flexibility for viewing cameras and signal system maps  
● Space for multiple operators  
● Improved emergency management and operation capabilities |
| TM_05     | Dynamic Route Guidance                | This system will automatically calculate the ideal route between two points based on real-time roadway congestion data. Initially this project would be used to provide route information for emergency vehicles. | L        | $250,000     | $15,000   | Primary: Bellevue | This project will require congestion data collected in the Arterial Congestion Map project (TM_18). | This system could be mapped using the City’s GIS database. | Decrease in response time for emergency vehicles  
● Decrease in travel time for motorists |
| TM_06     | Automated Commuter Alert System       | This project will automatically alert motorists through e-mail, pager, and other wireless devices of potential issues along their predefined commute route. This system would require the input of real-time incident data into a database that could be queried by the commuter alert system. The incident database could be shared with the media and posted on the Internet. | M        | $100,000     | $5,000    | Primary: Bellevue | None | The City would like to expand upon their current e-mail alert system for the Downtown Access project by sending out real time information. The current e-mail system only addresses planned events. | Availability of real-time incident information  
● Improved traffic coverage of Bellevue by local media  
● Reduction in congestion around incident locations |
| TM_07     | Downtown Parking Management System    | This project will install active signs around Bellevue Square to direct motorists to parking facilities with available parking. This project assumes monitoring equipment for the west and southeast parking facilities (it already exists for the northeast facility) and four advisory signs. | L        | $300,000     | $15,000   | Primary: Bellevue Secondary: Bellevue Square Management | None | The project will require the cooperation of the Bellevue Square Management. | ● Reduce driver frustration during shopping season  
● Reduce congestion around mall due to circling traffic  
● More efficient use of parking |
| TM_08     | Permanent Highway Advisory Radio (HAR)| A permanent HAR will be located in Bellevue to notify motorists of incidents or construction in the HAR region. | M        | $20,000      | $1,000    | Primary: Bellevue | None | The frequency and location of the antenna will need to be coordinated with WSDOT’s HAR equipment. | Increase availability of real-time traveler information  
● Reduce congestion and delay  
● Increase flexibility for distribution of traveler information |
### Table E-5. Project Summary Table

