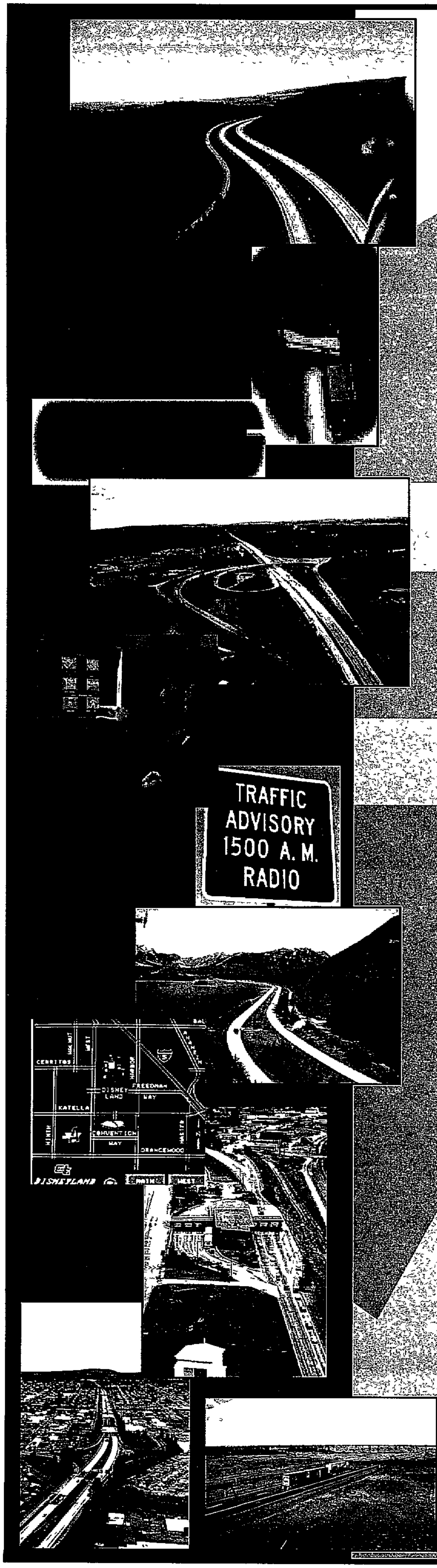

Technical Memoranda

ITS Early Deployment Program
I-5 Seattle to Vancouver B.C.

Prepared for
Washington State
Department of Transportation

Prepared by
Parsons Brinckerhoff
PB Farradyne Inc.
in association with
IBI Group
JHK & Associates
David Evans & Associates
Pacific Rim Resources
K2 & Associates
Rajappan & Meyer
ICON
Matrix Management Group

1998

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February 24, 1998

25089.3.4

Mr. Eldon L. Jacobson, P.E.
Advanced Technology Engineer
Washington State Department of Transportation
Washington State Transportation Center
1107 N.E. 45th Street, Suite 535
Seattle, WA 98105-4631

Subject: Seattle to Vancouver, B.C. & Seattle to Spokane: Intercity/Rural ITS Corridor Study
Final Report
Reference: Consultant Agreement (Y-6276)

Dear Mr. Jacobson:

Please find enclosed 1 copy of the final reports for the I-5 and I-90 ITS Early Deployment Program. We appreciate the opportunity to have worked on this exciting project. We feel that the project prospectuses developed for these corridors present WSDOT with genuine opportunities to address many of the needs of the corridors. The deployment of intelligent transportation infrastructure in specific targeted areas as outlined in Section 4 will greatly enhance safety and operations for all corridor stakeholders.

I would like to personally thank you for you commitment to this project and your leadership throughout the duration of the project. We would be happy to assist you as may be required in developing these projects further.

Please call me at (301) 998-6627 if you have any questions. Ron Atherley can be reached at (206) 382-5214 and Ron Lewis can be reached at (206) 689-4905 for specific questions concerning the I-90 and the I-5 corridors, respectfully.

Sincerely,
PARSONS BRINCKERHOFF QUADE & DOUGLAS, INC.

Kern L. Jacobson, P.E.
Project Manager

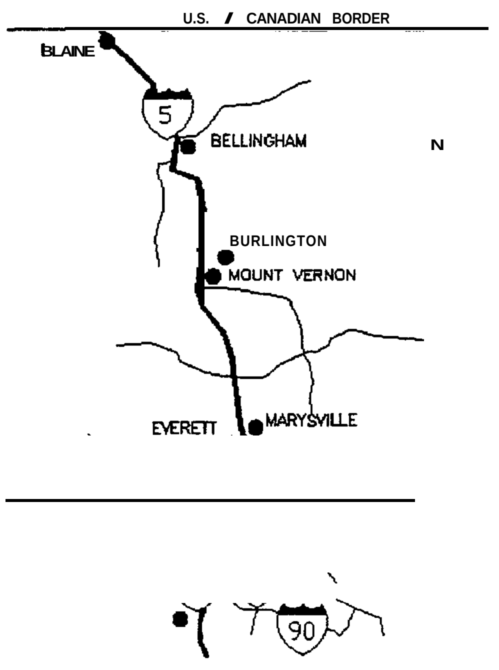
Ron Atherley, I-90 Corridor Manager
Ron Lewis, I-5 Corridor Manager
KLJ/sjm

Executive Summary

This executive summary presents the **final recommendations** and a brief *description of the Interstate 5 (I-5) Seattle to Vancouver, B.C. Intelligent Transportation System (ITS)* **Early** *Deployment Program. The study was performed by Parsons Brinckerhoff, PB Farradyne* Inc., *and their subconsultants.*

Project Description

The I-5 Seattle to Vancouver B.C. study is intended to provide the Washington State Department of Transportation (WSDOT) with an implementation plan for the deployment of ITS technologies along Interstate 5 from the U.S./Canadian international border to the King/Snohomish County line. This study follows the guidance set forth by the WSDOT Venture program in providing a fully integrated state-wide transportation system on the roadways within WSDOT's jurisdiction. The study focused on specific applications in the areas of traffic management, traveler information, emergency management, and commercial vehicle operations (CVO) with the emphasis on providing specific projects to be deployed throughout the corridor.



Corridor Limits
Snohomish/King County Line (MP 177 76) to
I.S./Canadian Border (MP 276.56)

As a result of this study, thirteen project prospectuses that address the corridor transportation needs have been prepared. Each prospectus includes a project description, cost estimate, and an implementation schedule.

The corridor study included the seven project tasks summarized below.

Work Element 1- Assess Transportation Needs

Work element 1 consisted of corridor tours and interviews with key stakeholders and officials from the WSDOT, Washington State Patrol (WSP), city and county agencies, U.S. and Canadian Customs, B.C. Ministry of Transportation (MoTH) and others. Data was gathered relating to the transportation needs along the I-5 corridor with emphasis given to safety, congestion management, CVO, and the U.S./Canadian border crossings.

Work Element 2 - Identify Corridor ITS Opportunities
Based on the findings of the needs assessment, work element 2 identified specific ITS applications to address the corridor needs.

Work Element 3 - Recommend Corridor Strategies
Based on an assessment of appropriate ITS applications and project steering committee input, work element 3 finalized and prioritized the specific ITS applications considered for implementation.

Work Element 4 - Develop Corridor Plan
Work element 4 prepared the specific project prospectuses recommended for the corridor by the steering committee. Cost estimates and benefit/cost analyses were conducted for each of the proposed projects,

Work Element 5 - Develop Corridor Communication Plan
Work element 5 assessed the existing communication system along the corridor. Specific recommendations on the communication infrastructure to be utilized for the ITS elements along the corridor **was** included as part of the corridor plan developed in work element **4.**

Work Element 6 - ITS Coordination/Outreach Effort
Work element 6 established the project steering committee which provided input, direction, and participative decision-making for the project. The steering committee included members from the WSDOT, WSP, Federal Highway Administration, Whatcom and Skagit Counties, and B.C. MoTH. In addition, the coordination and outreach efforts for the project were initiated during this work element. This effort was intended to stimulate interest and deepen the understanding of the ITS efforts for the corridor through a variety of media.

Work Element 7 - Final Report
Work element 7 consolidated the results of previous work elements and developed the executive summary.

Corridor Synopsis

Interstate 5 travels along the entire west coast of the United States ending at the Canadian border crossing. This route is a primary north/south corridor, serving transport, tourism, and commuters in cities such as Seattle, Portland, and Los Angeles.

The focus of this study is on the portion of I-5 within Washington State, from the northern King County line (MP 177.76) to its terminus at the Canadian Border (MP 276.56) a total length of 98.80 miles or 159.0 kilometers. The study route passes through or by the cities of Mountlake Terrace, Lynnwood, Everett, Marysville, Mount Vernon, Burlington, Bellingham, Femdale, and Blaine. The study area crosses Snohomish, Skagit and Whatcom Counties.

The WSDOT operates a surveillance, control and driver information (SC&DI) system along the corridor. The system is operated by the department's Traffic Systems Management Center (TSMC) in north Seattle. The SC&DI infrastructure includes ITS field devices such as ramp meters, closed circuit television (CCTV) cameras, data stations, variable message signs (VMS), and highway advisory radio (HAR). The system utilizes a fiber optic cable infrastructure for the transmission of analog video, while Synchronous Optical Network (SONET) technology is utilized for the transmission of data.

This infrastructure provides tremendous benefits for the WSDOT, including improved freeway efficiency through maintaining freeway capacity, reduction in merging and congestion related incidents, reduction in the time needed to clear incidents, and improving traffic information available to motorists. The SC&DI infrastructure along the I-5 corridor currently extends to 164th St. SW (MP 184), with plans for expansion to the Marysville area (MP 206).

System Architecture

The WSDOT has an extensive regional architecture currently in place along the I-5 corridor in accordance with the tenets of the ITS national architecture. The SC&DI program has developed installation, operations, and maintenance standards for this ITS infrastructure. This study recommends the expansion of the existing SC&DI field devices, and SONET based fiber optic communications infrastructure north of the Marysville area.

The expansion is highlighted by two specific projects recommended as part of this study. The northwest region TSMC expansion project would extend the SC&DI infrastructure north to the Mt. Vernon Area (MP 223). The Mt. Vernon and Bellingham area TMS project would further the SC&DI infrastructure north to the Bellingham area (MP 256). It would also introduce remote monitoring and control terminals in the Bellingham area at a remote Traffic Operations Center (TOC). The initial phases of these two projects would focus on the installation of fiber optic communications infrastructure and field devices at priority corridor locations, followed by the final build-out of the ITS field devices and communications infrastructure in future phases. Other recommended projects would be deployed throughout the corridor utilizing the ITS field devices when applicable and introducing new technologies to address the identified corridor needs such as rest area security, weather-related incidents, and low bridges. Finally, ITS technologies would be deployed at the U.S./Canadian border to enhance the efficiency of border crossing operations. Certain project elements would utilize leased communication lines for both field device and control center communications in the short-term followed by their integration with the WSDOT-owned fiber optic communication links as this infrastructure is extended northward along the corridor.

It is important that each of the recommended projects allow for the exchange of data with the WSDOT Smart Trek ITS backbone currently being developed under the U.S. DOT Model Deployment Initiative (MDI) program. Each effort must emphasize the utilization of consistent communication protocols and data exchange schemes. The data exchange would benefit the individual projects along the corridor by providing access to corresponding traffic information. It would also benefit the ITS backbone system itself by adding valuable data to this integrated traveler information network.

Project Summaries

The I-5 corridor study resulted in thirteen specific project recommendations. The following is a summary of the recommended deployment for the corridor.

Broadcast Radio Dissemination System
Develop a system that allows route, weather, and traffic condition information to be sent to local broadcast radio stations. Each station would then have the capability to broadcast this information to its listeners.

Ice Detection Weather Warning System
Develop an ice detection and warning system at selected locations. Sensors would detect when bridge and road conditions become icy and a warning system would disseminate real-time, site- specific information to travelers, WSDOT maintenance personnel, and the WSP.

Internet Pre-Trip Traveler Information
Expand WSDOT's existing capabilities to provide weather, travel, and traffic information on the World Wide Web (WWW).

Rest Area Information Kiosks
Install traveler information kiosks at rest stops along the corridor. Traveler information would include both static and real-time data applicable to the corridor.

Over-Height Detection
Implement a system that provides advanced warning of low bridge clearances to commercial vehicle drivers and drivers of other high profile vehicles.

Portable Traffic Management System (TMS)
Develop a portable TMS to be utilized by WSDOT and WSP personnel during special events and maintenance and construction activities. Portable devices would include VMS, traffic signals, CCTV, and vehicle detection systems.

Speed Detection/Warning System
Install a speed detection/warning system at steep upgrade and downgrade locations as well as areas of known recurrent speeding. The warning system will be activated upon sensing a potentially hazardous condition.

Variable Speed Limit Signing and Weather Warning System
Implement a variable speed limit signing and weather warning system in the Mt. Vernon hills area (MP 223-228). The system will detect changing weather conditions and provide motorists with information, weather-related warnings, and variable speed limits.

Northwest Region TSMC Geographic Expansion
Expand the WSDOT SC&DI network along I-5 from Marysville (MP 206) to the Mt. Vernon interchange (MP 223). The expanded coverage along this stretch of roadway would provide better traffic management capabilities and increased motorist safety.

Mt. Vernon and Bellingham Traffic Management System
Install a TMS system which is consistent with the existing WSDOT SC&DI network for the Mt. Vernon and Bellingham area (MP 223 to MP 256).

Rest Area Security System
Enhance public security at rest areas along the corridor through the establishment of safe areas with enhanced lighting and improved surveillance and communication to emergency services.

Portable License Plate Optical Reader
Deploy portable license optical reader technologies to assist the WSP in streamlining inspection efforts at weigh stations, assist in enforcement, and provide WSDOT personnel with the means to conduct origin and destination studies.

US/Canadian Border Crossing Systems
Develop a system of data collection, computer database/algorithm and driver information technologies to reduce the travel times and improve efficiencies for the border crossing location.

Deployment Costs

The following is a budgetary estimate for the thirteen projects recommended for the corridor. These costs reflect initial project developments and deployment. In many cases the detailed prospectus recommends limited application such as prototype and spot deployments during phase one, followed by expanded application during subsequent phases. It is widely recognized that the costs of implementation beyond phase one will be significantly affected by the availability of rapidly developing technology and thus are not included in these estimates.

ITS Project	Estimated Capital Cost
Broadcast Radio Dissemination System	$174,000
Ice Detection Weather Warning System	$1,360,000
Internet Pre-Trip Traveler Information	$204,000
Rest Area Information Kiosks	$23 1,000
Over-Height Detection	$179,000
Portable Traffic Management System (TMS)	$780,000
Speed Detection/Warning System	$372,000
Variable Speed Limit Signing and Weather Warning System	$660,000
Northwest Region TSMC Geographic Expansion	$2,095,000
Mount Vernon and Bellingham Traffic Management System	$3,440,000
Rest Area Security System	$125,000
Portable License Plate Optical Reader	$22,000
US/Canadian Border Crossina Svstems	$700.000
Total Deployment Costs	**$10,342,000**

ITS EARLY DEPLOYMENT PROGRAM

I-5 SEATTLE TO VANCOUVER, B.C.

Technical Memorandum 1

CORRIDOR NEEDS ASSESSMENT

prepared for the

Washington State Department of Transportation

prepared by

PARSONS BRINCKERHOFF

PB FARRADYNE INC.

in assooiation with

JHK & Associates
IBI Group
David Evans & Associates
Pacific Rim Resources
K2 & Associates
Rajappan & Meyer
ICON
Matrix Management Group

February 1998

TABLE OF CONTENTS

LIST OF TABLES

1 .0 INTRODUCTION

1 .1 OVERVIEW

This report has been prepared as part of the I-5 Seattle to Vancouver B.C. & I-90 Seattle to Spokane Inter-City Urban/Rural Corridors ITS Early Deployment Project. This is the first technical memorandum for the ITS Early Deployment Plan for the I-5 Corridor and is submitted in fulfillment of Work Element 1.5: Data Assessment/Corridor Needs Summary. The I-90 Data Assessment/Corridor Needs Summary is provided under separate cover. Revisions based on the review of this document will be presented in the I-5 ITS Corridor Study - Final Report, Work Element 7, which will be composed of subsequent memoranda in their final form from the other five ITS Study work elements.

This scope of this Work Element reads as follows:

> The CONSULTANT shall analyze the compiled data prepared by the Washington State Department of Transportation (WSDOT) to determine short-term, mid-term, and long-term transportation needs in the corridor. The CONSULTANT shall identity specific problems, and estimate their magnitude. Special attention shall be given to safety, congestion, and commercial vehicle operations. This analysis shall serve as a baseline for gauging the impact of recommended ITS solutions. The results of this assessment shall be compiled in a graphic format using charts and maps in a technical memorandum to be submitted to WSDOT for review.

This report summarizes findings and presents the current transportation needs of the I-5 corridor based on a physical assessment of existing and planned corridor conditions conducted under Work Elements 1.1: Corridor Tours; 1.2: Non-Accident Data Summary; 1.3: Accident Data Summary; and 1.4: Border Crossing Situational Analysis. Tasks 1.2 and 1.3 were the responsibility of WSDOT. These previous tasks involved the physical characteristic assessment of the transportation infrastructure, an assessment of existing operational characteristics, current progress on Intelligent Transportation Systems (ITS) infrastructure, and proposed planned improvements. These findings were collected in both anecdotal format from minutes of the Corridor Tours and through existing conditions documentation provided by the WSDOT, and are presented in the appendices.

1.2 ORGANIZATION OF THE TECHNICAL MEMORANDUM

Section 1.0 of this technical memorandum provides an overview of the technical memorandum and presents the organizational structure for the memo. Section 2.0 summarizes the transportation needs of the corridor by five different categories: Safety and Enforcement; Traffic Operations, Congestion, and Traffic Management; Traveler Information; Commercial Vehicle Operations; and Other Transportation Needs. Section 3.0, the Summary of Results, will conclude this report through presentation of findings, summarizing corridor-wide transportation needs as determined through this investigation. Transportation needs are presented without regard to ITS solution potential, but rather in a time frame reference based on short-, mid- and long-range needs listing. Supporting information is contained in each of the appendices. The content of each of the appendices is described below:

Appendix A presents a map of I-5, which is a straight line illustration of the corridor.

Appendix B presents minutes developed based on the Corridor Tours, Work Element 1.1, which were conducted with WSDOT and Washington State Patrol (WSP) personnel.

Appendix C presents the results of the Non-Accident Data Summary, Work Element 1.2. This appendix includes a Corridor Description; a review of Current and Future Transportation Infrastructure, including geometric characteristics and planned improvements, motorist information signing, transit systems, rail, marine and airport facilities, and pipelines; existing and forecasted Traffic Conditions; and Other Existing Conditions including unstable slopes, weather data, assistance calls and citations, and a listing of ITS devices along the corridor.

Appendix D presents the results of the Accident Analysis Summary, Work Element 1.3. This appendix presents a variety of findings related to the location and causes of traffic accidents along the corridor as prepared by WSDOT.

Appendix E is the Group Participation Plan completed under Work Element 0.5. This is presented here as background to the group participation process.

Appendix F is the Border Crossing Situational Analysis, Work Element 1.4.

2.0 SUMMARY OF CORRIDOR TRANSPORTATION NEEDS.

Transportation needs of the corridor are defined as the need for physical and operational improvements. These needs represent areas of concern for which improvements should provide or enhance the efficient movement of people and goods, and improve safety. The following sections describe these needs in terms of their primary function, including safety and enforcement, traffic operations, traveler information, commercial vehicle operations, border crossings, weather, communications, and maintenance.

Some of these needs have been previously identified by WSDOT, and are included in their Five Year Plan. A summary of the Five Year Plan is presented in the appendix to this Technical Memorandum.

2.1 SAFETY AND ENFORCEMENT NEEDS

From the results of Work Element 1.3, Accident Data Summary, and through information obtained during the corridor tours, several observations were made with regard to corridor safety and enforcement. From speeding, to crime at rest areas, to HOV lane violations, the corridor has a number of safety and enforcement needs which may lend themselves to ITS applications. These needs are summarized below.

2.1.1 General

- WSP and WSDOT Coordination: WSP is emphasizing public safety as well as law enforcement, which has resulted in expanded opportunities for coordination between WSP and WSDOT. There are continuing needs for coordination between WSP and WSDOT in the areas of incident management, HOV and speed enforcement as well as rest area surveillance. In addition, coordination between the WSP and WSDOT in the area if equipment purchasing and use was also identified as beneficial.

- Surveillance: There are needs for additional surveillance at locations throughout the corridor. These include the need for video cameras to aid in HOV enforcement, traffic management (e.g. Bellingham), surveillance at rest areas, and the need to address problems associated with pursuits.

  The use of video cameras and fixed location monitors for HOV enforcement is the subject of current research at TTI. This technique utilizes CCTV cameras to get a view of a vehicle interior thus allowing one to determine HOV violations. If proven successful, this technique may provide a strong incentive for the public to adhere to the required number of occupants per vehicle. Currently WSP troopers have very limited ability to see into vehicles, especially during darkness and inclement weather. They also have difficulty seeing into sports utility vehicles that are taller than patrol vehicles. The WSP has reduced the number of motorcycle officers which further reduces the tools usually associated with HOV enforcement.

There is also a need to enhance the tools available for WSP to identify and prosecute perpetrators for a wide variety of crimes. As WSDOT considers expanding the use of video surveillance for highways and rest areas, the system could conceivably also record major accidents, enforcement actions, vandalism or theft of property, and crimes against persons.

- Vehicular Pursuits: The continuing problems associated with vehicular pursuits, such as injuries to innocent motorists, may make this a priority for consideration of ITS technology applications. Installation of devices with the capability to electronically track or disrupt a fleeing driver would give the WSP a strong tool to reduce danger to the public.

- Medians and Barriers: In most areas of I-5 there is a median, but no barrier to prevent cross-over accidents resulting in head-on collisions from occurring. In many cases the time required for a vehicle to cross-over the median is shorter than the perception-reaction time of on-coming motorists. Median landscaping with shrubs is an effective method of screening on-coming headlights particularly on curved sections of the roadway. However, they further obstruct the view of on-coming cross-over traffic.

- Low Bridges: Several low bridges were identified as being frequently hit by high vehicles. Some of these bridges are planned for replacement in the WSDOT five year plan.

2.1.2 Everett and Vicinity

- There is a need to address a crime problem (personal and property) at rest areas. The WSP reports that stolen cars are recovered at rest stops regularly.

- Physical constraints make enforcement on the Hewitt Avenue Trestle (SR 2) difficult. A suggestion was made during the corridor tours to consider automated enforcement in this area.

- High urban accident locations include the area from 220th Street SW interchange [milepost (MP) 179] to the vicinity of the SR 528 Bridge (MP 199).

- High rural accident locations include the vicinity of SR 531/Smokey Point interchange, and the vicinity of the SR 530 interchange (MP 205.8).

- The highest number of motorist assistance calls and citations in the corridor were recorded for the area from Montlake Terrace (MP 178) to Marysville (MP 197).

2.1.3 Mount Vernon and Vicinity

- Need to address speeding in this area, particularly on hills.

- High urban accident locations include the vicinity of the SR 536 interchange (MP 226).

- High rural accident locations include the vicinity of the SR 11 interchange (MP 231) and the vicinity of the Cook Road interchange (MP 232.5).

2.1.4 Bellingham and Vicinity

- The old railroad bridges south of mile post 255 are too low, creating vertical clearance problems.
- High urban accident locations include the vicinity of the SR 539 interchange (MP 256).
- High rural accident locations include the area from the Samish Highway interchange vicinity (MP 246) to the vicinity of the SR 548 interchange (MP 276).

2.2 TRAFFIC OPERATIONS, CONGESTION AND TRAFFIC MANAGEMENT

From the results of Work Element 1.2, Non-Accident Data Summary, and through information obtained during the corridor tours, several observations were made with regard to traffic operations and traffic management. Related issues throughout the corridor include capacity, geometrics, and traffic data collection. From the analysis as presented in Appendix C, there were several noteworthy traffic related needs. These are briefly described below:

General

- Continued Expansion of the Northwest Region Traffic Management System (TMS): The WSDOT's Northwest Region TMS program is currently being operated out of the Shoreline-Dayton Avenue headquarters. The TMS program provides the monitoring and control of the WSDOT ITS field devices including ramp meters, data stations, closed circuit television (CCTV), variable message signs (VMS), highway advisory radio (HAR), and weather stations. Data archiving and coordination with WSP and neighboring jurisdictions is also a function of the WSDOT TMS program. This system has profound operational benefits and a need exists to expand its current coverage area.
- Traffic Data Stations: There is a need to expand traffic data stations along the corridor. These stations allow for the assessment of the corridor transportation performance by collecting vehicle volume, occupancy, speed, classifications, etc. The current WSDOT TMS provides traffic data station coverage up to the Everett area. High congestion areas such as the Mt. Vernon and Bellingham downtown areas as well as the Canadian/U.S. border area were identified as priority locations.

2.2.1 Everett and Vicinity

- There is a need to accommodate the projected growth in traffic, estimated to range from about 1 percent to 1.5 percent per year.
- Traffic Queuing: Address the Rest Area traffic back-up onto I-5 at 128th.

2.2.2 Mount Vernon and Vicinity

- Community Transit provides transit service via 300th Street (exit 215) to serve existing park and ride lots. This area experiences heavy congestion in the early mornings and late afternoons.

2.2.3 Bellingham and Vicinity

- There is a need to accommodate the projected growth in traffic, estimated to range from about 2.5 percent to 3 percent per year.

2.2.4 U.S. - Canada Border

- There is a need to address queuing on border crossing approaches.

- There is a need for traffic data collection.

2.3 TRAVELER INFORMATION NEEDS

There are a number of traveler information needs throughout the I-5 corridor. These needs range from variable message signs (VMS) which were identified by a number of corridor tour participants, to additional measures to help accommodate special events, to measures to reduce the time associated with crossing the border. Establishing WSDOT traveler information policies and strategies was also identified as a need. Specifically, it was recommended that WSDOT establish signing strategies and policies for the use of VMS signs in the areas of traveler information, incident management.

2.3.1 Everett and Vicinity

- VMS needs: Additional VMS near the Eastmont approaches and at the Visitor Information Center at 128th.

- Partnerships: Consider providing travel information in partnership with private entity such as casinos (Harrah's).

2.3.2 Mount Vernon and Vicinity

- Special Event Signing: Special signing is installed for the annual Tulip Festival. WSDOT grants a permit for signs to be in place for a three week period. A total of twelve motorist information signs are used. Consider providing similar traveler information for other events.

- There is a need for additional advance signing for the North Cascades Highway (Hwy. 20).

- The effectiveness of static "watch for ice" signing is questionable. There is a need to provide motorists with real time information when icy roadway conditions occur. The Skagit River bridge is one area that experiences icing problems.

- There is a need for additional use of advance warning VMS for incident management.

2.3.3 Bellingham and Vicinity

- There is a need for additional tourist information signing for the Anacortes Ferry.
- There is a need to provide additional advanced border crossing information to motorists.

2.3.4 U.S. - Canada Border

UNITED STATES

- Blaine was recently selected as one of three participants on the northern border in a National Review Program for passenger vehicle pri'mary processing. Currently, thirty percent of the passenger vehicles crossing the border use the PACE lane. Customs Headquarters has targeted a goal of 70 percent PACE lane usage, but the region believes that 50 percent usage is more realistic and achievable. Currently there is a need for a new Customer Service agent position whose primary function would be to develop the PACE user market and act as a customer service advocate for PACE.
- There is a need for U. S. Customs to direct limited resources toward high risk travelers. The program requires individuals to apply to both the U.S. and Canadian Customs to obtain a vehicle decal. Individuals must be U.S. or Canadian citizens, have no criminal record, and no customs or immigration violations. Therefore, the premise of PACE is to provide an opportunity for a "self-directed primary assessment" whereby the motorist makes a determination and self-selects the appropriate action. The main objective of dedicated lanes such as PACE is to segregate and clear low risk travelers.
- There is a need for U.S. Customs to complete installation of license plate readers which have an 80 percent read-rate. U.S. Customs is actively responding to this need which will match Canadian Customs operations, which have had this capability since October 1994.
- Point Roberts is a potential site for an unstaffed PACE lane using license plate readers. There is currently an unstaffed customs station at Scoby Montana. Investment in an appropriate ITS technology will be required if Customs proceeds with this plan.
- WSDOT currently does not have a comprehensive data collection program in place near the border. WSDOT is responding to the need to enhance their data collection capabilities with plans to implement a data collection and remote video program in the vicinity of the Blaine border crossing.

There is a need to expedite the processing of bus passengers crossing the border. Currently, all buses use the Blaine truck crossing. Passengers on commercial buses disembark with luggage and proceed through Customs and Immigration. Charter bus passengers are generally subject to less scrutiny, i.e. on-board questioning. Greyhound is interested in entering into a partnering carrier agreement, whereby advance passenger information would be made available to customs officials, similar to Amtrak and airlines, where manifests are faxed ahead.

