Assessment of Puget Sound Regional Traffic Signal Operations Program

By

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

November, 2006
Final v3-1b
Puget Sound Regional
Traffic Operations Program Assessment

PUGET SOUND SIGNAL OPERATIONS REVIEW TEAM
To conduct an effective peer review, a team of highly qualified Signal Operations Engineers from the Federal Highway Administration was assembled and traveled to meet with traffic signal operators in the Puget Sound region of Washington State. Discussions with regional traffic operations staff consisted of:

- Organization
- Staff
- Funding
- Assets
- Related Initiatives
- Completed Signal Ops Self-Assessment

Contact information of the individuals that comprised the Peer Review Panel team and those that participated indicated in Appendix B.

The Review Panel would like to thank Puget Sound Regional Council for their effort in coordinating and hosting this review. A tremendous amount of preparatory work and staff time were dedicated to this review, and were instrumental in making this review a success.

GENERAL
Prescribed recommendations in this report were developed by the Review Panel based on current industry practice; previous operational reviews; combined practical and technical expertise; as well as a significant level of input by regional traffic operations managerial and technical staff. The views reflected by this document are those of acting practitioners, representing various municipal, county, state and federal agencies.

Due to time constraints the team was not able to interview more than those agencies identified in this report. In the future we would also like to interview other regional partners to better understand their needs and views of traffic signal operations in the Puget Sound Region.
# Puget Sound Regional Traffic Operations Program Assessment

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Executive Summary

A review of traffic signal operations in the Puget Sound Region was undertaken in May of 2006. The participants in this review represented a cross section of traffic signal operators in the region.

The request for this review originated jointly from Puget Sound Regional Council (PSRC) and the Federal Highway Administration (FHWA) Washington Division office. The FHWA Washington Division, working with FHWA’s Resource Center prepared this document.

In general the review team found a lot of enthusiasm for improving the operation of traffic signals region wide. However, there is no mechanism or regional leadership to focus and coordinate this enthusiasm.

The review team also found that there is limited focus on support for operations at all levels. While state and federal regulations require consideration of traffic signal operations, such operational projects often do not get top priority for funding from the sponsoring agency, or they become encompassed in larger capital projects. Then the projects that are selected are primarily construction projects rather than to provide funding to support the active operation and management of the infrastructure installed by those projects.

The absence of regional agreements on operation of traffic signals is a concern as well. Most motorists expect the same level of service regardless of which jurisdiction they happen to be passing through. There are no regional agreements on operational procedures or levels of service. One important requirement might be regular monitoring and reporting of traffic operations.

The one important topic that we have not specifically addressed is that of how many people are needed to make the proposed programs viable. Making specific recommendations on adequate staffing levels is quite difficult and is directly linked to how the region decides to organize. It is also a function of the technologies selected. There is also little industry guidance or agreement on what this level should be. Nonetheless this is a critical issue as the relationships, systems and programs are not autonomous. They require smart, skilled and dedicated people to make it happen. Staffing levels are also an integral function of the funding available such that no construction or system project should be contemplated without deliberate consideration of the people that would be required to actively and efficiently maintain and operate the facility or system long term.
As a result of this assessment effort the following ten summary Observations and recommendations are offered for consideration.

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**Overall Bottom Line:**

A program to focus on the overall regional operation of the traffic signal systems in the Puget Sound Region does not appear to exist. By establishing strong regional leadership in this area is a major opportunity to developing such a regional traffic signal operations program. King County has been working to try and fill this short fall as presented in their ITS Strategic Plan¹ but does not appear to be in a position to provide leadership to the transportation system operators in the other counties that comprise the Puget Sound Region.

One of the first tasks in development of this regional operating program should be the identification of a regional champion to provide stronger regional leadership needed to focus the region on operations. This regional champion should then organize a regional group or consortium to begin the development of a Regional Operations Action Plan that should include as a major feature a Regional Concept of Transportation Operations.

¹ King County Department of Transportation Intelligent Transportation Systems (ITS) Strategic Plan Final Report August 26, 2005.
The Regional Concept of Operations should be an ongoing development based upon the work to develop the Regional ITS Architecture but would take it to the next step by setting in place actual operational policies, strategies, agreements and relationships for real time day to day operations. The development of a Regional Concept of Transportation Operations would put down on paper the details of who does what, when does it get done, why it gets done, what projects need to get done and when, plus much more. One of the keys in the development of this document should be the inclusion of the planning community to help get the work into the funding stream, ensure it has adequate visibility and priority and to help link it to overall regional transportation goals. This linkage should also include overall monitoring and reporting of system performance, assessment of project improvements as they would map to projected project goals, and possibly overall project contribution congestion mitigation.

Once this is all on paper an active and funded set of written commitments by regional partners will be needed to ensure that the program is actually brought to life. This must be a long term commitment that isn’t easy to evade. It must also carry unambiguous incentives awarding active participation.

When complete the Regional Operations group could then use this Regional Concept of Operations to seed the project selection criteria and process for the next Transportation Improvement Program update and funding cycle. This will provide support to decision makers for a broader acceptance of and funding for actual operations work. This won’t be easy given the intense demands upon severely constrained transportation funding.

Operationally focused projects or long term commitments to traffic signal operations also appear to be a minimal part of the normal funding program or planning process in the region. There does not appear to be many projects focused on active operation of systems on the list approved by PSRC for 2006. Some form of active operation may be embedded in large construction projects. It also appears that agencies have apparently elected not to submit projects focused strictly on active operations of traffic signal systems. This is not to say that there are none. There is a project funded for $1 million called Traffic Busters that will implement a network for agencies to share video information. This is a step in the right direction as it brings agencies to the table and allows some form of collaboration. However, this does not appear to include active operation of the links and systems for automated or semi automated traffic data exchange which will support actual systems operations. The sharing and active use of video images requires and actual physical operator presence in a TMC. It should be noted that many of the local agency TMC’s are operated for a limited number of hours, typically during peak periods and not at all off peak and weekends.

While the focus of this review has been on actual hands on operation of existing infrastructure there are key construction projects that will provide a multi agency communications back bone. The WSDOT Traffic Buster project is one of the most important. This project should be fully funded and accelerated to the fullest extent possible. Consideration should also be made to expand this connection to regional
partners in Kitsap, Pierce and Snohomish counties. This project will go a long way towards addressing several of the recommendations of this review.

Along with this effort everyone has to understand and accept that there is a significant difference between construction projects labeled as operations and the actual physical operation of the infrastructure installed via construction projects. Decision-makers need to understand is that investing in active operations will help to maximize the capital investments they make. Decision makers also have recognize that for every traffic signal approved to accommodate a development there is an ongoing cost to operate and maintain that signal.

The Puget Sound Region has experienced significant growth and appears on track to continue that trend into the future. The region also has some major work to repair and/or replace significant transportation features such as the Alaskan Way Viaduct, the Evergreen Point Floating Bridge, major repair/reconstruction of the elevated portions of I-5 north and south of Seattle. These projects will result in increased pressure to improve traffic signal operations in the region.

In essence there has to be a very active broad partnership focused on regional traffic congestion. This will not happen in a vacuum. Strong responsible and responsive regional leadership is required.
Background

Traffic management systems are an important part of today’s transportation infrastructure. These systems include a wide variety of subsystems including traffic signals, vehicle volume reporting systems, closed circuit television systems, dynamic message sign systems and telecommunications systems to send all this information back to system operators.

In a February 2005 ABC/Time/Post poll, 55% of respondents said that “improving lights,” meaning traffic signals, was a “very effective” remedy to improve traffic flow. In an earlier survey by the U.S. Department of transportation, 50% of travelers said that signal timing should be improved and 36% said that signals should be checked more often. Forty seven percent of travelers surveyed believe that delays caused by congestion are the top community concern, and air pollution from vehicles is a concern for 31%, both of which can be improved thru better signal operation.

On April 20, 2005 the National Transportation Operations Coalition released the results of the first ever National Traffic Signal Report Card. This report card was prepared using the results of a nationwide Traffic Signal Self Assessment Survey completed in August 2004. The findings indicate that, overall, traffic signal operations in the United States scores a D-. The scores for the agencies the panel talked to ranged from a high of a B+ to a low of F.4

One major Observation of this nationwide assessment effort is that most programs are being run on an “ad hoc” basis with little or no overall direction. This has essentially relegated operators and maintainers to the task of “fighting fires” on a daily basis. A proactive, integrated management approach for traffic signal operation has become increasingly elusive. This and

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4 See Appendix G for text of full article.

ITE Journal June 20053

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many of the other Observations echo those in a 1994 GAO report5.

In many areas of the country, traffic signals comprise the majority of the traffic operations system. They function to safely assign right of way to competing flows of vehicles at locations where roadways cross each other. Their level of complexity varies with respect to their position within the roadway network. In general those used to control locations with high demand for vehicle flow are the most complex.

These systems, even considering the sophistication of current technology, are not an “install and forget” proposition. Changes in land use, weather, planned events, incidents, and the roadway network itself all contribute to changing patterns, volumes and demands for service at each signalized intersection.

An active concerted effort is required to ensure that they are kept operating at peak efficiency. Failure to do so can result in potentially severe negative impacts such as:

- Increased crash frequency and severity
- Increased travel times and delay resulting in increased fuel usage and reduced air quality
- Negative economic impact to commercial carriers and public transit
- Traffic diversion to side streets and neighborhoods
- Citizen complaints and non-compliance

By installing these systems, a governmental entity also shoulders the responsibility to make the best use of that investment. Undertaking an assessment exercise, such as this, is one method the entity can use to judge how well they are fulfilling that responsibility, along with helping to identify opportunities for improvement.

This may all boil down to the facts that sometimes signal operational improvements are not always easy to comprehend to motorists and decision makers. Consider the following benefits presented in the National Traffic Signal Report Card:

- Delay would decrease by 15 to 40%
- Travel time would reduce up to 25%
- Emissions would reduce up to 22%
- Fuel use would reduce up to 10%
- B/C ratios up to 40:1

Let us take a quick look at what these potential benefits might mean to the average motorist. Consider an average 30 minute travel time a 25% reduction would result in an approximate 7 minute travel time savings. Also note that this 7 minute saving may well be perceived as within the normal travel time variability. Then consider that with a vehicle that averages 20 MPG a 10% improvement would increase it to 22 MPG. Now

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having presented this we have to ask how many motorists are actually cognizant of their average travel times or keep a log of their vehicles fuel economy much less how many are able to perceive the reduction in auto emissions? Yet for the overall system including all the users these are very significant improvements. While system users may not have a keen awareness of improvements to a system they are keenly aware of degraded operations.

The recently passed SAFETEA-LU legislation also adds very pointed requirements to embrace operational and management strategies to reduce congestion and improve the performance of existing facilities.6 These requirements have been made a part of the FHWA Interim Guidance that must be included in regional Transportation Improvement Plans adopted after July 1, 2007. The region should look to implementing them at the earliest possible convenience.

Introduction

Key questions raised by the regional partners that participated in this effort were:

- What level of engineering/management resources is needed?
- How to handle public input and complaints?
- What role should consultants play?
- How can we improve our program?
- What training is available and can training be funded regionally?

Most of these questions are addressed in this assessment. However, it is beyond the scope of this effort to provide more than high-level general guidance on the formulation of a specific policy.

Since this is a regional multi agency effort we have not made a detailed review of individual agency staffing levels. Neither were we able to include and discuss issues that may be important to those that were unable to participate in the initial interviews.

The Self-Assessment and Review efforts reflect a desire by national transportation policy leadership to gain a better understanding of the situation and quality of traffic management programs nationwide. Information from these efforts will be used to shape programs to help agencies improve the management and operations of the Nation’s roadways.

Assessment Details

FHWA offers the following observations and recommendations based upon completion of the interviews with regional traffic operations personnel and review of the documentation provided by the agencies reviewed.

Observation 1: A Good Foundation Exists

A good foundation exists in the Puget Sound Region for signals operations. Several of the agencies we interviewed were working very hard to overcome challenges to good operations. Some of the major challenges have been in inter agency communications both person to person and system to system. The King County Intelligent Transportation Systems (ITS) Strategic Plan provides a good foundation for a program with King County as the regional leader but only for agencies within the County.

The City of Bellevue has embarked on a program to present to the motoring public via the Internet a real time traffic conditions map. Also posted are views from the closed circuit television system. Other agencies are also considering this. However, these appear to be individual uncoordinated efforts at this time. The agencies that participated

expressed interest in developing a more coordinated effort. But note that traffic conditions on the freeways are not included with the conditions on adjacent arterials so the picture is not yet complete.

Nationwide this work by the City of Bellevue is unique to our knowledge only the city of Los Angeles has done this. The City of Bellevue and the other agencies we talked to that are working on similar efforts are to be commended for being insightful industry leaders.

The City of Seattle has a written policy for the removal of unwarranted traffic signals. To our knowledge this is the first one like this we have seen. It hasn’t gotten much use but consider that there is a very significant cost to operate and maintain a traffic signal so removing them if possible could allow that cost to be applied more important work.

WSDOT has begun development of a system they call SIMMS that will program and track traffic signal operational reviews. There is the potential that this system could be employed by other agencies.

Several of the agencies we talked to are making a good effort to try and keep the traffic signals operating efficiently. WSDOT and King County presented recent reports from signal retiming work as evidence of their efforts.

The King County has made major efforts in the area of traffic signal coordination with the Cities and WSDOT. These projects include signal interconnection and coordination across jurisdictional boundaries. Interagency agreements were entered into by all partnering agencies regarding operation of the corridors.

- **NE 124th St. ITS** is a joint effort between King County, the City of Kirkland, and WSDOT. This arterial route includes 5 signals within the City, 3 within WSDOT and 3 within King County. King County implemented coordinated signal plans throughout the corridor and is actively monitoring and operating the signals from the King County Traffic Control Center. These signals are on an icons central system.

- The Trans-Valley ITS project was completed by the County partnering with the Cities of Tukwila and Renton and WSDOT. This arterial route includes 6 signals within Tukwila, 7 within Renton, 3 WSDOT and 7 King County. King County implemented coordinated signal timing plans throughout the corridor and is actively monitoring and operating the signals from the King County TCC. These signals are on an ACTRA Central System.

- The County is currently designing a project partnering with the City of Redmond to provide communication to the signals along Avondale Road and connect the City of Redmond Traffic Management Center with WSDOT TMC and King County TCC.

Many agencies are working to expand connections to field equipment and to other agency TMCs. However, the TMC interconnections are not universal because there are no
regionally accepted standards for the data exchange to occur. They are nonetheless working to share video images.

In many cases the agencies interviewed were developing traffic signal management systems and understood the importance of using the systems to manage traffic signal operations. Evidence of this would be that many agencies are developing Traffic Management Centers and doing some limited sub regional cooperation to the extent there is some sharing of communications systems.

WSDOT and King County are also preparing reports that measure performance of traffic signal timing projects. They also appear to be working hard to achieve a goal common to all in the region, that being to operate the systems to the best of their abilities.

**Recommendation 1: Maintain, Reinforce and Expand This Foundation**

At this time only the Puget Sound Regional Council of Governments and the Washington State Department of Transportation are in a position to provide regional guidance. While King County is not in a position to provide regional leadership for the entire Puget Sound region it has shown leadership as evidenced though the scoping of a Regional ITS Implementation Plan for it’s service area that has received Federal funding\(^8\). We are not confident that the desire to provide leadership is shared by all agencies in the region. A possible indicator of this inconstant leadership is that the review team was only able to rally a few agencies to participate in this review. Agencies in Pierce and Kitsap Counties which are a part of the region served by PSRC did not participate in part due to time constraints of the review team. We would welcome a future opportunity to discuss these important issues with these other regional partners.

A program to develop a one stop traffic conditions public information program should be considered. This program would include traffic flow conditions maps for all agencies in the region for all transportation facilities, freeways, arterials, transit, ferries and more. It should present the user with a seamless and borderless presentation of the information regardless of the facility/system operator/owner. This is important since most system users expect the same service regardless of the jurisdiction.

There are currently several potential sites for a one stop traffic conditions service. Some of them are already of a basic regional view and could simply be expanded. One of them is the Regional Public Information Network\(^9\) which could serve as a model for a larger more regional portal. WSDOT and others also have very well done sites that have a regional view. This one stop service should also be linked to the 511 telephone based system. These improvements will also need to be marketed to the public to achieve a reasonable level of success.

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\(^8\) Note: The King County plan has a draft scope of work completed and is tasked to determine ITS needs throughout King County inclusive of the incorporated urban areas. This plan has not been developed at this time, but the County is hoping to use this plan to determine ITS improvements and needs throughout King County and provide information on how these projects will link into Snohomish and Pierce Counties.

\(^9\) [http://www.rpin.org/rpinweb/](http://www.rpin.org/rpinweb/)
Observation 2: Inadequate Funding for Traffic Operations

Current PSRC and WSDOT project funding and selection process is primarily focused on construction projects.

Quotes from PSCR selection criteria:

*Examples of projects eligible for STP funds:*

8. Signalization and signal timing, transit signal priority, re-striping, bus turnouts, traffic monitoring, management, and control facilities and programs.

*Categories of Eligible CMAQ Projects*

30. Traffic signal modernization, coordination, or synchronization projects designed to improve traffic flow within a corridor or throughout an area like a central business district.