<table>
<thead>
<tr>
<th>Project ID</th>
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<th>Capital Cost</th>
<th>O&amp;M Cost</th>
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<th>Relationship to Other Projects</th>
<th>Other Considerations</th>
<th>Expected Benefits</th>
</tr>
</thead>
</table>
| TM_09      | Vehicle Classification Detection       | This project will deploy detectors strategically around the City to collect vehicle classification information. It is assumed 10 detectors will be deployed. | M        | $100,000     | $2,000    | Primary: Bellevue | None              | It is assumed these detectors will be tied to a nearby traffic signal for communications back to central. | • Increase availability of vehicle classification information  
• Ability to track truck route adherence  
• Ability to improve traffic signal simulation  
• More accurate data for pavement design |
| TM_10      | Driver Feedback Signs                  | The City would like to expand the use of Driver Feedback signs in the City as a means of traffic calming. These signs notify the driver of their current speed and flash the speed when they are traveling over the speed limit. The City has approximately 20 signs and would like to deploy an additional 10 signs. | H        | $84,000      | $4,000    | Primary: Bellevue | None              | None                                                                                 | • Improved safety for motorists, pedestrian and cyclists  
• Reduce traffic speed  
• Increase in speed limit adherence  
• Increase in driver awareness of speed limits and personal driving characteristics  
• Wide-spread support  
• Low-impact traffic calming |
| TM_11      | Rail Crossing Interconnect             | The City would like to be able to reach the rail crossing at NE 8th Street to the signal at 116th, and the crossing at SE 1st Street to the adjacent signals at 116th Avenue NE and at Main St. This interconnect will notify the neighboring signals of the approaching train to allow for the clearing of queued vehicles backed up to the tracks. The cost includes interconnect to the nearby signal via a new preemption cable in existing conduit. | M        | $50,000      | $4,000    | Primary: Bellevue | Secondary: BNSF | To provide enough warning of an arriving train to clear queued vehicles, improvements may need to be made to the train detection system. This rail detection upgrade is assumed in the cost. | • Increase in safety near rail crossings |
| TM_12      | Traveler Information Kiosks            | The City would like to have the ability to communicate to the signs from the TMC. This project will deploy traveler information kiosks at transit centers, Bellevue Community College (BCC), and major shopping centers. | M        | $0           | $1,000    | Primary: Metro, BCC, and Local Malls | Secondary: Bellevue | Bellevue could enhance the kiosks by providing data from the Arterial Congestion Map (TM_18) and the Automatic Commuter Alert System (TM_06). | • Increase availability of traveler information in public places  
• Decrease congestion and delay |
| TM_13      | Variable Speed Limit Signs             | This project will deploy approximately 72 variable speed limit signs within school speed zones on Bellevue streets. These signs will adjust the posted speed by time of day. The City deployed their first set of time of day signs at Lake Hills Elementary. The City would like to have the ability in the future to communicate to the signs from the TMC. | H        | $504,000     | $12,000   | Primary: Bellevue | Requires communications through the City-Wide Communications Project (TM_16) and when remote communications to the signs is added. | It is unknown if it is possible to interconnect the signs for remote communications. As the deployment of signs continues, this requirement will need to be integrated into the product procurement specification. | • Reduced speeds in school zones  
• Increased safety for students and drivers  
• Increase in driver awareness  
• Decrease in motorists confusion |
| TM_14      | City-Wide CCTV Deployment              | High, medium and low priority CCTV locations have been identified throughout the City. These cameras will be used to monitor traffic conditions, monitor emergency events, optimize signal timing, view high accident locations and monitor flooding and weather.  
- 16 cameras  
- 23 cameras  
- 12 cameras | H        | $400,000     | $16,000   | Primary: Bellevue | Requires communications from the City-Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images. | The City’s local video switcher will need to be expanded as more cameras are installed. | • Improved signal coordination and real-time traffic signal adjustments  
• Increased availability of CCTV cameras  
• Increased availability of CCTV cameras for local arterials  
• More wide spread driver information |
|            |                                        |                                                                                                                                             | M        | $575,000     | $23,000   | Primary: Bellevue | Requires communications from the City-Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images. |                                                                                     | |
|            |                                        |                                                                                                                                             | L        | $300,000     | $12,000   | Primary: Bellevue | Requires communications from the City-Wide Communications Project (TM_16). The TMC build out (TM_04) would increase quality and flexibility of viewed images. |                                                                                     | |
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</tr>
</thead>
</table>
| TM_15      | Dynamic Message Signs                      | Full function VMS signs and limited state wayfinding signs will be deployed to manage traffic during incidents such as flooding and large freeway accidents as well as during special events in downtown Bellevue. The following signs will be deployed:  
  - SB 148th Ave NE south of Bel-Red Rd  
  - NB 148th Ave NE north of SE 22nd St.  
  - Wayfinding for diverting around flooding on Factoria Blvd near SE 36th St (3 signs)  
  - WB NE 8th St west of 112th Ave NE  
  - SB Lake Hills Connector north of Richards Road  