CANADA

- There is a need to provide additional information to motorists as they approach the border from the north. The Ministry of Transportation and Highways (MoTH) is discussing the possibility of installing VMS on border approaches to advise motorists of potential crossing delay. A key criteria for implementation is that enforcement must not suffer. Implementation measures include use of remote video, interagency training, re-engineering, and application of Port Quality Improvement Council (PQIC) monitoring. The PQIC has developed a list of 79 recommended improvements to address border crossing issues.

- There is a need to consider Internet application (i.e. web page) for real time travel data and PACE permit information. Currently, WSDOT has an operational web page; U. S. Customs and MoTH are interested in establishing web pages.

- There is a need to identify and explore opportunities to improve the efficient movement of passengers by bus through the provision of advanced passenger information to customs officials, similar to Amtrak and airlines, where manifests are faxed ahead.

- There is a need to consider the potential impacts of ITS applications on the diversion of traffic through nearby jurisdictions such as the City of Surrey, which has expressed a concern.

2.4 COMMERCIAL VEHICLE OPERATIONS NEEDS

There are a number of commercial vehicle operational needs throughout the corridor. These needs manifest themselves in delay, lost efficiencies, and higher costs for the movement of goods. The Commercial Vehicle Operations (CVO) ITS applications identified for the corridor include weigh-in-motion, smart railroad crossings as well as several border crossing applications including electronic pre-clearance technologies.

2.4.1 Everett and Vicinity

- The truck weigh station at Everett is semi-dysfunctional due to short ramp design and frequent queue backup from the scales out to the freeway mainline. When these queues develop, the scale crew must close the station and allow trucks to bypass the scales until the queue dissipates. This problem may be remedied relatively easily and at relatively low cost by installing ITS-CVO technologies such as weigh-in-motion.

- WSP and WSDOT are investigating alternative sites for a new weigh station in the Marysville area. A new facility would provide an opportunity to fully integrate ITS technologies into the facility and take maximum advantage of current ITS-CVO technologies.

2.4.2 Mount Vernon and Vicinity

- An existing overpass (MP 226) on the southern approach to Mount Vernon is struck by trucks three to four times a year. The overpass height is 14’4”. WSDOT is currently considering replacement of the overpass. Given the timing of a replacement, there may be an opportunity for an interim ITS application to provide an advanced warning system for overpass clearance.

- Weigh-in-motion should be considered for Bow Hill.

2.4.3 Bellingham and Vicinity

WSDOT is considering bridge replacement for three bridges with less than 15'6" clearance. They are: Alabama Street bridge (MP 254.26); Milwaukee RR bridge (MP 254.47); and the Nooksak River bridge (MP 263.05). Given the timing of replacement, there may be an opportunity for an interim ITS application to provide an advanced warning system for overpass clearance.

2.4.4 U.S. - Canada Border

UNITED STATES

- U.S. Customs has automated air and ocean manifest systems and is engaged in pilot tests of rail automated manifests across the U.S. - Canadian border at Champaign, NY and Rainier, MN. While development of an automated land border truck manifest process had been anticipated, that activity has been indefinitely shelved to enable concentrated focus on development of the U.S. Customs' Automated Customs Environment architecture and information systems re-engineering.

- There are potentially significant short-term gains associated with electronic pre-clearance. The benefit of having information available to customs agents prior to the arrival of commercial vehicles would be in providing valuable time (and cost) savings opportunities. Database management, data formatting, and standardizing are key issues to be addressed. Brokers need information as early as possible to prepare paperwork for customs agents.

- U. S. Customs and American Presidents Line (APL) participated in a pilot project using radio frequency (RF) transponders to verify outbound (export) border crossings to trigger required export system reporting. The transponders were installed on (B.C.-bound) containers in Seattle, and each transponder was then linked to the respective container manifest. An RFID (radio frequency id) reader installed on the side of the U.S. Customs building at the border read each container transponder ID and reported the container's ID back to APL, which then triggered APL's export report filing to U.S. Customs. No errors were detected during the pilot test and, by filing timely reports, APL did not incur any export filing penalties - in contrast to the experience immediately before and again after the test was concluded. This application could be considered for long term application.

- U. S. Customs at Blaine favor full container x-ray capability (approximately $3 million).

- There is potential for heavy southbound cargo traffic from the Delta Port, scheduled for opening in 1997.

- There is potential for heavy southbound cargo traffic from the Delta Port, scheduled for opening in 1997.

- The GSA and U. S. Customs are acquiring and reconfiguring land for improvements at the Blaine truck crossing. There is a need to identify any special requirements necessary to accommodate future ITS applications.

- Current volumes at the Blaine truck crossing are approximately 100 trucks per day; however, this crossing is forecasted to reach saturation in approximately 20 years. Options include expansion of the Lynden crossing or construction of a new crossing. Currently, trucks must have a permit to use the Lynden crossing.

- Problems identified with truck crossings at the border include inadequate holding lanes, passenger cars using the truck crossing, lack of adequate signage, and an increasing volume of trucks.

- Consider operating the truck crossing as an exclusive facility for trucks. This approach would need to address the associated political problems.

- Need to try to recapture some of the lost time associated with truck crossings delays.

CANADA

- Advanced information on cargo (line release) is used on approximately 50 percent of all northbound cargo crossing the border. Such information can be provided up to 72 hours prior to arrival, and must be provided at least two hours prior to arrival for processing.

2.5 OTHER CORRIDOR NEEDS

2.5.1 Weather

High winds, heavy rain, ice and fog are the typical weather conditions which contribute to vehicular accidents in the I-5 corridor. While heavy snow is relatively infrequent, it can also cause serious problems when it does occur.

2.5.1.1 EVERETT AND VICINITY

- There is a need to address the common problem of fog from Eastmont to mile post #208.

- There is a need to address bridge icing that occurs at the I-51SR 526 interchange, particularly for the eastbound to northbound movement.

2.5.1 .2 MOUNT VERNON AND VICINITY

- There is a need to consider temperature-activated signs at bridge approaches to inform approaching motorists of possible icy conditions.

- There is a need to address northbound and southbound problems with black ice between MP 210 and 215. Black ice in this segment results in run-offs into the median.

- There is a need to address roadway icing that occurs on the northbound on-ramp at MP 208, continuing to MP 209. There is a problem with vehicles loosing traction in the uphill direction, and with skidding in the in the downhill direction.

- There is a need to address a problem situation at the Anderson Road overpass (MP 225). The speed limit is reduced, a lane is dropped, and icing occurs, resulting in median cross-overs.

2.5.1.3 BELLINGHAM AND VICINITY

- British Columbia uses salt on their roadways. Some B.C. motorists may not be aware that salt is not used on I-5, and thus may not be prepared for different roadway conditions. There is a need to inform motorists so they can adjust their speed accordingly.

- No current snow & ice emphasis from + MP 235 to Bow-Hill Road. I-5 from Bow-Hill Road to Bellingham is currently a calcium magnesium acetate (CMA) test area. CMA is applied based on weather service reports and forecasts at a ratio of 30 gallons per lane mile. There is a need to determine if the application of CMA should be expanded.

- There is a need to address frequent ice conditions on I-5 in the vicinity of Lake Samish.

- There is a need to address frequent ice conditions on the Nooksack River Bridges.

- I-5 north of Bellingham is considered a rural highway for purposes of snow removal, and thus is a lower priority. This contributes to the different expectations of motorists from the north. There is a need to inform motorists of changing conditions.

2.5.2 Communications

Improved communications was identified as a need throughout the corridor. The following specific needs were identified:

- The need for better communication/fusion of available technical information (weather, surveillance, and communication)

- The need to pay greater attention to how information flows, and how and by whom it is used.

- The need to take greater advantage of the Internet for communications.

- Sharing radio sites between WSP and WSDOT is already happening and is essential. This needs to continue and to be expanded.

- There is a need to enable/enhance surveillance and communications for WSP and WSDOT maintenance. Consideration should be given to cameras operating with microwave communication technology, permanent data stations for long-term data collection, and VMS.

2.5.2.1 EVERETT AND VICINITY

- The Marysville WSP station has a Computer Aided Dispatch System which provides electronic communications for Snohomish, Skagit, Whatcom, and Island counties. In addition, this WSP station communicates directly with the public over the counter and responds to phone inquiries, including 911 calls. There is a need to consider installation of field cameras and TV monitors to enhance the capabilities of this WSP control center.

- There is a need to consider CCTV/data stations/fiber optics extension north from 164th Street Southwest to Broadway with HOV projects. A second phase would extend from Broadway to SR 2 with additional HOV facilities. From SR 2 to Marysville would include connections with the WSP and lower intensity slow-scan CCTV.

2.5.2.2 MOUNT VERNON AND VICINITY

There is a need for Highway Advisory Radio to provide information on current weather conditions.

2.5.3 Maintenance

The need for a comprehensive maintenance management system was identified as a need throughout the corridor. WSDOT maintenance staff identified a specific need for the inclusion of the maintenance of electronic equipment as well as mechanical equipment into a maintenance system. They also expressed a need to consider a range of maintenance alternatives, including incorporating "self-diagnosis and self-maintenance" procedures into equipment.

Maintenance costs were a key concern. There is a need to consider incorporating maintenance costs into projects. This approach recognizes that after the first + five years, maintenance time and costs go up significantly.

Maintenance facilities are currently set up for maintenance only. There needs to be a feedback mechanism so that information obtained through monitoring can be used to refine maintenance programming.

2.5.3.1 BELLINGHAM AND VICINITY

- There is a continuing need to address rock-fall incidents. There are approximately 35 rock-fall incidents per year in the vicinity of Chuckenut Drive. Five years ago WSDOT installed Jersey barriers to prevent falling rock from entering the roadway. WSDOT maintenance budget for this area is $2.7 million; construction budget is $500,000 per biennium. During the past few years the construction budget has been used for rock-fall mitigation and wall repair.

3.0 SUMMARY OF CORRIDOR NEEDS

Table 1 summarizes the I-5 corridor needs. This table was distributed to the project steering committee and the results accumulated were used to develop the overall ITS strategy for the corridor.

Table 1

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE			
CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.1 SAFETY AND ENFORCEMENT			
2.1 .1 General			
WSP & WSDOT Coordination			
Video Surveillance			
Vehicular Pursuits			
2.1.2 Everett and Vicinity			
Crime at rest areas			
Enforcement at Hewitt Trestle			
Urban Accidents from 220th St SW to SR 528			
Rural Accidents, Smokey Point & SR 530			
Motorist Assistance & Citations (Montlake Terrace to Marysville)			
2.1.3 Mount Vernon and Vicinity			
Speeding			
Urban Accidents SR 536			
Rural Accidents SR 11 & Cook Road Interchange			
2.1.4 Bellingham and Vicinity			
Cross-over Accidents			
Vertical Clearance at RR Bridges MP 255			
Urban Accidents vicinity of SR 539			
Rural Accidents from Samish Hwy. to SR 548			

RATING GUIDELINES		
Level of Support	**Number of Barriers**	**Severity of Barriers**
1 = High	**1 = None**	1 = Common
2 = Moderate	2 = Few	2 = Limited Application
3=Low	3 = Many/Several	3 = Experimental

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE

CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.2 TRAFFIC OPERATIONS, CONGESTION & TRAFFIC MANAGEMENT			
2.2.0 General			
Install Permanent Traffic Data Recorders			
Address Low Bridges			
Expand Region's Traffic Management Center			
2.2.1 Everett and Vicinity			
Accommodate Forecast Growth of up to 1.5%/Yr			
Address Traffic Queuing at Rest Area at 128th			
2.2.2 Mount Vernon and Vicinity			
Address Heavy Morning Congestion (MP215) - Transit Route			
2.2.3 Bellingham and Vicinity			
Accommodate Forecast Growth of up to 3%/Yr			
2.2.4 U.S. - Canada Border			
Address Queuing			
Data Collection			

RATING GUIDELINES

Level of Support	Number of Barriers	Severity of Barriers
1 = High	**1 = None**	1 = Common
2 = Moderate	**2** = Few	2 = Limited Application
3=Low	3 = Many/Several	3 = Experimental

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE

CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.3 TRAVELER INFORMATION NEEDS			
2.3.1 Everett and Vicinity			
VMS Near Eastmont Approaches & Visitor Center at 128th			
Provide Travel Information Through Partnership			
2.3.2 Mount Vernon and Vicinity			
Special Event Signing			
Additional Advance Signing for Hwy. 20			
VMS for Incident Management			
2.3.3 Bellingham and Vicinity			
Additional Tourist Information Signing for Anacortes Ferry			
Advance Border Crossing Information			
2.3.4 U.S. - Canada Border			
U.S.			
Additional Customer Service Agent			
Expand PACE Operations			
Complete Installation of License Plate Readers			
Implement Un-staffed PACE Lane at Point Roberts			
Traffic Data Collection			
Expedite the Processing of Bus Passengers			
CANADA			
Provide Additional Motorist Information			
Consider Internet Application for Real Time Travel Data			
Expedite the Processing of Bus Passengers			
Monitor &Address Traffic Diversion			

RATING GUIDELINES		
Level of Support	Number of Barriers	Severity of Barriers
1 = High	1 = None	1 = Common
2 = Moderate	2=Few	2 = Limited Application
3=Low	3 = Many/Several	3 = Experimental

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE

CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.4 COMMERCIAL VEHICLE OPERATIONS			
2.4.1 Everett and Vicinity			
Address Queuing At Everett Truck Weigh Station			
Consider Constructing a New Weigh Station			
2.4.2 Mount Vernon and Vicinity			
Address Low Overpass (MP 226)			
Consider Weigh-in-Motion for Bow Hill			
2.4.3 Bellingham and Vicinity			
Address Low Bridges (MP 254.26,254.47,263.05)			
2.4.4 U.S. - Canada Border			
U.S.			
Consider Automated Manifest System			
Consider Electronic Pre-Clearance			
Consider Long-term Application of Transponders			
Consider Sharing Commercial Manifests with Canada			
Consider Full Container X-ray			
Identify Special ITS Requirements for Truck Crossing			
Consider Long-term Upgrade at Lynden Crossing			
Address Inadequate Holding Areas & Signing			
Consider Exclusive Truck Crossing			
Reduce Border Crossing Delay for Trucks			
CANADA			
Advanced Information on Cargo (line release)			

RATING GUIDELINES

Level of Support	Number of Barriers	Severity of Barriers
1 = High	1 = None	1 = Common
2 = Moderate	2 = Few	2 = Limited Application
3=Low	3 = Many/Several	3 = Experimental

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE

CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.1 SAFETY AND ENFORCEMENT			
2.1.4 General			
WSP & WSDOT Coordination			
Video Surveillance			
Vehicular Pursuits			
2.1.2 Everett and Vicinity			
Crime at rest areas			
Enforcement at Hewitt Trestle			
Urban Accidents from 220th St SW to SR 528			
Rural Accidents, Smokey Point & SR 530			
Motorist Assistance & Citations (Montlake Terrace to Marysville)			
2.1.3 Mount Vernon and Vicinity			
Speeding			
Urban Accidents SR 538			
Rural Accidents SR 11 & Cook Road Intemhange			
2.1.4 Bellingham and Vicinity			
Cross-over Accidents			
Vertical Clearance at RR Bridges MP 255			
Urban Accidents vicinity of SR 539			
Rural Accidents from Samish Hwy. to SR 548			

RATING GUIDELINES

CORRIDOR NEEDS ASSESSMENT SUMMARY TABLE

CORRIDOR NEED	LOCAL PRIORITY	INSTITUTIONAL BARRIERS	AVAILABILITY OF ITS APPLICATION
2.5.2 COMMUNICATIONS			
2.5.2.0 GENERAL			
Communication/Fusion of Available Information			
Improve Information Flow			
Fully Utiliie Internet			
Expand Use of Common Systems			
Enhance Surveillance and Communications			
2.5.2.1 Everett and Vicinity			
Consider Surveillance Cameras to Enhance WSP Center			
Consider CCTV From 164th SW to Broadway w/HOV Project			
2.5.2.2 Mount Vernon and Vicinity			
Consider Highway Advisory Radio			
2.5.3 Maintenance			
2.5.3.0 GENERAL			
Consider Comprehensive Maintenance Program			
2.5.3.1 Bellingham and Vicinity			
Address Rock-Fall Problems			

RATING GUIDELINES

Level of Support	Number of Barriers	Severity of Barriers
1 = High	1 = None	1 = Common
2 = Moderate	2=Few	2 = Limited Application
3 = Low	3 = Many/Several	3 = Experimental

Source: Parsons Brinckerhoff

APPENDICES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX A: STRAIGHT LINE MAPS OF CORRIDOR

Appendix A contains a reproduction of the Washington State interstate Guide, produced by the Washington State Department of Transportation. Shown on this set of schematic maps are rest areas, motorist information service signs locations, exit numbers, cross street names, parallel bike trails, state parks, visitor information centers, and other points of interest. This map represents conditions as of 1997, the last year WSDOT produced this map.

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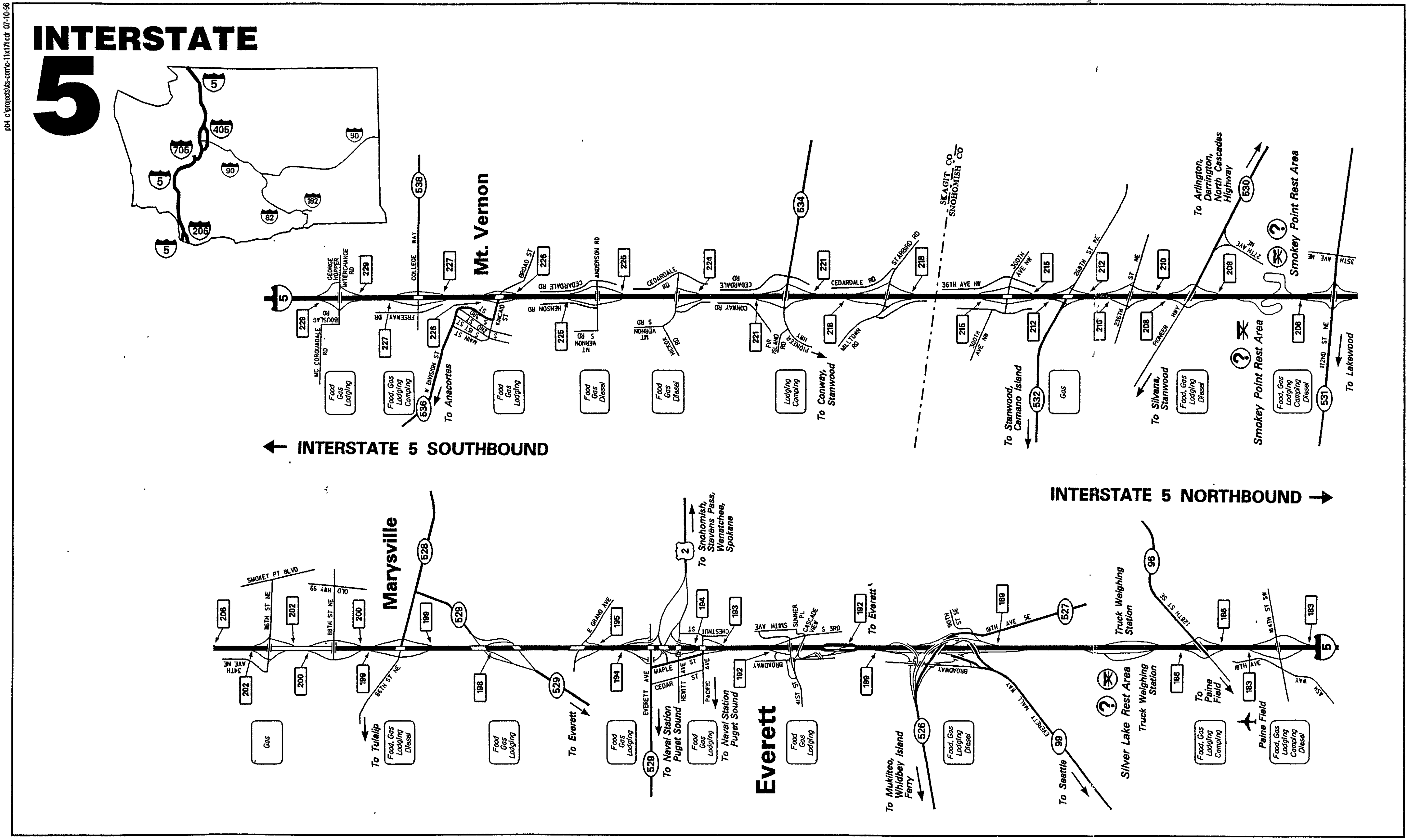
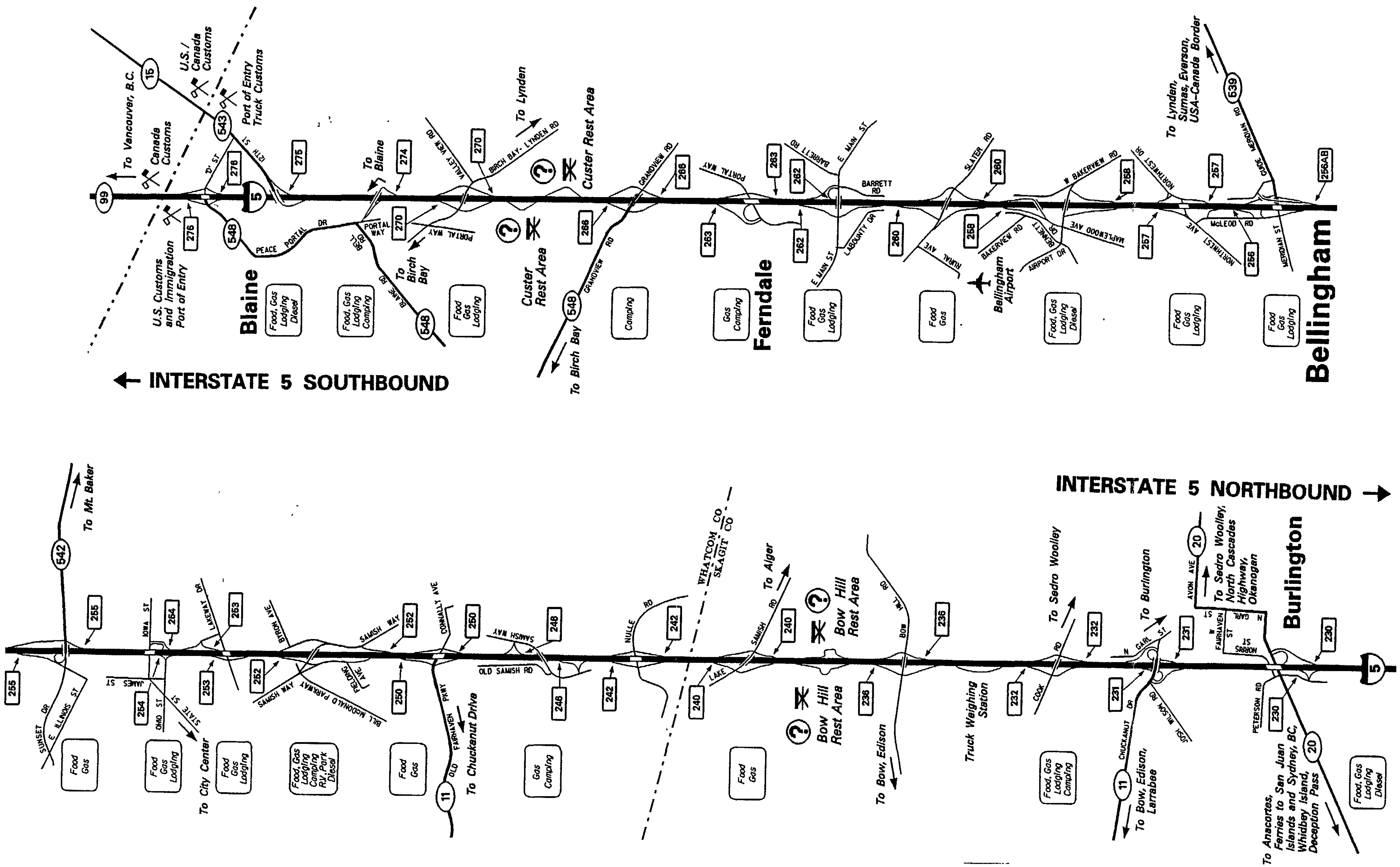


I-5 Corridor - 1 of 2
Corridor Needs Assessment
I-5 Seattle to Vancouver B.C.
ITS Early Deployment Program
FIGURE A-1a

INTERSTATE 5



I-5 Corridor - 2 of 2

Corridor Needs Assessment

I-5 Seattle to Vancouver B.C.

ITS Early Deployment Program

FIGURE A-1b

APPENDIX B: CORRIDOR TOUR MINUTES

SCOPE 1.1: *CORRIDOR TOURS*

Corridor tours will be conducted by the CONSULTANT's Project Manager and the appropriate members of the study team. These tours will consist of joint tours of each Region's area of jurisdiction, including the Regional Traffic Engineer, Maintenance Area Superintendent and the Washington State Patrol. Video tapes, road logs films and road inventory listings will be provided by WSDOT and be reviewed under this work element. The entire corridor will be driven and reviewed by the appropriate members of CONSULTANT team. Information obtained through these corridor tours will be collected in a series of meeting minutes, corridor notes and photo logs. This work element is the forerunner to the formal outreach effort in that it will assist in identifying participants for stakeholder meetings. Results will be included in Corridor Needs Assessment technical memorandum.

B.1 INTRODUCTION

A tour of the I-5 corridor was conducted on December 18th and 19th by key members of the study team. Regional field personnel from WSDOT familiar with the I-5 corridor attended these tours, sharing their local knowledge with the study team. Study team members included Eldon L. Jacobson - WSDOT Project Manager, Kern Jacobson - PB Project Manager, Ron Lewis - PB I-5 Corridor Manager and John O'Laughlin - PB Enforcement Specialist. Sergeant Dan Pemerl from the WSP Research and Development branch office also accompanied the team to offer insight into the State Patrol's efforts in this arena. Attending this tour providing local insight included the WSDOT Regional Traffic Engineers, the WSDOT Maintenance Area Superintendents and Washington State Patrol officers. Each jurisdiction was driven and reviewed by these team members. Information obtained through this corridor tour is shown in the following sections and subdivided by WSDOT maintenance areas.

These results have been reviewed with each of the participants to assure a reasonable assessment of observed conditions. The issues stated in these minutes will assist the team in focusing their efforts on what local officials view as their primary concerns. The intent of these minutes however, is not expected to be all inclusive of problems, but rather used as a snapshot to gather a general understanding of issues within the I-5 corridor. Statistics obtained through the accident analysis and the non-accident data summary and will be used in many cases to confirm and/or pinpoint trouble spots. This analysis is presented in the main body of the technical memorandum.

The tour minutes are divided into five sections: the WSDOT Regional Office, Everett and Vicinity, Mount Vernon and Vicinity, Bellingham and Vicinity, and the U.S. - Canada Border.

B.2 REGIONAL OFFICE - SHORELINE

ITS Early Deployment Program Corridor Tours
December 18, 1995
8:00 - 9:30
Washington State DOT Regional Office - Shoreline

Participants:

Eldon L. Jacobson, Washington State DOT
Les Rubstello, Washington State DOT
Mark Leth, Washington State DOT
Kurt Schleichert, Washington State DOT
Karl Westby, Washington State DOT
Ed Conyers, Washington State DOT
Pat Moylan, Washington State DOT
Les Jacobson, Washington State DOT
Dave McCormick, Washington State DOT
Dan Pemerl, Washington State Patrol
Kern Jacobson, Parsons Brinckerhoff
Ron Lewis, Parsons Brinckerhoff
John O'Laughlin, Parsons Brinckerhoff

Meeting Location:

15700 Dayton Avenue North, Seattle, WA.

Purpose:

The purpose of this ITS Corridor tour was for the Consultant Team to learn more about the critical transportation safety, efficiency, communication, enforcement, and maintenance issues faced in the field, and to discuss the potential for ITS application. Participants included Washington State Department of Transportation (WSDOT), the Washington State Patrol (WSP), and members of the Consultant Team.

Following a brief project overview by Eldon Jacobson, **WSDOT,** participants identified specific problem areas and discussed potential ITS applications. Information obtained during this session is summarized below and will be used in subsequent tasks of the ITS Early Deployment Program project.