There are several boards and programs within the region that claim to focus on transportation improvements such as the Transportation Improvement Board and the Arterial Improvement Board. However, these organizational structures don’t seem to put much emphasis on actual facility operations. They seem more focuses on infrastructure construction.

Section 23 CFR 940.11(c)(7) further requires that federally funded projects clearly identify, as a part of the systems engineering analysis, “Procedures and resources necessary for operations and management of the system.” It also points to the fiduciary responsibilities an agency accepts to adequately and efficiently operate the systems they install. WSDOT, PSRC and FHWA should review this situation with regard to current federal regulations.

Recommendation 2: Craft Program of Sustainable Funding for Traffic Operations

Funding of Traffic Operations and Maintenance must consider the requirements for ongoing traffic signal operations and maintenance; it is directly proportional to the type, complexity, location and quantity of traffic devices deployed. Any successful program must specifically define its objectives; establish the methods and processes to meet the objectives; provide resources, time, personnel and equipment to meet those objectives; and have specific quantifiable performance measures in place to make certain those objectives are met. Without a sustainable funding source, additional benefits from traffic signal deployment will be hard to sustain throughout the life cycle of the program. This is an iterative process that continually gauges performance against objectives, insures that the program meets the expectation and establishes a value baseline for the investment. Therefore each device or system of devices should have a scalable annualized operation and maintenance budget based on its function, complexity, lifecycle, and location.
Federal resources can be used to provide a significant portion of funding to sustain this program.

As each new proposed signal location meets the MUTCD warrants for a traffic signal deployment, it should also meet the agency’s self-imposed warrant to be adequately operated and maintained. It is not practical to continue to install new signals while O&M budgets are held constant or even reduced. Just as it is given that each new signal constructed will generate an additional electrical utility expense, it should be a given that each new signal will generate fractional Full Time Staff Equivalents that must eventually materialize into additional personnel and resources.

Traffic Engineers and Technicians must be able to operate and maintain a manageable number of installations. It is not efficient to be strictly reactionary. Devices deployed over large geographic areas require a disproportional amount of time to be devoted to transportation time and expense when operating in a reactionary fashion. Obviously, at the other end of the spectrum, there is a point of diminishing returns where any additional time and attention devoted to an installation would have little value. The most effective use of funds will be utilized when the program is managed within an optimized margin, where routine service is manageable and maximized at a level that minimizes unscheduled maintenance calls.

Traffic control devices require attention and resources for a number of reasons and on various cycles. Industry seems to have settled on guidance that a Conflict Monitor/Malfunction Monitor Unit requires an annual recertification cycle to procedurally insure safe signal operations. Other devices such as induction loops have known failure cycles that may potentially be linked to climatic changes and pavement conditions and other devices such as software settings and signal timing have lifecycles tied to ever changing traffic conditions. Replacing devices on a designated lifecycle is also far better than the “drive it till the wheels fall off” method. Does it also make sense long term to replace failed Model T’s with Model T’s or with more modern equipment? Not only does the former method leave the program with the entire inventory in an unpredictable state, it often leaves no migration path forward as generations of technologies have been skipped. Consider the Model T analogy above, if the old system is only capable of handing the power produced by the Model T what happens to the system when a newer more powerful device is installed? Failure to develop and follow a coherent migration path can lead to situations where the failure of a single piece of minor equipment can force the replacement of entire systems at great expense.

Look to and budget for new technologies for potential savings. Technologies sometimes provide an economic advantage and can produce an overall net savings over and above the initial investment. Many regional traffic signal operators are actively deploying LED signal heads that have been shown to quickly pay for themselves and reduce maintenance requirements on the program. The initial cost of an LED signal head is far greater than a traditional signal bulb, but it would have been short sighted not to use them. Likewise, other relatively inexpensive technologies such as laptop computers or PDAs in the hands of field personnel used to actively maintain databases can help reduce unnecessary trips.
to the cabinet and improve efficiency and the overall quality of the program. However, these efficiencies may only provide minor savings as compared to overall increases in costs for fuel, energy, materials and worker salaries.

Federal funding can be used to provide a significant portion of funding to sustain the traffic operations in the Puget Sound Region. Appendix F provides guidance on current Federal policy for funding for operations. It is strongly recommended that the Puget Sound Region pursue this avenue.

Observation 3: Regional Leadership Inconsistent

There appears to be no overall leadership for traffic signal operations in the region. Several agencies have worked hard to try and fill this void. For example King County has through their ITS Strategic and Implementation Plans has demonstrated leadership in King County. However, we are not confident that this view is shared by all agencies in the region. King County is also not in a position to provide leadership for the other counties in the Puget Sound Region. At this time only the Puget Sound Regional Council of Governments and the Washington State Department of Transportation are in a position to provide this regional guidance.

Each agency has assigned a different level of support for traffic signal operations. It has also allowed very inconsistent implementation of critical standards and operational parameters for example uniform and consistent calculation of clearance intervals. This lack of consistency has also been intensified by the lack of guidance to the local agencies contracted to maintain traffic signals on state highway or city arterials through maintenance agreements. It should be noted that these agreements typically don’t include requirements for systems operations and performance. This lack of consistency would include the absence of common guidelines for determination of such things as minimum green times, when is a protected left turn required, how clearance intervals shall be determined and how often should intersection operation be reviewed.

One of the key requirements for consistency is that motorists expect uniformity of operations regardless of the political boundaries. They don’t often know or care that the signals are operated by the state, county or city they expect the same service. A typical example would be where an arterial intersects a freeway with a signalized diamond interchange. The signals on one side of the freeway could be operated by a city, the diamond interchange signals by the state DOT and the signals on the other side of the freeway by the county.

Recommendation 3: Build Stronger Regional Leadership

Identify and support a regional leader and champion for operation of the transportation systems in the Puget Sound Region. One possibility for this leader could be the Puget Sound Regional Council another potential is the Washington State Department of Transportation. Formation of a regional operations council, consortium or regional operations task force should also be considered to support and compliment the regional
leader. It would also provide a much stronger single voice to hopefully inform and influence regional transportation leadership.

This leadership or governance role can take on many forms all of which should be presented and considered. The structure needs to be carefully selected so that it can provide actual active leadership and legitimately represent all of the regional partners large and small. The region may wish to consider bringing in an organizational expert to facilitate the discussions and negotiations needed to organize the structure and define the roles. The organization and promulgation of this entity is critical to the future success of regional traffic signal operations in the Puget Sound Region.

Some potential organizational structures could be:

- Single Strong Leader
- Consortium of equals
- Facilitator/coordinator/advisor/spokesperson for a steering committee
- Several Sub Regional Groups with representatives on a Regional Board

Traffic signal operations in region should be organized around regional operational and performance guidelines. While there will always be different operating organizations a structure should be sought to cross those lines.

The creation of a Tiger Team\(^\text{10}\) approach within the selected regional leader could help set the standards as well as serve as a pool of expertise for regional partners. The development of manuals to document standards of practice and operations will also assist this.

Some of the regional leaders in other parts of the country have taken on significant operational responsibility such as actually operating the coordinated signal operations for the entire region. A few examples of these are the Regional Transportation Commission in Las Vegas FAST Program and the Mid America Regional Council in Kansas City, Operation Green Light, others have taken a more facilitative role by serving as an organizing an information exchange entity. Some also provide on call engineering services to assist local agencies with a wide range of operational issues from signal timing to assistance with systems and technology. Examples of these are the Metropolitan Transportation Commission in the San Francisco Bay Area and the Denver Regional Council of Governments.

\(^{10}\text{tiger team} - (US\text{ military jargon})\) 1) Originally, an allied team whose purpose is to penetrate security, and thus test security measures. These people are paid professionals who perform hacker-type activities, e.g. leave cardboard signs saying "bomb" in critical defense installations, hand-lettered notes saying "Your codebooks have been stolen" (they usually haven't been) inside safes, etc. After a successful penetration, a "security review" is performed to evaluate effectiveness of security measures. In extreme cases successes of tiger teams has lead to organizational and personnel changes.

2) Recently, and more generally, any official inspection team or special firefighting group called in to look at specific set of problems.

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Some of the services this leader could provide:

- Monitor and report on attainment of performance goals
- Set equipment and design standards
- Guide research efforts
- Guide training and staff qualification standards and goals
- Facilitate quarterly regional information exchange and tele/video conferences of standing technical committees
- Provide expertise directory to the local agencies, in particular to those that are operating systems on state highways
- Provide expertise and coordination across all agencies within Puget Sound Region. For example telecommunications systems and expertise is a common component to these systems and needs a common set of standards, in particular those that would need to interact with one another on things like emergency management, weather information and more. Additional areas of specialized expertise should include computer hardware and software, telecommunications, procurements, systems testing and acceptance, asset configuration and management and systems engineering.
- Develop, promote and maintain a region wide traffic operations knowledge exchange via a Traffic Operations “Technical Services” Committee
- Liaison to planning programs to provide data collection and archiving activities
- Liaison to University of Washington
- Responsible for key decisions on technical issues and policy
- Provide a standardized interagency traffic signal operating agreement
- Coordinate regional traffic information sharing and exchange protocols
- Provide a central point of communication for motorist to report traffic problems and receive traffic information.
- Coordinate a regional traffic operations training program.

Observation 4 Little Regional Information Sharing

In the regional meetings it was observed that there is very little interaction between neighboring jurisdictions. For some neighboring operators this was their first meeting. Many didn’t know the phone numbers needed to contact their neighbors. While this wasn’t universal to everyone we interviewed it did emerge as a relatively common thread for some.

The issue of information and data sharing also extends to communications between those in charge of operations and those responsible for overall regional transportation system planning. Without this exchange it is quite difficult for the planners to get the needed projects into the process for funding. It also limits their ability fit all of the various pieces together to form a comprehensive and cohesive program.

At one time there used to be regular meetings of user groups held by those with the same traffic signal hardware. The vendor that provided the equipment often helped to facilitate these meetings as not only a way to help sell additional equipment but also to build
relationships between the users. These group meetings were well received and attended by the users. The hardware systems that these meetings revolved around have by and large been replaced. New user groups focused on the replacement hardware have not been chartered.

Communications is also a problem internally in some jurisdictions. One of the agencies recounted a situation where the police had placed a signal on flash and did not tell the traffic signal operations staff. The signal was on flash a couple of weeks before the signals people found out. King County had this problem at one time and has since made some innovative changes to their “Police Panel”. The have removed the “on-off” switch and place the switch for flashing operations under a red switch guard\textsuperscript{11}. The police officer would have to raise this bright red cover to access the actual switch. This home grown innovation has had the desired effect. One other suggestion was to place the phone number for traffic operations inside the door.

There is also only limited exchange traffic signal operational information. There are few data communications interconnections between agencies to share hardware and system level information or computer to computer connections.

King County is currently connected to WSDOT, the City of Renton and the City of Tukwila to exchange signal operational information. The connections are via workstations off the County’s Actra central system. The software currently does not support center-to-center communication, requiring the workstation solution at this time. The City of Kirkland will also soon be connected into King County’s icons central system to monitor the NE 124\textsuperscript{th} St. ITS corridor signal operations.

In the future the WSDOT Traffic Buster project will provide a backbone for additional communications. However, it has not been fully funded and is still far from completion.

\textsuperscript{11} \url{http://aerospace.eaton.com/pdfs/power/Switch_Catalog_With_Cover.pdf} Page F2
Recommendation 4 Develop Regional Information Sharing Program

It is recommended that the regional traffic signal operators create a means to share information. This program would take at least two levels one would be for information about the individuals who are responsible for traffic signal operations and management and another at the hardware and system level.

The information at the level of the operating personnel might include:

- Names and numbers of key operations people,
- Information about systems and equipment,
- Emergency Contacts,
- Available skills, knowledge and expertise.

Information at the hardware and system level might include:

- Signal status
- Signal timing database information
- CCTV images
- Vehicle volume information
- Incident information
- Equipment disposition

The WSDOT Traffic Busters project will hopefully serve as a communications backbone for this information interchange system. However, it is not fully funded or close to completion. We would strongly recommend that this work be accelerated and more fully supported. A sub group of the regional operations leadership team should also be formed at the earliest possible moment to begin development of agreements and creation of a common set of protocols that can be used to exchange information at the system level.

To better support this program the region should actively participate with the development of the NTCIP standards program. In particular there should be a connection to the development of the standards for Center to Center information exchange. The region should also consider becoming a national test bed for this effort.

The local chapter of the Institute of Transportation Engineers has offered to help with this. Substantial work will also be needed to keep it current once created.

Some of the concepts for this could also include web based user forums and bulletin boards. A web based implementation could also contain important training materials.

One key goal for this recommendation is to build lasting relationships between those responsible for operating and maintaining traffic signals in the Puget Sound Region. These relationships will help build and maintain the community. For example one is more likely to call someone with which they have an existing relationship for help or
advice. You are also more likely to trust what ever help or advice is provided through such relationships. These relationships will also endure as people move from agency to agency or job to job.  

Observation 5 Shortage of Qualified People

The groups interviewed expressed concern over the shortage of qualified operations people. This has been primarily linked to budget issues that have resulted in the inability to hire new staff but also to retain existing qualified people. This funding issue also has impacted the ability to train existing people so that they reach an acceptable skill level.

One almost universal complaint has been that the turnover at WSDOT has made it extremely difficult for the local agencies to mount lasting working relationships.

This is not solely an issue for the public sector but also impacts the private sector contractors that perform much of the signal timing work. There was also concern that it is very difficult to find reliable qualified consultant help. They expressed dismay with the number of consultants that have performed very poorly on signals operations work.

Some also felt that it was hard to recruit and retain people because there are few career paths and not enough glamour in traffic operations.

Recommendation 5 Create Qualified Signal Operations Corps

The region should consider identifying or creating for the region a list of highly skilled and qualified professionals to perform signal operations work. Traffic signal timing and operational tasks would be their prime duty. These people could either be staff employees within the regional leadership organization or private sector contractors. The key here is that they have the knowledge and skills to develop, install and fine tune the operation of traffic signal systems.

The operators in Las Vegas, Kansas City, Denver and Houston have utilized regional authority to design, evaluate and set regional priorities for traffic signal timing and maintenance practices.

This signal operations corps should be considered to be available to assist any agency operating traffic signals in the region on an on-call basis. But it may be more efficient to develop a particular scheduled work program that coincides with the various performance measures. This traffic signal operations corps would be one of the “tiger teams” mentioned earlier.

Another possible method might be to pool expertise. One possible way may be for agencies to cooperate with system monitoring. For example 24/7 operations could be rotated from TMC to TMC (assuming appropriate interconnections etc.) or using

http://www.esquiregroup.com/jobs_career_24.cfm
temporary assignments to a larger regional TMC. This would primarily be focused on off hours such as late night and weekends.

Consider a consultant selection program that would require them to use the either hardware or software in the loop technology to solve a signal timing problem; the consultant that does the best and most efficient job would win the contract.

**Observation 6: Lack of Staff Qualifications Standards**

There are no regional requirements or standards to depict qualifications and certifications for staff involved in the operations and/or maintenance of traffic signal systems. This may be particularly important when one agency contracts with another for operation and maintenance of signals. In the Puget Sound Region WSDOT, King County and Snohomish County have many signals under contract for operations and maintenance.

When you visit the doctor, lawyer or even have your automobile serviced, isn’t it reasonable to expect that those professionals have some form of accreditation for the services provided?

A lack of qualification standards is further exacerbated by the lack of any succession planning to ensure that there are qualified candidates to replace people lost to normal attrition.

**Recommendation 6: Create a Standard for Personnel Certification/Qaulification**

It is recommended that standards for personnel qualification and certification be created. Certification organizations such as the Transportation Professional Certification Board\(^\text{13}\) for traffic operations engineers and the International Municipal Signal Association\(^\text{14}\) for maintenance technicians should be consulted. The certifications conferred by these organizations also require continuing training/education. While learning on-the-job should always be part of the program it is not an adequate substitute for more intensive, up to date and continuous formal learning. The region could also develop a separate certification program and qualification criteria.

The Transportation Professional Certification Board offers the following Certifications:

- Traffic Operations Practitioner Specialist (TOPS)
- Traffic Signal Operations Specialist (TSOS).
- Professional Traffic Operations Engineer™ (PTOE)

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\(^{13}\) [http://www.ite.org/certification/index.asp](http://www.ite.org/certification/index.asp)

\(^{14}\) [http://www.imsasafety.org/](http://www.imsasafety.org/)
The International Municipal Signal Association is in the process of restructuring their certification program. They currently offer certification in the following:

- Public Safety Dispatcher
- Roadway Signs and Markings
- Roadway Lighting
- Traffic Signal Technician
- Work Zone Traffic Safety

The certifications do not substitute for appropriate professional licenses when they are required for specific responsibilities or jurisdictions.

The recommendation for certification/qualification comes with a significant cost in time and dollars. But this cost is easily offset by improvements to staff efficiency. To put it more plainly a better-trained and educated person is much more likely to implement the best solution to a problem more quickly and competently with a lower overall cost. Also providing the funding sufficient to move the whole effort away from a “fighting fires” mode will lower the life cycle costs of operations as the best lowest cost longer term solutions can be implemented.

Having a clear set of certifications and qualifications would also be important in selecting contractors and consultants. When hiring a consultant to provide services such as signal timing wouldn’t it be important that they have some minimum level of accreditation judged by a qualified third party. Wouldn’t this also provide some sense of security knowing that the candidate had some actual training and testing on the particular device/service that they would be providing?