  - WB NE 4th St west of 112th Ave NE  
  - Wayfinding signs for WB I-90 traffic diverting off the freeway at 156th Ave NE (2 signs)  
  - Wayfinding signs for traffic diverting of WB SR-520 at 149th Ave NE (2 signs)  
  - Wayfinding for diverting around flooding on Kamber Road (3 signs)  
- Required communications from the City-Wide Communications Project (TM_16).  
The City does not have any permanent VMSs so they will need to decide how they want to manage the control. It may be possible to integrate the control into the Computran system. | H,M      | $50,000     | $5,000              | Primary: Bellevue                                                               | Requires communications from the City-Wide Communications Project (TM_16).                  | The City currently uses multi-mode fiber for communications to CCTV cameras. The City may need to gradually switch to single mode fiber cabling as the need for faster speeds and higher bandwidth increases. | Improved driver safety during incidents and events  
  - Improved travel time through alternate routes and closure advisories  
  - Reduction in staff time needed to deploy temporary signs  
  - Provide motorists information on incident/events more quickly |
| TM_16      | City-Wide Communications                   | This project will phase in new fiber optics throughout the City to communicate to the new field devices and to upgrade communications to existing field devices.                                                                 | H,M      | $1,400,000  | $5,000              | Primary: Bellevue                                                               | Required for numerous projects in the City.                                                |                                                                                              | Communication to existing isolated field devices  
  - Communication to new field devices  
  - Improved reliability for communications  
  - Redundancy in communications |
| TM_17      | Communications to Isolated Signalized Intersections | This project will provide remote communications to all the signalized intersections in the City that are currently isolated from the signal interconnect network.                                                                 | H,M,L    | $0           | $0                  | Primary: Bellevue                                                               | Relies heavily on the City-Wide Communications project.                                     |                                                                                              | More efficient operations of isolated signals  
  - Decrease in staff time needed to maintain these signals  
  - Quicker response time when problems occur with the isolated signals  
  - Ability to obtain data from remote signals |
| TM_18      | Arterial Congestion Map                    | This project will develop an arterial congestion map based on system detector data and future floating car data from GPS sensors. The City has an extensive deployment of system detectors that can initially be used for measuring congestion in the region. It is assumed that GPS data will provide a more accurate measurement in the future, so it is anticipated that the system will eventually migrate to a GPS system. | H,M      | $250,000    | $15,000             | Primary: Bellevue Secondary: KC Metro, Sound Transit, Cell Carriers           | Feeds data into the Dynamic Route Guidance project (TM_05) and the Traveler Information Kiosk project (TM_12). | A standard methodology for using system detector data to report congestion has not been developed in the traffic industry. Many agencies are waiting to use GPS or probe vehicle data. The use of GPS data from cell phones has been identified as a possible means of collecting probe vehicle data. | Increase driver awareness to congested areas  
  - Increase distribution of traffic on parallel arterials  
  - Decreased motorial delay |
| TM_19      | Central Signal System Replacement          | The City of Bellevue’s central computer for traffic signal control will be due for replacement by 2010. This project will define and procure a new signal system for the City of Bellevue. With this replacement will also come a migration of the signal system to Ethernet communications. The replacement of controller cabinets will be part of the annual cabinet replacement program. | M        | $400,000    | $15,000             | Primary: Bellevue                                                               | Could incorporate the 911 Computer Aided Dispatch Interface (TM_02), the Dynamic Route Guidance Project (TM_05), the Automصالized Commuter Alert System (TM_06) and the Traffic Data Query System (IM_01). |                                                                                              | Decrease in motor vehicle delay  
  - Decrease in emergency vehicle response times  
  - Enhanced system communications  
  - Improved transit speed and reliability |
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</tr>
</thead>
<tbody>
<tr>
<td><strong>TM_20</strong></td>
<td>Center to Center Integration - Redmond and WSDOT</td>
<td>This project will implement center-to-center communications with Redmond’s future central signal system and will re-establish the connection to WSDOT. The center-to-center communications to WSDOT requires software upgrades on the interface servers.</td>
<td>H</td>
<td>$200,000</td>
<td>$10,000</td>
<td>Primary: Bellevue Secondary: Redmond WSDOT</td>
<td>Needs to connect to a common point with the Redmond fiber optic system. The interface point is currently designed for 152nd Avenue NE near NE 24th Street.</td>
<td>WSDOT has recently selected a new central signal system for managing its traffic signals. Additional software design may be required to establish a connection to their new system. $50,000 of the deployment cost was allocated to connect to their old MIST system. The remaining $100,000 is for the connection to Redmond.</td>
<td>Improved traffic management across jurisdictional boundaries.</td>
</tr>
<tr>
<td><strong>TM_21</strong></td>
<td>Signal System Upgrade for TSP and TRPS</td>
<td>This project will upgrade the City’s Computer System to improve traffic responsive pattern selection (TRPS) and transit signal priority (TSP) operations.</td>
<td>H</td>
<td>$75,000</td>
<td>$5,000</td>
<td>Primary: Bellevue None</td>
<td>None</td>
<td>None</td>
<td>Decrease transit travel time.</td>
</tr>
</tbody>
</table>