ITS Issues and Opportunities:

Weather Systems Technology

- Area 5 has SSI computer. There is a WeatherNet station in Issaquah which provides daily forecasts. Existing weather stations provide information into WeatherNet.
- WSP weather information comes from WSDOT - and in-turn WSP provides feedback information to WSDOT

- University of Washington Professor Tom Seliga, Electrical Engineering, was identified as a source for Weather Systems Mapping information using Doppler Radar

Commercial Vehicle Operations

- WSDOT is currently working on a Smart Railroad crossing project that includes use of a GPS system for select trains. Contact the WSDOT Rail Branch in Olympia for more information
- Weigh-in-motion should be considered, contact Mark Hallenback, University of Washington for more information. The Ridgefield project costs approximately $400k for the scale, plus $400k for roadway improvements. Bow Hill may be a future candidate for application of this technology.
- Develop “smart RR crossings”

Traveler/Tourist Information

- Crime at rest stops is an issue
- Consider public/private initiatives to address crime along with traveler information services

Enforcement

- WSP is emphasizing public safety as well as law enforcement, which has resulted in expanded opportunities for coordination between WSP and WSDOT
- There is a need for coordination between WSP and WSDOT in the purchasing and use of equipment.
- Currently, the WSP has the only State-wide emergency communication system
- Video technology combined with a HERO type program should be considered for Transit/HOV enforcement
- Pursue enforcement enhancement opportunities to address speeding and HOV violations

Maintenance

An assessment of maintenance needs must address the maintenance of electronic equipment as well as mechanical equipment

- Consider a range of maintenance alternatives, including incorporating “self-diagnosis and self-maintenance” procedures
- Incorporate maintenance costs into the projects, and recognize that after the first + 5 years maintenance time and costs go up significantly
- Need to assess facility needs for monitoring and signing. Currently maintenance facilities are set-up for maintenance only. There needs to be a feedback mechanism so that information obtained through monitoring can be used to refine maintenance programming.

Communications

- Need better communication/fusion of available technical information (weather, surveillance and communication)

- Pay attention to how information flows, and how and by whom it is used
- The Internet provides one of the best means for communication for the WSP
- Sharing radio sites between WSP and WSDOT is already happening and is essential, need to continue and expand use of common systems
- There is a need to enable/enhance surveillance and communications for WSP and WSDOT maintenance. Consideration should be given to:
  - cameras operating with microwave communication technology.
  - permanent data stations for long-term data collection
  - variable message signing
- WSDOT's relationship with cities is important

Resources

- When considering adding or modifying electronic equipment, also need to identify the associated staffing requirements in terms of FTE's
- There is a need for an overall systems plan for prioritizing needs, identifying a phasing plan for implementation, cost estimating, conducting cost-benefit analysis, and allocating resources
- There is a need for WSDOT to coordinate with local jurisdictions such as:
  - City of Bellingham (mini ATMS system)
  - Ports
  - Freight operations
  - Regional rail planning
- Mark Hallenback, University of Washington, work on "Transparent Borders"

Other

- WSDOT staff are interested in receiving a copy of the Seattle to Portland study
- The "Great Master List" of project needs was mentioned. A copy was requested by the Consultant
- Need to address recurrent congestion problems north of Marysville
- Combine a rail detection system with WSDOT's GIS system
- Implement additional signal priority treatments

END

B.3 EVERETT AND VICINITY

ITS Early Deployment Program Corridor Tours
December 18,1995
10:00 - 13:00
Everett and Vicinity

Participants:

Eldon L. Jacobson, Washington State DOT
Dave McCormick, Washington State DOT
David Pierce, Washington State DOT
Dan Pemerl, Washington State Patrol
Chuck Jenkins, Washington State Patrol
Kern Jacobson, Parsons Brinckerhoff
Ron Lewis, Parsons Brinckerhoff
John O'Laughlin, Parsons Brinckerhoff

Meeting Location:

Standard Gas Station

Purpose:

The purpose of this ITS Corridor tour was for the Consultant Team to learn more about the critical transportation safety, efficiency, communication, enforcement, and maintenance issues faced in the field, and to discuss the potential for ITS application. Participants included the Regional Traffic Engineer, Maintenance Area Superintendent, the Washington State Patrol, and members of the Consultant Team.

Following a brief project overview by Eldon Jacobson, WSDOT, participants identified specific problem areas and discussed potential ITS applications. Information obtained during this session is summarized below and will be used in subsequent tasks of the ITS Early Deployment Program project.

ITS Issues and Opportunities:

Weather Systems Technology

- Fog is a common problem from Eastmont to mile post #208

Commercial Vehicle Operations

The truck weigh station at Everett is semi-dysfunctional due to short ramp design and frequent queue backup from the scales to the freeway mainline. When that happens the scale crew must close the station and bypass trucks until they can clear the queue. This problem can be remedied relatively easily and at relatively low cost by installing appropriate ITS-CVO technologies.

WSP state that WSDOT is investigating an alternative site for a new weigh station in the Marysville area.

Traveler/Tourist Information

- Registered non-profit volunteer organizations are allowed to provide coffee and snacks at rest stops with authorization from WSDOT Maintenance.
- Consider installing additional VMS signs near the Eastmont approaches
- Consider installing additional VMS at the Visitor Information Center at 128th
- Tulip festival traveler information is provided
- Rest area traffic backs up onto I-5 at 128th
- Consider providing travel information in partnership with private entity such as casinos (Harrah's)
- Consider an interchange at 188th

Enforcement

- Crime at rest areas **is** a problem
- Stolen cars are recovered at rest stops regularly
- Hewitt Avenue Trestle (SR 2), consider automated enforcement in construction areas
- A WSP station is located at 116th

Maintenance

- I-5 is the number one priority for snow removal within the maintenance area, up to four trucks are assigned for this task
- Bridge icing occurs at the I-5/SR 526 interchange, particularly for the eastbound to northbound movement. Consider ice detection and reduction systems

Communications

- The Marysville WSP station has a Computer Aided Dispatch System which provides electronic communications for Snohomish, Skagit, Whatcom, and Island counties. In addition, this WSP station communicates directly with the public over the counter and responds to phone inquiries (including 911 calls).
- Consider installation of field cameras and TV monitors for WSP control center
- Consider CCTV/data stations/fiber optics extension north from 164th Street Southwest to Broadway with HOV project. Second phase would extend from Broadway to SR 2 with additional HOV facilities. From SR 2 to Marysville include connections with WSP, lower intensity: slow-scan CCTV. This Early Deployment study will help determine priorities for implementation.

Resources

- **WSDOT** maintains a GIS based inventory of all VMS electronic facilities

Other

- The Arlington airport is at exit #206
- The Tulalip destination resort is located at mile post 202 on the west side of I-5

- WSDOT maintains informal coordination with the City of Everett. During the PM peak period, congestion occurs in the southbound direction in the vicinity of exit #189
- Community Transit stops at 116th to serve a park and ride lot

END

8.4 MOUNT VERNON AND VICINITY

ITS Early Deployment Program Corridor Tours
December 18, 1995
14:00 - 17:00
Mount Vernon and Vicinity

Participants:

Eldon L. Jacobson, Washington State DOT
Dave McCormick, Washington State DOT
Wayne Starck, Washington State DOT
Dan Pemerl, Washington State Patrol
Chuck Jenkins, Washington State Patrol
Kern Jacobson, Parsons Brinckerhoff
Ron Lewis, Parsons Brinckerhoff
John O'Laughlin, Parsons Brinckerhoff

Meeting Location:

From I-5 NB, take ramp to SR 530. Denny's Restaurant is on the right-hand side.

Purpose:

The purpose of this ITS Corridor tour is for the Consultant Team to learn more about the critical transportation safety, efficiency, communication, enforcement, and maintenance issues faced in the field, and to discuss the potential for ITS application in your area. Participants included the Regional Traffic Engineer, Maintenance Area Superintendent, the Washington State Patrol, and members of the Consultant Team.

The meeting began at Denny's Restaurant, near the southern boundary of the Washington State DOT Maintenance Area for a brief orientation, Participants then traveled the length of the Maintenance Area (mile post 208-231) together in a van. During the driving tour we identified specific problem areas and discussed potential ITS applications. Information obtained through this corridor tour is summarized below and will be used in subsequent tasks of the project.

ITS Issues and Opportunities:

Weather Systems Technology

- Consider temperature activated signs at bridge approaches to inform approaching motorists about possible icy conditions.
- Both north and southbound directions experience problems with black ice from mile post 210 north for approximately five miles. This results in run-offs into the median.

- WSDOT has experienced a small freezing problem along the fog line. They have implemented a corrective drainage control program which has been effective.

Commercial Vehicle Operations

- The overpass height of 14'4" entering the City of Mount Vernon are struck by trucks relatively frequently (3 to 4 times per year). An advanced warning system for overpass clearance is recommended.

Traveler/Tourist Information

- Community Transit provides transit service via 300th Street (exit 215) to serve existing park and ride lots. This area experiences heavy congestion in the early mornings and late afternoons.
- Special Tulip Festival signing is installed for the annual festival. WSDOT grants a permit for signs to be in place for a three week period. A total of twelve motorist information signs are used.
- There is limited advance signing for the North Cascades Highway (Hwy. 20)
- The effectiveness of static "watch for ice" signing is questionable
- Consider advance warning VMS for incident management
- Currently the outlet malls use VMS signing. Consider approaching the malls about the possibility of joint use of the VMS signs, i.e. add travel information
- The Skagit River bridge experiences icing problems

Enforcement

- Speeding is a concern particularly on hills
- A WSP patrol station is located on Bon-Edison Road

Maintenance

- Roadway icing occurs on the northbound on-ramp at mile post 208, and continuing up-hill to mile post 209. In the up-hill direction vehicles loose traction, in the down-hill direction skidding is a problem.
- The approach to the Anderson Road overpass (mile post 225) is a problem area. The speed limit is reduced, a lane is drooped, and icing occurs, resulting in median cross-overs.

Communications

- Currently no HAR in place .

Other

- The development of the "Truck City" truck stop at exit 212 has increased commercial vehicle movements

END

B.5 BELLINGHAM AND VICINITY

ITS Early Deployment Program Corridor Tours
December 19, 1995
9:00 - 12:00
Bellingham and Vicinity

Participants:

Morgan Balogh, Washington State DOT
Jim McDonald, Washington State DOT
Dave McCormick, Washington State DOT
Dan Pemerl, Washington State Patrol
Chuck Jenkins, Washington State Patrol
Kern Jacobson, Parsons Brinckerhoff
Ron Lewis, Parsons Brinckerhoff
John O'laughlin, Parsons Brinckerhoff

Meetina Location:

Washington State Patrol Station, Burlington, WA.

Purpose:

The purpose of this ITS Corridor tour is for the Consultant Team to learn more about the critical transportation safety, efficiency, communication, enforcement, and maintenance issues faced in the field, and to discuss the potential for ITS application; Participants included the Regional Traffic Engineer, Maintenance Area Superintendent, the Washington State Patrol, and members of the Consultant Team.

The meeting began at the Burlington Washington State Patrol Station, near the southern boundary of the Washington State DOT Maintenance Area for a brief orientation, participants then traveled the length of the maintenance area together in a van. During the driving tour we identified specific problem areas and discussed potential ITS applications. Information obtained during this corridor tour is summarized below and will be used in subsequent tasks of the project.

ITS Issues and Opportunities:

Weather Systems Technology

- British Columbia uses salt on their roadways. Some BC motorists may not be aware that salt is not used on I-5, and thus may not be prepared for roadway conditions.
- No snow & ice emphasis from +milepost 235 to Bow-Hill road. I-5 from Bow-Hill road to Bellingham is currently a CMA test area. CMA is applied based on weather service reports and forecasts. CMA is applied at a ratio of 30 gallons per lane mile.
- WeatherNet provides information for WSDOT
- Ice on I-5 is a problem in the vicinity of Lake Sammish, and also on curved sections of the roadway

- Heavy winds are common in the vicinity of Smith Road
- Icing is a problem on the Nooksack River Bridges
- I-5 north of Bellingham is considered a rural highway for purposes of snow removal, this also contributes to the different expectations of Canadian motorists

Commercial Vehicle Operations

- Problems identified with truck crossings of the border include:

  + inadequate holding lanes
  + passenger cars using the truck crossing
  + lack of adequate signing
  + volume of trucks continues to increase

- Consider operating the truck crossing as an exclusive facility for trucks. This approach would need to recognize the political problems with trying to restrict this crossing to trucks.
- Need to try to recapture some of the lost time associated with truck crossings

Traveler/Tourist Information

- Provide tourist information signing for Anacortes Ferry
- Rest areas are expensive to maintain
- Install surveillance cameras and post additional signing
- Provide advanced border crossing information to motorists

Enforcement

- In most areas of I-5 there is a median, but no barrier to prevent cross-over accidents resulting in head-on collisions from occurring. Consider installing barriers.
- In many cases the time required for a vehicle to cross-over the median is shorter than the perception-reaction time of on-coming motorists.
- Median landscaping with shrubs is an effective method of screening on-coming headlights particularly on curved sections of the roadway. However, they further obstruct on-coming cross-over traffic

Maintenance

- There are approximately 35 rock-fall incidents per year in the vicinity of Chuckenut Drive. Five years ago WSDOT installed jersey barriers to prevent falling rock from entering the roadway
- WSDOT maintenance budget for this area is $2.7M. The construction budget is $500k per biennium. During the past few years the construction budget has been used for rock-fall mitigation and wall repair.
- The Maintenance area has two truck mounted Variable Message Signs
- The old railroad bridges south of mile post 255 are too low, creating vertical clearance problems

- WSDOT has two blowers and crews totaling 8 people working on SR 542, access to the Mount Baker Ski area
- Deer on the roadway create a safety problem

Other

- This maintenance area extends from mile post 208 to the border
- Harrah's casino located on Bow Hill is now open for business
- Bellingham International Airport accommodates regularly scheduled jet traffic, which contributes to the growing demand at the facility
- The I-5 & SR 539 interchange experiences heavy congestion
- Birch Bay is experiencing rapid growth
- There is daily train service to & from Bellingham (north & south)
- The Lynden border crossing closes at midnight

END

B.6 CANADA BORDER

ITS Early Deployment Program Corridor Tours
December 19,1995
2:00 - 5:00
U.S. - Canada Border

Participants:

Keenan Kitasaka, BC MoTH
Max Walker, BC MoTH
Dan Pemerl, Washington State Patrol
Chuck Jenkins, Washington State Patrol
Kern Jacobson, Parsons Brinckerhoff
Ron Lewis, Parsons Brinckerhoff
John O'Laughlin, Parsons Brinckerhoff
Jim Schmidt, JHK & Associates
Steve Hayto, IBI Group
Mike Mah, City of Surrey
Bruce Agnew, Cascadia Project
Stephanie Bowman, Cascadia Project
Darryl Lavia, Customs Border Services Canada
Jan Brock, Customs Border Services Canada
Jay Brandt, U.S. Customs
Robert Koval, U. S. Customs
Randy Reid, U.S. Customs
Ken Peck, U.S. Customs
Bob Holliday, U.S. Customs
Morgan Balogh, Washington State DOT
Dave McCormick, Washington State DOT

Meeting Location:

9901 Pacific Highway, Blaine, WA.

Purpose:

The purpose of this ITS Corridor tour is for the Consultant Team to learn more about the critical transportation safety, efficiency, communication, enforcement, and maintenance issues faced in the field, and to discuss the potential for ITS application at the U.S./Canada border crossing. Participants included the Washington State DOT Regional Traffic Engineer, the Washington State Patrol, U.S. and Canada Customs, the Ministry of Transportation and Highways, Cascadia Project, local jurisdictions and members of the Consultant Team.

The meeting was held at the office of the Chief Inspector, Jay Brandt, of U.S. Customs. Information obtained during this corridor tours is summarized below and will be used in subsequent tasks of the project.

ITS Issues and Opportunities:

Kern Jacobson and Jim Schmidt began the discussion with an overview of the ITS Early Deployment Program project. Jim noted that in 1996, the U.S., Canadian and Mexican Customs Directorates will initiate the North American Trade Automation Prototype, 'NATAP' field tests to address the question, "how can the border crossing process be streamlined through electronic (paperless) processing"? The locations include three Mexican border sites, and two Canadian border sites (Buffalo and Detroit).

CASCADIA BORDER WORKING GROUP

Bruce Agnew continued the discussion with an update on border related activities of the Cascadia Border Working Group. The following, taken from a 10/20/95 Cascadia Border Working Group memo, are the key points raised by Mr. Agnew:

State funding for Maine border improvements: The Washington State Legislature earmarked $2.7 million in new state transportation funding to improve the Pacific Highway Crossing. Cascadia is working with the congressional delegation to find matching federal funds.

Congressional directive for PACE expansion in 7996: Language was included in the 1996 Appropriations bill directing the Immigration and Naturalization Service (INS) to work with the Cascadia Border Working Group to expand the PACE program using unencumbered PACE funds. The goal is to match Canadian initiatives.

Permanent authorization of PACE: The PACE program is set to expire in September 1996. Cascadia, in conjunction with the Washington delegation is seeking permanent authorization of the program with 75% of the funds ($300 to $400k) earmarked for local staffing, infrastructure and operational improvements. Cascadia is also seeking 20-30 new inspection positions in the 1997 budget for the Cascadia region. New passenger train service, immigration requirements for secondary inspections, Open Skies Agreement, and NAFTA are being cited as reasons for new positions.

Congressional funding for Blaine **and** *Point Roberts Expansion:* Congress is considering appropriations of $11 M and $3M to the General Services Administration for new border stations at Blaine/PacHwy and Point Roberts respectively.

Commercial Crossings: A NAFTA Prototype Agreement is under development to harmonize data, documents, electronic data interchange etc., between the U.S., Canada and Mexico. The goal is a single, simple multi-lingual system. Besides filing documents electronically in advance of clearance, carriers can also use transponders to help border inspectors speed cargo processing.

This is particularly important at the Blaine crossings because auto traffic volumes are down, but commercial traffic is up. It is becoming increasingly difficult to secure funding for major highway projects, however funding for ITS initiatives appears more readily available.

CAN PASS/Airport A new CAN PASS card (like a bank card) will be tested at Vancouver International Airport. This wallet-sized card will open an automatic gate, the traveler will wave their hand across a special screen which uses finger and palm prints to confirm identity of the card holder.

CAN PASS/PACE at Blaine: Revenue Canada has initiated new CAN PASS/PACE program at the Pacific Highway crossing in Blaine and Sumas/Huntingdon.

Commercial Vehicle Operations

UNITED STATES

- Commercial traffic is increasing in volume and is projected to continue to increase in the future
- U.S. Customs has automated air and ocean manifest systems and is engaged in pilot tests of rail automated manifests across the U.S. - Canadian border at Champaign, NY and Rainier, MN. While development of an automated land border truck manifest process had been anticipated, that activity has been indefinitely shelved to enable concentrated focus on development of the U.S. Customs' Automated Customs Environment architecture and information systems re-engineering.
- There are potentially significant short-term gains associated with electronic pre-clearance. The benefit of having information available to customs agents prior to the arrival of commercial vehicles would provide valuable time (and cost) savings opportunities. Database management, data formatting, and standardizing are key issues to be addressed. Brokers need information as early as possible to prepare paperwork for customs agents.
- U. S. Customs and American Presidents Line (APL) participated in a pilot project using RF transponders to verify outbound (export) border crossings to trigger required export system reporting. The transponders were installed on (BC bound) containers in Seattle and each transponder was then linked to the respective container manifest. An RFID reader installed on the side of the U.S. Customs building at the border read each container transponder ID and reported the container ID's back to APL which then triggered APL's export report filing to U.S. Customs. No errors were detected during the pilot test and, by filing timely reports, APL did not incur any export filing penalties - in contrast to the experience immediately before and again after the test was concluded..
- WSDOT has a demonstration project utilizing global positioning technology, and also has excellent mapping capabilities utilizing GIS. Both of these initiatives may be useful in support of electronic tracking of commercial cargo.
- Currently, the U.S. Customs does not have a means of sharing commercial manifests with Canadian Customs officials. The Trades Services Act of 1927 prohibits the sharing of commercial information with Canada.

- Currently approximately 95% of vessel, and the majority of air manifests arrive in electronic format.
- U. S. Customs at Blaine favor full container x-ray capability which costs approximately $3M
- There is potential for heavy southbound cargo traffic from the Delta Port which is scheduled for opening in 1997.
- The three planned weigh-in-motion locations within Washington State may provide some helpful information for the application of such a technology at border approaches.
- U. S. Customs uses NCIC (National warrants) and WASIC (local warrants) checks on individuals crossing the border.
- There are issues and obstacles associated with joint border enforcement, i.e., shared facilities and staffing. Obstacles to such arrangements include privacy issues codified in U.S. legislation (the Trades Services Act of 1927), the absence of jurisdictional authority outside of U.S. territory (and vice versa for Canadian custom officials).
- U. S. Customs mission is to facilitate legitimate travel, prevent illegitimate importation, and collect appropriate revenue . The Canadian Customs mission appears to remain more revenue driven.
- The GSA and U. S. Customs are acquiring and reconfiguring land for improvements at the Blaine truck crossing
- The Blaine truck crossing will reach saturation, at which point the options include expansion of the Lynden crossing or construction of a new crossing (in about 20 years). Currently, trucks must have a permit to use the Lynden crossing. Volumes are approximately 100 trucks per day.

CANADA

- Advanced information on cargo (line release) is used on approximately 50% of all northbound cargo crossing the border. Such information can be provided up to 72 hours prior to arrival, and must be provided at least 2 hours prior to arrival for processing.

PACE/Traveler/Tourist Infomation/General Border Crossing

UNITED STATES

- Blaine was recently selected as one of three participants on the northern border in a National Review Program for passenger vehicle primary processing. Currently, thirty percent of the passenger vehicles crossing the border use the Pace lane. Customs Headquarters has targeted a goal of 70% PACE lane usage, but the region believes that 50% usage is more realistic and achievable. U.S. Customs anticipates filling a position for a Customer Service agent whose primary functions will be to develop the PACE user market and act as a customer service advocate for PACE.

- U. S. Customs describes the premise of PACE as a “self-directed primary assessment’ whereby the motorist makes a determination and self-selects the appropriate action. The main objective of dedicated lanes such as PACE is to segregate and clear low risk travelers so that resources can be more focused on high risk travelers.
- U. S. Customs is currently installing licensing plate readers which have an 80% read-rate. Canadian Customs has had this capability since October 1994.
- U. S. Customs has established a goal of no more than a 30 minute delay at the border crossing, with a 25% northbound inspection rate
- Currently legal aliens cannot use the PACE lane. U. S. Customs believes that permitting legal aliens to use the PACE lane would result in the need for a second lane.
- Point Roberts is a potential site for an un-staffed PACE lane using license plate readers. There is currently an un-staffed customs station at Scoby Montana
- Current PACE legislation allows for charging up to $25 per person per year) - or - a maximum of $50 per household.
- WSDOT has plans to implement a data collection and remote video program in the vicinity of the Biaine border crossing.
- Ail buses use the Biaine truck crossing. Passengers on commercial buses disembark with luggage and proceed through Customs and immigration. Charter bus passengers are generally subject to less scrutiny, i.e. on-board questioning.

  Greyhound is interested in entering into a partnering carrier agreement, whereby advance passenger information would be made available to customs officials, similar to Amtrak and airlines, where manifests are faxed ahead.

CANADA

- The Ministry discussed the possibility of installing variable message signs on border approaches to advise motorists of potential crossing delay. in February 1996, an implementation plan will be completed. A key criteria for implementation is that enforcement must not suffer. Compliance Measures include:

  + Remote Video
  + interagency training
  + Reengineering
  + Port Quality improvement Council (PQIC) monitoring. The PQIC also developed a list of 79 recommended improvements to address border crossing issues.

- Canada’s new CAN PASS will be broader, will be multi-modal, may utilize biometrics, and will be implemented on the following schedule:

  + April 1996 - CAN PASS for small boat pre-approved traveler plan
  + April 1996 - CAN PASS for small aircraft

- March 1996 - Conversion to new mainframe computer equipped with Accelerated Commercial Release Crossings (ACROSS) capability will occur.

- Consider Internet application (web page) for real time travel data and PACE permit information. Currently, WSDOT has an operational web page, U. S. Customs and the BC Ministry of Transportation and Highways (MoTH) are interested in establishing web pages.

- Make better use of both the Canadian and U. S. public information officers

- Look for opportunities to improve the efficient movement of passengers by bus through the provision of advanced passenger information to customs officials, similar to Amtrak and airlines, where manifests are faxed ahead.

- City of Surrey has expressed a concern about the potential for cut-through traffic on local streets

END

APPENDIX C: NON-ACCIDENT DATA SUMMARY .

SCOPE 1.2: NON-ACCIDENT DATA SUMMARY

During this work element, the STATE shall gather and present existing information on transportation conditions in the corridor that identify and estimate the magnitude of transportation problems in the corridor. This assessment shall serve as a baseline for determining ITS needs and estimating the potential benefit of any recommended ITS applications.

information, provided by the State - see Section D, includes the following (unless unavailable):

- Forecasted Person Trips;
- Forecasted intercity Person Trip Origins and Destinations;
- Current and Forecasted Commercial Trips;
- Current and Forecasted Vehicle Volumes;
- Current and Forecasted Vehicle Classification;
- Roadside Assistance Calls;
- Number of Freeway Lanes (as an indicator of capacity);
- Current and Predicted Levels of Congestion;
- Weather Conditions;
- Programmed and Planned Highway improvements;
- Planned intercity Transit and Passenger Railroad improvements;
- Current and Planned ITS Programs and Projects; and
- Numerical and other data shall be summarized on a series of maps and charts to illustrate potential problem areas and transportation needs. For purposes of presentation, the i-90 corridor will be segmented by WSDOT Region.

The STATE will summarize data into a base map or other means that provides the CONSULTANT a format that is readily interpretable and suitable for presentation. This format will be collaboratively developed with the CONSULTANT. The base map will include such features as state routes, rivers, rest stops, weigh stations, information centers, WSDOT facilities, WSP facilities, train stations, transit facilities, ports, automated volume counting stations. and WSDOT District Boundaries. Base maps will be provided on 11 by 17 inch paper.

C.1 CORRIDOR DESCRIPTION

interstate 5 travels along the West Coast of the United States through the state of Washington ending at the Canadian Border Crossing. This route is a primary north/south corridor, serving transport, tourism and commuters in cities such as Seattle, Portland, and Los Angeles.

The focus of this study is on the portion of i-5 within Washington State, from the northern King County line (MP 177.76) to its terminus at the Canadian Border (MP 276.56) a total length of 98.80 miles or 159.0 kilometers. The i-5 corridor passes through or by the cities of Mountlake Terrace, Lynnwood, Everett, Marysviiie, Mount Vernon, Burlington, Bellingham, Femdaie, and Biaine. The study area crosses Snohomish, Skagit and Whatcom Counties.

Table C-l depicts the corridor county populations based on the 1990 census figures. The estimated 1995 and projected 2020 population are also shown in Table C-l. Anticipated population growth over the 30 year period from 1990 to 2020 ranges from 35% in King County to a high in Skagit County of 92%, with a statewide average of 56%.

Table C-1

I-5 County Population Statistics

County	**1990** US **Census**	**1995 Estimated**	2020 **Projected**
King •	1,507,305	1,613,600	2,030,700
Snohomish	465,628	525,600	837,000
Skagit	79,545	93,100	152,800
Whatcom	127,780	148,300	224,400
Statewide Total	4,866,663	5,429,900	7,610,100

• *While not part of the corridor study, King County is listed for comparison purposes.*
1990 and 7995 data courtesy of Washington State Association of Counties. 2020 data courtesy of Washington State Office of Financial Management.

Within the i-5 corridor as defined for this study, Snohomish County has the largest population. Snohomish County experienced the largest single-decade population increase in its history becoming the fastest growing county in Washington State during the 1980s. Snohomish County added 127,908 residents during this ten year period. Snohomish County is Washington State's third most populous county after King and Pierce Counties. For Snohomish County to attain a population of 837,000 by the year 2020, the population would have to grow at an average annual rate of 2.0%.

More than half of ail Whatcom County residents live in or near cities. in the first few years of the 1990s, unincorporated areas grew at a faster rate than cities. The most striking example was 1990 when the population rose by just over 2% in the cities, but rose by nearly 5% in unincorporated areas of Whatcom County. The balance shifts from year to year, thus, growth rates for the decade of 1990 are fairly evenly distributed between incorporated and unincorporated areas. For Whatcom County to attain a population of 224,400 by the year

2020, the population would have to grow at an average annual rate of 1.9%. Since 1990, however, the annual growth rate for the county as a whole has been estimated to average 2.9%.

C.2 CURRENT AND FUTURE TRANSPORTATION INFRASTRUCTURE

C.2.1 Highway System

The majority of i-5 consists of two lanes in each direction, with added lanes in Snohomish County. Table C-2 describes the geometric characteristics of I-5. The speed limits listed in Table C-2 have recently increased in urban areas to 60 MPH and in rural areas to 70 MPH. Figure C-1 illustrates the locations of rest areas and weigh stations along the i-5 corridor.

Tables C-3 through C-5 are a listing of the planned improvements for Snohomish, Skagit, and Whatcom Counties, and are categorized by service objectives. The three primary service objectives listed are: Mobility, Safety, and Economic initiatives.