Finally these standards for certification and qualifications should be applied to those contractors and consultants that may be hired to help fill gaps in personnel. One should reasonably be able to expect that both contracted and on staff personnel be held to the same standard?

Observation 7 No Formal Regional Training Program Exists

There was a common frustration voiced with the difficulty in obtaining training. Most of the agencies interviewed have trouble getting to the few training opportunities currently available. One result is that much of the training is done on the job.

Other frustrations are over when and where the training is available. Many agencies due to short staffing and immediate maintenance demands can’t always set aside specific large blocks of time for training. Many also have trouble traveling long distances to training opportunities.

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15 http://www.imsasafety.org/rfp0107.pdf
There were several suggestions that a focused training program was needed to help public officials and decision makers better understand traffic signal operations. They also felt a need for more work to educate the public about the need for good traffic signal operations.

**Recommendation 7 Form Regional Training Partnership**

The development of such a regional training program should be begun as soon as possible. Placing it under the jurisdiction of the regional leadership identified in Recommendation 3 should also be considered.

Some of the training activities could be as simple as peer exchanges between regional operators. Agencies could consider assigning people to work in and along side more experienced operators in other agencies. This could be relatively low cost but would also provide a forum for building regional relationships and partners.

This regional program would also be helpful in marshalling resources needed to bringing some of the more costly training programs to the region. Consider that many of these courses are provided at a flat rate regardless of the number of students. This makes it particularly difficult for a single small agency to go it alone.

This program might also include a regular lecture series. The Arterial Operations Committee of the San Francisco Bay Area MPO has for the past 10 years sponsored a series of quarterly one day lectures on wide variety of topics. Some of the speakers have been brought in from around the nation others have been local professionals telling others about successful projects.

The region could also look to some of the newer training technologies and programs being developed. Some of them are web based and one of them the University of Idaho Mobile hands-On Signal Training or MOST\(^{16}\) are meant to be on demand. The MOST training is unique in that it will present the students with the actual controller software interfaced to a microsimulation model all on a single go anywhere any time PC.

The ITE has prepared an assessment of traffic signal training\(^{17}\) which has identified the types and sources of training currently available. The region should begin this by attempting to identify how the currently available training can be harnessed to satisfy the initial regional needs.

A public relations type training effort for the public, elected officials and other decision makers may also be considered.

\(^{16}\) http://www.webs1.uidaho.edu/fhwa-signals/

\(^{17}\) See Appendix H.
Observation 8 No Process to Measure Success

At this time traffic signal operators in the Puget Sound Region have no clear way of measuring the success of the entire traffic operations program. Without such a measure it is difficult to guide the entire program. These measures can be used to tell the motoring public and decision makers in plain terms the status of Puget Sound Region stewardship of transportation systems.

In 2002 the Washington State Legislature in ESHB 2304 the Transportation Efficiency Act\(^\text{18}\) set forth the following goals:

\begin{quote}
No interstate highways, state routes, and local arterials shall be in poor condition; no bridges shall be structurally deficient, and safety retrofits shall be performed on those state bridges at the highest seismic risk levels; traffic congestion on urban state highways shall be significantly reduced and be no worse than the national mean; delay per driver shall be significantly reduced and no worse than the national mean; per capita vehicle miles traveled shall be maintained at 2000 levels; the non-auto share of commuter trips shall be increased in urban areas; administrative costs as a percentage of transportation spending shall achieve the most efficient quartile nationally; and the state's public transit agencies shall achieve the median cost per vehicle revenue hour of peer transit agencies, adjusting for the regional cost-of-living.
\end{quote}

And

\begin{quote}
It is the intent of the legislature that the transportation commission establish performance measures to ensure transportation system performance at local, regional, and state government levels, and the transportation commission should work with appropriate government entities to accomplish this.
\end{quote}

Performance measurement and monitoring will help the Puget Sound Region to focus their limited resources on things that need the most help. It can also help identify those things that can achieve the greatest benefit.

**Recommendation 8: Adopt and Implement Performance Monitoring Program**

The Puget Sound Region should institute a program of frequent planned system performance measures. This could take the form of a report card that could serve as primary input to the WSDOT Grey Notebook. It should have a regional focus using local agency input and report work toward several different regionally adopted operational goals.

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\(^{18}\) http://www.wsdot.wa.gov/ta/T2Center/Mgt.Systems/PavementTechnology/2304-s_sl.pdf#search=%22ENGROSSED%20SUBSTITUTE%20HOUSE%20BILL%202304%22
This report card could include measurements such as travel times and travel time variability. It should also include reporting how well the systems components are maintained and their operational status. It could also form an important input to the priority programming for the transportation improvement program as required by ESHB 2304.

Consideration should also be given to creation of very visible public relations program to showcase and promote these performance measures. Public and political support will be critical to the success of the overall program.

In addition to a quarterly or yearly report card consideration should be given to promoting the good work accomplished by the overall program. The Denver Regional Council of Governments produces a one page two sided promotional piece following the completion of each signal retiming project\(^\text{19}\). They circulate these to the elected officials and decision makers where the work was done. This quick simple report has helped them gain political support needed to continue and even expand their program.

One potential performance measure should be calls and complaints from the motoring public. Most agencies cite this as their most important measure but if it is difficult for the public to provide feedback and input you may never really know how well you are doing. Providing an easy avenue to solicit and collect public input provides several benefits at a very low cost. Washington State DOT has begun putting a sticker on each device cabinet as shown in Figure 1. The telephone number is of the maintenance radio operator in Seattle. The Seattle maintenance radio is operated 24/7 so that there is always an individual present to answer the call. This is very important as the problem reported may be a safety issue that needs immediate attention. It has proven quite effective and is seen as good customer service. It also enlists the public to be additional observers and has resulted in solving several previously unsolvable problems.

In our interviews with agency operators there was some support for a single region wide one call telephone number to handle citizen’s complaints. If such a system is implemented it is recommended that it retain a very high level of customer focus and service. Implementing an Interactive Voice Response system will not be as well received nor produce the same level of public acceptance. The public should be able to access appropriate agency staff as quickly and simply as possible.

\(^{19}\) See Appendix E.
However, great care should be taken in the consideration, development and implementation of a call in hotline. These programs have the potential to generate a lot of call traffic. Some of these calls may be completely disconnected and out of place others may even be malicious. Nonetheless they must be handled with a high degree of sensitivity. The Puget Sound Region should therefore work closely with experts in public relations and similar programs to craft a system that can provide effective input to operations. Those that have developed a program have had good public relations success with it. An additional example of another similar program, from the Denver Regional Council of Governments, is shown in Appendix H.

This program should include provisions to review and revise as necessary the traffic signal timing or other operational improvements for critical corridors. As a minimum it is recommended that each individual signal be reviewed and updated at least every three years. The program should also consider setting reasonable thresholds that might trigger more frequent reviews in response to change in regional or local travel conditions as development and roadway construction occurs.

The Puget Sound Region traffic management systems should collect real time raw data for use in such assessments. This data should be archived and used for analysis. This historical data could and should be used in assessing regional performance or better yet performance of the overall system. To do so will also require investing in the maintenance of detection systems, an area in the NTOC self-assessment report card with a very low score.

A high percentage of traffic signals in the Puget Sound Region have some ability to detect vehicles. Some have better ability that others but at the current time very little use is made of this ability. In other words the vehicle detector sensor data is for the most part left at the intersection and not used for other purposes. This data should be collected and used to monitor and report real time performance. It should also be considered as a data source for the traffic demand models used by PSRC and others for planning studies.

The region should consider sharing traffic count/flow data with those responsible for transportation planning to help them prepare a report card on the outcome/impact of the projects contained in the Long Range Plans and the Transportation Improvement Program. Consideration could be given to requiring a public report of whether completed projects achieved their operational goals before identifying any new projects.

Reporting travel times is often a quite powerful public relations tool. WSDOT has begun to report these on their web site as well as post them on overhead Dynamic Message Signs. Point to point travel times are something that the average citizen can comprehend. They can also independently measure them to verify the relative accuracy of the report. Regional operators may also want to consider including the participation of average citizens, decision makers and local business representatives in a program to measure these travel times. While it may be important to measure and report them it is also very important that the citizens understand how they were collected and what they mean.
The City of Bellevue currently is measuring and posting this information on their website. Other jurisdictions are attempting to develop similar systems. Shouldn’t all of these individual efforts be rolled into a single common system that would include not only arterials but also the freeways and span jurisdictional boundaries?

Consideration should be given to include performance measures for systems that are operated under agreement to local agencies. This requirement should also apply to tasks contracted to the private sector. These performance measurements should be compared to WSDOT or other local agency performance on the same tasks.

However, the performance-monitoring program must be done in balance with the overall agency charter. In some organizations these programs take on a life of their own. Before long the whole enterprise can lose its main goal and effectiveness as large blocks of operating capital are taken away from actual operations to fund performance-monitoring activities. Therefore it is critical that the effectiveness of the program-monitoring effort itself must also be continuously evaluated.

**Observation 9  No Regional Uniformity**

There is no consistent documentation of parameters, procedures or guidelines for actual operation of traffic signal systems. This lack of documentation has lead to a considerable amount of inconsistency between agencies. It also makes it difficult to provide adequate direction to contractors that might be hired for such tasks as development of implementable signal timing. Consider an above example of traffic signals owned by different agencies surrounding a freeway interchange. Shouldn’t they all share many of the same basic operational settings so they appear like a seamless system to the motorists.

One very important example is that all signals should have the clearance interval timing determined using a uniform procedure. While there are procedures such as ITE recommended methods these are subject to interpretation. For example one of the variables is the vehicle approach speed which could be assumed to be the posted speed limit, the 85 percentile speed or some other seemingly reasonable assumption. Now that some of the signal operators in the Puget Sound Region are implementing automated Red Light Running citation system it is imperative that there be a uniform regional policy on how there intervals are determined.

Documented guidelines for the procurement or maintenance of these complex systems also do not exist. The basis for the procurement of these systems should be founded in a systems engineering process. The systems engineering process is specifically formulated for the procurement of high tech computers, software and other common systems employed by traffic signal operators. For projects using Federal Funds a systems engineering process is required.  

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20 23 CFR 940.11 see also [http://ops.fhwa.dot.gov/its_arch_imp/faq.htm](http://ops.fhwa.dot.gov/its_arch_imp/faq.htm)
Recommendation 9  Develop Uniform Guidance Documentation and Policy

The Puget Sound Region and potentially the entire state of Washington should develop documentation on traffic signals procurement and operations. This effort could be an expansion of the existing WSDOT Traffic Manual to provide adequate coverage of these important topics. Current FHWA, ITE and AASHTO guidance is very limited in this area. There is some guidance in procurement but it tends to be more general and broad in nature and would need to be tailored to the specific regulations and needs in this area.

An effort should also be mounted to standardize the interagency traffic signal operating agreements. A review of agreements provided by the regional agencies reviewed shows little uniformity. Consider that some agencies would have significantly different agreements with different partners. The agreement provided by King County\(^\text{21}\) addressed many of the following suggestions.

- How performance would be monitored and reported,
- The minimum expected staffing qualifications,
- Commitments to ongoing continuing competency
- A complete description of the services they are providing.

King County has a draft of an operations manual that may be a seed to this. FHWA is currently the developing a Traffic Signal Timing Manual which may also prove helpful.

Portions of the existing Traffic Design Manuals should be revised to embrace a Systems Engineering approach. The existing approach taken by this manual is that of a traditional roadway construction project. This legacy process is very often less than satisfactory for the high technology hardware and software systems common in the traffic operations realm.

\(^{21}\) See Appendix D
Regional uniformity should also be sought through the deployment of uniform and standardized data exchange system. This standardized data exchange is needed for at least the following:

- Common data archiving
- Regional combined freeway and arterial traffic conditions map
- Inclusion into the 511 Traffic Information System
- Day to day minute to minute operations across jurisdictional boundaries.

Historical experience shows a dismal track record for these high tech procurements under traditional low bid construction contract process. The track record is even worse for high tech procurements included in large roadway construction projects. Therefore a procurement manual should also be prepared to assist in the procurement of the high tech hardware and software.

These documents could also be made an integral part of the agreements with local cities and counties operating devices on state highways. It would seem reasonable that WSDOT or other agencies contracting for signals operations services would require the contractor to adhere to some clear standards.

**Observation 10: National Guidelines and Standards are Lacking**

There is a current lack of sufficient guidance available to the State and local agencies in the area of signal operations. These agencies are seeking resources that the entities can utilize to direct their deployment and integration of traffic control devices and establishment of practices and procedures. The current ITE (Institute of Transportation Engineers) manual is the most current resource document, and may no longer adequate serve the needed purposes.

There is also considerable discussion and disagreement on what would constitute “best practices” that would be needed to develop such national guidelines and standards. No single entity has collected, analyzed and reported comprehensively on this topic. Given the results of the NTOC Traffic Signal Report Card it appears to be very difficult for most agencies to even reach minimally efficient traffic signal operations to seed such a study effort. Dr. Tom Urbanik former chair of the Transportation Research Board Traffic Signal Systems Committee contends “We can’t begin to discuss Best Practice until we understand and define good practice”.

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*Fundamental flaw of software acquisition: “[One can specify a satisfactory system in advance, get bids for its construction, have it built, and install it….this assumption is fundamentally wrong. It is necessary to allow for extensive iteration between the client and the designer as part of the system definition.”* [Fredrick P. Brooks, The Mythical Man-Month: Essays on Software Engineering, 1975]
The groups we talked to are clearly looking for guidance on funding and staffing levels to support their programs. At the current time many of them are having trouble meeting the basic system needs, while others have been able to undertake more advanced operations programs such as the City of Bellevue’s traffic conditions map.

**Recommendation 10: Develop National Guidelines and Standards**

FHWA, AASHTO, and ITE could be appropriate resources to develop national guidelines and standards. These guides could be all inclusive, covering systems management, concepts of operation, and performance measures.

At the present time there are a myriad of documents that discuss guidelines and standards for operations but many are dated others are hard to find. Few are available for use to found a set of regional guidelines and standards for traffic signal operations.

However, this would require the identification and study of agencies that have actually adopted good practices that the entire industry could agree upon. Consideration would also have to be made for rapid changes in technology, research results and philosophy towards traffic signal operations.

The FHWA is working on a number of tasks including the development of a Traffic Signal Timing Manual which should help. The Institute of Transportation Engineers has also begun work on a Traffic Signal Audit document that would help agencies identify and address operational deficiencies.

It should also be noted that this recommendation is one that can’t be acted upon solely by the agencies in the Puget Sound Region. However, if the regional operators were to aggressively implement the recommendations of this review they could provide invaluable experience and data for the development of such guidance and standards.

**Conclusion**

The Puget Sound Region has traditionally been a national leader in transportation systems and management. A strong leader is needed to set regional goals and direction as well as to coordinate activities, provide technical support, consolidate and promote training opportunities and promote funding for these activities. Both the Puget Sound Regional Council of Governments and Washington State Department of Transportation are in a position to provide this leadership.

To accomplish significant improvement as outlined in this report will require funding; **there is no free lunch here.**

The region should also investigate the potential cost impacts of regionalization of certain functions and services. Consider the potential savings that may occur if the leader organization provides technical assistance to all regional partners. This in addition to
providing uniformity would save the regional partners from the costs of separately contracting or hiring for these services. It may also improve program delivery by bring the needed technical expertise to the project faster.

In essence there has to be a very active broad partnership focused on regional traffic congestion. This will not happen in a vacuum. Strong responsible and responsive regional leadership is required.
Appendix A: Puget Sound Traffic Signal Operational Review

Puget Sound Regional
Traffic Signal Operations Review

Schedule

April 25, 2006  9:00 to 12:00  Renton City Hall, 1055 S. Grady Way, Room 511
Renton/Auburn, Kent, Tukwila

April 26, 2006  9:30 to 12:30  Bellevue City Hall, 450 110th Ave NE
Bellevue/Issaquah, Kirkland, Redmond

April 27, 2006  9:00 to 12:00  Lynnwood City Hall
Lynnwood/Everett, Snohomish County

April 28, 2006  8:30 to 12:30  King County, King Street Center, Room 2A
King County and City of Seattle

April 28, 2006  1:30 to 4:30  WSDOT-Northwest Region, Dayton Ave., Rm. 4B
WSDOT
Review Agenda

**Purpose:** The purpose of this meeting is to assist the Puget Sound Region with a review of their signal system operations. The review will use the newly created national signal operations self-assessment evaluation document as the evaluation tool along with questions specific to regional needs.