### Public Transportation

| **PT_01**  | Transit Signal Priority | In a joint effort with King County Metro and Sound Transit, the City of Bellevue will deploy new TSP sites near the Bellevue Transit Center as part of the Downtown Access Project. In addition, the City is starting a project to evaluate TSP along the corridor of six of the most heavily traveled transit routes in Bellevue. This project involves a joint effort with King County Metro and Sound Transit to install TSP at up to 120 sites in the next twenty years. | H | $480,000 | $20,000 | Primary: Bellevue Secondary: Sound Transit | The Signal System software upgrade described in project TM_21 will be beneficial with the deployment of new TSP sites. Future TSP sites can funnel data into the Arterial Congestion Map (TM_18). | King County is in the process of developing new TSP hardware that will use wireless communications from the bus to the controller cabinet to activate TSP. This will reduce the installation cost from roughly $35,000 to $5,000. The High priority location assumed half at the current cost and half at the future cost. All Medium and Low priority project assumed the future cost. | Increased transit reliability. |
| **PT_02**  | Smart-Bus TSP Enhancements | This project is a joint effort with King County Metro and Sound Transit to improve the use of TSP through the new technology deployed on the future Smart-Buses. The Smart-Buses will have the ability to track ridership and schedule adherence real-time. This project will use this information to prioritize which buses receive TSP. | M | $200,000 | $10,000 | Primary: Metro, Sound Transit Secondary: Bellevue | This project will use the TSP deployed in PT_01. | Increase TSP efficiency. |