Mobility solution types fail into several strategies including: System expansion, HOV/TSM/Transit & HCT, Further Study Needed, No Action, Other Efficiency improvements, Core HOV System, Urban Bicycle Connection. These mobility solutions are shown as either included in the Financially Constrained Plan or excluded from the Financially Constrained Plan.

Safety improvement solution types fail into the categories of Collision Reduction - High Accident Corridor, three Collision Prevention types including Risk reduction (run-off-road accidents), At Grade intersection improvements, and bringing facilities up to current interstate Standards. Many of these safety improvement are also intertwined with mobility programs.

Economic initiatives include strategies such as Ail weather road improvements, Truck System Completion, Vertical Clearance Restricted interstate Bridge improvements, Load Restricted Bridge improvements, Bicycle Touring Route improvements, and Proposed new rest areas.

Table C-2

I-5 Basic Geometry

I-5 Milepost (MP)		Description		Number of Lanes		Width of lanes (feet)		Median Width	Median Barrier		Speed Limit (Prior to March 1996)
Begin	End	From	To	SB	NB	SB	NB	(feet)	Type	Class.	MPH
177.76	178.37	King/Snohomish Line	228th St. SW	3	3	36	36	16-60	Varies	U5	55
178.37	180.75	228th St. SW	SR 524 Spur	3	3	36	36	100	Varies	U5	55
180.75	186.43	SR 524 Spur	SR 96/128th St. SW	3	3	36	36	100	None	U5	55
186.43	187.29	SR 96/128th St. SW	Entering Everett	3	3	36	36	Varies	None	U5	55
187.29	189.00	Entering Everett	MP 189 vicinity	3	3	36	36	300	None	U5	55
189.00	189.40	MP 189 vicinity	NB add lane	4	3	48	36	100	GR	U5	55
189.40	192.10	NB add lane	Lanes end	4	4	48	48	Varies	None	U5	55
192.10	192.59	Lanes end	Cascade View U/C	3	3	36	36	Varies	GR	U5	55
192.59	198.94	Cascade View U/C	Leaving Marysville	3-4	3-4	36-48		21-22	Jersey	U5	55
198.94	200.85	Leaving Marysville	Visitor Info. Center	3	3	36	36	40-58	None	U5	55
200.85	203.73	Visitor Info. Center	Rural Boundary	3	3	36	36	40	None	U5	65
203.73	209.35	Rural Boundary	Stillaguamish River	3	3	36	36	40	None	R5	65
209.35	223.90	Stillaguamish River	MP 224 Vicinity	3	3	36	36	76-540	None	R5	65
223.90	228.67	MP 224 Vicinity	Gore area vicinity	2	2	24	24	5-40	Jersey	U5	55
228.67	230.50	Gore area vicinity	Leaving Burlington	2	2	24	24	5-12	Jersey	U5	65
230.50	248.91	Leaving Burlington	Entering Bellingham	2	2	24	24	40-800	None	R5	65
248.91	250.21	Entering Bellingham	Speed limit change	2	2	24	24	80	None	U5	65
250.21	253.70	Speed limit change	Whatcom Creek	2	2	24	24	40-80	None	U5	55
253.70	255.00	Whatcom Creek	MP 255 vicinity	2	2	24	24	16	Jersey	U5	55
255.00	259.06	MP 255 vicinity	MP 259 vicinity	2	2	24	24	40	None	U5	55
259.06	260.47	MP 259 vicinity	Urban boundary	2	2	24	24	40-80	None	R5	65
260.47	264.58	Urban boundary	Leaving Ferndale	2	2	24	24	40	None	R5	65
264.58	276.20	Leaving Ferndale	SR 548 bridge	2	2	24	24	40-76	None	R5	65
276.20	276.38	SR 548 bridge	Begin third lane NB	2	2	24	24	100	None	R5	35
276.38	276.56	Begin third lane NB	International border	2	3	24	36	100	None	R5	35

Notes: Data derived from State Highway Log, Planning Report 1995. Short sections of median barrier or median guard rail, or changes in median width are not included. New high occupancy vehicle (HOV) lanes being built in South Snohomish County are not included. GR = Guard Rail. Jersey = Jersey shape Barrier.

I-5 REST AREA & WEIGH STATION LOCATIONS

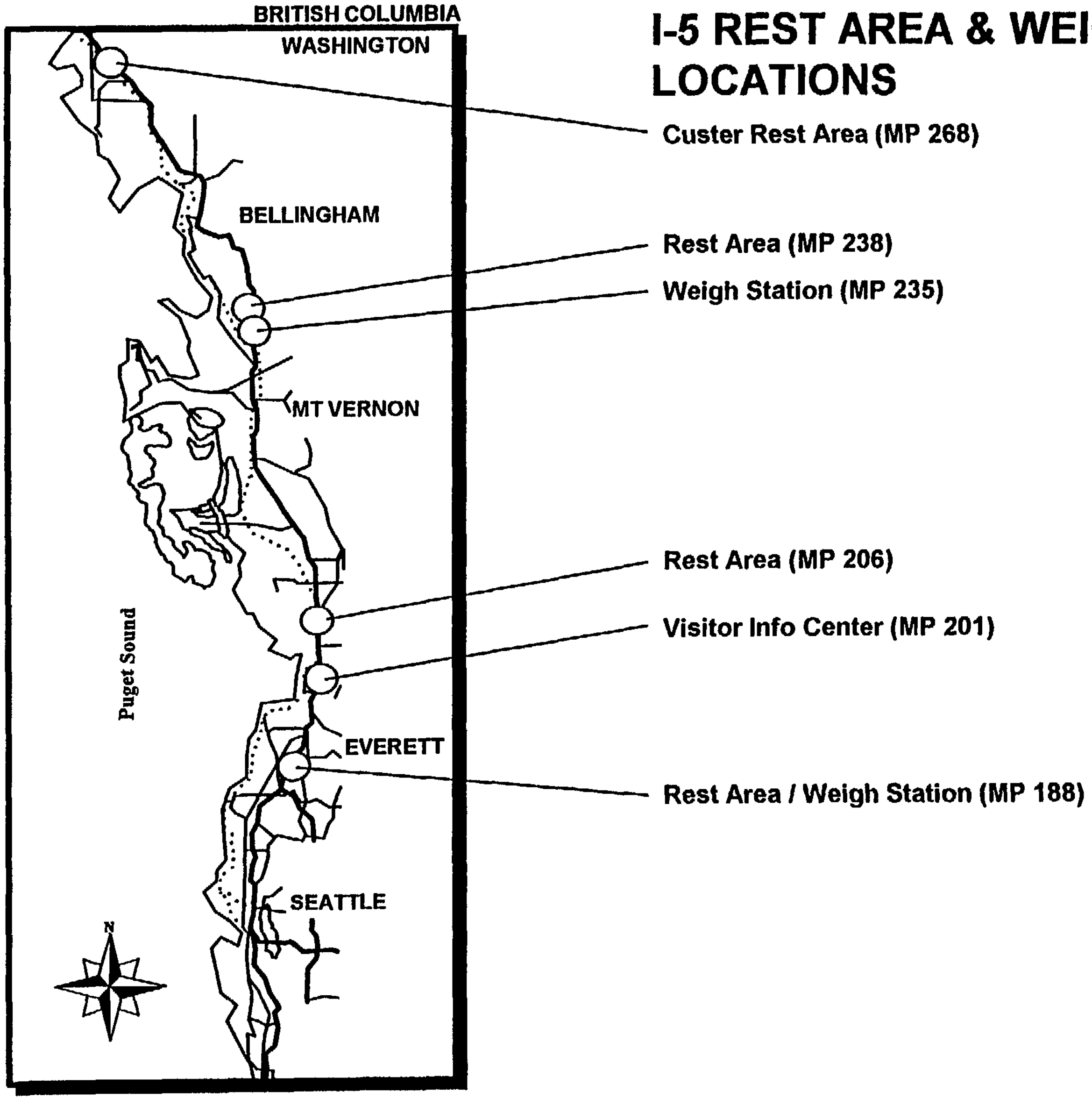


Table C-3

Summary of Planned Corridor Improvements I-5 Snohomish County		
IMPROVEMENT TYPE	**DESCRIPTION**	**LOCATION**
Mobility Improvements (Included in Financially Constrained Plan)	Interchange improvements and construct new Lynnwood #2 Park & ride lot.	MP 180.70 to MP 181.53
	Construct new Park & ride lot @ SR 526 Interchange	MP 188.53
	Ramp improvements, HOV lanes, Interchange improvements and TSM. Regional rail system and Park & Ride lots by other agencies.	MP 189.31 to MP 194.28
	HOV lanes. Park & Ride lots.	MP 194.28 to MP 199.58
	88th Street NE/Tulalip Interchange Coordination	MP 200.62
	172nd Street Interchange modifications; Widen structure to 5/6 lanes.	MP 206.10
Mobility - Core HOV Mobility Strategy	HOV lanes, SC&DI, TSM, Park & Ride lots, Regional rail system	MP 177.76 to MP 183.90
	HOV lanes, Interchange modifications, TSM, Regional Rail System	MP 183.90
Mobility - Urban Bicycle Strategies	Provide bike/ped crossing facility at Interurban Trail crossing of SR 524 (Lynnwood)	
Safety Improvements	Included in Mobility solution and cost estimate	MP 181.50 to MP 182.00
	Included in Mobility solution and cost estimate	MP 182.00 to MP 183.00
	Included in Mobility solution and cost estimate	MP 183.00 to MP 185.00
	Included in Mobility solution and cost estimate	MP 186.50 to MP 188.00
	Included in the Interstate safety estimates	MP 194.67 to MP 194.77
	Guardrail end treatments	MP 195.00 to MP 197.00
	Retrofit for Earthquakes, included in mobility estimates	MP 197.00 to MP 198.00
	Widen BR shoulders and guardrail end treatments	MP 198.00 to MP 202.00
	New signals. Guardrail end treatment	MP 202.00 to MP 204.00
	See 172nd Street Interchange modifications below. Guardrail end treatments.	MP 204.00 to MP 207.00
	New signals. Guardrail end treatment. Left Turn pockets. Illumination of bridge.	MP 207.00 to MP 210.00
	Widen Bridge for proper shoulder width and guardrail end treatments.	MP 210.00 to MP 211.50
	Guardrail end treatments	MP 214.50 to MP 216.50

Source: January 1995 State Highway System Plan

Table C-4

Summary of Planned Corridor Improvements **I-5 Skagit County**		
IMPROVEMENT TYPE	**DESCRIPTION**	**LOCATION**
Mobility Improvements (Excluded from Financially Constrained Plan)	NFS - widen to 6 lanes, rebuild bridges over Gages Slough Parallel road improvements. (Riverside Drive)	MP 225.64 to MP 229.60
Safety Improvements	Illumination	MP 218.00 to MP 219.00
		MP 219.00 to MP 220.00
	Guardrail end treatments and widen shoulders to proper width	MP 225.00 to MP 226.00
	Widen BR for proper shoulder width	MP 233.50 to MP 234.00
	Widen BR for proper shoulder width	MP 234.00 to MP 235.00
	Guardrail end treatments	MP 235.00 to MP 237.00
	Guardrail end treatments and widen shoulder to proper width	MP 238.00 to MP 240.00
	Left Turn Pockets	MP 240.00 to MP 241.00
Economic Initiatives	Replace bridge with less than 15'-6" on Trunk System (2nd Street UC 5/709)	MP 226.72

Source: January 1995 State Highway System Plan

Table C-5

Summary of Planned Corridor Improvements **I-5 Whatcom County**		
IMPROVEMENT TYPE	**DESCRIPTION**	**LOCATION**
Mobility Improvements (Included in Financially Constrained Plan)	Reconstruct Interchange, Replace U'xings, new ramps install signals, Widen to 6 lanes, new interchanges @ SR 539, Northwest Ave., Bakerview Rd. and Widen O'xing @ Slater Rd. I/C	MP 254.82 to MP 259.85
	Rebuild 4th Street Interchange and South Blaine Interchange, Extend PACE lane south, Rebuild shoulder	MP 273.86 to MP 276.56
Mobility Improvements (Excluded from Financially Constrained Plan)	Improve Samish Way Interchange	MP 251.55
	Reconstruct Overcrossing @ Lakeway Drive Interchange	MP 252.99
	Rebuild Iowa/Ohio Street Interchange	MP 253.62
	Improve Main Street (Axton Road) Interchange and construct new Park & Ride lot at Smith Rd	MP 261.52 to MP 262.57
	Signalize NB ramps at Birch Bay-Lynden Road Interchange	MP 270.24
Safety Improvements	Guardrail end treatments	MP 241.00 to MP 244.00
	Guardrail end treatment	MP 244.00 to MP 245.00
	Guardrail end treatments	MP 245.00 to MP 246.00
	Clear zone. Install guardrail.	MP 246.00 to MP 247.00
	Extend guardrail	MP 247.00 to MP 248.00
	Extend guardrail and guardrail end treatment	MP 249.00 to MP 250.00
	On-ramp signalization. New Signals. Guardrail end treatment. Clear zone.	MP 250.00 to MP 253.00
	Install guardrail	MP 259.00 to MP 261.00
	Widen Bridge for proper shoulder width and guardrail end treatment.	MP 263.00 to MP 264.00
	Guardrail end treatments.	MP 265.00 to MP 266.00
	Extend guardrail and guardrail end treatment.	MP 266.00 to MP 267.00
	Widen bridge for proper shoulder width. Guardrail end treatment. Illumination.	MP 273.00 to MP 275.00
Economic Initiatives	Replace bridge with less than 15'-6" on Trunk System (Alabama Street UC 5/814)	MP 254.26
	Replace bridge with less than 15'-6" on Trunk System (Milwaukee RR UC 5/816)	MP 254.47
	Replace bridge with less than 15'-6" on Trunk System (Nooksak R 5/828E)	MP 263.05

Source: January 1995 State Highway System Plan

C.2.2 Highway Motorist Information Signing

WSDOT is involved in installing signs along the roadsides that advertise services provided by businesses at locations near freeway interchanges. Businesses such as gas stations, motels and hotels, restaurants, and camping parks participate in the program. Table C-6 indicates how many motorist information signs (MIS) of this type are present. This does not include emergency signing such as for hospitals or police stations.

Table C-6

Number of MIS **Signs on I-5 by WSDOT Region**

Highway	MP Limits	WSDOT Region	Number of MIS
I-5	177.76 to 276.56	Northwest	113

Appendix A contains a reproduction of the Washington State Interstate Guide, produced by the Washington State Department of Transportation. Shown on this set of schematic maps are rest areas, motorist information service signs locations, exit numbers, cross street names, parallel bike trails, state parks, visitor information centers, and other points of interest. This map represent conditions as of 1991, the last year WSDOT produced this map.

C.2.3 Transit Systems

Four local transit agencies operate within the I-5 corridor. Community Transit (CT) and Everett Transit operate in Snohomish County. Skagit and Whatcom County each have one transit agency which are Skagit Transit and Whatcom Transit Authority (WTA) respectively. CT operates along I-5 throughout Snohomish County and has several park & ride facilities adjacent to the highway. CT also operates express bus service on I-5 to downtown Seattle and the University of Washington. Everett Transit serves only the city of Everett and does not use I-5 for transporting passengers. Skagit County operates along I-5 for a short portion in Mount Vernon. WTA operates from Blaine to Bellingham (MP 274 to MP 254) with one official Park-n-Ride in Ferndale at MP 262. The service, Dial-a-Ride, also operates frequently along I-5.

Other commercial bus service carriers which operate along I-5 include Trailways, Greyhound, and a variety of charter services. Amtrak also operates three buses daily between Seattle and Vancouver, B.C.

C.2.4 Rail Systems

The Burlington Northern Sante Fe railroad company has a single track main line with passing sidings that parallels I-5 from Everett to Vancouver, BC. From Everett south to Seattle, the mainline is double track.

Passenger rail service along the I-5 corridor includes daily Amtrak service from Seattle to Vancouver, BC. This route makes stops at the Amtrak stations located in Edmonds, Everett, Mt.

Mt. Vernon and Bellingham. Total trip length from Seattle to Vancouver, B.C. is approximately four hours.

A study entitled "High Speed Ground Transportation Study" was completed in October of 1992. This study examined both north-south and east-west corridors to determine the potential feasibility of High Speed Ground Transportation (HSGT) by the year 2020. Of the three alternative routes in the north-south corridor that were considered, only one was recommended for further study, the corridor which connects Vancouver, BC to Seattle, WA and Portland, OR. This corridor follows the same general path as I-5.

This corridor was assigned a "moderate to high" overall rating because of its adequate ridership potential, its moderate physical assessment and its good support for growth management. The implementation of HSGT service will require that numerous institutional, legislative, funding and technology issues be addressed.

C.2.5 Marine Facilities

There is much waterborne commerce along the I-5 corridor since it travels along the coast. Whatcom County has a deep-water port at Cherry Point along with additional port facilities in Bellingham and a harbor in Blaine. The Port of Bellingham's major seaport facility, Whatcom International shipping Terminal is located on Bellingham Bay. The Port of Bellingham owns and operates a large commercial and pleasure boat marina in Squalicum Harbor and a second marina at Drayton Harbor in Blaine. In 1993, the public Port facilities handled approximately 384,000 metric tons of cargo. Very little of the cargo moving through the Port of Bellingham moves via rail - virtually all of the Port's present cargo base moves directly by truck.

The Port of Everett has three principal cargo areas: East Waterway, the Hewitt Terminal and South Terminal. In addition, the Port of Everett has a thriving marina and substantial commercial and industrial users located in the Port harbor area. The Port of Everett handled approximately 1.2 million total tons of cargo in 1993. Major log export facilities exist at the Port of Everett and Port of Bellingham.

In Snohomish County, Washington State Ferries offers service between Edmonds and Kingston and between Mukilteo and Clinton. Skagit County Ferries provides ferry service to Guemes Island. Whatcom County provides ferry service between Lummi Island and Gooseberry Point carrying about 400,000 passengers per year. The Port of Bellingham operates the Bellingham Cruise Terminal (BCT) which serves the Alaska Marine Highway System ferries and commercial cruise ship lines. The BCT also provides passenger ferry service to the San Juan Islands and Victoria, BC.

C.2.6 Airport Facilities

There are five airports that can be accessed directly from I-5. Two of the airports, Bellingham International Airport and Blaine Municipal Airport, are located in Whatcom County. Two are also in Snohomish County - Arlington Airport and Paine Field Snohomish County Airport located southwest of Everett. Increasing congestion at Sea-Tat International Airport has led to a re-examination of Paine Field as a reliever facility for Sea-Tat. The remaining airport is Skagit Regional Airport. All serve passenger traffic while Bellingham is also a cargo handling airport. According to the 1991 Washington Ports and Transportation Systems Study, Bellingham more than doubled air cargo tonnage from 1986 to 1990.

C.2.7 Pipelines

Northwest Pipeline distributes gas to Washington's seven natural gas utilities. Its principal pipeline parallels I-5 from Vancouver, BC to Vancouver, WA. Crude oil moves via the Trans Mountain Pipeline, which connects Vancouver, BC with refineries at Cherry Point and Anacortes. This line supplies Washington refineries intermittently, e.g., when Alberta crude is cheaper than Alaska crude. The Olympic Pipeline Company moves refined products from the Cherry Point and Anacortes refineries to Oregon's Willamette Valley.

The only large pipeline project in the planning stages is the proposed Trans Mountain Pipeline which would transport crude oil from Low Point, 18 miles west of Port Angeles, to the Cherry Point and Anacortes refineries running under Puget Sound. The future of this proposal does not look promising because it is facing stiff opposition from environmental groups and the reception from refineries has been lukewarm.

C.3 TRAFFIC CONDITIONS

C.3.1 Existing Traffic Conditions

Table C-7 shows the daily GP volumes on I-5 for 1990 from the King County/Snohomish County border to SR 530 north of Marysville. Volumes are heaviest between the County border and Mountlake Terrace, dropping off slightly at 220th, peak again through Lynnwood, and then begin a downward trend, dropping off significantly after the SR 2 interchange.

Figure C-2 shows the average daily traffic volumes for 1994.

C.3.2 Future Travel Demand

Table C-8 shows the forecasted daily GP volumes on I-5 for 2010 from the King County/Snohomish County border to SR 530 north of Marysville. The volumes show the percentage increase from 1990 volumes. Volume characteristics are similar to those of 1990, with the addition of a third peak area. The highest volumes are between the King/Snohomish County border and Mountlake Terrace, dropping off slightly between there and south Lynnwood, and peaking again between the 196th Street exit and the I-405 interchange. Volumes then drop slightly again, peaking for a third time around the SR 2 interchange, and drop off significantly after that point. The forecasted 20-year increase in volumes ranges between 0.9 percent to 3.2 percent, with the highest rates of growth north of Marysville.

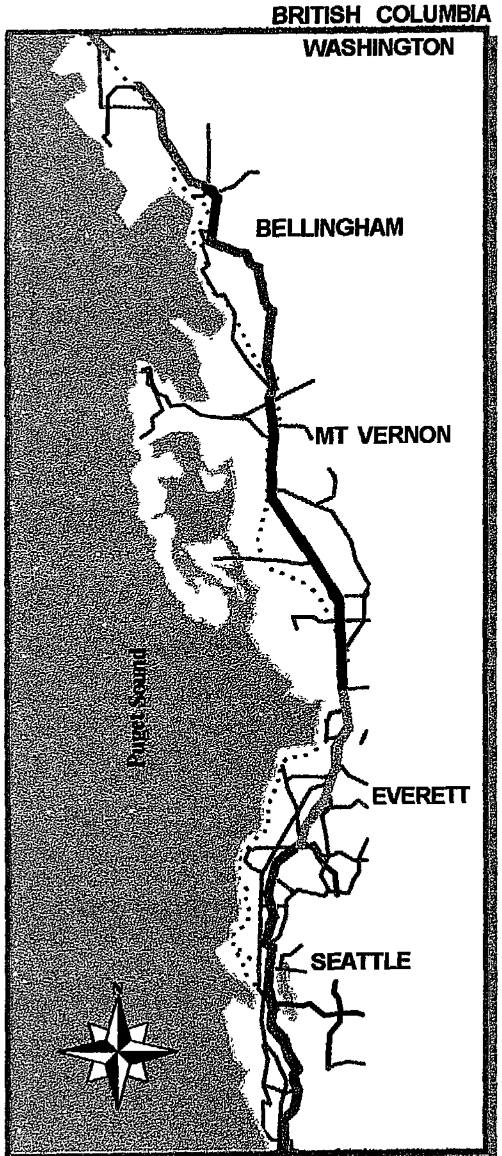
Table C-7

1990 Daily GP Volumes on I-5

Location 1	Location 2	Volumes
I-6 North of King/Snohomish Border		
Snoh/King Brdr	S. 236th St	77,621
S. 236th St	Snoh/King Brdr	77,644
S. 236th St	220th st SW	66,881
220th St SW	S. 236th St	66,050
I-6 North and South of I-405 Interchange		
44th Ave W	196th St SW	55,057
196th St SW	44th Ave W	55,384
196th St SW	I-405 I/C	68,773
I-405 I/C	196th St SW	69,119
I-405 I/C	164th St SW	72,650
164th St SW	I-405 I/C	72,899
164th St SW	128th St SW	67,917
128th St SW	164th St SW	68,189
I-6 North and South of SR 526 Interchange		
S of 112th St	SR 526	59,705
SR 526	S of 112th St	59,998
SR 526		61,995
	SR 526	62,288
I-6 North and South of SR 2 Interchange		
SofSR2	SR2	63,628
SR2	SofSR2	63,925
SofSR2		52,645
	SofSR2	53,104
I-6 North of Matysville		
88th St NE	116th Ave NE	37,199
116th Ave NE	88th St NE	37,658
116th Ave NE		34,033
	116th Ave NE	34,492
I-6 North and South of SR 530 Interchange		
200th St NE	SR 530 I/C	30,463
SR 530 I/C	200th St NE	30,922
SR 530 I/C		21,968
	SR 530 I/C	22,253

Source: *WSDOT, 1996*

Note: HOV volumes occur mostly during peak period. Volumes range between 100 and 400 vehicles per hour, which generally accommodates the movement of greater numbers of people than the GP lanes.



I-5 AVERAGE DAILY TRAFFIC VOLUMES (1994)

- Over 150,000
- 80,000 - 150,000
- 40,000 - 80,000
- 20,000 - 40,000
- 10,000 - 20,000
- 5,000 - 10,000

Table G8

2010 Forecasted Daily GP Volumes on I-5			
Location 1	**Location 2**	**Daily Volumes**	***Annual Increase From 1990***
I-5 North of King/Snohomish Border			
Snoh/King Brdr	S. 236th St	**96,876**	1.11%
S. 236th St	Snoh/King Brdr	**96,824**	1.10%
S. 236th St	22ottlstsw	***80,740***	0.95%
220th st SW	***S. 236th*** St	***79,523***	0.93%
I-5 North and South of I-405 Interchange			
44th Ave W	196th St SW	**74,869**	***1.55%***
196th St SW	***44th*** Ave W	***73,881***	***1.45%***
196th St SW	I-405 I/C	91,843	***1.46%***
I-405 I/C	196th St SW	90,719	***1.37%***
I-405 I/C	164th St SW	90,453	***1 10%***
164th St SW	I-405 I/C	89,815	***1.05%***
164th St SW	128th St SW	***83,730***	***1.05%***
128th St SW	164th St SW	***84,444***	***1 07%***
I-5 North and South of SR 526 Interchange			
S of 112th St	SR 526	**79,658**	***1.45%***
SR 526	Sof 112th St	***80,228***	***1.46%***
SR 526		***79,996***	***1.28%***
	SR 526	***80,327***	***1.28%***
I-5 North and South of SR 2 interchange			
SofSR2	SR2	***84,403***	***1.42%***
SR2	SofSR2	***84,839***	***1.43%***
SofSR2		***74,279***	***1.74%***
	SofSR2	***74,512***	***1.71%***
I-5 North of Marysville			
88th St NE	116th Ave NE	61,181	***2.52%***
116thAveNE	***88th*** St NE	61,481	***2.48%***
116th Ave NE		56,779	***2.59%***
	116th Ave NE	56,908	***2.54%***
I-5 North and South of SR 530 Interchange			
200th St NE	SR 530 I/C	**48,938**	***2.40%***
SR 530 I/C	***200th*** St NE	**48,198**	***2.24%***
SR 530 I/C		41,599	***3.24%***
	SR 530 I/C	41,374	***3.15%***

Source: WSDOT, 1996

Note: HOV volumes occur mostly during peak period. Volumes range between 800 and 2500 vehicles per hour, which generally accommodates the movement of greater numbers of people than the GP lanes.

C.4 OTHER EXISTING CONDITIONS

C.4.1 Unstable Slopes

The WSDOT Geology Branch maintains a list of unstable slopes that sometimes impact a roadway. The slopes are either above the roadway or below the roadway. Slopes that are above the roadway can slide onto the roadway, or can deposit loose rocks onto the roadway. Slopes that are below the roadway can settle, or erode causing the pavement to fail.

The major freeways in Washington State have generally been located in areas where unstable slopes are not normally a problem, compared to older, narrower roads in mountainous terrain. However, there are a few locations that have unstable slope problems along I-5.

The largest reported problem along I-5 is falling rocks that get deposited onto the roadway south of Bellingham between MP 244 and 249. Table C-9 lists the currently known unstable slope problems in increasing mileposts while Table C-10 lists the same areas in order of "score." A high "score," or total points, indicates a greater potential problem area. Figure C-3 shows unstable slope locations.