- Introductions and Agenda/Schedule Revisions (if needed)
- Background of Signal Operations Self-Assessment (FHWA)
- Discussion of Assessment Scoring Methods/Interpretation
- Discussion of Agency Management and Operations
- Discussion/Assessment of Signal Management Activities
- Discussion/Assessment of Signal Timing Updates
- Discussion/Assessment of Coordinated Traffic Signal Operations
- Discussion/Assessment of Detection Systems
- Discussion of Municipal Signal Partnerships

**Agencies are requested to provide copies of the following materials, if available:**

- Organization charts – showing the parts of their organizations and numbers of personnel committed to signal operations activities.
- Any written materials (or other medium references) that the agency uses to share their general philosophies and/or signal system performance both in-house and with the public.
- Evidence of an established and published hot-line for reporting incorrectly operating systems.
- Regional concepts of operations developed in-house and/or with adjacent jurisdictions.
- Written agreements with adjacent jurisdictions (and/or major traffic generators within their own jurisdictions) to address the coordination, implementation, maintenance, and operations of signal systems and equipment.
- Formalized programs to analyze/evaluate/adjust signal operations on a routine basis.
- An established core curriculum of training for signal personnel covering multiple disciplines.
- Certification requirements.
- Policy for removal of no longer warranted signals.
- Performance measures documentation if any.
- Evidence of an operations budget within the agency’s overall program budget.
Appendix B: Review Team

Review Team Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Organization</th>
<th>Address</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Peter Briglia, P.E.</td>
<td></td>
<td>Puget Sound Regional Council</td>
<td>1011 Western Avenue, Suite 500</td>
<td>(206) 464-7599</td>
<td><a href="mailto:PBriglia@psrc.org">PBriglia@psrc.org</a></td>
</tr>
<tr>
<td>Paul R. Olson, P.E., PTOE</td>
<td>ITS Technology Engineer</td>
<td>Federal Highway Administration Resource Center</td>
<td>201 Mission Street, Suite 2100 San Francisco, California 94105</td>
<td>415-744-2659</td>
<td><a href="mailto:paulolson@fhwa.dot.gov">paulolson@fhwa.dot.gov</a></td>
</tr>
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Renton Meeting Attendance

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<tr>
<th>Name</th>
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</tr>
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<tbody>
<tr>
<td>Robert H. Cavanaugh, P.E.</td>
<td>Project Manager</td>
<td><a href="mailto:Bcavanaugh@ci.renton.wa.us">Bcavanaugh@ci.renton.wa.us</a></td>
</tr>
<tr>
<td>Dave Whitmarsh, Sr.</td>
<td>Transportation Maintenance Supervisor</td>
<td><a href="mailto:dwhitmarsh@ci.renton.wa.us">dwhitmarsh@ci.renton.wa.us</a></td>
</tr>
<tr>
<td>Karl Hamilton</td>
<td>Manager</td>
<td><a href="mailto:khamilton@ci.renton.wa.us">khamilton@ci.renton.wa.us</a></td>
</tr>
<tr>
<td>Bob Giberson, P.E.</td>
<td>Acting City Engineer</td>
<td><a href="mailto:bgiberson@ci.tukwila.wa.us">bgiberson@ci.tukwila.wa.us</a></td>
</tr>
<tr>
<td>Robin Tischmak, P.E.</td>
<td>Senior Transportation Engineer</td>
<td><a href="mailto:rtischmak@ci.tukwila.wa.us">rtischmak@ci.tukwila.wa.us</a></td>
</tr>
<tr>
<td>Stan Anderson</td>
<td>Superintendent</td>
<td><a href="mailto:sanderson@ci.tukwila.wa.us">sanderson@ci.tukwila.wa.us</a></td>
</tr>
<tr>
<td>Steve Mullen</td>
<td>Transportation Engineering Manager</td>
<td><a href="mailto:smullen@ci.kent.wa.us">smullen@ci.kent.wa.us</a></td>
</tr>
<tr>
<td>Laura K. Philpot</td>
<td>Traffic Engineer</td>
<td><a href="mailto:lphilpot@auburnwa.gov">lphilpot@auburnwa.gov</a></td>
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## Bellevue Meeting Attendance

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<tr>
<td>Mark Poch, P.E., PTOE</td>
<td>Traffic Engineering Manager</td>
<td>Transportation Department</td>
<td>City of Bellevue, 450 110th Avenue NE, P.O. Box 90012, Bellevue, Washington 98004</td>
<td>425-452-6137</td>
<td><a href="mailto:mpoch@ci.bellevue.wa.us">mpoch@ci.bellevue.wa.us</a></td>
</tr>
<tr>
<td>Mike L. Whiteaker, P.E., PTOE</td>
<td>Traffic Signal Operations Engineer</td>
<td>Transportation Department</td>
<td>City of Bellevue, 450 110th Avenue NE, P.O. Box 90012, Bellevue, Washington 98004</td>
<td>425-452-4230</td>
<td><a href="mailto:mwhiteaker@ci.bellevue.wa.us">mwhiteaker@ci.bellevue.wa.us</a></td>
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<tr>
<td>Fredrick Liang, P.E.</td>
<td>Traffic Signals Operations Engineer</td>
<td>Transportation Department</td>
<td>City of Bellevue, 450 110th Avenue NE, P.O. Box 90012, Bellevue, Washington 98004</td>
<td>425-452-5361</td>
<td><a href="mailto:fliang@ci.bellevue.wa.us">fliang@ci.bellevue.wa.us</a></td>
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<tr>
<td>Paul Cho, P.E.</td>
<td>Traffic Operations Engineer</td>
<td>Public Works Transportation</td>
<td>City of Redmond, MS: 2NPW, P.O. Box 97010, Redmond, Washington 98073-9710</td>
<td>425-556-2751</td>
<td><a href="mailto:pcho@redmond.gov">pcho@redmond.gov</a></td>
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<tr>
<td>Iris Cabrera, P.E.</td>
<td>Transportation Engineer</td>
<td>Public Works</td>
<td>City of Kirkland, 123 5th Avenue, Kirkland, Washington 98033-6189</td>
<td>425-587-3866</td>
<td><a href="mailto:icabrera@ci.kirkland.wa.us">icabrera@ci.kirkland.wa.us</a></td>
</tr>
<tr>
<td>Bill Prellwitz</td>
<td>Mr. Fixit</td>
<td>Public Works</td>
<td>City of Kirkland, 123 5th Avenue, Kirkland, Washington 98033-6189</td>
<td>425-846-0283</td>
<td><a href="mailto:bprellwitz@ci.kirkland.wa.us">bprellwitz@ci.kirkland.wa.us</a></td>
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<tr>
<td>Matthew T. Enders, P.E.</td>
<td>Traffic Services Branch Manager</td>
<td>Highways &amp; Local Programs Division</td>
<td>Washington State Department of Transportation, 310 Maple Park Avenue SE, P.O. Box 47390, Olympia, Washington 98504-7390</td>
<td>360-705-6822</td>
<td><a href="mailto:endersm@wsdot.wa.gov">endersm@wsdot.wa.gov</a></td>
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<tr>
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<td>Lester O. Rubstello, P.E.</td>
<td>Transportation Manager</td>
<td>City of Lynnwood</td>
<td>P.O. Box 5008, Lynnwood, WA 98046-5008</td>
<td>425-670-6262</td>
<td><a href="mailto:lrubstello@ci.lynnwood.wa.us">lrubstello@ci.lynnwood.wa.us</a></td>
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<tr>
<td>Dick Adams, P.E.</td>
<td>Transportation Engineer</td>
<td>City of Lynnwood</td>
<td>19100 44th Avenue West, P.O. Box 5008, Lynnwood, WA 98046-5008</td>
<td>425-670-6663</td>
<td><a href="mailto:dadams@ci.lynnwood.wa.us">dadams@ci.lynnwood.wa.us</a></td>
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<tr>
<td>Seyed Safavian</td>
<td>Transportation Manager</td>
<td>City of Bothell</td>
<td>9654 NE 182nd Street, Bothell, WA 98011</td>
<td>425-486-2768</td>
<td><a href="mailto:seyed.safavian@ci.bothell.wa.us">seyed.safavian@ci.bothell.wa.us</a></td>
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<tr>
<td>John Tatum, P.E., PTOE</td>
<td>Transportation Engineer</td>
<td>Snohomish County</td>
<td>2930 Wetmore Avenue, Everett, WA 98201</td>
<td>425-388-3488 ext. 4522</td>
<td><a href="mailto:john.tatum@co.snohomish.wa.us">john.tatum@co.snohomish.wa.us</a></td>
</tr>
<tr>
<td>Harold Wirch</td>
<td>Traffic Signal Operations Engineer</td>
<td>Snohomish County</td>
<td>3000 Rockefeller, M/S 607, Everett, WA 98201</td>
<td>425-388-6421</td>
<td><a href="mailto:harold.wirch@co.snohomish.wa.us">harold.wirch@co.snohomish.wa.us</a></td>
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<tr>
<td>Name</td>
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<tr>
<td>Brian Kemper</td>
<td>Seattle Department of Transportation</td>
<td>PO Box 34996, Seattle, WA 98124-4996</td>
<td>206-684-5096</td>
<td><a href="mailto:brian.kemper@seattle.gov">brian.kemper@seattle.gov</a></td>
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<tr>
<td>Aileen McManus</td>
<td>King County Department of Transportation</td>
<td>King Street Center: KSC-TR-0222, 201 South Jackson Street, Seattle, WA 98104</td>
<td></td>
<td><a href="mailto:aileen.mcmanus@metrokc.gov">aileen.mcmanus@metrokc.gov</a></td>
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<tr>
<td>Fred Housman</td>
<td>King County Department of Transportation</td>
<td>King Street Center: KSC-TR-0222, 201 South Jackson Street, Seattle, WA 98104</td>
<td></td>
<td><a href="mailto:fred.housman@metrokc.gov">fred.housman@metrokc.gov</a></td>
<td></td>
</tr>
<tr>
<td>Stephanie Rossi</td>
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<td><a href="mailto:srossi@psrc.org">srossi@psrc.org</a></td>
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### WSDOT Meeting Attendance

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<tr>
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<tr>
<td>Mark P. Leth, P.E.</td>
<td>Regional Traffic Engineer</td>
<td>Northwest</td>
<td>15700 Dayton Avenue North, NB82-120</td>
<td><a href="mailto:lethm@wsdot.wa.gov">lethm@wsdot.wa.gov</a></td>
</tr>
<tr>
<td>Dongho Chang, P.E.</td>
<td>Snohomish Area Traffic Engineer</td>
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</tr>
<tr>
<td>Morgan Balogh, P.E.</td>
<td>Traffic Engineer – Region Wide Operations</td>
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</tr>
<tr>
<td>Saeed Nowkhasteh</td>
<td>Signal Ops/ITS Engineer</td>
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</tr>
<tr>
<td>Jon Cornelius</td>
<td>Assistant Superintendent</td>
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</tr>
<tr>
<td>Stephanie Rossi</td>
<td>Puget Sound Regional Council</td>
<td></td>
<td>1011 Western Avenue, Suite 500</td>
<td><a href="mailto:srossi@psrc.org">srossi@psrc.org</a></td>
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**Puget Sound Regional Traffic Operations Program Assessment**

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Appendix C Puget Sound Regional Self Assessment Scoring Summary

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<tr>
<th>Section</th>
<th>Agency 1</th>
<th>Agency 2</th>
<th>Agency 3</th>
<th>Agency 4</th>
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<td><strong>Section 3: Signal Operation at Individual Intersections</strong></td>
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<td>Procedures to monitor ramp meter operations to prevent backups?</td>
<td>34</td>
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<td>Procedure to measure impact of signal control priority by buses, emergency?</td>
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### Section 5: Detection Systems

<table>
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<tr>
<th>Procedures for collecting/using information re: turning movements?</th>
<th>37</th>
<th>WSDOT</th>
<th>3</th>
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<td>Procedures for collecting/using information re: traffic flows, volumes, for performance?</td>
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<td>WSDOT</td>
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<td>2.7</td>
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<tr>
<td>Policy or program for gauging the quality of data gathered?</td>
<td>39</td>
<td>WSDOT</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>3</td>
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<td><strong>11</strong></td>
<td><strong>8.1</strong></td>
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<td><strong>7.9</strong></td>
<td><strong>8.1</strong></td>
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### Section 6: Maintenance

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<tr>
<th>Commit resources to align with industry guidelines for signal I/S maintenance?</th>
<th>41</th>
<th>WSDOT</th>
<th>3</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>4</th>
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<th>3.4</th>
<th>3.0</th>
<th>3.1</th>
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<tbody>
<tr>
<td>Commit resources/coordinate maintenance activities to sustain ops per needs?</td>
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<td>WSDOT</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>Regular training programs for traffic signal maintenance personnel?</td>
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<td>WSDOT</td>
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<td>3</td>
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<td>4</td>
<td>5</td>
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<td>3.5</td>
<td>3.7</td>
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<td>Do personnel regularly assess the condition of traffic control equipment?</td>
<td>44</td>
<td>WSDOT</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>4</td>
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<td>3.8</td>
<td>3.7</td>
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<td>Do you maintain configuration inventories of all signal equipment?</td>
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<td>WSDOT</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>4</td>
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<td>3.5</td>
<td>3.5</td>
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<tr>
<td>Monitor operating condition of signal system equipment in real-time?</td>
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<td>WSDOT</td>
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<td>1</td>
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<td>3</td>
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<td>2.8</td>
<td>2.6</td>
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<td>Policies/processes to remedy malfunctions (time frames)?</td>
<td>47</td>
<td>WSDOT</td>
<td>4</td>
<td>4</td>
<td>4</td>
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<td>Maintain management system to evaluate equipment reliability/schedule maintenance activities?</td>
<td>48</td>
<td>WSDOT</td>
<td>3</td>
<td>1</td>
<td>3</td>
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<td>2.7</td>
<td>2.8</td>
<td>2.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Battery backup/generators?</td>
<td>49</td>
<td>WSDOT</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
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<td><strong>36</strong></td>
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**Score:** (Possible 205 - adjustable) 131 91.5 127 104 162 143 106.1 109.0 105.3 105.5

**Potential Score - adjusted** 185 180 180 180 185 180 175 175 175 175

**Weighted Score:** National Average = 62

| 62 | 69.2 | 48.5 | 70.1 | 58.5 | 88.8 | 78.8 | 61% | 62% | 60% | 60% |
Appendix D: Example Interagency Agreement
SIGNAL MAINTENANCE AND OPERATION
AGREEMENT BETWEEN
WSDOT AND KING COUNTY
GM-_______

This AGREEMENT is made and entered into this _____ day of ________, 2004, by and between the State of Washington Department of Transportation (STATE) and King County, acting through its Department of Transportation (COUNTY), each of which entity may be referred to hereinafter as "PARTY" or collectively as "PARTIES".

Whereas, the STATE is the owner of certain traffic signal systems (STATE SIGNALS) within the I-405 right of way corridor perpendicular to NE 124th St. in the City of Kirkland, as shown on Exhibit A.; and

Whereas, the COUNTY wishes to improve traffic flow in the area of I-405 and NE 124th St. by coordinating the operation of the STATE SIGNALS with the local COUNTY and City of Kirkland traffic signal systems; and

Whereas, the COUNTY has a Capital Improvement Program (CIP # 101496) for the design and construction of an Intelligent Transportation System on Northeast 124th Street (NE 124TH PROJECT); and

Whereas, as part of the NE 124TH PROJECT, the COUNTY proposes to install closed circuit television cameras (CCTV), a fiber optic communications cabinet, and fiber optic communication cable (ITS equipment) and replace signal controllers and cabinets in the
STATE SIGNALS within the I-405 right-of-way corridor perpendicular to NE 124th St. in the City of Kirkland, as shown on Exhibit A and transit priority request (TPR) equipment to support the operation of transit signal priority, said TPR equipment as itemized in Exhibit B; and

Whereas, the COUNTY shall transfer ownership of all equipment that the County installs on STATE SIGNALS and the ITS and TPR equipment within the STATE right-of-way after completion of the NE 124th PROJECT; and

Whereas, the STATE and COUNTY find that it would be mutually beneficial for the STATE to maintain its STATE SIGNALS, ITS and TPR equipment within the STATE’s I-405 right-of-way corridor and the COUNTY to operate the system in coordination with related COUNTY and city equipment,

NOW, THEREFORE, by virtue of RCW 47.28.140 and in consideration of the terms, conditions, covenants, and performance contained herein, IT IS MUTUALLY AGREED AS FOLLOWS:

1. APPLICABILITY

This AGREEMENT applies to the STATE SIGNALS and the ITS, TPR and new signal equipment that the County installs as part of its NE 124th PROJECT within the STATE’s I-405 right-of-way corridor.
2. COUNTY RIGHTS AND RESPONSIBILITIES

2.1 COUNTY will pay for the initial purchase, installation, integration, testing and acceptance of the ITS, TPR and new signal equipment related to this agreement as part of the construction of the NE 124th PROJECT. Following final inspection and acceptance of the NE 124th PROJECT by the COUNTY, ownership of the ITS, TPR and County-installed signal equipment shall automatically transfer to the STATE, per Exhibit A and Exhibit B.

2.2 COUNTY shall own and maintain, at its sole cost, the modem connection to the TPR management server, the TPR management server, TPR application software, and the STATE access to the COUNTY’s wide area network where the TPR application is housed.

2.3 COUNTY shall operate the STATE SIGNALS, ITS and TPR equipment to optimize safety and efficiency of traffic flows on I-405 and local streets in such a way that the NE 124th Street arterial is treated as a corridor and consistent with the needs of the I-405 entrance and exit ramps. COUNTY shall be responsible for all costs associated with the operation of the STATE SIGNALS, ITS and TPR, including CCTV operation, signal timing generation and implementation, inclusive of transit signal priority (TSP) settings, citizen requests for timing information, and annual signal timing review.
2.4 COUNTY shall prepare a Signal Plan for the operation and coordination of the STATE SIGNALS and shall provide the Signal Plan inclusive of TSP settings to the STATE for its review, modification, and acceptance. COUNTY shall not implement the Signal Plan without first obtaining written authority from the STATE to proceed.