### Emergency Management

| **EM_01**  | Inter-Agency Video Sharing | This project will provide video to the Police, Fire, the 911 center, the Emergency Operations Center and the Bellevue Service Center. | H | $30,000 | $2,500 | Primary: Bellevue | Will be enhanced by the additional cameras included in the City-Wide CCTV Deployment Project (TM_14). | Communication exists to the Bellevue Service Center and communications will be installed in the new City Hall for connections to the EOC and 911 Center. The only expense is the hardware. | Improved emergency and incident identification, verification, monitoring and management. |
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<th>Expected Benefits</th>
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</thead>
</table>
| EM_02      | Traffic Information on Mobile Data Terminals | This project will provide incident information, the City’s congestion map, variable message sign status and video feeds directly to the mobile data terminals in police and fire vehicles in Bellevue. | M        | $50,000      | $5,000   | Primary: Bellevue ITS Master Plan | Requires the 911 CAD Interface project (TM_02) for incident data and the development of an Arterial Congestion Map as described in project TM_18. | Data terminals should be installed in all Bellevue emergency response vehicles by the end of the year. This cost could be significantly reduced if the data terminals have access to the internet. All but the VMS status data would be accessible from the web. | * Improved emergency management*  
* Reduction in travel time to emergency sites*  
* Reduction in congestion near incidents* |
| EM_03      | Remote Monitoring of City Facilities | This project will monitor City facilities such as Downtown Park or water reservoirs. The monitoring may be via CCTV or other technologies. | M        | $200,000     | $10,000  | Primary: Bellevue ITS Master Plan | It will require communications from the City-Wide Communications project (TM_16). | Ideally, some of the cameras needed to monitor City facilities could be strategically placed to also benefit observation of traffic conditions. | * Increase security at City facilities*  
* Improve response time to incidents at City facilities*  
* Increase staff efficiency* |
| EM_04      | Flood Warning System                  | This project will deploy flooding monitoring equipment at the following locations:  
1. 140th at Larson Lake  
2. Factoria Blvd at SE 36th Street  
3. Kamber Road just east of Richards Road  
4. SE 7th Place just east of Lake Hills Connector  
5. NE 21st St just east of 140th Ave NE  
6. SE 30th Street just east of Richards Road | M        | $50,000      | $1,000   | Primary: Bellevue ITS Master Plan | City-Wide Communications (project TM_16) is required to communicate to the flood monitoring devices. These projects will be incorporated with the dynamic message signs identified in project TM_15. | The City currently has a flood monitoring device deployed on SE 30th Street near Richards Road. | * Increase in flood awareness for the City*  
* Decreased response time for maintenance crews*  
* Decrease in congestion on roadways in flood zones*  
* Increase in safety for drivers*  
* Ability to easily monitor multiple flood locations* |
| IM_01      | Traffic Data Query System             | This project will enhance the loop data management program in the Computran system to improve access to historic system detector data and provide access to automated traffic count information. | H        | $50,000      | $10,000  | Primary: Bellevue ITS Master Plan | This equipment can be procured as separate portable devices or as a complete portable ITS unit. | Database could be integrated with the City’s GIS database, with the Computran System, or a hybrid that uses both. | * Increase in staff efficiency*  
* Safety*  
* Enhanced management of roadway operations*  
* Better use of existing data* |
| MC_01      | Roadway Weather Information System    | Weather stations with roadway temperature monitoring will be included at the following locations:  
1. Lakemont Boulevard near Fire Station 8  
2. The two Lakemont Bridges near I-90  
3. Near Somerset Elementary school  
4. Lake Hills Connector west of 140th Ave NE  
5. Meydenbauer Bridge on NE Lake Washington Blvd  
6. NE 12th St bridge over the BNSF railroad tracks. | H        | $25,000      | $1,000   | Primary: Bellevue ITS Master Plan | City-Wide Communications (project TM_16) is required to communicate to the weather stations. | The distribution of this weather information should be combined with the information currently collected by WSDOT. Some of the WSDOT weather stations may need to be enhanced to include features such as roadway temperature. | * Better, more efficient response to current weather conditions*  
* Faster response time to ice conditions by roadway maintenance crews*  
* Increase in available local weather information*  
* Increase in driver safety*  
* Increase in staff efficiency* |
| MC_02      | Portable Work Zone ITS Equipment      | This project will procure portable CCTV cameras, variable speed limit signs and speed detection devices to monitor and control conditions in construction zones. | M        | $80,000      | $1,000   | Primary: Bellevue ITS Master Plan | None | This equipment can be procured as separate portable devices or as a complete portable ITS unit. | * Increased safety in work zones*  
* Reduction in congestion and delay* |
| MC_03      | Maintenance Vehicle AVL Tracking System | This project will track Bellevue maintenance vehicles to enhance dispatch of personnel and equipment to daily events and projects. | L        | $150,000     | $5,000   | Primary: Bellevue ITS Master Plan | None | | * Decreased maintenance response times*  
* Decreased emergency response times*  
* Increased personnel coordination* |
Figure E-7. Proposed Variable Speed Limit Sign Locations
Figure E-8. Proposed Weather Station Locations
Figure E-9. Proposed City-Wide CCTV Deployment
Figure E-10. Proposed Dynamic Message Signs
Figure E-11. Proposed Fiber Optic Communications
Figure E-12. Proposed Transit Signal Priority

Legend
- Transit Signal Priority
  - Existing
  - Funded
- Transit Study Routes

Bellevue ITS Master Plan

July 2004
Figure E-13. Proposed Flood Warning Equipment Locations

Legend

Flood Detector Locations
- High
- Medium

 Deployment Plan
Figure E-14. Proposed Real Time Transit Arrival Signs

Legend
Transit Transfer Centers
- Park & Ride
- Other

Bellevue ITS Master Plan
July 2004
Implementation of the Bellevue ITS Master Plan has the potential to provide the following benefits to the City:

**Improve Vehicle Travel Time**
By decreasing the response time of City Staff to incidents such as flooding and icy roads, vehicle travel times can be greatly reduced. In addition, the Signal System Upgrade for TSP and TRPS will provide more options for City Staff to improve network efficiency.

**Improve Traveler Safety**
Driver feedback signs, variable speed limit signs and photo enforcement will increase safety by reducing vehicle speeds and erratic behavior at signalized intersections. City facility, flood, and weather monitoring will improve the safety of the City’s roadways and infrastructure by reducing maintenance response time.