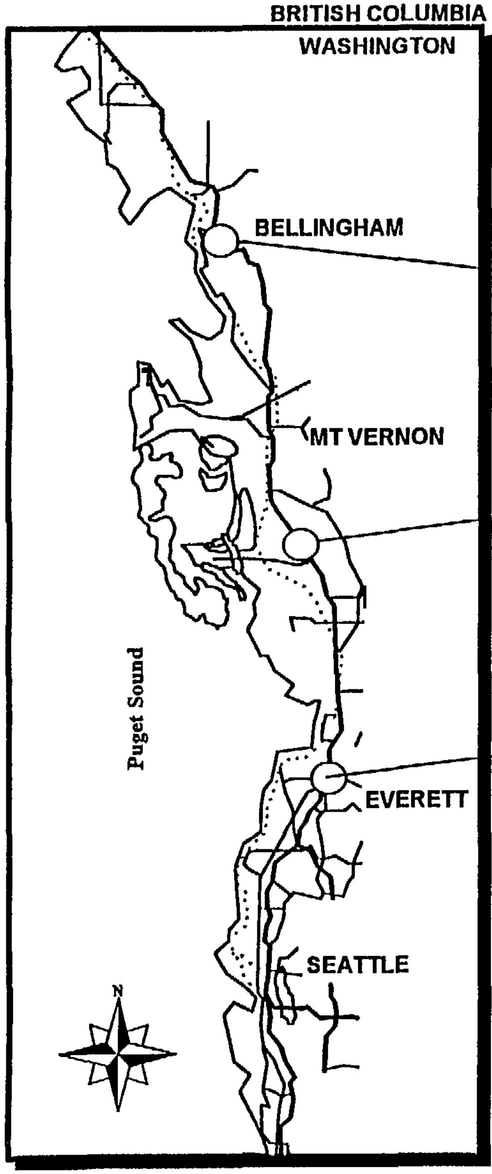
Table C-9

I-5 Unstable Slopes In Milepost Order				
STATE ROUTE	BEGIN MILEPOST	END MILEPOST	PROBLEM TYPE	TOTAL POINTS
5	189.90	189.95	SETTLEMENT	0
5	190.70	190.85	SETTLEMENT	354
5	190.89	190.95	SETTLEMENT	318
5	215.05	215.06	EROSION	0
5	215.06	215.07	EROSION	0
5	244.55	244.60	ROCKFALL	96
5	244.65	244.75	ROCKFALL	366
5	244.75	244.80	ROCKFALL	240
5	246.20	246.25	ROCKFALL	198
5	246.69	247.77	ROCKFALL	0
5	247.45	247.55	ROCKFALL	252
5	247.48	247.53	ROCKFALL	0
5	247.79	248.51	ROCKFALL	0
5	247.85	247.95	ROCKFALL	366
5	247.85	248.26	DEBRIS FLOW	0
5	247.95	248.05	ROCKFALL	438
5	248.05	248.20	ROCKFALL	294
5	248.20	248.40	ROCKFALL	366
5	248.26	248.43	ROCKFALL	0
5	248.40	248.50	ROCKFALL	384
5	248.65	249.00	ROCKFALL	0
5	248.70	248.90	ROCKFALL	252

Table C-10

I-5 Unstable Slopes In "Score" Order				
STATE ROUTE	BEGIN MILEPOST	END MILEPOST	PROBLEM TYPE	TOTAL POINTS
5	247.95	248.05	ROCKFALL	438
5	248.4	248.50	ROCKFALL	384
5	244.65	244.75	ROCKFALL	366
5	247.85	247.95	ROCKFALL	366
5	248.20	248.40	ROCKFALL	366
5	190.70	190.85	SETTLEMENT	354
5	190.89	190.95	SETTLEMENT	318
5	248.05	248.20	ROCKFALL	294
5	247.45	247.55	ROCKFALL	252
5	248.70	248.90	ROCKFALL	252
5	244.75	244.80	ROCKFALL	240
5	246.20	246.25	ROCKFALL	198
5	244.55	244.60	ROCKFALL	96
5	189.90	189.95	SETTLEMENT	0
5	215.05	215.06	EROSION	0
5	215.06	215.07	EROSION	0
5	246.69	247.77	ROCKFALL	0
5	247.48	247.53	ROCKFALL	0
5	247.79	248.51	ROCKFALL	0
5	247.85	248.26	DEBRIS FLOW	0
5	248.26	248.43	ROCKFALL	0
5	248.65	249.00	ROCKFALL	0

I-5 UNSTABLE SLOPE LOCATIONS



North Lake Samish Road (MP 244.55-248.70)

300th Street (MP 215.05, 215.06)

SR 9 / SR 527 / SR 526 (MP 189.90 - 190.89)

Range of Thresholds:
0 - 438

C.4.2 Weather Data

Current and programmed weather observing systems are defined below in Table C-11, which provides a summary of the 16 agencies which maintain and manage weather observing sites/systems within Washington State.

The TOTAL WX (weather) OBS (observations) category refers to aviation weather observations. They are more complete than other categories of observations and include the taking, recording, and archiving of visibility; air temperature and dew point/humidity; wind speed and direction; atmospheric pressure; cloud cover; and precipitation amount, type, and intensity to include measurement of snow depth. At larger observing sites, such as major airports, these observations also include significant comments such as "fog bank 3 miles NW, etc. Data from these sites is also taken hourly or more often, except at smaller airports where observations may be limited (e.g., daylight hours, etc.).

The LIMITED WX OBS category refers to observations which normally report air temperature and dew point/humidity, wind speed and direction, and precipitation amount and/or type. Most also include snow depth. Information from these sites is normally received on an hourly basis, but site data is usually limited to specific hours of the day. Data in some cases is also seasonal (such as for the NW Avalanche Center which operates most of its sites during winter months).

The SNOWTEL, or snow telemetry, sites report snowpack, air temperature and precipitation. These are primarily managed by the Natural Resources Conservation Service (formerly the Soil Conservation Service), but a few Corps of Engineer locations can also be considered SNOWTEL sites.

Table C-12 shows the number of weather observing sites operated by each agency. The number of sites within 5 miles of the corridors is also shown by Table C-12.

A number of other organizations use the data of the agencies depicted in Tables C-11 and C-12. For example, the Environmental Protection Agency (EPA) has its own **mobile** weather observing equipment, but uses the fixed-site observations from other agencies in its day-to-day operations.

Table C-11

I-5: Current and Programmed Weather Observation Systems

AGENCY	TOTAL WX OBS	LIMITED WX OBS	SNOTEL SITES	WINDS AND TEMPS	WINDS	PAVE-MENT TEMP
Army Corps of Engineers		X	X			
Bureau of Indian Affairs		X				
Bureau of Land Mgmt.		X				
City Seattle		X				
City Spokane		X				X
Dept. of Nat'l. Resources		X				
Dept. of Ecol.				X	X	
National Park Service		X				
Natural Resou. Con. Service			X			
NW Avalanche Center		X				
National Weather Svc.	X					
Puget Snd. Air Poll. Con. Auth					X	
TV Stations		X				
US Military (AF, NV, AR)	X					
US Coast Gd.		X				
US Forest Svc.		X				
WA State DOT		X				X

Table C-12

I-5: Number of Weather Observation Sites by Agency

AGENCY	TOTAL SITES	I-5 SITES
Army Cps. of Eng.	63	1
Bureau of Indian Af.	7	0
Bureau of Land Mgt	5	0
City of Seattle	2	0
City of Spokane	2	0
Dept. of Natural Resources	30	1
Dept. of Ecology	20	2
National Park Svc.	11 (seasonal)	0
Natural Resources Conserva. Service	50	0
NW Avalanche Ctr.	16 (seasonal)	0
National Weather Service	29	4
Puget Sound Air Poll. Con. Authority	16	1
TV Stations	39 (variable)	4
US Military (AF, etc)	4	0
US Coast Guard	11	1
US Forest Service	51 (seasonal)	0
WA State DOT	21	0,.1 planned

The specific locations for each existing and planned weather observation site for the I-5 corridor is listed below:

Location	Type of Data	Data Source	Remarks
1. I-5 @ SR-524	Limited Wx Obs & Pavement Temp	WSDOT	Planned Site
2. Lynnwood	Winds Only	Ecology/PSAPCA	
3. Paine Field, Everett	Total Wx Obs	NWS	
4. Hoyt Ave & 26th St., Everett	Winds Only	Ecology/PSAPCA	
5. Marysville	Winds Only	PSAPCA	
6. Arlington Airport	Total Wx Obs	NWS	
7. Burlington Airport	Total Wx Obs	NWS	
8. Sedro Wooley	Limited Wx Obs	DNR	
9. Sedro Wooley	Limited Wx Obs	Corps of Eng.	
10. Bellingham Airport	Total Wx Obs	NWS	
11. Bellingham Port	Limited Wx Obs	US Coast Guard	
12. Puget Sound Area (4 sites in corridor)	Limited Wx Obs	King 5 TV, Seattle	"school wx net"

As can be seen by this list, there are only four weather reporting sites along the I-5 corridor from the King County line to Bellingham which report total weather observations. The remainder of reporting stations are extremely limited in both content and frequency of weather observations. The King 5 TV sites are in schools surrounding the I-5 corridor from Seattle to Bellingham. These reporting stations are also very limited in operation, and this data is not currently available to corridor travelers except through the news broadcasts of King 5 TV. The Department of Ecology (DOE) and Puget Sound Air Pollution Control Authority (PSAPCA) sites report only wind information.

There are more than three times the number of weather reporting sites along the I-90 corridor as compared to the I-5 corridor. The location of both existing and planned weather observation sites along the corridor are illustrated in Figure C-4.

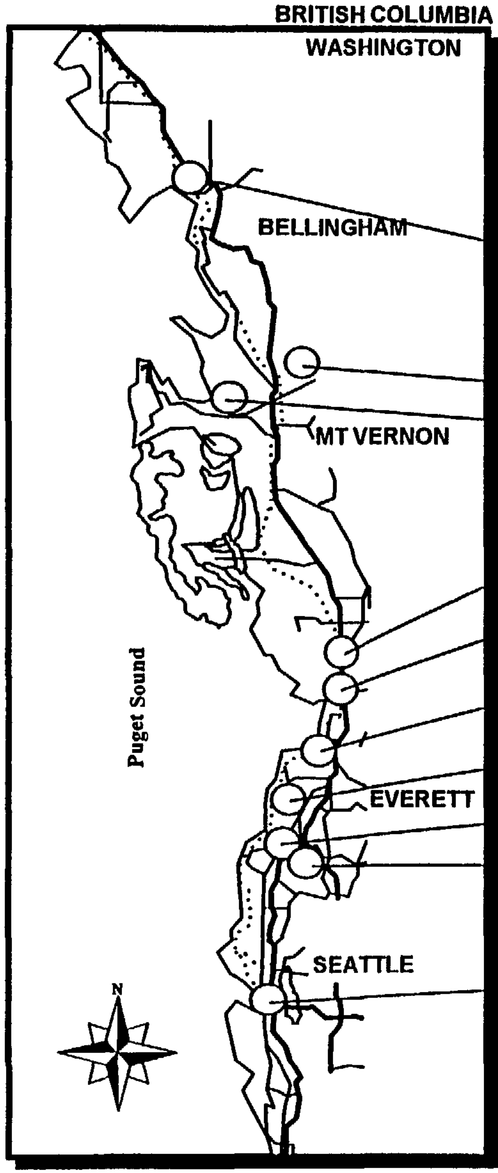
C.4.3 Assistance Calls and Citations

The Washington State Patrol (WSP) is the primary enforcement agency that operates on I-5. The WSP responds to phone calls requesting assistance, and provides tickets (citations) for violations of traffic law.

Two tables showing the number of calls for assistance and number of citations given between April 1995 and March 1996 are presented below. In Table C-13, the highest number of calls for assistance occurred near the Silver Lake and Smokey Point Rest Areas. Other locations with a high number of calls were near the Martha Lake, SR 99/526/527, and Starbird Road interchanges, and at the Bow Hill Rest Area.

In Table C-14 the highest number of citations occurred near the 300th Street NW and SR 530/534 interchanges. Other locations with a high number of citations were in Lynnwood, in the Martha Lake/128th Street/Silver Lake Rest Area, and at the Starbird interchange.

I-5 WEATHER OBSERVATION SITES (EXISTING & PLANNED)



- Bellingham Port (US Coast Guard - limited info)
- Bellingham Airport (NWS - Total)
- Sedro Wooley (2) (DNR/Corps of Eng. - both limited info)
- Burlington Airport (NWS - Total)
- Arlington Airport (NWS - Total)
- Marysville (PSAPCA - Winds)
- Hoyt & 26th (DOE/PSAPCA - Winds)
- Paine Field (NWS - Total)
- SR 524 (Planned) (WSDOT - limited info)
- Lynnwood (DOE/PSAPCA - Winds)
- Puget Sound Area (4) (King 5 TV - limited info)

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Table C-13

I-5 Assistance Calls									
MP	Number of Calls	MP	Number of Calls	MP	Number of Calls	MP	Number of Calls	MP	Number of Calls
178	842	198	1,312	218	2,038	238	2,245	258	1,750
179	1,626	199	1,450	219	475	239	237	259	308
180	1,259	200	959	220	537	240	389	260	770
181	1,753	201	666	221	1,970	241	219	261	308
182	1,481	202	997	222	327	242	695	262	610
183	1,617	203	442	223	301	243	178	263	265
184	943	204	455	224	413	244	204	264	174
185	985	205	460	225	1,047	245	155	265	262
186	2,310	206	585	226	1,025	246	316	266	405
187	1,581	207	3,572	227	757	247	161	267	382
188	3,080	208	690	228	347	248	269	268	929
189	2,230	209	300	229	388	249	240	269	978
190	1,632	210	794	230	530	250	403	270	799
191	1,786	211	458	231	402	251	229	271	402
192	1,780	212	1,099	232	368	252	1,284	272	244
193	1,040	213	1,687	233	142	253	761	273	221
194	1,035	214	399	234	199	254	953	274	251
195	1,196	215	723	235	469	255	1,290	275	107
196	1,094	216	441	236	786	256	1,241	276	123
197	1,373	217	481	237	429	257	957	277	54

Source: WSDOT, 1996

Table C-14

I-5 Citations									
MP	Number Given	MP	Number Given	MP	Number Given	MP	Number Given	MP	Number Given
178	264	198	525	218	663	238	290	258	581
179	592	199	448	219	125	239	49	259	70
180	345	200	175	220	197	240	57	260	158
181	617	201	126	221	928	241	64	261	76
182	490	202	144	222	83	242	78	262	119
183	439	203	77	223	64	243	43	263	67
184	174	204	88	224	52	244	46	264	37
185	233	205	85	225	397	245	15	265	69
186	871	206	101	226	344	246	32	266	106
187	529	207	113	227	224	247	19	267	34
188	728	208	130	228	78	248	50	268	231
189	449	209	79	229	84	249	39	269	345
190	434	210	176	230	110	250	85	270	289
191	570	211	125	231	93	251	37	271	166
192	381	212	410	232	80	252	495	272	81
193	226	213	1188	233	38	253	166	273	76
194	242	214	182	234	42	254	212	274	34
195	268	215	205	235	144	255	415	275	11
196	302	216	53	236	352	256	303	276	8
197	425	217	80	237	96	257	299	277	1

Source: WSDOT, 1996

C.4.4 TSMC Devices

TSMC devices along the I-5 corridor are listed by milepost in Table C-15.

Table C-15

Device Name	Device ID (New)	Device ID (Old)	Status E=existing P=proposed	State Route	Mile Post	Location
RC	ES-181R	ES 23.4	E	5	177.65	NE 205th - SB 5
CCTV	CCTV-182	n/a	P	5	177.75	NE 205th - SB 5
RC	ES-182R	ES 23.6	E	5	177.84	244th SW - SB 5
RC	ES-185R	n/a	P	5	178.12	SR104-NB
CCTV	CCTV-188	236TH SW	E	5	178.19	236th St SW
RC	ES-188R	ES 24	E	5	178.19	236th SW - SB 5
DS	ES-190D	n/a	E	5	178.6	228th SW
RC	ES-192R	ES 27	E	5	179.28	220th St SW - SB
CCTV	CCTV-192	n/a	P	5	179.28	220th St SW
RC	ES-193R	ES 27.2	E	5	179.3	220th St SW - NB
DS	ES-195D	n/a	E	5	179.9	213th St SW
CCTV	CCTV-195	n/a	P	5	179.9	212th St SW
DS	ES-196D	n/a	P	5	180.2	208th St SW
RC	ES-197R	ES 30	E	5	180.63	NB 44th Ave W - SB
RC	ES-198R	ES 31	E	5	180.63	SB 44th Ave W - SB
CCTV	CCTV-198	n/a	P	5	180.7	44th Ave W
HARS	HARS-199	n/a	E	5	181.14	NB @ Birch Way
DS	ES-199D	n/a	P	5	181.14	Birch Way
CCTV	CCTV-200	n/a	P	5	181.53	196th St SW
RC	ES-200R	n/a	P	5	181.6	196th SW - NB 5
DS	ES-201D	ES 34	E	5	182	192ND PL SW
HART	HART-203	n/a	E	5	182.5	Swamp Creek
RC	ES-203R	ES 35	E	5	182.5	SB SR 525 - SB 5
HUB	SWC	HUB-204	P	5	182.5	Swamp Creek Hub
RC	ES-204R	ES 36	E	5	182.5	NB SR 525 - SB 5
CCTV	CCTV-203	n/a	P	5	182.62	SR 525/SR 405
CCTV	CCTV-204	n/a	P	5	182.62	SR 525/SR 405
DS	ES-205D	n/a	P	5	182.65	SR 405
DS	ES-206D	n/a	P	5	183.25	178th St SW
VMS	VMS-205	n/a	P	5	183.5	SB @ 170th St SW
VMS	VMS-206	VMS 32	E	5	183.7	SB @ 170th St SW
CCTV	CCTV-205	n/a	P	5	183.87	164th St SW
CCTV	CCTV-206	n/a	P	5	183.89	164th St SW
RC	ES-207R	ES 39	E	5	183.89	164th SW - SB 5
RC	ES-208R	n/a	P	5	183.92	164th SW - NB 5
HARS	HARS-208	n/a	E	5	184.05	SB @ 162nd Pl SW

Device Name	Device ID (New)	Device ID (Old)	Status E=existing P=proposed	State Route	Mile Post	Location
DS	ES-209D	n/a	P	5	184.5	156th St SW.
CCTV	CCTV-209	n/a	P	5	185	148th St SW
DS	ES-210D	n/a	P	5	185	148th St SW
CCTV	CCTV-210	n/a	P	5	185.03	148th St SW
DS	ES-211D	n/a	P	5	185.5	140th St SW
CCTV	CCTV-211	n/a	P	5	185.62	137th St SW
DS	ES-212D	n/a	P	5	186	134th St SW
DS	ES-213D	ES 42	E	5	186.4	128th St SW
CCTV	CCTV-213	n/a	P	5	186.43	128th St SW
RC	ES-214R	n/a	P	5	186.5	128th SW - NB 5
DS	ES-215D	n/a	P	5	187	3rd Ave SE
CCTV	CCTV-216	n/a	P	5	187.6	117th St SE
DS	ES-216D	n/a	P	5	187.6	117th St SE
CCTV	CCTV-217	n/a	P	5	188	Weigh Station: NB
DS	ES-217D	n/a	P	5	188	Weigh Station
CCTV	CCTV-218	n/a	P	5	188.1	Weigh Station: SB
VMS	VMS-218	n/a	P	5	188.1	NB @ Weigh Station
HUB	BRD	HUB-218	P	5	188.53	SR 526 (Broadway Hub)
DS	ES-218D	n/a	P	5	188.6	100th St SE
RC	ES-219R	n/a	P	5	189.15	SR 526 - SB 5
RC	ES-220R	n/a	P	5	189.2	SR 99/SR 526-NB 5
RC	ES-221R	n/a	P	5	189.3	SR 527 - NB 5
CCTV	CCTV-220	n/a	P	5	189.34	SR 526
CCTV	CCTV-221	n/a	P	5	189.34	SR 526
RC	ES-222R	n/a	P	5	189.4	SR 99 - SB 5
DS	ES-223D	n/a	P	5	189.8	Larlin Dr
CCTV	CCTV-223	n/a	P	5	190.21	75th St SE
DS	ES-224D	n/a	P	5	190.3	75th St SE
CCTV	CCTV-224	n/a	P	5	190.4	Jackson Ave
DS	ES-225D	n/a	P	5	190.9	Lexington Ave
CCTV	CCTV-225	n/a	P	5	190.9	Lexington Ave
CCTV	CCTV-226	n/a	P	5	191.2	Franklin St
DS	ES-227D	n/a	P	5	191.55	Lowell Rd
CCTV	CCTV-227	n/a	P	5	191.55	Lowell Rd
CCTV	CCTV-228	n/a	P	5	192	SR 529
RC	ES-228R	n/a	P	5	192	SR 529 - SB 5
CCTV	CCTV-229	n/a	P	5	192.66	41st St SE
RC	ES-229R	n/a	P	5	192.75	41st SE - NB
CCTV	CCTV-230	n/a	P	5	193.1	36th St
DS	ES-230D	n/a	P	5	193.15	36th St
RC	ES-231R	n/a	P	5	193.6	Pacific Ave - SB
CCTV	CCTV-231	n/a	P	5	193.64	Pacific Ave

RC	ES-232R	n/a	P	5	193.7	SR 2 - SB 5
HUB	EVT	HUB-232	P	5	193.7	SR 2 (Everett Hub)
CCTV	CCTV-233	n/a	P	5	194.02	Everett Ave
Device Name	**Device ID (New)**	**Device ID (Old)**	**Status E=existing P=proposed**	**State Route**	**Mile Post**	**Location**
RC	ES-234R	n/a	P	5	194.15	SR 2 - NB
CCTV	CCTV-235	n/a	P	5	194.44	23rd St
RC	ES-236R	n/a	P	5	194.7	Marine View Dr - SB
CCTV	CCTV-236	n/a	P	5	194.81	Marine View Dr
CCTV	CCTV-237	n/a	P	5	195.2	4th St SE
DS	ES-237D	n/a	P	5	195.2	4th St SE
VMS	VMS-237	n/a	P	5	195.2	SB @ 4th St SE
CCTV	CCTV-239	n/a	P	5	196	12th St NE
DS	ES-239D	n/a	P	5	196	12th St NE
DS	ES-240D	n/a	P	5	196.6	20th St NE
CCTV	CCTV-241	n/a	P	5	197.2	Union Slough Br
DS	ES-241D	n/a	P	5	197.2	Union Slough Br
DS	ES-243D	n/a	P	5	197.9	Steamboat Slough Br
CCTV	CCTV-244	n/a	P	5	198.31	SR 529
RC	ES-244R	n/a	P	5	198.35	SR 529 - NB 5
RC	ES-245R	n/a	P	5	199.05	SR 528 - SB 5
HUB	MAR	HUB-245	P	5	199.12	SR 528 (Marysville Hub)
CCTV	CCTV-245	n/a	P	5	199.14	SR 528
RC	ES-246R	n/a	P	5	199.24	SR 528 - NB 5
DS	ES-247D	n/a	P	5	199.9	72nd St NE
CCTV	CCTV-249	n/a	P	5	200.5	88th St NE
DS	ES-249D	n/a	P	5	200.5	88th St NE
DS	ES-251D	n/a	P	5	201.2	98th St NE
CCTV	CCTV-252	n/a	P	5	201.7	100th Pl NE
DS	ES-253D	n/a	P	5	201.9	104th Pl NE
RC	ES-254R	n/a	P	5	202.37	116th NE - SB
CCTV	CCTV-254	n/a	P	5	202.47	116th St NE
RC	ES-255R	n/a	P	5	202.57	116th NE - NB
DS	ES-256D	n/a	P	5	203.1	128th St NE
CCTV	CCTV-257	n/a	P	5	203.74	136th St NE
DS	ES-257D	n/a	P	5	203.74	136th St NE
DS	ES-259D	n/a	P	5	204.5	148th St NE
CCTV	CCTV-260	n/a	P	5	205.05	156th St NE
DS	ES-260D	n/a	P	5	205.05	156th St NE
RC	ES-262R	n/a	P	5	205.98	172nd St NE - SB
CCTV	CCTV-262	n/a	P	5	206.08	172nd St NE
RC	ES-263R	n/a	P	5	206.18	172nd St NE - NB

APPENDIX D: ACCIDENT DATA SUMMARY

SCOPE F.3: ACCIDENT ANALYSIS

The STATE will provide accident data sorted and plotted in a manner developed collaboratively with the CONSULTANT, and within the STATE's readily available format, for the most recently available three years. The STATE will also provide other reference material necessary to interpret the data including Milepost/Node references, high accident listings, accident rates, and accident cost data.,

The collection, summary and presentation of accident data will be the responsibility of the STATE. The presentation of this data is the responsibility of the STATE. It will be the responsibility of the STATE to investigate and query the data in a manner that will provide meaningful results readily available for interpretation. The STATE will be responsible for the interpretation of the data.

The preparation of corridor base maps and other graphic presentation material will be produced by the STATE under this work element. A clear presentation of this data will assist in understanding trends, critical regions or other "hot spots". High accident spot locations and segments that experience particular accident trends will be documented. High frequency accidents areas will be analyzed as to the effect of adverse roadway conditions such as night-time visibility, inclement weather, pavement condition, or for other specific criteria. Other patterns including high number of truck roll-over, rear-end, head-on, or fatal collisions will also be examined as these typically have a high cost associated with them in terms of delay, liability and property damage. These areas that could be enhanced through ITS strategies will be identified and examined thoroughly in later work elements.

D.1 INTRODUCTION

Various types of accidents were investigated for the stretch of I-5 being studied in this project. WSDOT's accident data base can generate reports based on whether the accident location is within an urban or rural area. Generally, since traffic volumes tend to be higher in urban locations, total traffic accidents are higher in urban areas than in rural areas.

When looking at accident data, it is good to keep in mind that the data is based on reported accidents. Almost all serious accidents are reported, but many minor accidents are not reported, and thus do not get recorded in the accident data base.

The following tables reference data in either half mile or mile segments. When a milepost (MP) location is indicated, the reader must understand it covers the following half mile or full mile section of freeway. For example, if MP 206.0 is listed, it is actually referring to the stretch of highway from MP 206.00 to MP 206.49. If MP 204 is listed, it is actually referring to the stretch of highway from MP 204.00 to MP 204.99.

The following tables list the freeway segments that have the highest number of accidents in the corridor for rural and urban areas. Comments: The injury and fatality accidents tend to parallel the total accidents. So the higher the total number of accidents, the higher the number of injury and fatality accidents.

The following I-5 data is based on 9,818 reported accidents between January 1, 1990, and June 30, 1995 (five and a half years) from MP 177.76 to MP 276.56.

D.2 TOTAL ACCIDENTS

The locations with the highest number of rural and urban accidents are listed by MP in Tables D-l and D-2. High accident locations in rural and urban areas are illustrated in Figures D-l and D-2.