2.5 COUNTY, in the event of an emergency, such as caused by acts of nature, vandalism or traffic accidents, shall have the ability to modify the operation of the Signal Plan to reduce resultant traffic hazards.

2.6 COUNTY shall modify its operation of its Signal Plan and the STATE SIGNALS upon request to do so by the STATE.

3. STATE RIGHTS AND RESPONSIBILITIES

3.1 STATE shall perform all routine and ordinary maintenance and repair on its STATE SIGNALS, as well as the ITS and TPR equipment installed by the COUNTY pursuant to this AGREEMENT. STATE shall be responsible for all costs associated with such maintenance and repair.

3.2 Following COUNTY acceptance of the NE 124th PROJECT, STATE shall own and maintain, at its sole cost, the County-installed ITS, TPR and signal equipment within the State's I-405 right-of-way corridor, including the reader, antenna, transit priority
request generator, interface panel, associated interconnect, pole attachment agreements, and utility costs.

3.3 STATE shall be entitled to receive read-only access to the COUNTY’s Advanced Transportation Management System (ATMS), so that the STATE may remotely monitor the traffic signal timing and traffic flow information for STATE SIGNALS on the ATMS system, as well as the traffic signals owned by the COUNTY and the City of Kirkland that are on the ATMS system.

3.4 STATE shall be provided with the COUNTY’s operational Signal Plan and will review the plan, suggest modifications if necessary, and approve the plan in writing before its implementation.

3.4.1 STATE shall monitor the Signal Plan to determine whether there are any adverse impacts to the traffic functions of I-405. Should the STATE determine that modifications to the COUNTY’s Signal Plan are necessary for the operation of STATE SIGNALS and I-405, STATE shall modify the Signal Plan and provide such modifications to the COUNTY for the COUNTY’s implementation.

3.5 STATE shall replace, at its sole cost, the components of the STATE SIGNALS, ITS and TPR equipment, as required, due to failure, deterioration, and deficiency, according to the STATE’s programming system and available funding for such work. COUNTY shall provide the STATE with appropriate documentation, showing any signal
deficiencies on a biennial basis (by approximately May on odd years), so that the STATE has sufficient time to consider the funding of replacement or upgrade of STATE SIGNALS components and ITS and TPR equipment during the STATE's biennial programming process.

3.6 STATE, in the event of an emergency, such as caused by acts of nature, vandalism or traffic accidents, shall repair the STATE SIGNALS, ITS and TPR equipment or modify the operation of the Signal Plan to reduce resultant traffic hazards.

4. ADVISORY INPUT

4.1 STATE and COUNTY shall cooperate with each other in good faith and take into consideration the comments of the City of Kirkland and other public agencies as to the operation of the STATE SIGNALS, ITS and TPR.

4.2 STATE and COUNTY shall cooperate with each other in good faith to monitor and evaluate the operation of the Signal Plan. The PARTIES will meet at least quarterly to review coordination issues, system changes, and maintenance and operation issues, regarding the STATE SIGNALS, ITS, and TPR equipment.

4.3 STATE and COUNTY shall support the implementation of priority treatment for transit where it is determined to be effective, so long as such transit priority treatment does not adversely affect the traffic movements and functioning of I-405.
4.4 STATE and COUNTY will jointly agree upon hardware requirements for the TPR
equipment that is required to implement TSP and on the operational parameters for the
implementation of transit priority treatments.

4.5 Within ninety (90) days following the execution of this AGREEMENT, the Metro
Transit Division of the COUNTY and STATE shall jointly develop TSP maintenance
guidelines outlining the expectations and work processes for the operation and
maintenance of TPR equipment.

5. DATA AND INFORMATION EXCHANGE

5.1 STATE and COUNTY shall make available to each other such information and
data, if available, that may be useful in coordinating the operation and maintenance of the
NE 124th Street and I-405 area. The information and/or data includes, but is not limited
to, traffic counts, signal status, detector occupancy, timing plans, and video signals. The
PARTIES recognize that certain information and/or data may be time sensitive and
should be provided as quickly as practicable to the other PARTY.

5.2 STATE and COUNTY will agree upon how to configure the data exchange
network server to control what information is available to each PARTY. STATE and
COUNTY agree that all data should be made available to each PARTY, unless there is a
legal, operational, or proprietary reason for withholding the data or information.
6. **ACCESS – RIGHT OF ENTRY**

6.1 STATE authorizes the COUNTY access to and a right-of-entry upon the STATE's I-405 limited access right-of-way for the purpose of carrying out the terms of this AGREEMENT.

6.2 COUNTY shall perform all work within STATE limited access right-of-way in conformance with the STATE's Work Zone Traffic Control Guidelines, as amended. COUNTY shall further provide the STATE with 48 hour notice that the COUNTY will be performing such work.

7. **TERM OF AGREEMENT AND TERMINATION**

7.1 The term of this AGREEMENT shall begin on the date this AGREEMENT is executed and end on December 31 of that year. Subject to Sections 7.3 and 7.4 below, this AGREEMENT shall automatically be renewed on a yearly basis, beginning January 1 of the following year, unless either PARTY has terminated this AGREEMENT under the terms hereof.

7.2 Either the STATE or COUNTY may terminate this AGREEMENT for any reason by providing sixty (60) days written notice to the other PARTY. Termination of this
AGREEMENT shall constitute termination of all signal assignment documents as well.

Upon termination the following shall apply:

a. COUNTY shall provide the STATE with sufficient documentation and training on the control equipment deemed necessary by the STATE for the continued operation of the Signal Plan should the STATE decide to operate the Signal Plan.

b. COUNTY shall release operating access to the state-owned CCTV cameras to the STATE. The COUNTY may maintain read only access to the state-owned cameras.

c. The STATE and the Metro Transit Division of the COUNTY will need to enter into a separate agreement if the STATE elects to continue the TSP function. Otherwise, the STATE shall relinquish its ownership of all TPR equipment as described in Exhibit B. The STATE shall collect this equipment from the field and deliver it to a location designated by the Metro Transit Division of the COUNTY.

d. The STATE and the Road Services Division of the COUNTY will enter into a separate agreement for operation and maintenance of the communication HUB located at 116th Ave NE and NE 124th Street to
maintain communication access between King County Traffic Control Center and STATE Traffic Operation Center.

7.3 Funding for this AGREEMENT beyond the COUNTY's current appropriation year is conditional upon appropriation by the King County Council of sufficient funds to support the COUNTY's obligations described in this AGREEMENT. Should such appropriation not be approved, the AGREEMENT will terminate at the close of the current appropriation year. The appropriation year ends on December 31 of each year. In the event of such termination, the provisions of Sections 7.2a through 7.2d shall apply.

7.4 Either the STATE or COUNTY may partially terminate this AGREEMENT by terminating the TSP element of this AGREEMENT by providing sixty (60) days written notice to the other PARTY. Should the STATE exercise its right of partial termination, it shall be responsible for the cost of collecting from the field all of the TPR equipment from the field and delivering it to the COUNTY at the location requested by the Metro Transit Division of the COUNTY.

8. **LEGAL RELATIONS**

8.1 No liability shall attach to the STATE or the COUNTY by reason of entering into this AGREEMENT, except as expressly provided herein.
8.2  a. Each PARTY shall protect, defend, indemnify and hold harmless the other PARTY, its officers, officials, employees, and agents while acting within the scope of their employment as such, from any and all costs, claims, judgments and/or awards of damages (both to persons and property), arising out of, or in any way resulting from, each PARTY’s negligent acts or omissions performed in accordance with or under the authority as provided in this AGREEMENT. No PARTY shall be required to indemnify, defend, or hold harmless the other PARTY if the claim, suit or action for injuries, death or damages is caused by the sole negligence of the other PARTY, and the indemnity provisions provided herein shall be valid and enforceable only to the extent of the PARTY’s own negligence.

b. Each PARTY agrees that its obligations under this section extend to any claim, demand and/or cause of action brought by or on behalf of, any of its employees or agents. For this purpose, each PARTY, by mutual negotiation, hereby waives, with respect to the other PARTY only, any immunity that would otherwise be available against such claims under the Industrial Insurance provisions of Title 51 RCW.

8.3 In the event either PARTY incurs attorney’s fees, cost or other legal expenses to enforce provisions of this section against the other PARTY, all such fees, costs, and expenses shall be recoverable by the prevailing PARTY.

8.4 This AGREEMENT shall be interpreted in accordance with the laws of the State of Washington in effect on the date of execution of this AGREEMENT. The Superior
Court of King County, Washington shall have exclusive jurisdiction and venue over any legal action arising under this AGREEMENT.

8.5 The provisions of this section shall survive any expiration or termination of this AGREEMENT with respect to any claim that arises during the term of this AGREEMENT.

9. **NOTICE**

9.1 When notice or information or data is provided to be provided to either PARTY as required by this AGREEMENT, notice shall be sent to:

State of Washington  
Department of Transportation  
Northwest Region  
P.O. Box 330310  
Seattle, WA 98133-9710

King County Department of Transportation  
Road Services Division  
King Street Center  
201 South Jackson  
Seattle, WA 98104

10. **EXHIBITS**

The following exhibits are attached hereto and incorporated herein by reference:

A. STATE SIGNALS, ITS and TPR Equipment Locations  
B. TPR Equipment  
C. Glossary of TPR Related Terms
11. MODIFICATION AND AMENDMENTS

11.1 The provisions of this AGREEMENT may be amended only by an instrument in writing, duly executed by authorized personnel of both PARTIES, except as provided in Section 11.2 below.

11.2 Exhibits A and B may be modified by adding or deleting traffic signal, ITS or TPR equipment upon written modification, signed by the STATE’s Regional Traffic Engineer and by the Director of the COUNTY’s Department of Transportation. Such modification shall be appended to this AGREEMENT.

IN WITNESS WHEREOF, the PARTIES hereto have executed this AGREEMENT as of the day and year first written above.

STATE OF WASHINGTON
DEPARTMENT OF TRANSPORTATION

By:  
Assistant Regional Administrator
For Maintenance and Traffic

Date: 2/1/05

Approved As To Form:
Assistant Attorney General

KING COUNTY

By:  
Director, Department of Transportation

Date: 11/2/04

Approved As To Form:
Deputy Prosecuting Attorney
EXHIBIT “A”
STATE Traffic Signal Systems and ITS and TPR Equipment Locations

NE 124<sup>th</sup> Street/I-405 Northbound Off-ramp: Traffic Signal system and TPR equipment

NE 124<sup>th</sup> Street/I-405 Southbound Off-Ramp: Traffic Signal system and TPR equipment

NE 124<sup>th</sup> Street/116<sup>th</sup> Ave NE: Traffic Signal system, CCTV camera system, and Fiber Optic Communications Cabinet.

NE 124<sup>th</sup> Street: Within Limited Access: Fiber Optic Communication System.
Exhibit B

Transit Priority Request Equipment

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<tr>
<th>Equipment</th>
<th>Quantity</th>
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<td>Reader Assembly</td>
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<tr>
<td>Yagi Antenna</td>
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</tr>
<tr>
<td>Interface Panel</td>
<td>2</td>
</tr>
<tr>
<td>Vilink VK230 fiberoptic modem</td>
<td>2</td>
</tr>
<tr>
<td>Transit Priority Request Generator</td>
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</table>

<table>
<thead>
<tr>
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<th>Direction</th>
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<td>116th Ave NE @ NE 124th St.</td>
<td>Southbound on 116th Ave NE</td>
</tr>
<tr>
<td>05003</td>
<td>NE 124th St @ 116th Ave NE</td>
<td>Westbound on NE 124th</td>
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<tr>
<td>05004</td>
<td>NE 124th St @ 116th Ave NE</td>
<td>Eastbound on NE 124th</td>
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<tr>
<td>05022</td>
<td>I-405 off-ramp @ NE 124th St</td>
<td>Northbound on northbound I-405</td>
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<table>
<thead>
<tr>
<th>TPRG Node Number</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>05000</td>
<td>NE 124th St @ 116th Ave NE</td>
</tr>
<tr>
<td>05020</td>
<td>I-405 NB Ramp @ NE 124th St</td>
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</table>
EXHIBIT C
Glossary of TPR Related Terms

Section 1. Definitions

1. “Transit Priority Request System” (TPR System) shall mean the technology that has been selected by the County, in consultation with local traffic engineers throughout King County, to identify transit buses as they approach a signalized intersection for the purpose of requesting priority treatment from the signal controller. The system is comprised of (i) on-board components including Radio Frequency (RF) transponder (King County Metro Transit supplied), (ii) the TPR Detection System, (iii) the TPR Generator, (iv) TPR interconnect, (v) Interface Panel and the TPR Management Server and (vi) TPR remote work stations.

2. “Traffic Signal Control System” (TSC) shall mean the system of traffic control maintained and owned by the STATE for the purpose of managing and controlling vehicular traffic, including, but not limited to, intersection street equipment (traffic signal heads, poles, detectors, conduit, interconnect, traffic controllers and cabinets), and supporting Traffic Management Center (TMC) software and/or hardware.

3. “Transit Signal Priority” (TSP) shall mean the ability of a traffic signal control system, generally within the traffic controller functional capability, to grant special
priority treatment to buses by adjusting traffic controller settings so as to reduce signal
delay for transit buses. Synonymous with TSP functionality.

4. "Transit Signal Priority System" (TSP System) shall mean the functional
integration of Transit Priority Request system with the Traffic Signal Control System
whereby TSP is provided.

5. "Transit Priority Request Management System" shall mean the TPR Management
Server, modern bank, phone lines and other central system hardware and applications
located at the King Street Center County Offices that are used to manage and
communicate with the TPR Generators in the field, inclusive of the phone drop located at
the master TPR Generator. Also includes any TPR Remote Workstations that provide
user input and system management and operational functions.

6. "Transit Priority Request Generator" (TPR Generator) shall mean the portion of
the TPR System co-located in the traffic signal cabinet that provides the conditional
priority request via a low voltage (24v) contact closure (on/off/pulse) setting.

7. "Interface panel" means the electrical terminal strip located in the traffic
controller cabinet that provides a point of demarcation between the TSC System and the
TPR System.
8. "Transit Priority Request Equipment" all equipment that is physically used in the field to support TSP, inclusive of TPR generators, TPR Reader Cabinet, TPR antenna, TPR Interconnect, TPR detection and interface panels.
Smoky Hill Road Project

Traffic signal timing and coordination improvements are key to increasing the efficiency of the Denver metro area's arterial roadways. Coordinated signals allow traffic to move smoothly from one signal to the next, reducing how often and how long drivers must stop at signals. Since 1989, the Denver Regional Council of Governments (DRCOG) has spearheaded the region's efforts to improve traffic signal timing and coordination.

**Project Partners:** Arapahoe County (City of Centennial) and the City of Aurora

**Corridor:** Smoky Hill Road, Quincy Avenue to Arapahoe Road

**Situation:** Smoky Hill Road is a principal arterial traveling through the southern end of Aurora and Arapahoe County (City of Centennial). Smoky Hill Road interchanges with E-470 in the eastern portion of the project area and serves as a link with Parker Road and I-225 west of the project area. Land use along the roadway is a mixture of residential and commercial property.
Puget Sound Regional
Traffic Operations Program Assessment

DRCOG Signal Timing Briefs
Smoky Hill Road Project

Project Specifics: Retimed 23 signals.

Traffic Volume: Each day, Smoky Hill Road carries 20,000 vehicles northwest of Buckley Road and 17,000 vehicles at E-470.

Timing Revision:

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Before</th>
<th>After</th>
<th>Before</th>
<th>After</th>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning Peak</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Before</td>
<td>8 – 9 a.m.</td>
<td>3 – 7 p.m.</td>
<td>All Other Times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cycle Length (Seconds)</td>
<td>110/100/90</td>
<td>110/90</td>
<td>110/100/90</td>
<td>110/90</td>
<td>110/90</td>
<td>110/90</td>
</tr>
<tr>
<td>Other Timing Parameters</td>
<td>--</td>
<td>Revised</td>
<td>--</td>
<td>Revised</td>
<td>--</td>
<td>Revised</td>
</tr>
</tbody>
</table>

Travel Time and Speed Improvements: The signal at SH-42 and Baseline Road was included in the analysis. Analysis indicated there would be no benefit to coordinating it with the signals to the south, due to the distance between Baseline Road and South Boulder Road, so it was left uncoordinated.

![Graph showing travel times and speeds](image)

Legend
- Travel conditions before
- After
- Travel time
- Speed

<table>
<thead>
<tr>
<th>NORTHWESTBOUND</th>
<th>SOUTHEASTBOUND</th>
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</thead>
<tbody>
<tr>
<td>738</td>
<td>731</td>
</tr>
<tr>
<td>731</td>
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<td>732</td>
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<td>731</td>
<td>732</td>
</tr>
</tbody>
</table>

Overall Improvements:
The value to motorists, in terms of time and fuel savings, is calculated to be approximately $7,900 daily or nearly $2.0 million annually.