**Improve Emergency Management**
Projects like Intra-Agency Video Sharing, Traffic Information on Mobile Data Terminals, and City-Wide CCTV Deployment provide more critical information to emergency personnel; therefore increase their ability to respond to emergencies.

**Improve Communications Coverage and Reliability**
Both the City-Wide Communications project and the Communications to Isolated Signalized Intersections project will add scalability and redundancy to Bellevue’s communications infrastructure.

**Improve Traffic Conditions Awareness**
Permanent Highway Advisory Radio, Dynamic Route Guidance, Automatic Commuter Alert System, Dynamic Message Signs and the Downtown Parking Management System all provide information to motorists that can be used to adjust their trip patterns based on real-time information.

**Improve Transit Speed and Reliability**
Transit Signal Priority and Smart-Bus TSP Enhancements encourage transit use by decreasing transit travel time.

**Improve Interagency Communication**
The Center-to-Center Integration with Redmond and WSDOT will provide traffic managers with the traffic data and video necessary to manage traffic effectively near agency boundaries.

**Improve Data Management**
Projects like the creation of a Traffic Data Query System and an Arterial Congestion Map will provide City staff with the data needed to enhance the operations of Bellevue’s surface street network.

**Improve Staff Efficiency**
By adding the ability to remotely monitor weather, flooding and arterials, City staff will increase their efficiency to monitor and respond to traffic and weather related incidents and emergencies.
Completion of this plan is just the beginning of the work required to meet the City’s ITS vision. The next step is to find ways to fit ITS into the future capital and O&M expenditures for the City. The City currently spends roughly $200,000 a year on ITS related projects. To keep up with the deployment goals developed in this ITS plan, the City will need to increase this value to roughly $1.0M a year for the next ten years.

Given today’s budget conditions, allocating this amount of money into the City’s annual budget would be difficult. However, opportunities exist to use a small portion of local funds to match state or federal grant money. Partnering with local transit agencies on ITS projects can also open additional funding doors. There is also homeland security money available from the federal government for projects that enhance emergency management and surveillance.

The future of ITS in Bellevue will also rely on the maintenance of this document. The City should reevaluate it’s ITS needs every three to five years and update their list of projects and priorities, as well as the Regional Architecture. An updated and evolving plan will better position the City to take advantage of opportunities to deploy ITS projects.

Reevaluate ITS Plan Every 3 - 5 Years: Needs, Prioritized Project List and Regional Architecture
## Glossary of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AVL</td>
<td>Automated Vehicle Location</td>
</tr>
<tr>
<td>BCC</td>
<td>Bellevue Community College</td>
</tr>
<tr>
<td>BNSF</td>
<td>Burlington Northern Santa Fe</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Dispatch</td>
</tr>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television</td>
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<tr>
<td>EB</td>
<td>Eastbound</td>
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<td>EM</td>
<td>Emergency Management</td>
</tr>
<tr>
<td>EOC</td>
<td>Emergency Operations Center</td>
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<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
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<td>Geographical Information System</td>
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<td>Global Positioning System</td>
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<td>High Priority</td>
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<td>Highway Advisory Radio</td>
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<td>Intelligent Transportation System</td>
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<td>Low Priority</td>
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<td>Medium Priority</td>
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<tr>
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<td>Northbound</td>
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<tr>
<td>O&amp;M</td>
<td>Operations and Maintenance</td>
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<td>Puget Sound Regional Council</td>
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<td>PT</td>
<td>Public Transportation</td>
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<td>Southbound</td>
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<tr>
<td>TM</td>
<td>Travel &amp; Traffic Management</td>
</tr>
<tr>
<td>TMC</td>
<td>Traffic Management Center</td>
</tr>
<tr>
<td>TRPS</td>
<td>Traffic Responsive Pattern Selection</td>
</tr>
<tr>
<td>TSP</td>
<td>Transit Signal Priority</td>
</tr>
<tr>
<td>U.S. DOT</td>
<td>United States Department of Transportation</td>
</tr>
<tr>
<td>VMS</td>
<td>Variable Message Sign</td>
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<td>WB</td>
<td>Westbound</td>
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<td>WSDOT</td>
<td>Washington State Department of Transportation</td>
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