Table D-1

I-5 Rural Accidents		
MP	**Count**	**Location Description**
206.0	96	SR 531 Smokey Point Interchange vicinity
208.5	62	SR 530 Interchange vicinity
231.0	50	SR 11 Interchange vicinity
232.5	50	Cook Road Interchange vicinity
246.0	56	Samish Highway Interchange vicinity
260.0	45	Slater Road bridge vicinity
262.5	45	Axton Road Interchange vicinity
263.0	56	Nooksack River bridge vicinity
276.0	49	SR 548 Interchange vicinity

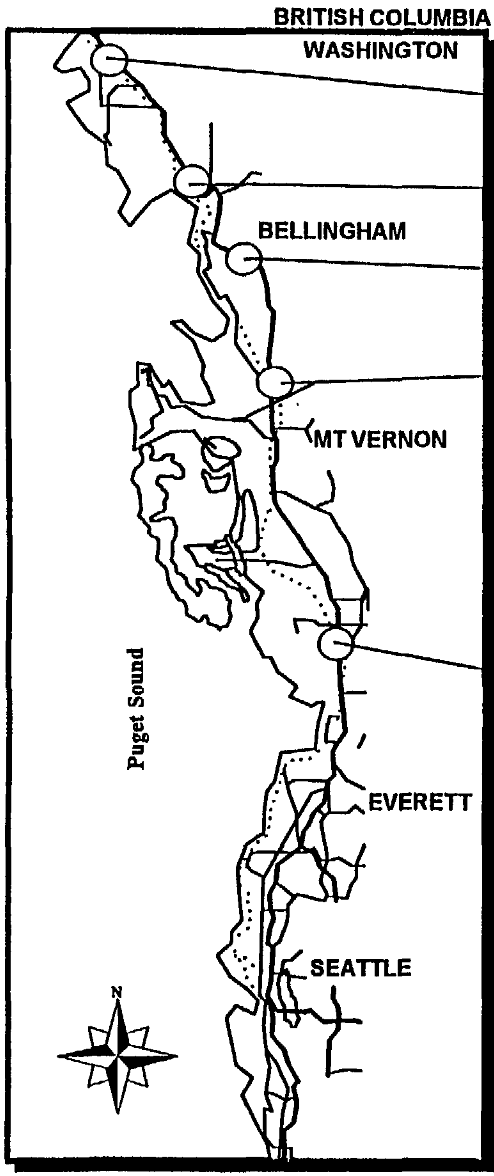
N=2,349 Average repotted accidents per half mile segment = 19.41

Table D-2

I-5 Urban Accidents		
MP	**Count**	**Location Description**
179.0	364	220th Street SW Interchange Vicinity
181.5	408	SR 524 Interchange Vicinity
183.5	375	164th Street SW Interchange Vicinity
186.0	271	SR 96/128th Street SW Vicinity
189.0	286	SR 99 and SR 527 Interchange Vicinity
192.5	263	BNSF Railroad Bridge Vicinity
193.5	227	SR 2 Interchange Vicinity
194.0	153	SR 2 Interchange Vicinity
199.0	184	SR 528 Bridge Vicinity
226.0	106	SR 536 Interchange Vicinity
256.0	194	SR 539 Interchange Vicinity

N=7,469 Average reported accidents per half mile segmenf = 76.21

I-5 RURAL HIGH ACCIDENT LOCATIONS



SR 548 (MP 276)

Slatter Road Bridge / Axton Road / Nooksack River Bridge (MP 260/262.5/263)

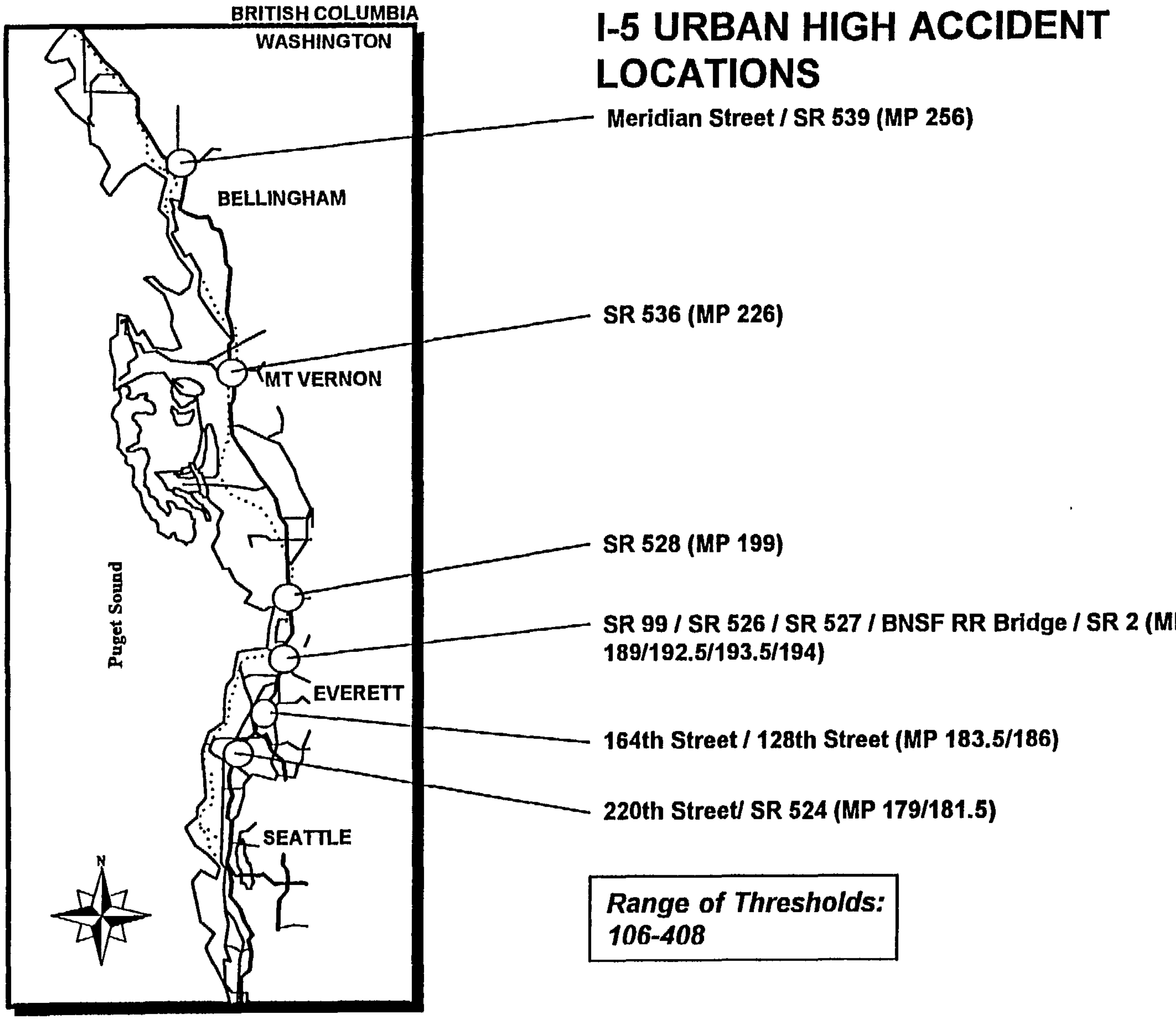
Samish Highway (MP 246)

SR 11 / Cook Road (MP 231/232.5)

Smokey Point / SR 530 (MP 206/208.5)

Range of Thresholds: 45-96

I-5 URBAN HIGH ACCIDENT LOCATIONS



Range of Thresholds: 106-408

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D.3 INJURY AND FATALITY ACCIDENTS

The locations with the highest number of rural and urban injury and fatality accidents are shown by milepost in Tables D-3 and D-4. Injury and fatality accident locations in rural and urban areas are illustrated in Figures D-3 and D-4.

Table D-3

I-5 Rural Injury and Fatality Accidents					
MP	**Count**	**MP**	**Count**	**MP**	**Count**
206.0	51	232.5	23	260.0	18
208.5	31	245.5	19	263.0	21
221.0	20	246.0	23	276.0	15

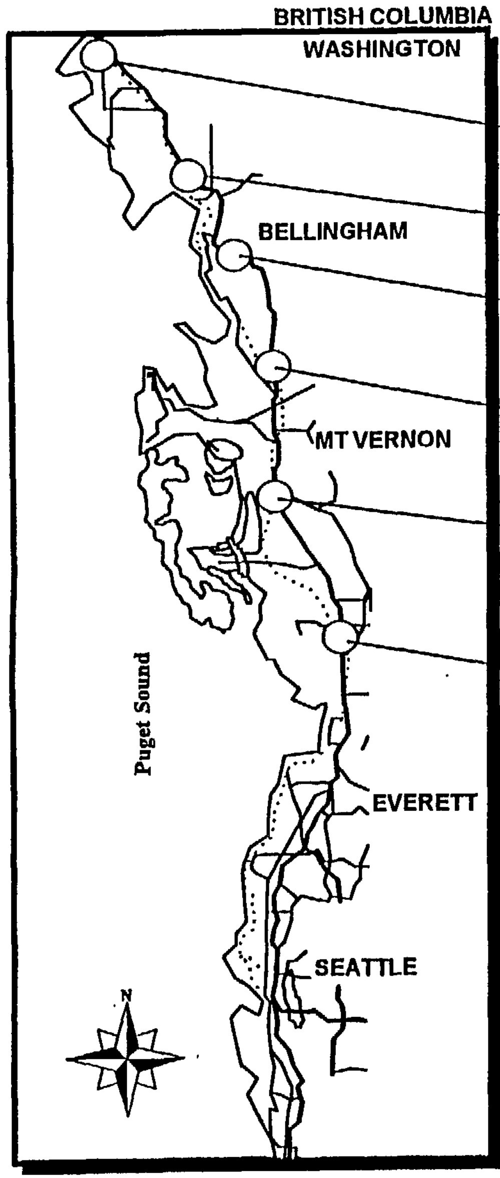
N=992

Table D-4

I-5 Urban Injury and Fatality Accidents					
MP	**Count**	**MP**	**Count**	**MP**	**Count**
179.0	177	189.0	116	198.5	65
181.5	225	192.5	99	199.0	82
183.5	203	193.5	91	202.0	51
186.0	104	194.0	71	256.0	89

N=3,392

I-5 RURAL INJURY & FATALITY ACCIDENT LOCATIONS



- Blaine (MP 276)
- Slatter Road / Nooksack River Bridge (MP 260/263)
- North Lake Samish (MP 245.5/246)
- Cook Road (MP 232.5)
- SR 534 (MP 221)
- Smokey Point / SR 530 (MP 206/208.5)

Range of Thresholds: 15-51

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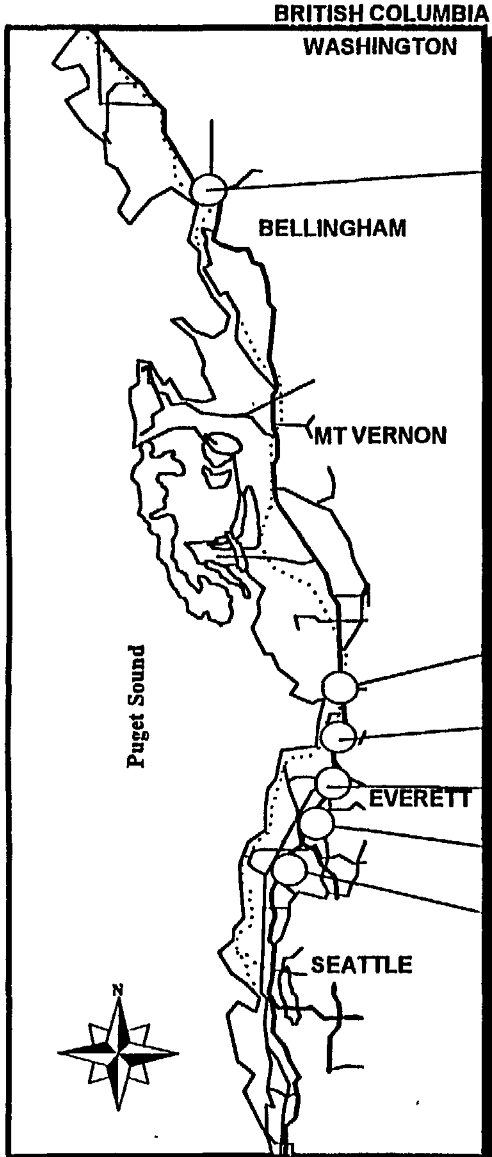
I-5 URBAN INJURY & FATALITY ACCIDENT LOCATIONS



Meridian Street / SR 539 (MP 256)

SR 529 / SR 528 / Marshall Road (MP 198.5/199/202)

41st Street / Pacific Avenue / SR 2 (MP 192.5/193.5/194)

SR 99 / SR 526 / SR 527 (MP 189)

164th Street / 128th Street (MP 183.5/186)

220th Street / SR 524 (MP 179/181.5)

Range of Thresholds: 51-225

D.4 ACCIDENTS INVOLVING HAZARDOUS MATERIALS

All rural and urban accidents involving hazardous materials are shown by milepost in Tables D-5 and D-6.

Table D-5

I-5 Rural Accidents Involving Hazardous Materials					
MP	**Count**	**MP**	**Count**	**MP**	**Count**
203.0	1	**237.0**	1	**244.0**	1

N=3

Table D-6

I-5 Urban Accidents Involving Hazardous Materials					
MP	**Count**	**MP**	**Count**	**MP**	**Count**
177.0	1	188.0	1	224.0	1
179.0	1	194.0	1	225.0	1
183.0	1	195.0	1	257.0	1

N=9 Comments: Reported accidents involving hazardous materials are very infrequent.

D.5 ACCIDENTS INVOLVING ICE ON ROADWAY

The locations with the highest number of rural and urban accidents involving ice on the roadway are shown by milepost in Tables D-7 and D-8, and located in Figures D-5 and D-6 for rural and urban areas.

Table D-7

I-5 Rural Accidents Involving Ice on Roadway					
MP	**Count**	**MP**	**Count**	**MP**	**Count**
204.0	9	233.0	8	246.0	15
209.0	18	239.0	9	263.0	15
210.0	11	240.0	8	265.0	12
216.0	12	245.0	8		

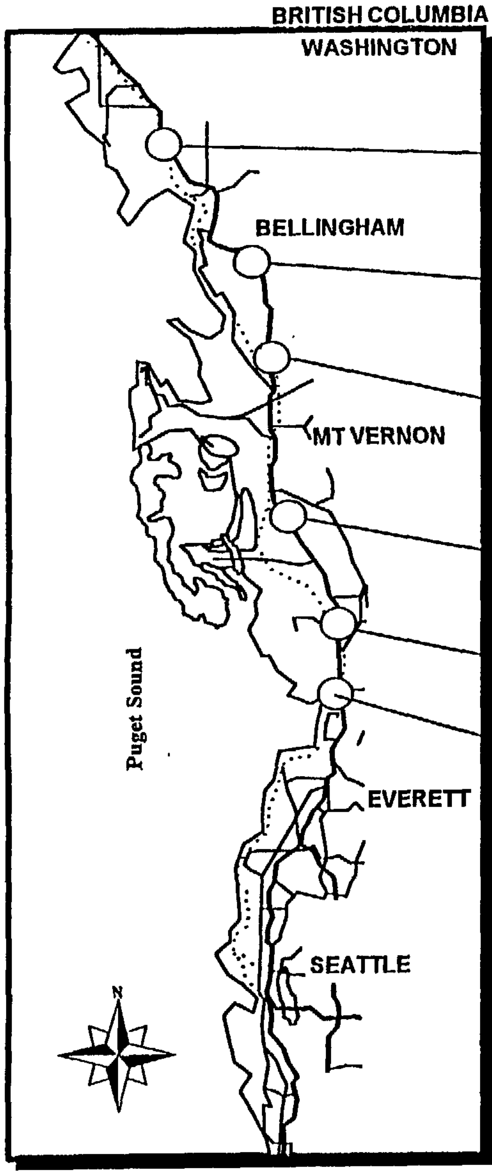
N=265

Table D-8

I-5 Urban Accidents Involving Ice on Roadway					
MP	**Count**	MP	**Count**	**MP**	**Count**
179	17	189	25	253	12
180	27	193	18	256	11
182	29	197	24		

N=326

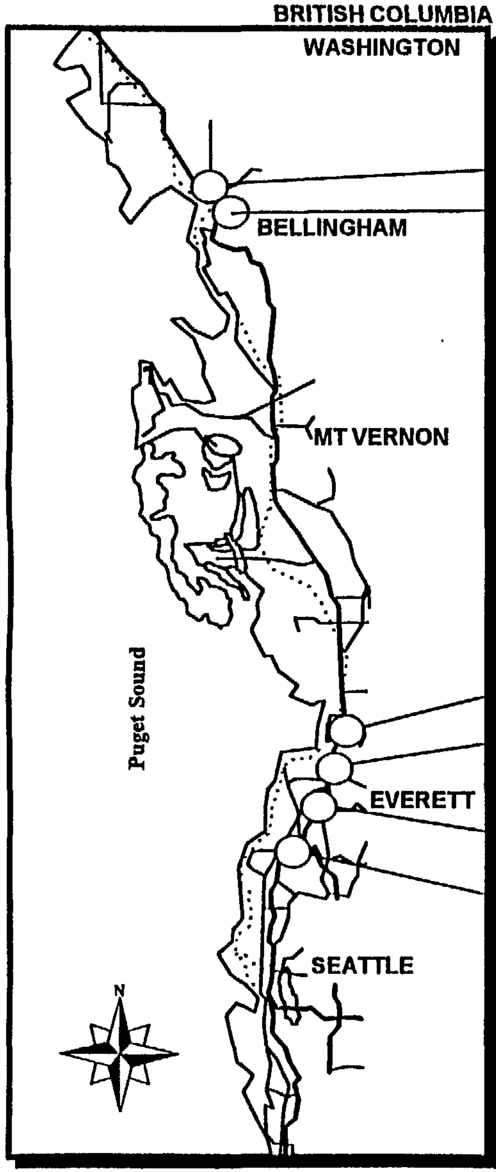
I-5 RURAL ACCIDENTS INVOLVING ICE ON ROADWAY LOCATIONS



- Ferndale / Grandview Road (MP 263/265)
- Lake Samish Road / South Lake Samish Road / North Lake Samish Road (MP 239/240/245/246)
- North of Cook Road (MP 233)
- Between 300th Street & Starbird Road (MP216)
- SR 530/236th Street (MP 209/210)
- Marshall Road/Smokey Point/SR 530/236th Street (MP 204)

Range of Thresholds: 8-18

I-5 URBAN ACCIDENTS INVOLVING ICE ON ROADWAY LOCATIONS



Meridian Street / SR 539 (MP 256)

Lakeway Drive (MP 253)

North of Grand Avenue (MP 197)

Pacific Avenue (MP 193)

SR 99 / SR 527 / SR 526 (MP 189)

220th Street / I-405 / SR 525 (MP 179/180/182)

Range of Thresholds: 11- 29

D.6 ACCIDENTS INVOLVING WET ROADWAY

The locations with the highest number of rural and urban accidents involving wet roadways are shown by milepost in Tables D-9 and D-10.

Table D-9

I-5 Rural Accidents Involving Wet Roadway					
MP	Count	MP	Count	MP	Count
206.0	22	235.0	14	265	17
208.0	21	246.0	16	276	15
231.0	16	262.0	14		
232.0	15	263.0	21		

N=477

Table D-10

I-5 Urban Accidents Involving Wet Roadway					
MP	Count	MP	Count	MP	Count
179.0	113	183.0	124	193.0	117
180.0	94	186.0	94	194.0	84
181.0	151	189.0	137	256.0	69
182.0	101	192.0	104		

N=2,079

D.7 ACCIDENTS IN CONSTRUCTION ZONES

The locations with the highest number of rural and urban accidents in construction zones are shown by milepost in Tables D-l 1 and D-12.

Table D-l 1

I-5 Rural Accidents in Construction Zones					
MP	Count	MP	Count	MP	Count
207.0	7	233.0	11	240.0	9
232.0	12	237.0	7	241.0	9

N=130

Table D-12

I-5 Urban Accidents in Construction Zones					
MP	Count	MP	Count	MP	Count
178.0	44	181.0	36	192.0	49
179.0	76	186.0	37	193.0	45
180.0	61	189.0	54	194.0	63

N=741

D.8 COMMERCIAL TRUCK ACCIDENTS

Commercial truck accidents comprised 10.05% of all accidents on the I-5 corridor for the period January 1, 1990 through June 30, 1995. Following are various commercial truck accident summary statistics. All of these accidents involve commercial trucks with a gross vehicle weight of over 10,000 pounds.

Table D-13

I-5 Commercial Truck Accidents by Roadway Surface Conditions

Roadway Surface	Number of Accidents	Percentage
dry	684	69.30
wet	214	21.68
snow	37	3.75
ice	52	5.27
other	0	0.00
TOTAL	987	100.00

Table D-14

I-5 Commercial Truck Accidents by Weather Conditions

Weather	Number of Accidents	Percentage
clear/cloudy	769	77.91
raining	170	17.22
snowing	35	3.55
foggy	13	1.32
TOTAL	967	100.00

Table D-15

I-5 Commercial Truck Accidents by Light Conditions

Light	Number of Accidents	Percentage
daylight	706	71.53
dawn	31	3.14
dusk	17	1.72
dark, street lights on	79	8.00
dark, street lights off	5	0.51
dark, no street lights	149	15.10
TOTAL	987	100.00

Table D-16

I-5 Commercial Truck Accidents by Diagram Accident Type

Code	Description	Number of Accidents	Percentage
0	code typo?	6	0.61
1	strikes other vehicle head on	2	0.20
2	strikes left side of other vehicle at angle	212	21.48
3	strikes right side of other vehicle at angle	94	9.52
4	sideswipes left side of other vehicle	2	0.20
5	sideswipes right side of other vehicle	0	0.00
6	strikes rear end of other vehicle	144	14.59
7	strikes front end of other vehicle, not head on	21	2.13
11	was struck by other vehicle head on	0	0.00
12	was struck on left side at angle by other vehicle	151	15.30
13	was struck on right side at angle by other vehicle	53	5.37
14	was sideswiped on left side by other vehicle	0	0.00
15	was sideswiped on right side by other vehicle	1	0.10
16	was struck in rear end by other vehicle	91	9.22
17	was struck in front end by other vehicle, not head on	16	1.62
27	code typo?	1	0.10
29	all other multi-vehicle involvements	29	2.94
32	collision with animal or bird	1	0.10
33	highway appurtenance	77	7.80
34	other object	11	1.11
35	code typo?	1	0.10
40	strikes railroad train	0	0.00
41	struck by railroad train	0	0.00
50	overturn	37	3.75
54	non-collision fire	2	0.20
60	ran into roadway ditch	4	0.41
61	ran into river, lake, slough, etc.	0	0.00
62	ran over embankment, no guardrail	2	0.20
71	pedestrian struck by vehicle	2	0.20
72	pedestrian strikes vehicle	0	0.00
73	pedalcyclist struck by vehicle	0	0.00
74	pedalcyclist strikes vehicle	0	0.00
98	jackknife trailer	12	1.22
99	all other single vehicle involvements	15	1.52
	TOTAL	987	100.00

Table D-1 7

I-5 Commercial Truck Accident by Driver's First Contributing Cause

Code	Description	Number of Accidents	Percentage
1	under influence of alcohol	32	3.24
2	under influence of drugs	1	0.10
3	exceeded stated speed limit	7	0.71
4	exceeded reasonable safe speed for conditions	152	15.40
5	did not grant right-of-way to vehicle	247	25.03
6	improper passing	6	0.61
7	following too closely	53	5.37
8	following too closely	1	0.10
9	over centerline	0	0.00
10	failing to signal	15	1.52
11	improper turning	1	0.10
12	disregarded stop and go light	4	0.41
13	disregarded stop sign or red flashing light	11	1.11
14	disregarded warning signal	28	2.84
15	apparently asleep	6	0.61
16	improper parking location	56	5.67
17	operating defective equipment	5	0.51
18	other cause	208	21.07
19	no violation	0	0.00
20	improper u-turn	1	0.10
21	headlight violation (no lights or failed to dim)	0	0.00
22	did not grant right-of-way to pedestrian or pedalcyclist	0	0.00
23	inattention	52	5.27
24	undefined?	11	1.11
	code typo?	90	9.12
	TOTAL	**987**	**100.00**

APPENDIX E: **GROUP PARTICIPATION PLAN**

Introduction

Over the post few years, the WSDOT has embarked on o ambitious venture to implement a fully integrated stote-wide transportation system on the roodwoys within the WSDOT's jurisdiction. Aptly named "Venture ", this oll-encompossing umbrella program seeks to implement projects which will improve highway safety, operating efficiency, environmental quality, and personal mobility through enhanced interaction between roadway, vehicles and travelers.

Venture projects may fall into any of the six ITS strategies -- Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Advanced Public Transportation Systems (ATPS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), and Advanced Rural Transportation Systems (ARTS) . The focus of this study – the ITS Early Deployment Program for the I-5 Corridor between Seattle and Vancouver and the I-90 Corridor between Seattle and Spokane -will be to recommend ITS projects which can be implemented over the short term (1997 - 2002), medium term (2003 - 2007) and long term (2008 - 2017).

From a brooder-based perspective, however, ITS is still relatively unknown. For this reason it is especially important to involve key stakeholders in the selection and prioritization of ITS strategies being considered along I-5 and t-90. This participative decision making will have many positive outcomes, including deepening understanding of ITS strategies as well as stimulating interest in specific projects being considered for the corridors. It is hoped that the outcome of this understonding and interest will be strong support at the local and regional levels for specific ITS strategies. The following Group Participation Plan is designed as a mechanism in which will help to secure this support.

Building A Common Vision through a Steering Committee

The Steering Committee Structure

Because of the unique characteristics and needs of the two corridors – the I-90 Corridor and the I-5 Corridor – two distinct Steering Committee, one for each corridor, will be formed. While the roles and responsibilities for these two Steering Committees will be similar -- to provide input and direction to the study team -- it is possible that the types ITS treatments put forth for consideration by the Steering Committees will vary significantly between the two corridors.

Steering Committee Roles and Responsibilities

The multi-disciplinary nature if the ITS Early Deployment Program and its policy ramifications calls for a process in which senior staff representing a variety of organizations have clearly-defined roles in a collaborative decision making process. This decision making is most effectively secured through a "Steering Committee" process.

Steering Committee members serving on the ITS Early Deployment Program for the two corridors are charged with the following:

1) Overseeing the process and progress of the Study
2) Attending Steering Committee meetings (total of three for each corridor)
3) Reviewing and commenting on reports
4) Sharing reports with their colleagues as appropriate and gathering this "outside" input
5) Approving/rejecting/modifying recommendations

Steering Committee Members

<u>I-90 Seattle to Spokane</u>

Washington State Patrol
Captain Timothy Quenzer
Captain Tom Robbins
Captain James LaMunyon
Dan Permerl

Federal Highway Administrotion
Mike Morrow

Spokone Regional Transportation Council
Glenn Miles

WSDOT - Northwest Region
Dave McCormick
Hank Peters

WSDOT - Eastern Region
Bob Earnest
Mike Frucci

WSDOT - South Central Region
George Hilsinger
Bob MacNeil

WSDOT - North Central Region
Jennene Ring
John Baker

I-5 Seattle to Vancouver

Woshington State Patrol
Captain Steve Seibert
Dan Permerl

Federal Highway Administration
Mike Morrow

WSDOT - Northwest Region
Dave McCormick
Hank Peters

Whatcom County Council of Governments
Gordon Rogers

Whatcom County
Nasser Mansour

Skagit County Public Works
Jan Keiser

Skogit Council of Governments
Eric Irelan

Steering Committee Input Process

Steering Committee members will be sent draft technical memorandum for their review throughout the project. Specific input will be sought at the three scheduled Steering Committees. Because of the minimal number of scheduled Steering Committee meetings, it will be important thot input on technical memorandum from Steering Committee members be provided in addition to discussions at meetings. It is desirable that this input be in the form of actual written comments, either noted on the report itself or put on a separate comments form.

In addition, face-to-face meetings between individual Steering Committee members and Study Team members will be held as needed. At the onset of the project, corridor tours and one-on-one meetings with selected agency representatives will be undertaken. information gathered at these meetings will be integrated into the evaluations process of potential ITS treatments.

Interface with Elected Officials

Elected Officials are not part of the Steering Committee. Elected officials will stay apprised of the study through actions coordinated jointly by the Study Team and the Steering Committee. Elected officials will also be included in the Venture Washington newsletter database. Steering Committee members may elect for the

Interface with Elected Officials (continued)

Study Team to communicate with elected officials in one or more ways -- including but not necessarily limited to -- periodic or one-time-only distribution(s) of written information; individual briefings; committee/sub-committee briefings and full council/board briefings. For example, o WSDOT Steering Committee member could request the Study Team to brief the Transportation Commission; the Washington State Patrol Steering Committee members could request a briefing to their Safety Committee, etc. Appropriate Steering Committee members are encouraged to attend those briefings to provide additional local or specialized insights and information.

Steering Committee Input Opportunities

The Steering Committee(s) will meet at key decision-making milestones throughout the project. Meetings will be scheduled when input is required or approval is necessary for the Study Team to move forward to the next stage of the study. At these meetings, the Steering Committee will discuss the information previously sent to them for their review, and approve or reject recommendations based on this information. In addition, Steering Committee members are expected to review and comment on technical memorandum developed during key milestones throughout the project.

According to the project schedule of activities, these key dates are:

Steering Committee Meeting #1

Project Kick Off / Assess Corridor Transportation Needs **April ,1996**

Items: Present Study Goals and Objectives
Present on Corridor Tour findings
Present Existing Conditions Technical Memorandum

Action: Approve/Reject/Modify Study Goals and Objectives

Steering Committee Input Opportunity

Corridor Transportation Needs Technical Memorandum **June, 1996**

Action: Review and comment on technical memorandum

Steering Committee Input Opportunity

Corridor ITS Opportunities Technical Memorandum **July, 1996**

Action: Review and comment on technical memorandum

Steering Committee Meeting #2

Project/Program Profile Review **July, 1996**

Items: Informational presentation ITS Corridor Opportunities

- Weather Systems Technology Assessment
- Traveler/Tourist Information Opportunities
- Enforcement Enhancement Opportunities Assessment
- Benefit/Cost Assessment
- Commercial Vehicle Operations Enhancement
- Border Gassing Technologies Assessment (I-5 Corridor only)
- Additional User Services Potential

Present Recommended Project/Program Profiles

Action: Approve/Reject/Modify Project/Program Profiles

Steering Committee Input Opportunity

Corridor ITS Opportunities Technical Memorandum **July, 1996**

Action: Review and comment on technical memorandum

Steering Committee Input Opportunity

Corridor Development Plan Technical Memorandum **September, 1996**

Action: Review and comment on technical memorandum

Steering Committee Input Opportunity

Communications Plan Technical Memorandum **November, 1996**

Action: Review and comment on technical memorandum

Steering Committee Meeting #3

Corridor Implementation Plan **November, 1996**

Items: Informational presentation ITS Corridor Implementation Issues

- Existing Communications Systems
- Alternatives Development
- Develop & Prioritize Recommendations
- Benefit/Cost Assessment
- Corridor Communication Needs
- Assessment of Cost/Benefits
- Implementation Plan

Present Recommended Project/Program Profiles

Action: Approve/Reject/Modify Project Implementation Plan and Schedule

Media Relations

Media kits will be distributed to local and regional media. These kits will contain information about the process and findings of the early deployment programs. Kits will be distributed following the finalization of the ITS Opportunities technical memorandum (July, 1996) , the Corridor Development Plan technical memorandum (September, 1996) and the Corridor Implementation Plan finalization (November, 1996). Courtesy media kits will also be sent to selected elected officials and other key stakeholders to facilitate awareness and understanding of ITS projects.