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>Daily Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle hours of travel</td>
<td>373 hours reduction</td>
</tr>
<tr>
<td>Fuel consumption</td>
<td>303 gallons decrease</td>
</tr>
<tr>
<td>Time and fuel costs</td>
<td>57,000 savings</td>
</tr>
<tr>
<td>Total pollutant emissions</td>
<td>610 Pounds reduction</td>
</tr>
</tbody>
</table>
Federal-aid Eligibility Policy Guide

The operating costs for traffic monitoring, management, and control systems, such as integrated traffic control systems, incident management programs, and traffic control centers, are eligible for Federal reimbursement from National Highway System and Surface Transportation Program funding. For projects located in air quality non-attainment and maintenance areas, and in accordance with the eligibility requirements of 23 USC 149(b), Congestion Mitigation and Air Quality Improvement Program funds may be used for operating costs for a 3-year period, so long as those systems measurably demonstrate reductions in traffic delays. Operating costs include labor costs, administrative costs, costs of utilities and rent, and other costs, including system maintenance costs, associated with the continuous operation of the system.

Introduction

The movement of people, goods, and vehicles on the nation’s surface transportation system is now critically dependent on how effectively that system is managed and operated. Adding to the roadway system is necessary in some key locations and corridors to serve the demands for this movement, and in some cases, provide for economic development in the area. However, the construction of new lanes will never alleviate the need for effective management and operations of the system – on existing as well as new segments. Well planned, cost-effective transportation operations and management actions can improve mobility, safety, and productivity of the system for transportation users in urban and rural areas.

Background – Legislative

The Transportation Equity Act for the 21st Century (TEA-21), signed into law on June 9, 1998, reinforces the Federal commitment to manage and operate the nation’s transportation system. Under TEA-21, the Federal-aid Highway Program continues
eligibility of operating costs for traffic monitoring, management, and control. The legislation defines operating costs as including labor costs, administrative costs, costs of utilities and rent, and other costs associated with the continuous management and operation of traffic systems, such as integrated traffic control systems, incident management programs, and traffic control centers. An “operational improvement” continues to mean a capital improvement for installation of traffic surveillance and control equipment; computerized signal systems; motorist information systems; integrated traffic control systems; incident management programs; transportation demand management facilities; strategies, and programs; and such other capital improvements to public roads as the Secretary may designate, by regulation. By definition, an operational improvement still does not include restoration or rehabilitating improvements; construction of additional lanes, interchanges, and grade separations; and construction of a new facility on a new location.

For both National Highway System (NHS) and Surface Transportation Program (STP), TEA-21 continues the eligibility of capital and operating costs for traffic monitoring, management, and control facilities and programs. Also, TEA-21 clarifies the eligibility of NHS and STP funds for Intelligent Transportation Systems (ITS) capital improvements to specifically allow funds to be spent for infrastructure-based ITS capital improvements.

For the Congestion Mitigation and Air Quality Improvement Program, TEA-21 continues to include the establishment or operation of a traffic monitoring, management, and control facility or program as potentially eligible projects. TEA-21 also explicitly adds, as an eligible condition for funding, programs or projects that improve traffic flow, including projects to improve signalization, construct high occupancy vehicle lanes, improve intersections, and implement ITS strategies.

**Interpretation / Rationale**

Examples of typical eligible operating cost and expenses for traffic monitoring, management, and control include those costs mentioned in the legislative definition for operating costs. In order to assure continuous operation, costs associated with maintaining these systems are necessary operating expenses so that traffic monitoring, management, and control facilities or programs provide their intended functions. Examples of these maintenance costs include system maintenance activities to assure peak performance (preventive computer maintenance) and replacement of defective or damaged computer components and other traffic management system hardware.

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22. 23 USC 101(a)(17)
23. 23 USC 101(a)(18)
24. 23 USC 103(b)(6)(H) and 23 USC 133(b)(6)
25. 23 USC 103(b)(6)(O) and 23 USC 133(b)(13)
26. 23 USC 149(b)(4)
27. 23 USC 149(b)(5)
Puget Sound Regional
Traffic Operations Program Assessment

(including street-side hardware). Specific eligibility determinations related to traffic control operational costs and maintenance expenses are the discretion of the FHWA Division Office in a particular state.

This interpretation is consistent with the FHWA Strategic Plan, specifically related to the Mobility Goal and the Strategic Objective to “Improve the operation of the highway systems and intermodal linkages to increase transportation access for all people and commodities.” In light of TEA-21, which reaffirms and increases the Federal commitment to manage and operate the nation’s surface transportation system, this interpretation is also consistent with the intent of Congress.

It is appropriate for FHWA to adopt policies that encourage efficient management and operation of surface transportation. With a greater shift toward applying technology to addressing transportation needs, a broader life-cycle view of transportation operations is warranted that includes all activities related to sustaining system performance.

Examples

Some of the types of Federal-aid projects that may be funded include the installation and integration of the Intelligent Transportation Systems Infrastructure such as:

- Planning for regional Management and Operations programs
- Traffic Signal Control Systems
- Freeway Management Systems
- Incident Management Systems
- Multimodal Traveler Information Systems
- Transit Management Systems
- Electronic Toll Collection Systems
- Electronic Fare Payment Systems
- Railroad Grade Crossing Systems
- Emergency Services
- Implementation of the National ITS Architecture for metropolitan and rural areas
- Development of regional ITS Architecture

Some examples of typical Federal-aid capital improvement projects that may include eligible operating costs include:

- System Integration
- Telecommunications
- Reconstruction of Buildings or Structures that house system components
- Control / Management Center (Construction) and System Hardware and Software for the projects
- Infrastructure-based Intelligent Transportation System capital improvements to link systems to improve transportation and public safety services
• Dynamic / Variable message signs
• Traffic Signals

Some examples of typical eligible operating cost and expenses for traffic monitoring, management, and control include:

• Labor Costs
• Administrative costs
• Costs of Utilities and Rent
• Other costs associated with the continuous operation of the above-mentioned facilities and systems
• System Maintenance (activities to assure peak performance)
• Replacement of defective or damaged computer components and other traffic management system hardware (including street-side hardware).
• Computer hardware and software upgrades to remedy Year 2000 (Y2K) problems.

Questions and Answers

Q. What would not be considered eligible as an operating cost?
A. The discretion and flexibility afforded FHWA Division Offices in determining the eligibility of specific activities under this guidance, the allowances for preventive maintenance in Title 2328, and other Federal-aid policies can allow for virtually any activity to be eligible. However, routine maintenance items that are not critical to the successful operation of the system, such as the painting of traffic signal controller cabinets or the maintenance of the exterior of transportation management center buildings, would normally fall outside of eligible operating costs.

Q. What are some typical activities associated with transportation management center computers whose costs could be eligible under Federal-aid?
A. Besides the costs associated with designing and procuring the computer system, other eligible activities could include regular checking of the computer components to make sure they are fully functional. Any corrective measures or upgrades (software or hardware) that are necessary would be eligible activities.

Q: Can “spare parts” be eligible for federal-aid?
A: System-critical parts (i.e., ones that are essential for the successful operation of the system) that are susceptible to failure, regardless of reason – acts of God, crashes, electronic “infant mortality” – have been determined by some FHWA Division Offices as eligible for federal-aid reimbursement.

28. 23 USC 116(d)
Q: What documentation do states or local governments need to submit (or present upon request) for approval or authorization of operating costs?
A: The amount and specific nature of documentation are left to the judgment of the FHWA Division Office, but the documentation should be sufficient to determine that the proposed expenditures would be eligible for Federal-aid reimbursement.

Q: Besides TEA-21 and Title 23, what overall rules govern the eligible operating costs and procurement method?

Q. Where can I find out more about the Congestion Mitigation and Air Quality Improvement (CMAQ) Program?
A. The latest guidance on the CMAQ Program was issued April 28, 1999, and is available from FHWA Division and FTA Regional offices. The guidance, along with other CMAQ Program information, is available on the internet at http://www.fhwa.dot.gov/environment/cmaqpgs/index.htm
Appendix G: ITE Journal Report

The National Traffic Signal Report Card: Highlights

ON APRIL 20, 2005, THE NATIONAL Transportation Operations Coalition (NTOC) released the first-ever National Traffic Signal Report Card. The report card is the result of a partnership between several NTOC associations led by ITE, the American Association of State Highway and Transportation Officials, the American Public Works Association, ITS America and the Federal Highway Administration.

The results of the report card are documented in the Executive Summary and Technical Report, which both are available on the ITE Web site or through the ITE Bookstore. This feature summarizes the results contained in the Technical Report and from the media effort.

PURPOSE AND BACKGROUND

The purpose of the National Traffic Signal Report Card is to:

• Assess the current state of traffic signal operations in the United States;

• Bring attention to the current state of signal operations;

• Create awareness of the congestion-reducing benefits of good traffic signal operations and;

• Make a case for additional investment in traffic signal operations.

To determine the current state of traffic signal operations in the United States, a self-assessment tool was created. The self-assessment tool was developed by a team of professionals representing NTOC and served as a basis for collecting information and assessing traffic signal systems across the country. This tool was made available to state and local agencies and served an additional purpose of giving agencies a way to benchmark their own performance.

A total of 378 respondents fully completed the self-assessment. The number of signals represented by the responding agencies correspond to about one-third of all signals in the United States. Table 1 shows the number of responses by agency type and signal system size, respectively.

OVERALL NATIONAL RESULT: D-

The report card includes six sections on topics considered critical to ensuring good traffic signal operations:

1. Proactive management;

2. Coordinated systems;

3. Individual intersections;

4. Specialized operations;

5. Detection; and


Although information regarding specialized operations was included in the self-assessment, scores for that section are not included in the figures or in the overall total due to the small number of

<table>
<thead>
<tr>
<th>Table 1. Number of responses by type of agency and signal system size.</th>
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<tr>
<td><strong>Type of agency</strong></td>
</tr>
<tr>
<td>State</td>
</tr>
<tr>
<td>County</td>
</tr>
<tr>
<td>City/municipality</td>
</tr>
<tr>
<td>Township</td>
</tr>
<tr>
<td>More than 1,000 signals</td>
</tr>
</tbody>
</table>

* Note: Represents multiple responses from some states with various districts or regions that operate their own traffic signal systems.
responses and the uniqueness of this category. The national results are shown in Figure 1.

Figure 2 represents the results by signal system size—the number of traffic signals managed by a responding agency. Figure 3 represents the results by agency type—state, county, city and township.

**Noteworthy Findings**

The overall national score was 62.

- Overall, the scores are low. This should not be a surprise to most traffic engineering professionals. Traffic engineers have known for years that resource constraints prevent the use of traffic signals to their full potential.
- The scores are remarkably similar across the United States and across jurisdictions. Although there may be some high-performing signal systems, on the whole, the vast majority of systems across the country have the potential for greatly improved performance.
- Individualized intersections is the highest scoring section, regardless of the size of the signal system or the agency. At first glance, this is surprising. Particularly for larger systems, the coordinated operations section would be expected to receive the most attention because signal coordination is a highly effective method for improving the performance of the transportation system and reducing delay. However, after further consideration and analysis of responses throughout the self-assessment, it appears that in situations of limited resources and staff, agencies are forced to address problems as they occur at individual intersections. This reflects a reactive approach to managing signal systems that is necessitated due to limited resources. In short, agencies are forced into a “firefighting” mode of operations rather than the preferable proactive management role.
- Another surprise is the comparatively high score in the maintenance section. This is historically an area that struggles to obtain adequate resources, but it scored second only to individualized intersections.
Again, reflecting on the analysis further, it becomes clear that for safety and liability reasons, agencies must ensure a basic level of operation so that signals continue to turn green, yellow and red. The signals may not function efficiently for traffic or pedestrians but, technically, the signals are working and that is what people see. However, the uniformly low scores indicate that, for the most part, people consistently experience poor traffic signal performance. The pattern, one again, is one of agencies forced to use their resources to deal with critical maintenance issues when they arise rather than proactively. Their signals systems are managed simply to ensure basic levels of performance.

When results are assimilated across the entire self-assessment, the picture that emerges is one of agencies across the United States fighting fires. The scarcity of resources, both for funding and staffing, necessitates that agencies do what is needed to provide basic functionality so that the public sees traffic signals turning green, yellow and red. The systematic and thoughtful management of the traffic signal system to maximize the flow of vehicles and pedestrians is not an option for most agencies.

**PROACTIVE MANAGEMENT: F**

Traffic signal operations is one of the most visible services provided to the traveling public by the transportation industry. Therefore, it is important that top management and elected leaders be attentive to and supportive of good traffic signal operations.

Outlining and documenting a management approach for traffic signal operations is important. Communicating the appropriate resources (staffing and attention); coordinating activities; communicating with travelers; and cooperating and integrating with others are important management activities.

**Noteworthy Findings**

The overall national numerical score for the proactive management section was 58.

* The poor performance in this section is the most noteworthy finding.

**SIGNAL OPERATIONS IN COORDINATED SYSTEMS: D-**

Traffic signal coordination is one of the most important aspects of good traffic signal operations. The issues addressed in this section include the timing, interconnection and operation of coordinated signals.

**Noteworthy Findings**

The overall national numerical score for signal operations in coordinated systems was 61.

* A significant indicator of strong traffic signal operations is the systematic and frequent review (about every three years) of traffic signal timing. More than half (67 percent) of respondents reported that they do not conduct routine reviews within three years or that their efforts in this area are ad hoc.

* Once a need has been identified for citywide or corridor timing, more than half (54 percent) take more than one-and-one-half years to implement the updated timing.

* Most mid- to large-size metropolitan areas comprise several independent jurisdictions, each with control of its own traffic signals. To truly be effective, traffic signal timing must be coordinated across jurisdictional boundaries. However, only slightly more than half (54 percent) reported strong efforts in coordinating traffic signal timing across jurisdictions.

* Incidentally, events such as roadway reconstruction, major sporting and/or civic events and roadway incidents can cause dramatic changes in travel patterns. Good traffic signal operations would call for revisions to signal timing to accommodate the revised traffic flow from these events. Of respondents, slightly less than half (46 percent) reported good efforts in this area; 33 percent (mostly in mid- to small-size areas) reported little or no progress.

**SIGNAL OPERATIONS AT INDIVIDUAL INTERSECTIONS: C-**

The issues addressed in this section include reviewing and updating the phasing, sequence, detectors, displays, timing parameters and other related operational aspects of individual signalized intersections within a jurisdiction.

**Noteworthy Findings**

The overall national numerical score for signal operations at individual intersections was 72.

* A well-managed traffic signal system includes a documented process that triggers routine timing reviews on individual intersections. An overwhelming majority (77 percent) showed only ad hoc or no such process. Large signal systems (greater than 450 signals) indicated a slightly improved performance, with 55 percent showing little progress in this area. This strongly indicates, for many agencies, minimal planning and organized management of traffic signal updates. Their resources are more likely to be allocated to deal with critical situations as they arise.

* When traffic signals are reviewed to update their timing, it is important that all relevant data be used in that review, including turning movement and pedestrian counts, crash histories and field observations. Again, as an indicator of a lack of staff resources, less than half (46 percent) regularly considered all of these factors when reviewing traffic signal timing.

* Once an agency has the time to update signal timing, more than 70 percent reported that they regularly update all aspects of the signal timing, including green time, yellow change interval and pedestrian times.

**DETECTION SYSTEMS: F**

A robust detection system is needed for traffic signal systems to respond to changes in traffic conditions.

**Noteworthy Findings**

The overall national numerical score for detection systems was 53.
It is essential to have basic data about traffic counts at intersections to effectively develop traffic signal timing plans. Collecting data requires that processes and systems be in place to routinely gather data, including turning movement counts. Nonetheless, about one-third of respondents (34 percent overall and 26 percent for signal systems larger than 450 signals) reported no regular process for collecting data to support traffic signal timing. Again, this is a likely indicator of staffing deficiencies.

**MAINTENANCE: D-**

Good maintenance is one of the keys to effective signal operation. A well-timed traffic signal system must be accompanied by effective maintenance if it is to provide continued high-quality service to the traveling public. This section is intended to assess the effectiveness of the planning, management, and execution of maintenance activities.

**Noteworthy Findings**

The overall national numerical score for maintenance was 67.

- To maintain a well-functioning traffic signal system, it is critical to have adequate maintenance resources either on staff or through contractors. Although industry practice can vary, in general, it is considered good practice to have a technician for every 40 or fewer traffic signals. When asked about maintenance technicians, 30 percent of respondents have 60 or more traffic signals for each maintenance technician or have not considered their staffing level at all. Agencies are struggling to maintain minimum levels of traffic signal functions due to minimum staffing levels. With resources stretched thin, agencies are forced to take a reactive approach to signal maintenance. In a very real way, they are putting out fires.

**IMPROVING THE SCORE**

Transportation dollars are stretched thin. In a time of competing needs, it is more important than ever to make wise investments. Studies have shown that the benefits of investments in signal timing outweigh the costs by 49 to 1 or more.1 To achieve an "A" level of traffic signal performance, more sustained resources must be devoted to signals and the professionals who design, operate, and maintain them.

For all agencies to achieve a "A" level of signal operation, investment must be made in current signal hardware, timing updates and maintenance resources. Ballpark estimates for these three areas indicate that a $655 million per year is needed. This is less than $6 per registered vehicle in the United States per year.

Nationally, in 2000, $104 billion in federal, state and local funds was spent on highway transportation.2 Spending less than 1 percent of this amount on traffic signal operations would result in an "A." If the United States supported its signals at an "A" level:

- Traffic delay would be reduced by 15 to 40 percent; stops would be reduced by 10 to 40 percent and travel time would be reduced by up to 25 percent.3 For example, if two hours in the car commuting to and from work was a hassle, 50 hours per year (or more than one week week) would be saved because of improved signal timing.
- Fuel consumption would be reduced by up to 10 percent. For one-half tank of gas per week, a full tank would be saved per year per commuter, or approximately $26.55 Nationwide, this would amount to a savings of almost 17,000 million gallons of motor fuels per year.4
- Emissions (carbon monoxide, nitrogen oxides and volatile organic compounds) would be reduced by up to 22 percent.5 According to the Surface Transportation Policy Project, motor vehicles are the largest source of urban air pollution.6 In addition, the U.S. Environmental Protection Agency estimates that vehicles generate 5 billion pounds of air pollutants per year.7

**STUDY CONCLUSIONS**

Overall, findings from the National Traffic Signal Report Card indicate that traffic signal operations in the United States scores a D. This does not mean that traffic signals fail to turn green, yellow and red. The nation's traffic signals do function. However, they do not operate as an efficient, well-integrated system that meets the traveling public's needs.

Findings from 378 agencies that collectively account for ownership of approximately one-third of the nation's 265,000 traffic signals indicate that resource constraints limit the effectiveness of traffic signal operations. As noted throughout this report, agencies are forced into difficult choices about how to spend their limited resources. For many agencies, this means simply lighting fires on a daily basis.

Proactive, integrated management approaches for traffic signal operations rarely are an option. However, traffic signal operations is an excellent investment with benefits to cost ratios of 40 to 1 and highest improved traffic signal operations reduces delay, emissions and fuel consumption, all at a low cost compared to other transportation improvement options.

**DOES ANYONE CARE? LESSONS FROM THE MEDIA**

The technical results from the report card likely are not a big surprise to most practicing traffic engineers. The traffic engineering community is well aware of the need for better signal operations and the need for more ongoing investment in signal systems. In many areas, funding and staffing for traffic signal operations historically have been scarce. Funding and staffing difficulties lead to a general feeling among transportation professionals that traffic signals are unappreciated, even though they are highly visible to the public. In other words—no one cares.

For this reason, the NTSC team felt that this study would not be complete without attempting to create general awareness about the need for more investment in traffic signal systems. The idea was to get the word out through the media. It was unclear, however, whether the media would be interested in the story. Extensive efforts were made through NTSC associations to prepare the transportation community for release.
of the results so that each agency would be prepared to tell its own story.

The results from the National Traffic Signal Report Card were released through various media channels and at a national press conference in Washington, DC, USA, in mid-April 2005. Professional public relations consultants developed the media plan, worked directly with the media and assisted in promoting the story. The Associated Press quickly agreed to pick up the story as did several major national television and radio outlets. Media outlets developed the story and supplied it to local papers and stations across the United States.

By the time of the press conference, the story already was in the papers and on radio and television. The press conference was well attended and the stories multiplied. Highlights included:

- A national Associated Press story that was picked up by hundreds of daily newspapers, radio and television stations and Web sites across the United States;
- A story on page 5A of USA Today;
- Major national coverage including segments on ABC World News Tonight and Good Morning America, CNN Headline News, FOX News Live with Brian Wilson and CBS’s O’Reilly File with Charles Osgood;
- More than 400 local television stories (with a media value of more than $350,000); and
- More than 25 local print stories.

Many lessons were learned from working with the media, including:

- The media use a different world—public relations professionals are essential;
- Prepared “messages” should be ready and reiterated by all spokespersons;
- Everyone involved must stay on message; and
- Likely questions, particularly sensitive ones, should be considered and answers should be prepared prior to talking to the media.

The most important lesson was that people do care about traffic signals. They appreciate good signal operations; they have a general understanding of how signals work; and they are capable of appreciating the effort needed to keep them functioning. Clearly, the transportation community has a story to tell. Other industries have learned to take their stories to the public, but the transportation profession has been reluctant to take that step.

The media relations aspect of the National Traffic Signal Report Card project was a small step into the public relations pond, but it made a big splash. The challenge is to keep the momentum going on behalf of good traffic signal operations and to become more comfortable within the transportation community in advocating for what it needs. If we do not do this, no one else will. ■

References:
5. Assumes a 15-gallon gas tank and $1.75 per gallon of gas.
Appendix H: Denver Regional Council of Government Web Pages

Since 1995, DRCOG's Traffic Operations Program has been working with the Colorado Department of Transportation and local governments to coordinate traffic signals on major roadways in the region. The program reduces traffic congestion and improves air quality. DRCOG was one of the first metropolitan planning organizations (MPOs) to conduct such a program, and remains the leader among the very few MPOs throughout the United States involved in traffic signalization efforts.

The Traffic Operations Program efforts are governed by the Traffic Signal System Improvement Program (TSSIP), which has two major components: a capital improvement program (which provides equipment and installs communications links), and a traffic signal timing improvement program (which provides new traffic signal timing and coordination plans).

The brochure ‘Why is the signal always red?’ prepared by DRCOG provides an informative overview of some of the challenges involved in improving traffic signal timing and coordination.

Current Projects

Projects in Process as of April 2006

Completed Projects

Projects Completed as of 2006

Citizen Feedback

Tell us your comments and concerns about your experiences with specific traffic signal timings.

For further information about the Traffic Operations Program please contact:

Jerry Luxor, P.E.
Traffic Engineering Supervisor
4400 Cherry Creek Drive South, Suite 800, Denver, CO 80240
303-467-0673
Citizen Feedback - Questions/Comments

Does the traffic signal you usually travel through seem not to give you enough time?

- Does the traffic signal you usually travel through seem not to give you enough time?
- Does the traffic signal along a corridor that you frequently travel seem not to flow smoothly; do you seem to stop at a lot of traffic signals?

If you answer "yes" to either of these questions, please fill out the form below and we will investigate your problem, and get back to you with the results.

If the problem you have encountered is not related to signal timing or progression, please contact your local jurisdiction.

Traffic Signal Operations Problem Report

Your Name:

Your Address:

Your Phone:

Your Fax:

Your E-Mail Address:

Please describe the problem in detail below:

What intersection or corridor?

What direction?

Date problem occurred?

Time problem occurred?

Details of problem:

[Submit] [E-mail]
Appendix I: ITE Traffic Signal Training Assessment

Traffic Signal Training Assessment

Summary Report

Prepared for the Federal Highway Administration Office of Operations

Institute of Transportation Engineers University of Maryland

June 29, 2005
The purpose of this report is to better understand the training needs for practitioners in the area of traffic signal timing and operations. It was prepared as part of a continuing program developed by the Federal Highway Administration (FHWA) and the Institute of Transportation Engineers (ITE) to place increased emphasis on the quality of U.S. traffic signal timing. The report includes an assessment of knowledge, skills and abilities (KSA) for traffic signal managers and technicians, identification of existing training resources and an identification of gaps between existing training and KSAs. This report includes three major sections. 1. Identification of knowledge, skills and abilities for traffic signal technicians, engineers and mid-level managers. 2. Categorization and assessment of existing traffic signal training courses and programs and identification of gaps that exist between them. 3. Assessment of the feasibility of a certification of completion or certification program for traffic signal operators. This report assumes that the reader has knowledge of traffic signal timing fundamentals. Appendix A contains the KSAs for traffic signal managers and technicians and a list of pertinent existing training courses. Appendix B contains details on the identified training courses.
This report was prepared by the Institute of Transportation Engineers and the University of Maryland, Center for Advanced Transportation Technology (CATT). The primary authors are:

Shelley Row, ITE
Phil Tarnoff, University of Maryland, CATT

The Institute of Transportation Engineers wishes to thank the team members who provided valuable review and guidance on this project. The team members include:

Pam Crenshaw
John Halkais
Woody Hood
Bill Kloos
Wayne Kurfees
Michael Kyte
Kurt Larson
Jeff Lindley
Troy Peoples
John Thai
Scott Wainwright
Pete Yauch
Traffic Signal Training Assessment Summary Report

Traffic signals are one of the most common traffic control devices in use today. There is little doubt that traffic signal timing has a great impact on transportation system efficiency. However, as the recent National Traffic Signal Report Card indicates, the nation as a whole has a long way to go to achieve excellence in traffic signal operation.

Many factors play a part in creating good traffic signal operations. One of those factors is having a well-trained and capable staff to manage and maintain traffic signals and their timing. Providing good traffic signal operations requires skilled practitioners at several levels within an agency.

The purpose of this project is to identify general types of traffic signal practitioners and the knowledge, skills and abilities they need in order to support good traffic signal operation. Additionally, the project includes a scan of currently offered training that supports the knowledge, skills and abilities needed. From this scan, gaps in existing training were identified.

A. Traffic Signal Operations: Knowledge, Skills and Abilities

Providing sustained excellence in traffic signal operations requires trained and well-qualified professionals throughout the operating agency. Traffic signal operations rely on expertise and support at all levels, from maintenance and engineering technicians to traffic engineers for signal operations and management. Specific job classifications vary between jurisdictions due to the size of the agency, number of signals operated and staffing levels. Regardless of the number of staff or the job classification, certain core functions must be performed to develop and sustain good traffic signal operations. These functions require specific knowledge, skills and abilities. The depth of knowledge needed varies by staff position and subject matter.

In order to stratify knowledge, skills and abilities and to provide an organizing structure for the analysis of training gaps, four generic categories of traffic signal professionals were defined. The following are descriptions of these categories or positions pertaining to traffic signal operations. It is important to note that the number of positions, titles and allocation of responsibilities can and should vary based on agency size and needs. For very small agencies, the traffic engineer for signal systems and the traffic signal design engineer may be a single individual. In some cases, these roles or some portions thereof may be performed by a traffic engineering technician. Therefore, the following descriptions are illustrative for the purpose of this project.

Traffic Engineer for Signal Systems:
This is typically a supervisory and advanced professional position responsible for directing the work activities pertaining to traffic engineering and operations, including the installation, monitoring, modification, maintenance and administration of all traffic signals and signal systems within the geographic
boundaries of the jurisdiction. This position ensures that signal-related
maintenance activities are adequately planned and executed and that there is an
adequate inventory for signal related projects. The traffic engineer for signal
systems is responsible for investigating and preparing specific recommendations
for all traffic-related inquiries from both the public and governmental agencies
and for providing overall traffic engineering expertise. This position plans,
administers and supervises the installation, alteration, maintenance and repair of
all types of traffic control devices. This position also develops and administers
contracts for the installation or modification of traffic signal installations.

Signal Operations Engineer: This is typically an advanced professional position
responsible for, among other duties, managing, directing and supervising the
planning, design, implementation, optimization and distribution of timing plans
for traffic signal and signal system timing projects. This position reviews and
approves plans for accuracy and clarity, conformance to standards, good
engineering practices and reviews the provisions for the safety of the motoring
public. Depending on the size of the agency, this position may be a supervisory
position responsible for managing, directing and supervising assigned personnel
on timing strategies, standards and practices for traffic signal and signal systems.
The signal operations engineer may manage and supervise the development,
approval, implementation and optimization of timing strategies at signalized
intersections and signal system corridors. This position will coordinate, plan and
evaluate computerized timing software packages. It also develops and
recommends new strategies and tactics for traffic signal and signal system timing,
including the development of performance criteria, methods of testing and an
evaluation of performance.

Traffic Engineering Technician: This position is typically responsible for advanced
technical engineering support in the design of traffic signal control,
communication systems and the operation of traffic signal systems. Depending
on the size of the agency, there may be several traffic engineering technician
positions with varying levels of expertise that correspond to designated technician
levels. The position performs a variety of functions, including but not limited to
the following:

- Provides technical assistance for traffic signal design, including phasing and
calculation of timing plans;
- Uses computer-based software programs to develop optimized timing plans
for individual intersections, corridors and/or networks;
- Maintains signal timing database;
- Maintains count database;
- Takes and responds to calls from the public pertaining to traffic signal
operation;
- Conducts traffic signal studies;
- Conducts field reviews of signalized operations to identify problems and/or
adjust timing plans; and
Evaluates signal system operations in the field.

Signal Maintenance Technician:
This position is typically responsible for the installation, diagnostics and maintenance of all electronic equipment pertaining to traffic signal operation. Depending on the size of the agency, there may be several traffic signal maintenance technician positions with varying levels of expertise that correspond to designated technician levels. This position must have knowledge related to the application of sophisticated electronics and data communications technologies to traffic control applications, and be knowledgeable of new technologies applied to both new and old traffic control applications, including the variety of brands, models, types of equipment, systems and software that are available. Changes in traffic control technology and the greater use of telecommunications require increasingly more knowledge of electronics and greater computer literacy. The individual also requires sophisticated skills to troubleshoot and repair the latest generation of traffic electronic equipment.

Using these four categories of traffic signal practitioners, Table 1 in Appendix A provides a general framework to depict the varying levels of knowledge and the core subject areas in traffic signal operations for which expertise must be maintained. Table 1 specifically focuses on knowledge and skills specific to traffic signal operations. It is important to note that the skills and knowledge included below are not the only skills needed to serve in these positions. Other technical skills such as knowledge of construction standards and telecommunication design are critical as well. Additionally, interpersonal communication skills, personnel management and knowledge of legal and tort issues are essential.

B. Traffic Signal Operations: Training Assessment

The need for training in traffic signal operations has long been recognized. Numerous training courses and materials are available through a wide variety of universities, associations, agencies and government providers. For this project, course materials were sought out and identified by their applicability to the KSAs previously defined.

Table 2 in Appendix A supplements Table 1 with codes for the course materials that were identified. Table 3 in Appendix B provides specifics for each of the identified courses. It should be noted that many courses include a wide range of subject matter and, therefore, may be listed for more than one practitioner category and KSA area. Also, the course content was not reviewed in depth. Assignment of a course to a particular KSA was based on a general review of the course title and overview.

Training Assessment Results
A review of Table 2 indicates that training opportunities are currently available for most KSAs for traffic signal practitioners. However, gaps in current training opportunities are evident. Based on this analysis, courses are not available for the following topics:

- Performance measures;

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- Performance measures;
Puget Sound Regional
Traffic Operations Program Assessment

- Data needs and principles of data collection (includes data analysis);
- Preparation of signal specifications including use of ITS standards;
- Construction management including quality control, construction practices and field implementation issues;
- Field timing plan implementation, adjustment including documentation, inventory and records; and
- Maintenance records.
Topic Areas Recommended for Future Training Development
The following courses are recommended for future development.

Performance Measures: Training in this area recognizes the increasing emphasis being placed on the measurement of system performance to evaluate staff activities, justify investments and benchmark operations against those of other agencies. This subject receives little emphasis in college-level curricula and is rarely included in on-the-job training of new staff (either technician or professional level). Performance measures training is required that will provide the following:
- Acquaint participants with the importance and varied applications of performance measures;
- Define performance measures used for evaluation of traffic signal operations, including those used by the agency for its own internal purposes as well as those that are used to communicate results to the public; and
- Discuss measurement techniques including the measurement process, sample sizes, procedures and presentation of results.

Data Needs and Principles of Data Collection: The successful development of signal timing plans depends on the availability of data that accurately represent the conditions for which the timing plans are being developed. These conditions are collected as part of a structured data collection process that measures traffic demand, turning movements, flow characteristics and roadway characteristics. While the procedures associated with data collection might appear to be obvious, in practice many mistakes are made. This training will include the following:
- Discussion of data requirements of signal timing programs including demand, speed and turning movements, as well as start-up delays, saturation flow rates and mid-block friction;
- Discussion of “typical” conditions, including time-of-year, day-of-week, weather, season, holidays, etc; x Collecting data to determine number of timing plans required; x Collecting data to justify traffic responsive operation; x Avoiding data collection pitfalls such as inadequate sample sizes and confusing volume with demand; and
- Data collection processes and shortcuts.

Signal Systems Specifications and Procurement: This course would provide engineering and technician level personnel with training required for the preparation of traffic signal systems plans, specifications and estimates, as well as the boilerplate associated with bid packages. The training would include:
- Elements of the plans, specification and estimate (PS&E) package;
- Ways to distinguishing between good and bad plans;
- Discussion on the challenge of preparing accurate, comprehensive, enforceable specifications;
• Key points regarding bid packages (pre-qualification, government furnished equipment, metrics, etc.); and
• Alternatives to the low-bid process including its applicability to signal system procurements.

Signal Systems Construction Management: State and local agency staffs are frequently assigned the responsibility for overseeing the installation of a signal system. This training would provide information on the rudiments of signal system construction management. Depending on how signal construction oversight is handled and by whom, this topic may not be a stand-alone training session, but rather may be incorporated into construction inspection training materials. Training would include:

• Reading and interpreting plans and specifications;
• Distinguishing between good and bad installation practices (with emphasis on lightning protection and grounding);
• Inspection, including both civil and electrical inspection;
• Traffic control; and
• Testing.

Field Timing Plan Implementation: Existing courses emphasize the process of systematically developing new timing plans for groups of signals. This process typically involves data collection, the use of computer-based signal timing software, simulation evaluation, field installation, observation and final adjustment. In practice however, the majority of signal retiming occurs when a single intersection requires adjustments due to a localized condition such as a change in demand at a single intersection, modifications to intersection geometrics, the need for modified phasing, complaints from motorists, political pressure, etc. A need to time a single intersection might also arise when a new signal is installed within an existing system. There is a requirement for training related to the appropriate procedures for implementing such changes. A course on this subject would include:

• Evaluating existing intersection operation in order to assess the needs for timing (include evaluating upstream and downstream intersection requirements);
• “Back-of-the-envelope” procedures for determining an initial set of timing for the intersection (How would cycle, split and offset be determined? How would these variables be translated into settings on an actuated controller?);
• What to do if the intersection is congested; and
• Evaluating the impact of the timing and making additional adjustments.