Articles about the process and findings of the I-90 and I-5 ITS Early Deployment Programs will also appear in the August, October and December issues of the Venture Washington newsletter sponsored by TRAC and the WSDOT. The mailing list used to distribute this ITS news-related newsletter will be expanded to ensure that stakeholders in the I-90 and I-5 corridor are newsletter recipients.

World Wide Web

Information about the I-90 and I-5 ITS Early Deployment Programs will be developed for use on the World Wide Web. This information will detail information by technology and region and provide a response mechanism to the project manager via E-mail.

Outreach through Presentations

Presentations with key stakeholders groups will be undertaken throughout the life of the project. The purpose of these presentations is to familiarize audiences with ITS technologies and to solicit audience feed back regarding specific treatments being considered for their particular region.

APPENDIX F: BORDER CROSSING SITUATIONAL ANALYSIS

SCOPE 1.4: BORDER CROSSING SITUATIONAL ANALYSIS

The CONSULTANT shall identify and evaluate political, operational, and technological issues associated with the movement of people and goods at the Blaine and Pacific Highway border crossings. The STATE will assist in this work element by making initial contacts with representatives of affected agencies. This assessment shall include current and planned efforts by the United States Federal Government, Canadian Customs and Immigration, WSDOT, the Province of British Columbia, local jurisdictions, and the Cascadia Task Force Border Crossing Work group.

The information gathered during this work element shall be compiled into a technical memorandum including: status of border fee legislation; reauthorization of PACE Lane legislation, and retention of PACE Lane revenue for local use; roadway expansion at border approaches, including possible expansion of PACE Lanes; customs processing; and, improvements to enhance the timely and efficient movement of goods across the border.

F.1 ANALYSIS FRAMEWORK

The context for the border crossing situational analysis is illustrated in Figure F-l. The analysis area includes two distinct crossing points:

- The Peace Arch crossing which connects I-5 to Highway 99 in British Columbia. This crossing is limited to non-commercial traffic and excludes trucks and passenger buses; and

- The Pacific Highway crossing which connects the Pacific Highway in Blaine to Highway 15 in British Columbia. Commercial vehicles, including trucks and passenger buses are required to use this crossing.

The I-5 corridor serves both of these crossings, the first directly and the second via exit 276 connecting to Pacific Highway.

F.1 .1 Types of Traffic

Border traffic is segregated into a number of different streams. The first segregation is commercial trucks and buses and non-commercial vehicles. As indicated above, commercial vehicles are required to use to Pacific Highway crossing. Non-commercial traffic is further segregated into those vehicles that are registered to use the PACE / CANPASS lanes and other vehicles. The users of these lanes are allowed to perform a “self-directed primary assessment”; as a result , the service rates in these lanes are higher than the rate through a typical customs booth. Southbound, a PACE lane is provided only at the Peace Arch crossing. Northbound, there is a CANPASS lane at both crossings; however, the lane at the Pacific Highway crossing is only 150 meters long and is partially shared with duty free traffic.

Since facilities and procedures differ for these different vehicle streams, the border crossing situational analysis examines separately the border crossing operations and issues associated with the following types of vehicles:

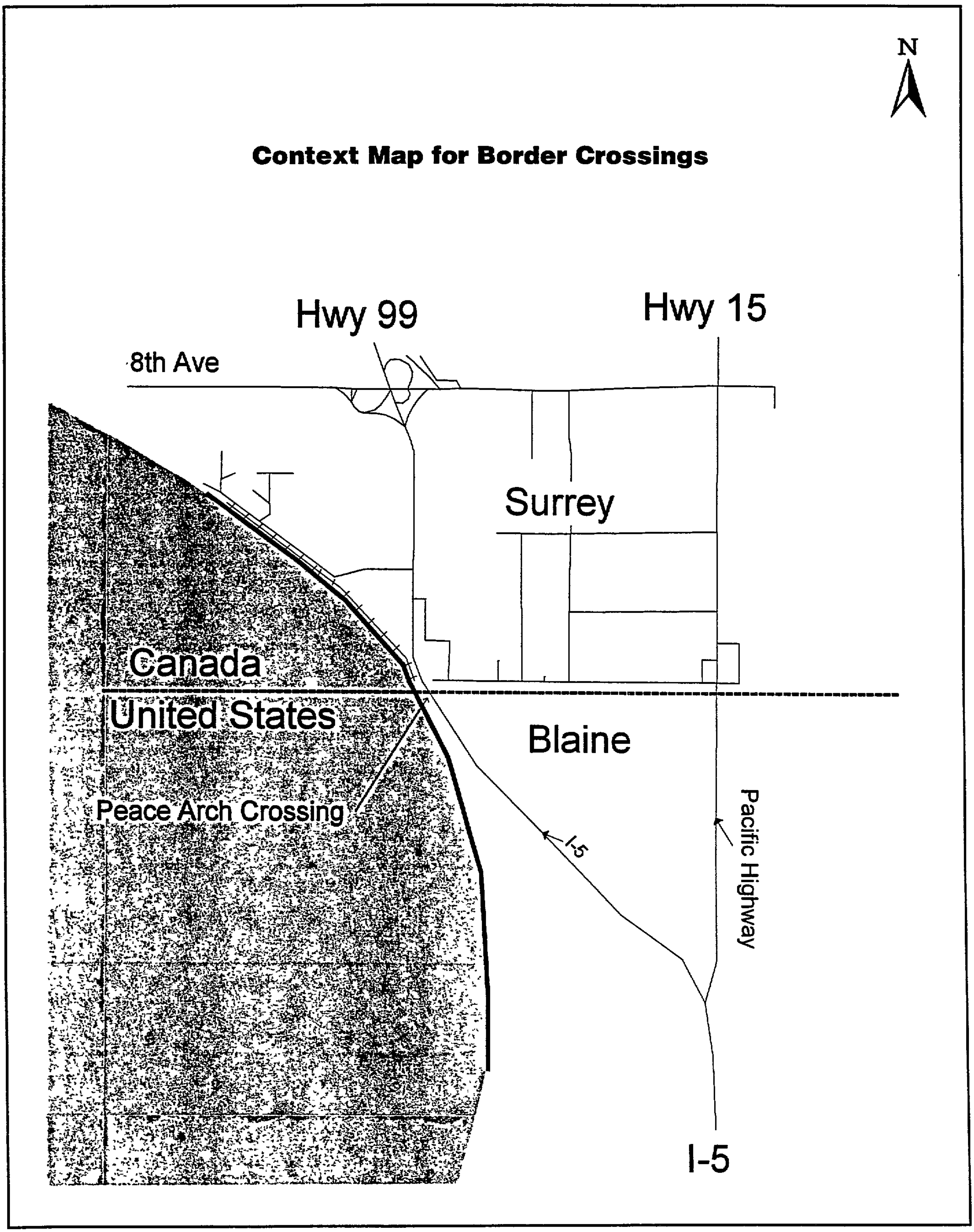
- Commercial vehicles
- Passenger buses
- PACE / CANPASS
- Other non-commercial

The analysis initially reviews the overall site and traffic characteristics of the crossing. The analysis also discusses the interaction of the four streams and how queues in one stream can affect the operations in other streams.

F.2 OVERALL SITE AND TRAFFIC CHARACTERISTICS

Information has been collected on some of the general characteristics of border operations and this information is categorized as follows:

- Physical characteristics
- Traffic volumes


N
Context Map for Border Crossings
Hwy 99
Hwy 15
8th Ave
Surrey
Canada
United States
Blaine
Peace Arch Crossing
I-5
Pacific Highway
I-5

- Congestion and delay patterns
- Accident data

F.2.1 Physical Characteristics

Some of the key physical characteristics of the two crossings are tabulated in Table F-1.

Table F-1

I-5 Border Crossing Characteristics

	Peach Arch Crossing		Pacific Highway Crossing	
Characteristic	**Northbound**	**Southbound**	**Northbound**	**Southbound**
No. of Approach Lanes	2	2	1	2
No. of Primary Booths - Autos (exclud. PACE)	6	6	6	4
Length of PACE / CANPASS Lane	700 m	700 m	150 m	n/a
No. of Truck Booths	n/a	n/a	2	2
Length of Truck Lane	n/a	n/a	-	300 m

As indicated in Table F-1, the Peace Arch crossing provides a higher overall service capacity for automobiles, with two additional southbound booths and longer PACE /CANPASS by-pass lanes. The Peace Arch crossing directly connects the I-5 and Highway 99 freeways, and provides balanced road capacities on either side of the border. Proposed changes to the U.S. side of the Pacific Highway crossing will also provide for balanced road capacities on either side of the border, as well as a northbound truck lane to reduce conflicts between commercial and passenger traffic.

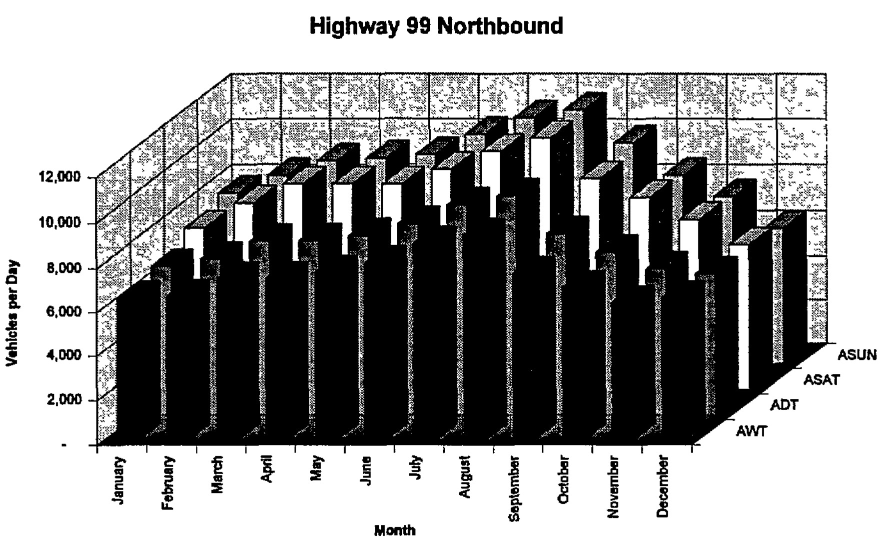
F.2.2 Traffic Volumes

The Ministry of Transportation and Highways (MoTH) maintains permanent traffic counting stations on both Highways 15 and 99 just north of the U.S. / Canada border. The location of these counters is such that the volumes recorded consist almost exclusively of cross border traffic. The most recent full year for which data were available was 1994. Figures F-2 and F-3 illustrate the trends in average daily volumes by month for both directions on the two highways. Each chart presents the following volumes:

- Average Weekday Traffic (AWT)
- Average Daily Traffic (ADT)
- Average Saturday Traffic (ASAT)
- Average Sunday Traffic (ASUN)

Figure F-2

Average Traffic by Month - Highway 99



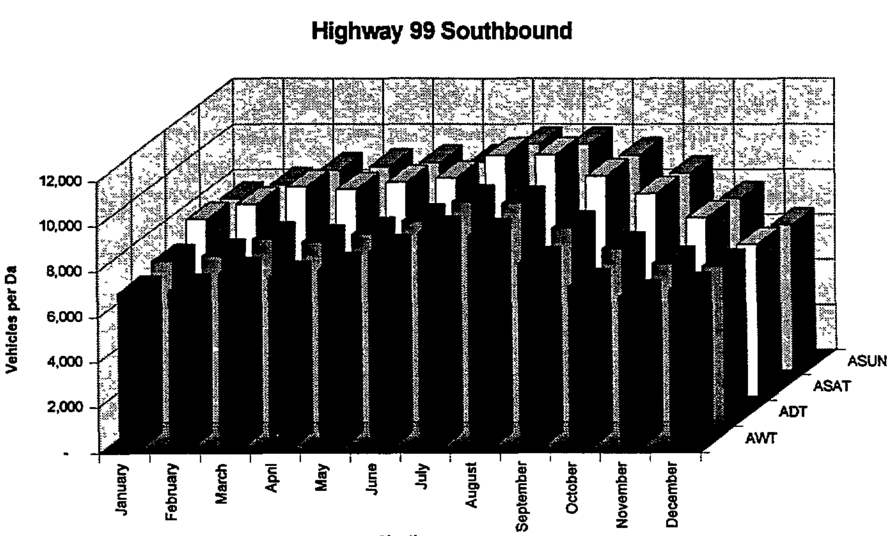
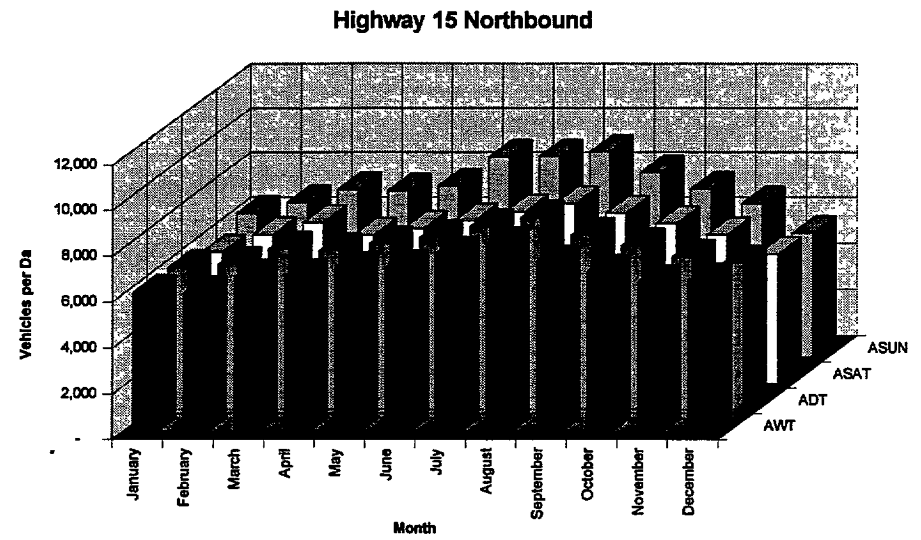
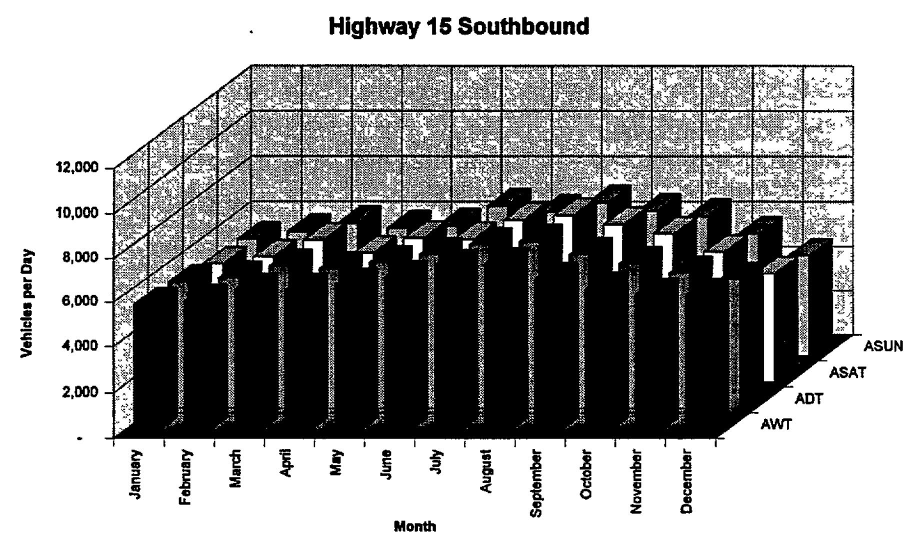


Figure F-3

Average Traffic by Month - Highway 15





As shown in Figures F-2 and F-3, there is significant seasonal variation in the traffic volumes as well variations between weekdays and weekends, particularly during the summer months. Table F-2 illustrates how these variations are greatest on Highway 99, particularly in the northbound direction.

Table F-2

1994 I-5 Border Crossing Traffic Volumes

	Highway 99		Highway 15	
1994 Values	**Northbound**	**Southbound**	**Northbound**	**Southbound**
AADT	7,870	8,141	7,081	6,431
Highest Monthly	August ASUN 11,334	August ASAT 10,732	August ASUN 8,969	August AWT 7.568
Percent of AADT	144%	132%	127%	118%
Lowest Monthly	December ASUN 6,165	December ASUN 6,448	December ASUN 5,379	December ASUN 4,546
Percent of AADT	78%	79%	76%	71%

The AADT values also illustrate that Highway 99 (and the Peace Arch crossing) is preferred to a larger degree in the southbound versus the northbound direction. This difference can be attributed to the location of retail, gas station, and duty free facilities just south of the border. Figures F-2 and F-3 and Table F-2 also illustrate the pronounced peaking that occurs northbound on Sundays during summer months at the border crossings. Weekend peaks occur throughout most of the year on Highway 99, while on Highway 15 weekday volumes are similar to weekend volumes outside of the summer months.

Based on a more detailed examination of separate print-outs of the hourly volumes, the following trends also emerge:

Northbound (both Highway 15 & 99)

- Hourly volumes are typically greater than 6% of the daily volume over the period 12:00 PM to 7:00 PM. During this period, the peak hour typically occurs between 4:00 PM and 5:00 PM; and

- During most of the year, peak hour volumes represent about 8 to 9% of the daily volume. Peaking is less pronounced during the summer months when the peak hour volumes represent about 7 to 8% of the daily volume.

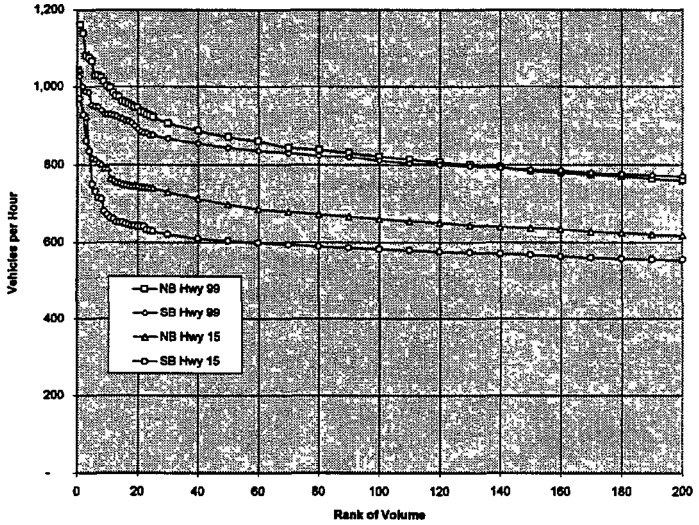
Southbound (both Highway 15 & 99)

- Hourly volumes are typically greater than 6% of the daily volume over the period 9:00 AM to 5:00 PM. During this period, the peak hour typically occurs between 10:00 AM and 11:00 AM; and
- During most of the year, peak hour volumes represent about 8 to 9% of the daily volume. Peaking is less pronounced during the summer months when the peak hour volumes represent about 7 to 8% of the daily volume. Peaking is also less pronounced on Highway 15 than on Highway 99.

The highest hourly volumes that occurred on both routes in both directions are illustrated graphically in Figure F-4

Figure F-4

I-5 Border Crossing Highest Hourly Volumes - 1994

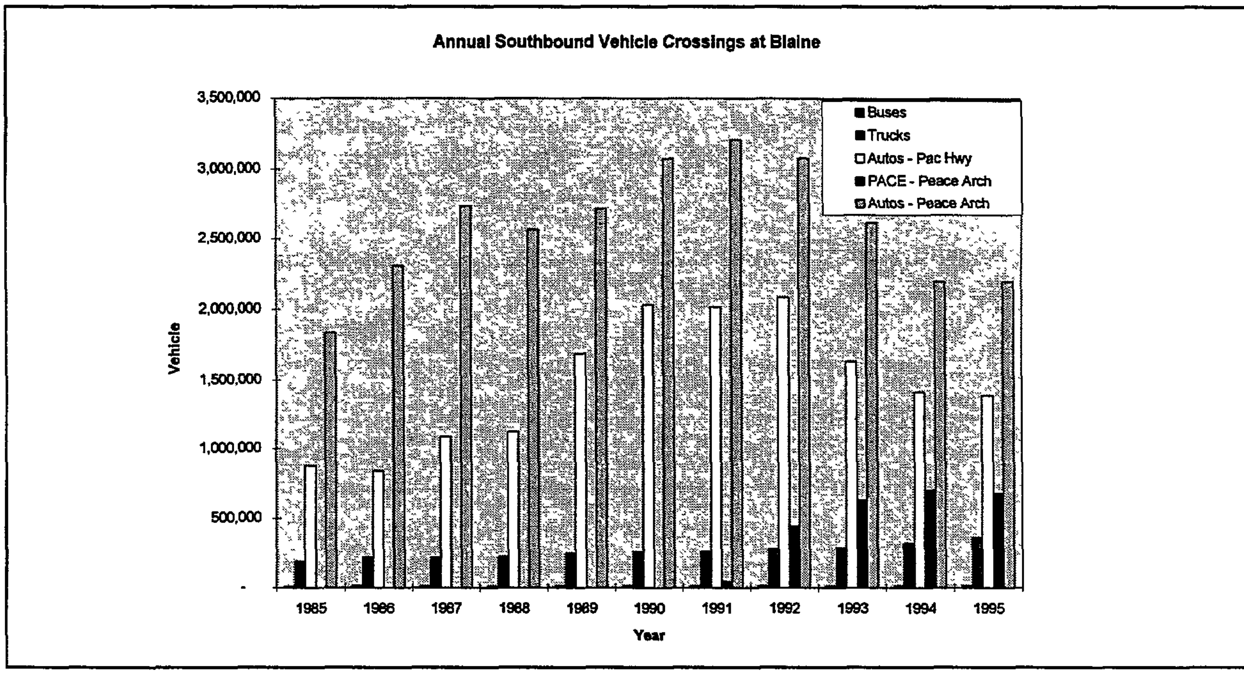


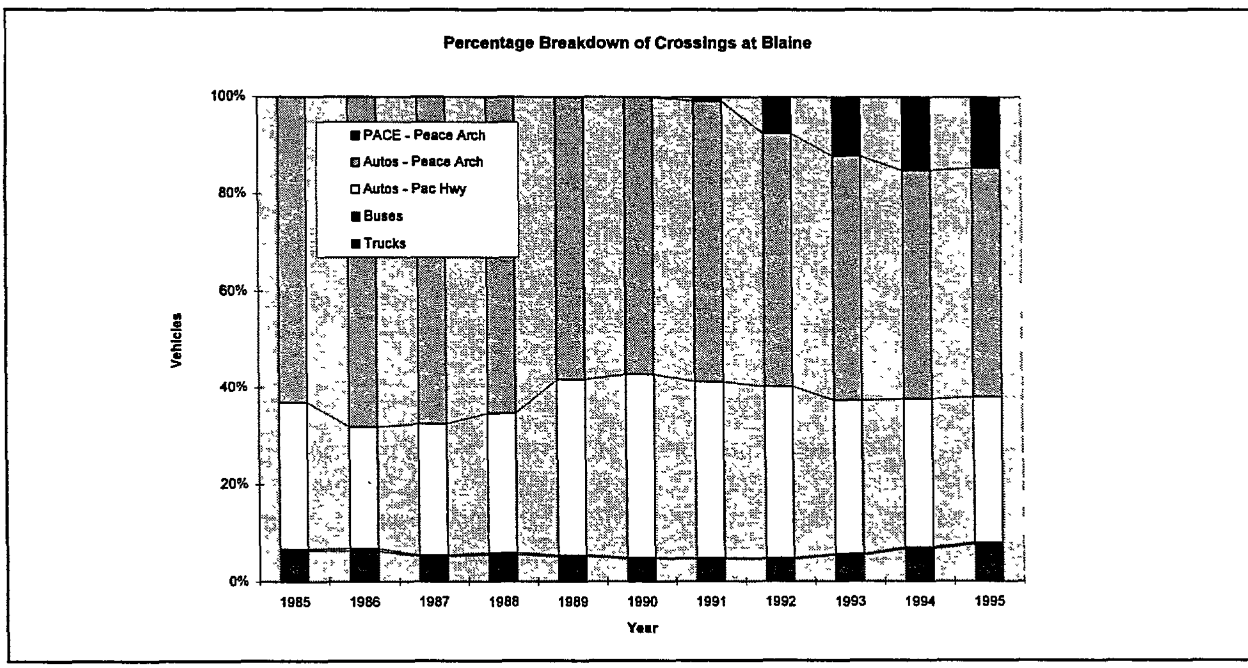
A review of these volumes indicates that northbound movements are more peaked than southbound movements on Highway 15. This peaking may be reflective of the location of duty free stores and retail outlets on the south side of the Pacific Highway crossing. The graphs also show that unusually high volumes occur during 10 to 20 hours over the year.

Although MoTH traffic data do not segregate traffic volumes by vehicle type, Customs data provide such a breakdown. A breakdown of southbound movements by traffic type over the past 10 years is presented in Figure F-5. The relative share of each traffic type is also illustrated in this figure. Specific characteristics of the different traffic types are discussed in later sections of the technical memo.

Figure F-5

I-5 Southbound Border Volumes by Vehicle Type





F.2.3 Congestion and Delay Patterns

There is no systematic tracking of congestion and delay patterns at either of the border crossings. The U.S. Customs service undertook an analysis of waiting times at the Peace Arch

Arch crossing during March and April of 1995. This analysis is documented in the "Blaine Traffic Management Report - Peace Arch". Data collection included number of lanes (primary customs booths) in operation and maximum waiting time for each hour of the day. Data were not collected on hourly arrival or service rates. A review of the detailed data indicates that:

- Queues seldom built up prior to 9:00 AM, regardless of the day of week;
- Waiting times on Mondays through Thursdays (excluding holiday weekends) were typically 5 minutes or less during the day. On days when waiting times were greater, the peak usually occurred during the mid-morning;
- Friday waiting times were generally comparable to other weekdays, except around Easter and the Tulip Festival season. During the Easter weekend, waiting times during the day were typically 30 minutes and went as high as 90 minutes;
- On Saturdays, peak waiting times occurred between 1:00 PM and 3:00 PM and were typically 30 to 40 minutes. On the Easter weekend, waiting times of two hours were recorded. Waiting times were minimal before 9:00 AM and after 7:00 PM (except during Easter); and
- On Sundays, waiting times typically peaked at 30 minutes with often a primary peak during the early afternoon and a secondary peak in the late afternoon / early evening.

During those periods when waiting times exceed approximately 30 minutes at the Peace Arch crossing, traffic in the general purpose lanes can block access to the PACE lane thereby causing delays to that traffic segment.

There were no delay data available for the Pacific Highway crossing. At that crossing, waiting times greater than about 20 minutes in the northbound direction can start to impede truck traffic. Similarly, queues of more than 15 to 20 trucks impede the flow of passenger car traffic. Proposed changes to the Pacific Highway will alleviate much of the conflict between traffic streams.

F.2.4 Accident Data

Accident data from 1987 through the end of 1994 on Highway 15 and Highway 99 just north of the border were reviewed. During those eight years, there were an average of nine accidents per year on Highway 99 within approximately 0.5 miles of the border. The predominate type of accident was a rear end collision. Of these nine accidents, an average of three accidents per year involved injuries (no fatalities). These accidents may reflect the transition from freeway speeds to reduced speeds in the vicinity of the customs plazas, as well as the impact of stop-and-go traffic during periods of congestion.

During the same time period on Highway 15, there were an average of 11 accidents per year within approximately 0.5 miles of the border. In addition to rear end collisions, there were also a significant number of accidents due to overtaking and backing up. An average of only 0.625 accidents per year resulted in personal injuries (no fatalities). This statistic may reflect the lower operating speeds approaching the border on Highway 15 versus Highway 99.

Data from WSDOT indicate that a similar accident rate exists on I-5 just south of the border.

Over a period of 5.5 years from January 1990 to June 1995, there were an average of nine accidents per year on I-5 within approximately 0.5 miles of the border.

F.3 COMMERCIAL VEHICLES

As indicated earlier, commercial vehicles are restricted to the Pacific Highway border crossing. Border crossing operations and impacts on non-commercial vehicles differ by direction, therefore the characteristics of each direction are described separately.