Maintenance records training was not recommended for further course development because some information has been developed through NCHRP and applicable training is likely to focus on a specific proprietary maintenance management system that is commercially available.

C. Certificate of Completion or Certification Programs

The final step in this project was to evaluate the existing and needed training to determine
suitability for a certificate of completion or certification program for traffic signal practitioners. The IMSA currently offers a certification program for technician training. This is a successful program for maintenance technicians and indicates levels of competence in basic electronics.

There is currently no such program available for traffic signal engineers or signal operations technicians. Some states and local governments have developed internal programs for their staff that are used to indicate competence and serve as credentials for career advancement. There is no nationally recognized standard of knowledge for traffic signal operation.
There are two basic approaches to be considered:
1. Certification program; and
2. Certificate of completion program.

Certification Program Development of a certification program requires considerable attention, organization and coordination. Certification credentialing must be fair, accurate and relevant to the competencies that are required to perform a specific job, and the process must be objective. While the steps and processes are rigorous, it results in a recognized standard for a body of knowledge that is objective and transferable across agencies and over time. It provides assurance to employers that an employee possesses identified KSAs and recognizes that credentials for an employee are transferable.

The National Commission for Certifying Agencies (NCCA) provides guidelines for agencies developing and managing certification programs. The purpose of NCCA accreditation is to provide the public and other stakeholders the means to identify certification programs that serve their competency assurance needs. NCCA standards address the structure and governance of the certifying agency, characteristics of the certification program, information required to be available to applicants, certificants and the public and recertification initiatives of the certifying agency. There are 21 standards that must be fulfilled for NCCA accreditation. A full description is available at www.noca.org/ncca/docs/STANDARDS904.pdf.

The basic steps in developing a certification program include:

1. Definition of the target population of candidates
2. Job analysis
   - Description of the work that is performed in a particular job through statements of KSAs or tasks resulting in a catalog of tasks or knowledge.
3. Validating the job description
   - Verification by surveying job incumbents that the catalog of tasks/KSAs compiled is accurate and job related. The importance of the specific KSAs/tasks to the ability to perform the job must be determined as part of the validation process. The validation process includes ensuring that a random sampling of the population eligible for the certification is consulted.
4. Standards setting
   - A minimum performance standard must be established in order to objectively evaluate candidates. This may include minimum passing exam score, relevant work experience, education, or a combination of these.
5. Credentialing policies and procedures
   - The process for application for certification, including minimum prerequisites to sit for the exam needs to be defined. Requirements and time periods for renewal and ongoing professional development must also be defined.
6. Examination development
   - A “blue print” of the exam specifying the content based on the
KSAs/tasks from the validation process facilitates organization and writing of items. Exam items are drafted to assess significant job-related KSAs that are required for competent performance. All drafted items are reviewed to determine accuracy, relevancy and suitability.

7. Test administration
   The test content must be kept secure, the location for the test needs to be quiet, comfortable and able to accommodate the number of exam takers. Test forms need to be calibrated to prior exams. Exam scoring is objective and done promptly to provide test results within a reasonable timeframe. Non-performing items need to be culled from the form.

ITE developed the Professional Transportation Operations Engineer™ (PTOE) certification program, which is very successful and has now become financially self-sufficient. Since the inception of the PTOE program, there has been a growing recognition that portions of the practicing professional community are not served by the PTOE. Therefore, ITE has started the development of a new certification program, the Traffic Operations Practitioner Specialist (TOPS). This certification program is targeted to practitioners who have little or no college engineering education, those who are new to the profession, or engineering graduates who have not met the requirements for the professional engineering license. There is likely to be an experience requirement prior to taking the TOPS exam.

TOPS is based on the premise that a competent traffic operational professional needs to have experience and knowledge in a range of topics, including traffic signals. Consequently, TOPS certification will require passing four modular exam as follows:

Required by all: Traffic Operations
Plus any three of the following:
- Traffic safety
- Traffic signals
- Traffic studies
- Geometrics
- Traffic control devices

At this time, the TOPS program is under development. The next phase is to convene a small group to initiate the validation process of KSAs. The results of this project have already been provided to serve as the basis for the traffic signal portion of the TOPS certification. Validation of the KSAs is required from a valid sample of the community of users. Test questions must be developed and validated for use in the exam. The first two TOPS modules will be ready in 2006 with all modules compete in 2007.

Certificate of Completion Program A certificate of completion program would provide recognition that a body of existing coursework had been completed. This approach does not require the rigor of validation and testing that is necessary for certification; however, in the case of traffic signal operation, it would be necessary to recognize training
provided through a variety of sources. As documented in Table 3, there is a wide range of existing signal courses. The courses were developed to meet the unique needs of the developer and its client or customer. Therefore, the courses cover an assortment of content and at differing levels of detail.

A certificate of completion program would require coordination between multiple suppliers of training programs and some level of agreement on the coursework that provides a meaningful body of knowledge. A more thorough review of course content would be needed and agreements among providers and the traffic signal community on what coursework is most meaningful would be necessary next steps. While possible, this is not an insubstantial level of effort.

The certificate of completion would not provide the depth of assurance that a person has achieved certain levels of knowledge since there is no quality control over the courses across suppliers and over time, nor is there testing for knowledge.

On the surface, a certificate of completion approach appears easier to adopt and implement; however, there is a level of effort required in coordination between large numbers of educational suppliers that should not be underestimated. The result would be a certificate that lacks the standing, quality control and value that can be obtained through certification. Hour for hour, the certification program approach may provide the better investment for the dollar for practitioners and employers. With the TOPS program under development, it is advisable to support its completion and reevaluate the need for a certificate of completion program at a later date.
Traffic Signal Training Assessment

Appendix A
<table>
<thead>
<tr>
<th>Job Category</th>
<th>Equipment Function/Capability</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Engineer for Signal Systems</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Safety</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Performance benefits</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Measures/Management</td>
<td>High</td>
<td>High</td>
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<td>High</td>
<td>High</td>
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</tbody>
</table>

### Table 1: Traffic Signal Operations: Knowledge, Skills and Abilities

- **High**: The knowledge or skill is a must have. The person cannot do the job without this knowledge or skill, or it will significantly affect their performance. They must possess the knowledge or skill in order to do the job effectively.
- **Medium**: The knowledge or skill is important for performing the job. While it is not required, its absence may result in inefficiency or decreased performance. The person should strive to develop or improve their knowledge or skill.
- **Low**: The knowledge or skill is not critical for performing the job. While it can contribute to better performance, its absence is not debilitating. The person can perform the job without it.

- **The knowledge or skill is a must have**: The person cannot do the job without this knowledge or skill. The absence of this knowledge or skill will result in failure or significant performance issues. This knowledge or skill is essential for the person to perform their job better.
- **The knowledge or skill is important for performing the job**: The person should strive to develop or improve their knowledge or skill. While the absence of this knowledge or skill will not result in failure or significant performance issues, it may contribute to inefficiency or decreased performance. The person should aim to improve their knowledge or skill to enhance their performance.
- **The knowledge or skill is not critical for performing the job**: The person can perform the job without it. While the presence of this knowledge or skill can contribute to improved performance, its absence is not debilitating. The person can focus on other areas to improve their job performance.
<table>
<thead>
<tr>
<th>Equipment Function/ Capability</th>
<th>Data Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium</td>
<td>High Use of standards</td>
</tr>
<tr>
<td>Medium</td>
<td>High Preparation of signal specifications</td>
</tr>
<tr>
<td>Medium</td>
<td>High Quality control</td>
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<tr>
<td>Signal Timings/Design</td>
<td>High Signal timing design</td>
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<tr>
<td>High</td>
<td>High Coordinated operations</td>
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<tr>
<td>High</td>
<td>Medium System documentation</td>
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<tr>
<td>Performance Measures/ Management</td>
<td>High System costs</td>
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<tr>
<td>High</td>
<td>High Staffing</td>
</tr>
<tr>
<td>High</td>
<td>Medium Traffic operations, including</td>
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<tr>
<td>High</td>
<td>Medium Personnel management</td>
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<tr>
<td>Job Category</td>
<td>Signal Engineering</td>
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<tr>
<td>High</td>
<td>High Construction</td>
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<tr>
<td>High</td>
<td>High Use of software products</td>
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<tr>
<td>High</td>
<td>High Signal system benefits</td>
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<td>High Safety</td>
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<td>High</td>
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<tr>
<td>Traffic Engineering Technician</td>
<td>Low Benefits/Costs of signal systems (general knowledge)</td>
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<td></td>
<td>Medium Coordinated operations</td>
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<tr>
<td></td>
<td>High Traffic engineering basics • signing, marking, human factors, MUTCD</td>
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<td>Equipment Function/Capability</td>
<td>Data Collection</td>
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<td></td>
<td><strong>Low</strong></td>
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<td>Field data collection</td>
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<td>Controls</td>
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<tr>
<td></td>
<td>Electronics</td>
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<td><strong>High</strong></td>
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</tbody>
</table>

Puget Sound Regional
Traffic Operations Program Assessment
Table 2: Traffic Signal Operations: Existing Training Courses

- **High** - The knowledge or skill is a “must have.” The person cannot do the job without this knowledge or skill.
- **Medium** - The knowledge or skill is needed for the position. It is nice for the person to have this knowledge or skill initially, but it may be developed as the individual progresses in the position. This knowledge will allow the person to perform their job better.
- **Low** - There should be a general awareness of the knowledge or skill.

<table>
<thead>
<tr>
<th>Job Category</th>
<th>Performance Measures/Management</th>
<th>Theory</th>
<th>Signal Timing/Design</th>
<th>Equipment Function/Capability</th>
<th>Data Collection</th>
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</thead>
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<tr>
<td>Traffic Engineer for Signal Systems</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Traffic systems benefits</td>
<td>High</td>
<td>Traffic operations concepts &amp; principles, including MUTCD</td>
<td>High</td>
<td>Signal timing/design</td>
<td>High</td>
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<td>• Congestion</td>
<td>• Phasing</td>
<td>• Signal timing/design</td>
<td>• Coordination</td>
<td>• High signal controller functionality</td>
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<td>• Safety</td>
<td>• Coordination</td>
<td>• Optimization</td>
<td>• State Supplements</td>
<td>• Low Electronics</td>
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<td>• Air quality</td>
<td>• Specialty timing</td>
<td>• State vehicle codes</td>
<td>• Preemption</td>
<td>• Medium Controller software</td>
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<td>• Fuel economy</td>
<td>• Priority</td>
<td>ICASA: 50, 52, 45</td>
<td>• Layout</td>
<td>HWP: 51, 52, 55, 60, 64</td>
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<td>• Detection</td>
<td>TST: 2, 8, 9, 10, 11, 12, 15, 14, 16, 21, 25, 29, 34, 35, 41, 45, 67</td>
<td>• Communication</td>
<td>Medium Capacity Analysis</td>
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<td>High</td>
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<td>• Design</td>
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<td>Data needs and principles of data collection</td>
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<td>• Phaser</td>
<td>• Intersection counts</td>
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<td>• Maintenance</td>
<td>• SIPAS: 21, 25, 63, 67</td>
<td>• Speed studies</td>
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<tr>
<td>• Staffing</td>
<td>• SIS: 32</td>
<td>• Engineering studies</td>
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<td>HWD: 50, 60, 71, 72, 75</td>
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<td>HWSP: 51, 52, 55, 60, 64</td>
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<td>HWM: 51, 52, 55, 60, 65, 68, 71, 72, 75</td>
<td>• SIVS: 43</td>
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<td>Medium Signal Construction practices</td>
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<td>• Establish</td>
<td>Medium Controller software</td>
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<td>• Monitoring</td>
<td>HWP: 51, 52, 55, 60, 64</td>
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<tr>
<td>Job Category</td>
<td>Performance Measures/Management</td>
<td>Theory</td>
<td>Signal Timing/Design</td>
<td>Equipment Function/Capability</td>
<td>Data Collection</td>
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<td>Signal system benefits • Congestion • Safety • Air quality • Fuel economy ICACA: 11, 15, 27, 28, 45</td>
<td>High</td>
<td>Traffic operations concepts &amp; principles, including • MUTCD • State supplements • State vehicle codes</td>
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<td>Signal timing/design • Phasing • Coordination • Optimization • Priority • Preemption • Layout • Detection • Communication TSST: 2, 9, 10, 11, 12, 13, 14, 16, 21, 23, 24, 29, 34, 35, 41, 45, 67</td>
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<td>Coordinated operations TSST: 2, 9, 10, 11, 12, 13, 14, 16, 21, 23, 24, 29, 34, 35, 41, 45, 67 ICACA: 30, 35, 42, 45 TSSPR: 28 TSSTV: 26, 58, 59, 66</td>
<td>High</td>
<td>Use of standards</td>
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<td>Preparation of signal specifications</td>
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<td>Personnel management</td>
<td>Low</td>
<td>Network simulation principles/ concepts and use of software products • SimTraffic SIBIT: 32 • SSSIM • SIVIS: 43 • CORSIM • SICOR: 25, 59, 55</td>
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<td>Quality control</td>
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HWD: 60, 69, 71, 72, 73
HWM: 51, 52, 55, 60, 65, 68, 71, 72, 75
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<th>Performance Measures/Management</th>
<th>Theory</th>
<th>Signal Timing/Design</th>
<th>Equipment Function/Capability</th>
<th>Data Collection</th>
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<td>Signal timing/design</td>
<td>Signal controller functionality</td>
<td>Field data collection design</td>
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<td>Traffic engineering basics - signage, marking, human factors, MUTCD</td>
<td>Phasing, Coordination, Optimization, Priority, Preemption, Layout, Detector, Communications</td>
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<td>Analyze data ICACA: 11, 15, 27, 28, 45</td>
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<td>ICASA: 30, 35, 42, 45</td>
<td>TSBSPI: 28</td>
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<td>TSSTV: 26, 38, 59, 66</td>
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<td>Traffic simulation products: SimTraffic, Vissim, SISYS, CORSIM, SIGOR: 25, 39, 55</td>
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<td>Medium Capacity Analysis</td>
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<td>Job Category</td>
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<td>Equipment Function/Capability</td>
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<td>Detailed knowledge of specific equipment functions/capabilities</td>
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<td>TSTST: 2, 8, 9, 10, 11, 12, 13, 14, 16, 21, 25, 24, 29, 33, 34, 41, 45, 67</td>
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<td>TSTST: 2, 8, 9, 10, 11, 12, 13, 14, 16, 21, 25, 24, 29, 33, 34, 41, 45, 67</td>
<td>Controllers, Detectors</td>
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<td>Field timing implementation/adjustment</td>
<td>HWI: 51, 52, 53, 60, 65, 68, 71, 72, 73</td>
<td>HWI: 51, 52, 53, 60, 65, 68, 71, 72, 73</td>
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<td>High</td>
<td>Field timing documentation/inventory</td>
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<td>Electronics</td>
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</table>
| High | Field timing plan records | High | Troubleshooting Operations
- Controllers
- Phasing
- Detectors
- Communications |
| High | Detector installation | HWI: 51, 52, 53, 60, 65, 68, 71, 72, 73 |
| High | Signal construction practices |

**Glossary of Abbreviations**

- ICACA: Intersection/Capacity Analysis - Capacity Analysis
- ICASA: Intersection/Capacity Analysis - Systems Analysis
- SIOR: Software Instruction - CORSIM
- SIGNS: Signal Inspection
- SIPIAS: Software instruction - Param
- SIVATE: Software instruction - SimTraffic
- SIVIS: Software Instruction - VISSIM
- TCL1: Technical Certification - IMSA Level 1
- TCL2: Technical Certification - IMSA Level 2
- TCL5: Technical Certification - IMSA Level 5
- TINC: Technical Instruction (non-certification)
- TSBSQ: Traffic Signal Basics - Signal Design
- TSBSIS: Traffic Signal Basics - Signal Priority
- TSBSIP: Traffic Signal Basics - Signal Preemption
- TSBSST: Traffic Signal Basics - Signal Systems
- TSBBT: Traffic Signal Theory - Signal Timing
- TSTVD: Traffic Signal Theory - Vehicle Detection

**Notes:**

- High
- Medium
- Low
Traffic Signal Training Assessment

Appendix B
<table>
<thead>
<tr>
<th>Course</th>
<th>Course Name</th>
<th>Location</th>
<th>Credit Hours</th>
<th>Tuition Fee</th>
<th>Hours</th>
<th>Fee</th>
<th>Notes</th>
<th>Additional Information</th>
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Note: All courses are offered by the Institution of Transportation and are subject to change based on enrollment and availability.
### Topics

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<thead>
<tr>
<th>Topic</th>
<th>State/City</th>
<th>Institution</th>
<th>Credits</th>
<th>Special Projects/fields of Emphasis</th>
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<td>Traffic Operations Workshops</td>
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<td>SCATS: State Traffic Control System</td>
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<td>Traffic Systems Communications</td>
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<td>Traffic Signal Control and Design Systems</td>
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### Courses

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