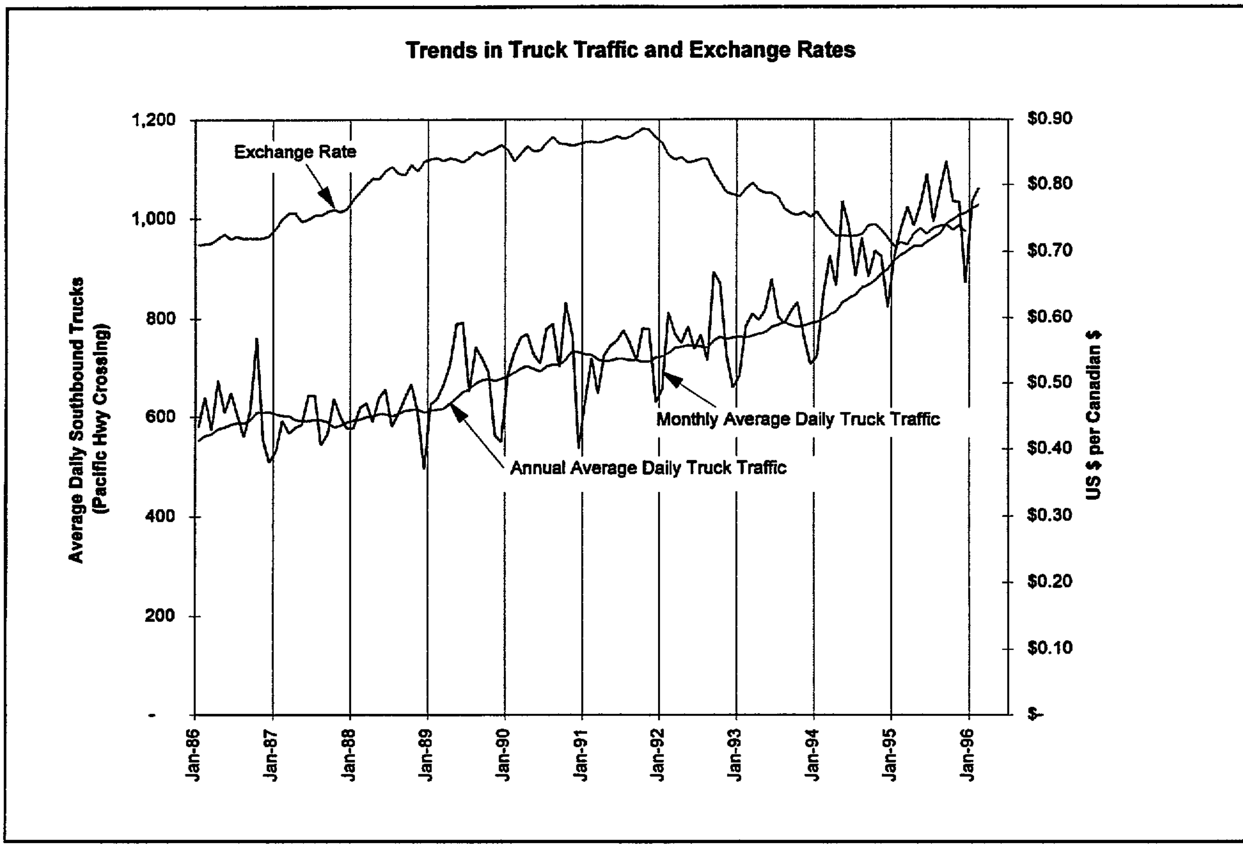
F.3.1 Southbound Commercial Vehicles

The major southbound approach routes to the Blaine border crossing are Highways 15 and 99. Trucks traveling on Highway 99 divert to Highway 15 approximately 1.5 km from the border. A truck lane is added to the two southbound lanes of Highway 15 some 350 meters from the border. The truck lane ends at a parking facility for trucks which accommodates about 12 vehicles. Trucks with incomplete paperwork stop at this facility just north of the border and complete their paperwork at adjacent brokerage offices. Once paperwork has been completed, the vehicles can queue for primary inspection. A total of 5 trucks can queue between the end of the truck lane and the primary booths.

Trends in southbound truck volumes over the last ten years are presented in Figure F-6.

Figure F-6

I-5 Average Daily Southbound Truck Traffic at Border



Current truck volumes are in the range of 900 to 1,000 per day. Approximately 20% of these are empty and less than 10% are carrying shipments in bond. Typically, these vehicles are quickly cleared through one of the two primary inspection booths. The remaining vehicles are transporting about 900 to 950 manifested cargoes for an average of 1.3 manifests each. About 60 to 70 of these vehicles have more than four bills of lading and can be classified as less than truckload shipments.

About 41% to 43% of the cargo releases are done under a "line release" program. Under this program, low risk, repetitive shipments are quickly cleared (about half a minute) through primary inspection. About 1% of these shipments undergo secondary inspection on either a random or selective basis.

Almost all of the remaining vehicles are processed through Border Cargo Selectivity (BCS). Under this process, brokers enter data on the shipper, broker, origin, destination and shipment into the U.S. Customs system. The broker is issued an entry number for each manifest. At primary inspection, the BCS process determines if the shipment should be sent to secondary inspection. Approximately 3.5% to 4% of the shipments are flagged for secondary inspection either by the system or by the customs agent at primary.

Commercial vehicles must have all of their paper work complete prior to proceeding to primary inspection. The truck plaza in front of the primary booths can accommodate five trucks. There are a further 12 slots for trucks on the Canadian side of the border where trucks can park while completing paper work at border brokerage offices. These slots are served by a truck lane that extends about 300 meters north along Highway 15.

Within the border facility, there is space for 4 to 5 trucks at inspection docks and an additional 4 to 5 parked trucks. There is no current capacity problem within the facility.

Truck arrivals are tracked on a daily basis but there are no data on variations in arrivals during the day. Customs officials observe that mid-morning is peak arrival time. This pattern was also observed in origin/destination surveys undertaken by the B.C. MoTH in February and March of 1995. These surveys also indicated that the primary origins of truck traffic at the Pacific Highway crossing were the cities of Vancouver, Surrey, and Richmond.

F.3.2 Northbound Commercial Vehicles

I-5 is the main access route for northbound commercial vehicles. These vehicles are directed to exit I-5 about 2 km south of the border and to enter Canada at the Pacific Highway border crossing. Between I-5 and the border, the Pacific Highway is limited to a two lane cross-section. Truck traffic is segregated from other traffic some 200 meters south of the border.

It is estimated that 25-30% of the truck movements are empty. Of the loaded trucks, approximately 70% are carrying truck load shipments, with the remaining 30% being less than truck-load. Container traffic represents about 20% of the truck volume. Most of the shipments (70%) are manufactured goods, with produce accounting for most of the remainder. About 50% of the clearances are through a line release program. A further 10% are bonded cargo.

Trucks arriving at the border go through an initial primary inspection. Access lanes to these inspection booths can accommodate 10 trucks. Waiting times at these booths are typically less than 2 minutes and targeted to be a maximum of 10 minutes. Within the border facility, there is storage room for 40 trucks. Trucks within the facility complete their paperwork and primary inspection. Service times are cargo dependent, and can be as long as two hours.

About 5% of the trucks are typically subject to physical inspection.

During weekdays, truck traffic typically peaks between 11:00 AM and 2:00 PM with most of the remaining traffic spread between 7:00 AM and 7:00 PM. After midnight mid-week and on Sundays there are heavy volumes of produce loads.

This pattern was also observed in origin/destination surveys undertaken by the B.C. MoTH in February and March of 1995. These surveys also indicated that the primary destinations of truck traffic from the Pacific Highway crossing were the cities of Vancouver, Surrey, and Richmond.

F.3.3 Issues and Plans

Both northbound and southbound, one of the primary issues is the segregation of truck traffic from other traffic, since queues in either traffic stream can cause extra delays in the other stream. The segregation of truck traffic will be addressed by the proposed modifications to the Pacific Highway border crossing facility and the widening of the Pacific Highway just south of the border.

There is a general desire to increase the degree to which information is provided electronically and exchanged between agencies. For example, US customs officials want to improve the process for checking that bonded cargo has left the US. Canadian customs officials would like advanced information on containers, including inspection information.

F.4 PASSENGER BUSES

As indicated earlier, passenger buses are restricted to the Pacific Highway border crossing. Passenger buses consist of both scheduled and charter services. Scheduled bus volumes are generally steady throughout the year, although extra trips are added during summer months. Charter services have more variation throughout the year and include gambling charters, special events such as the tulip festival, and services to cruise ship lines in Vancouver.

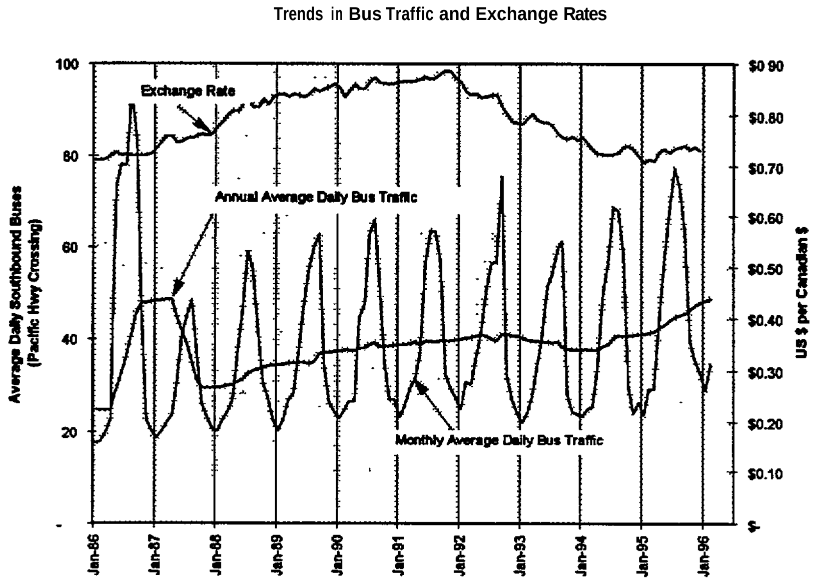
Border crossing operations differ somewhat by direction, therefore the characteristics of each direction are described separately.

F.4.1 Southbound Passenger Buses

Trends in southbound bus volumes over the last ten years are presented in Figure F-7.

Figure F-7

I-5 Average Daily Southbound Bus Traffic at Border



As illustrated in the chart, passenger bus volumes have been steadily growing after a dip following Expo 86 in Vancouver. The substantial variation between summer and winter months is primarily accounted for by charter services; however, even during the winter months, charter services represent over 50% of the bus traffic. Charter services tend to peak on weekends, while scheduled services have less variation throughout the week.

Passenger bus arrivals usually peak in the morning and it is not unusual to have 8 to 10 buses in queue on Saturday mornings. These queues can affect access to the truck booths. Proposed changes to the US Customs facility will eliminate this conflict.

On scheduled buses, all passengers and luggage are off-loaded for inspection, whereas 90% of charter buses are cleared on the bus. (Spot checks of charter buses are performed periodically.) Processing times are a function of passenger nationality since immigration requirements can differ significantly for different groups.

F.4.2 Northbound Passenger Buses

Comparable data were not available for northbound passenger bus movements. Customs officials indicate that peak arrivals typically occur between 2:00 PM and 4:00 PM. The Canadian Customs facility can accommodate 3 buses alongside their building plus an additional 2 buses in queue before this traffic affects truck or passenger car movements.

As with southbound movements, all passengers and luggage on scheduled buses are off-loaded for inspection, whereas most charter buses are cleared on the bus. It is estimated that it takes 10 to 20 minutes to clear scheduled buses. Clearances are handled by counter staff as required.

F.4.3 Issues and Plans

No significant issues were identified with respect to passenger bus operations. US Customs officials indicated that charter companies are happy with the current level of service. Although there may be some benefit in knowing waiting times at the border, many charter services as well as scheduled services do not have much flexibility in setting departure times.

Canadian Customs officials are considering selective examination of baggage on scheduled services. This would require operators to tag stowed luggage by passenger to permit passenger screening.

F.5 PACE / CANPASS

The PACE program was implemented in 1991 as a means of improving the level of service provided to regular users of the Peach Arch border crossing. The program under Canadian jurisdiction was subsequently expanded to include the Pacific Highway crossing and was renamed CANPASS. The program under US jurisdiction has continued to be called PACE.

The program requires individuals to apply to both the US and Canadian Customs to obtain a vehicle decal. Individuals must be US or Canadian citizens (or landed immigrants for the CANPASS program), have no criminal record, and no customs or immigration violations. Enrollment in each program costs $25 per year per vehicle. Currently there are approximately

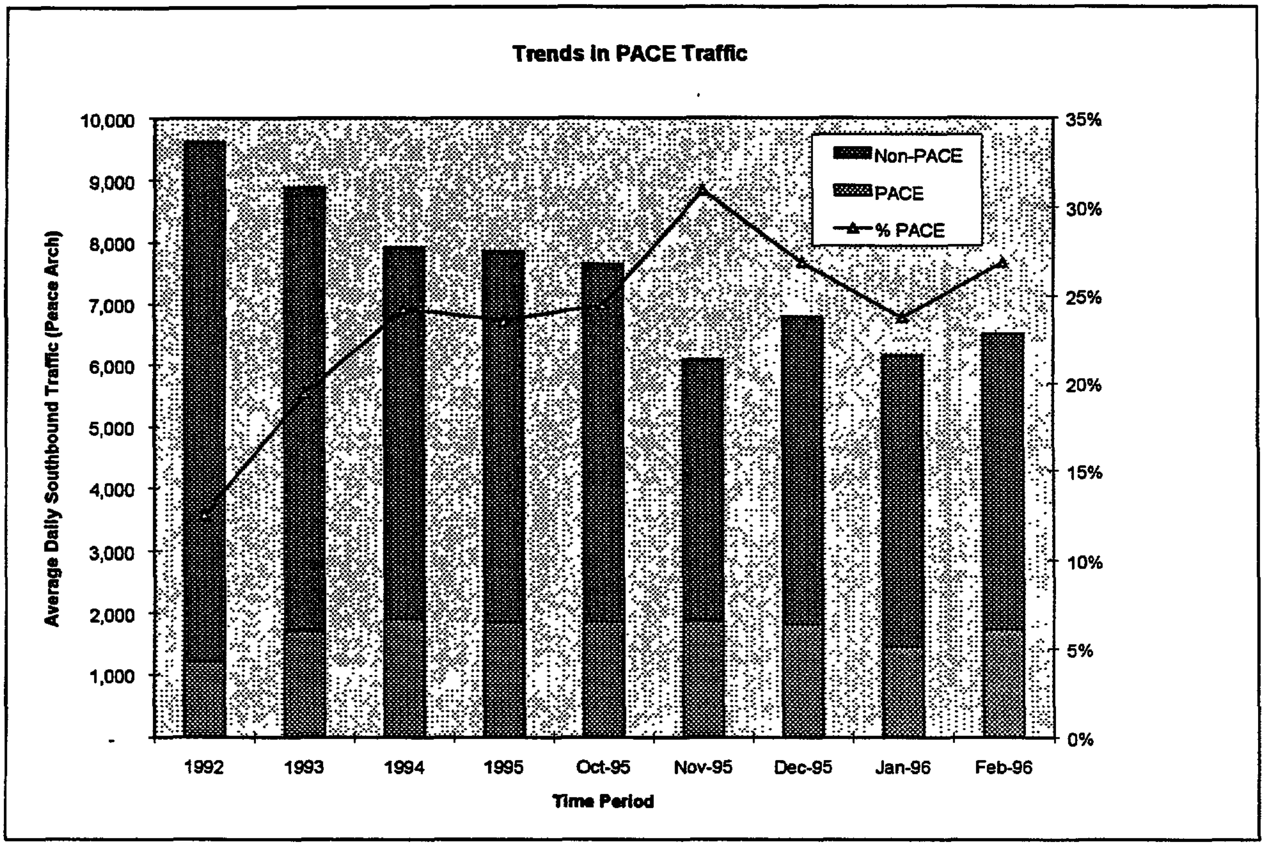
40,000 active decals with about 130,000 individuals registered.

In order to use the PACE or CANPASS lanes, a vehicle as well as all of its passengers must be registered (either with that or another vehicle). Vehicles do a slow roll by the inspector in the PACE / CANPASS both, and drop off any required customs forms. Service rates in these lanes are estimated to be 400 vehicles per hour versus 100 vehicles per hour through the regular lanes.

Utilization of the programs are estimated to account for 25 to 30% of Peace Arch traffic. Detailed data on utilization were not collected in the past; however, US Customs officials have begun to track PACE usage. Figure F-8 illustrates recent monthly trends.

Figure F-8

I-5 Average Daily Southbound PACE Traffic at Border



As indicated in the chart, PACE volumes have been more stable recently than the total southbound traffic volumes at the Peace Arch crossing.

Users of the PACE / CANPASS lanes have a higher rate of compliance with respect to customs regulations when compared with general purpose lanes. In addition, customs officials indicated that use of the lanes by non-registered vehicles is limited.

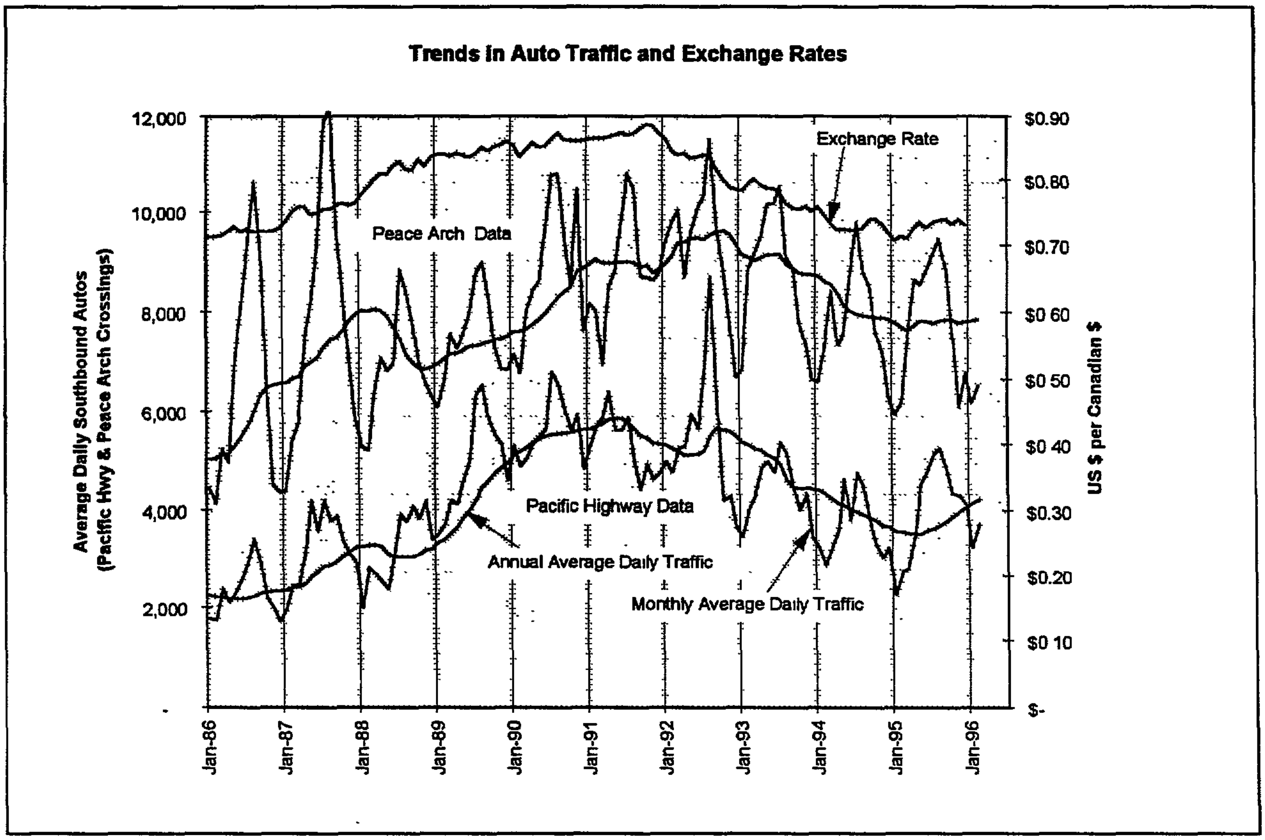
The use of electronic tags for registered vehicles is being piloted in Buffalo. This system could reduce manpower requirements for lane operation.

F.6 OTHER USERS

General automobile traffic at the two crossings are strongly affected by the extent of cross-border shopping trips, and therefore by exchange rates. Trends in southbound automobile volumes over the last ten years are presented in Figure F-9.

Figure F-9

I-5 Average Daily Southbound Automobile Traffic at Border



The chart illustrates the regular summer peaks that occur in automobile traffic as well as the correlation between trends in the annual average daily traffic and the $US/$Canadian exchange rate. Since early 1995 there has been a slight turnaround in average traffic volumes, particularly at the Pacific Highway crossing.

Detailed data on arrival and service were not available; however, customs officials observed the following patterns:

- Weekday arrivals escalate at about 9:00 AM in the southbound direction and 10:00 AM in the northbound direction. Volumes are steady throughout the day until early evening;

- On weekends, southbound peaks occur on Friday evenings, Saturday mornings, and Sunday afternoons. Northbound peaks occur during late afternoons on both Saturdays and Sundays;

- Although it only requires 10 to 20 seconds to process vehicles through primary assessment, average service rates per booth are 100 to 120 vehicles per hour;

- Based on these service rates, and the service rate and traffic volumes of the PACE / CANPASS lanes, the customs' plazas have adequate physical capacity for most arrival patterns. Budget constraints limit the amount of total service hours that can be offered, and queues develop during peak periods as a result; and

- US Customs has a target of a maximum waiting time of 30 minutes. Canadian Customs has a target of a 20 minute maximum. Since waiting times are not regularly monitored, there is no formal tracking of performance with respect to these service standards. Instead, these standards are used to determine when additional staffing is required at the booths.

The US Customs Service undertook an analysis of waiting times at the Peace Arch crossing based on data collected during March and April of 1995. This information was correlated with hourly counts taken on Highway 99 near the border. Estimated arrival and service patterns were graphed for the Friday and Saturday of the Easter weekend when waiting times had reached two hours. These graphs are presented in Figure F-IO. The actual breakdown between PACE and non-PACE traffic was not available and an estimate was derived using current percentages.

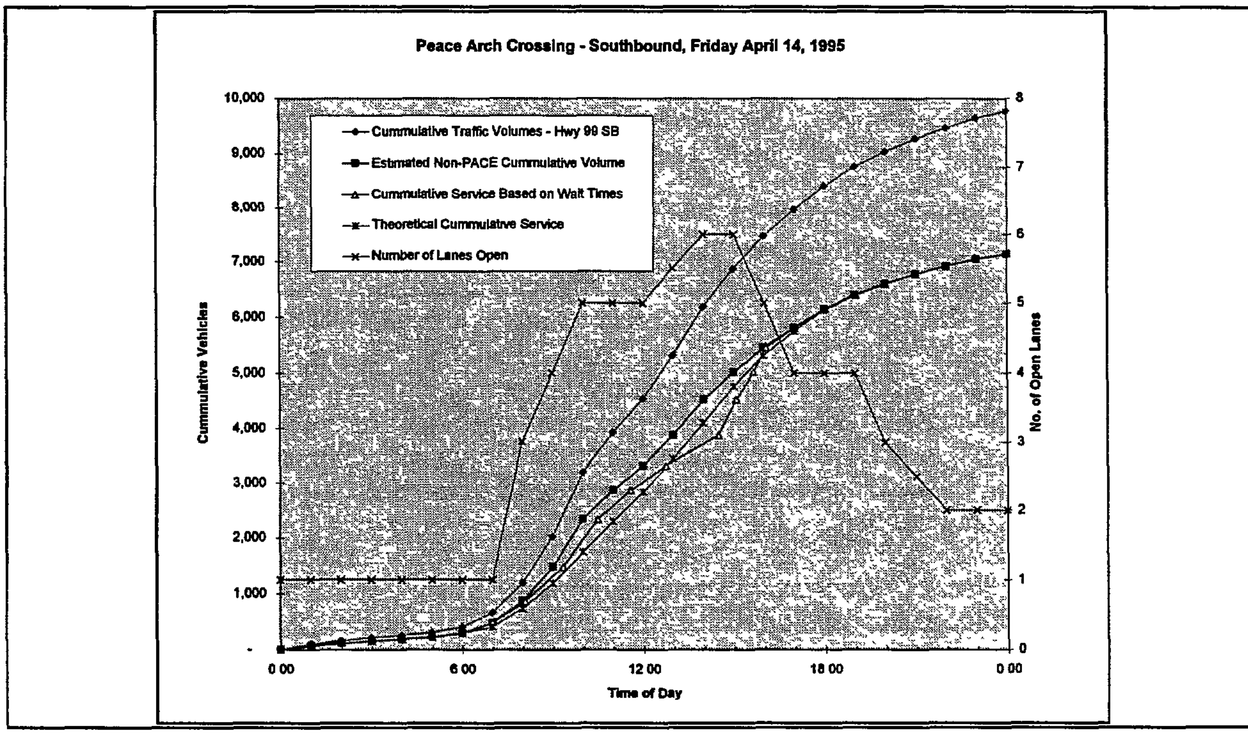
Maximum waiting times were greater on Saturday versus Friday, reflecting the reduced number of lanes in operation. In both cases, it appears that waiting times may have been reduced by earlier lane openings. Therefore, better real time information on arrival rates, service rates and waiting times would assist the Customs Service in responding to changes in demand in a more effective manner.

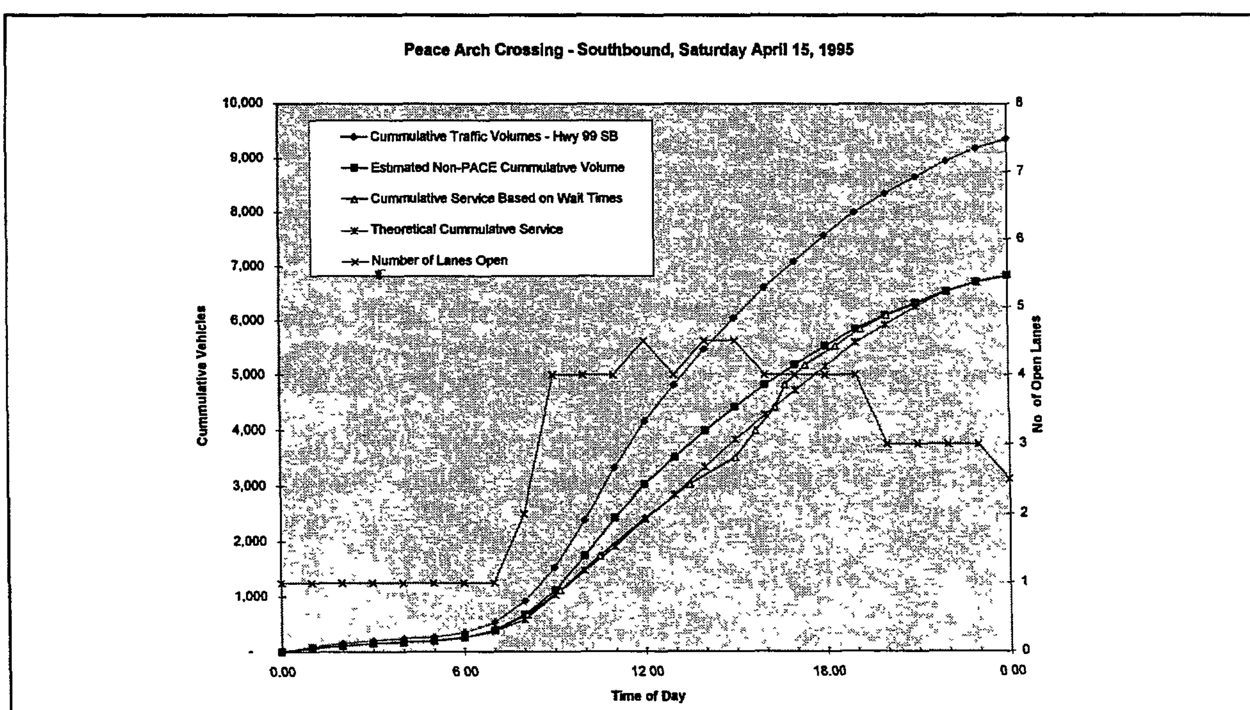
The proportion of PACE traffic in the vehicle stream can also significantly affect waiting times. If PACE traffic went from 27% to 45%, non-PACE arrivals would be near the theoretical service rate and maximum waiting times would be less than 15 minutes versus 90 to 120 minutes.

Both US and Canadian Customs officials indicated that improved traveler information on border traffic conditions would help to reduce the buildup of extensive queues, particularly on holiday weekends.

Figure F-10

I-5 Estimated Arrival and Service Patterns at Border





F.7 SUMMARY OF FINDINGS

The findings of the border crossing situational analysis can be summarized as follows:

- Border traffic can be segregated into four distinct traffic types: commercial vehicles, passenger buses, PACE / CANPASS users, and other passenger vehicles. The first two types must use the Pacific Highway crossing;
- The service requirements differ for each group and segregation of the traffic types reduces the impact of demand peaks of one group on congestion and delay for other groups. Proposed improvements to the Pacific Highway crossing and access to this crossing from the south will reduce conflicts between the different traffic types;
- The clearance of commercial vehicles benefits significantly from the line release program which reduces processing requirements for repetitive shipments. Line release accounts for 40% to 50% of cargo clearances;
- All traffic types could benefit from improved traveler information on border crossing congestion and delay; and

Real time information of arrival rates, service rates, and waiting times would assist customs officials in effectively scheduling their constrained staff resources.