ADVANCED TRAVELLER INFORMATION

AND

TRAFFIC MANAGEMENT SYSTEMS

FOR

HIGHWAY 2 BETWEEN EDMONTON AND CALGARY

NEEDS ASSESSMENT

EXECUTIVE SUMMARY

Prepared for:
Alberta Transportation, Edmonton

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DELCAN

In association with
Infrastructure Systems Limited
Earth Tech Canada
Mark F. Pinet Associates limited
Western Ergonomics, Inc.

TABLE OF CONTENTS

Introduction

The purpose of this report is to present the assessment of ITS needs for the Advanced Traveller Information and Traffic Management Systems Blueprint for Highway 2 between Edmonton and Calgary. The report addresses the needs for ITS within the Highway 2 corridor as well as road and weather information systems on the National Highway System within Alberta.

Exhibits 1 and 2 illustrate the study area for this project.

Exhibit 1 – Highway 2 Edmonton to Calgary Study Area

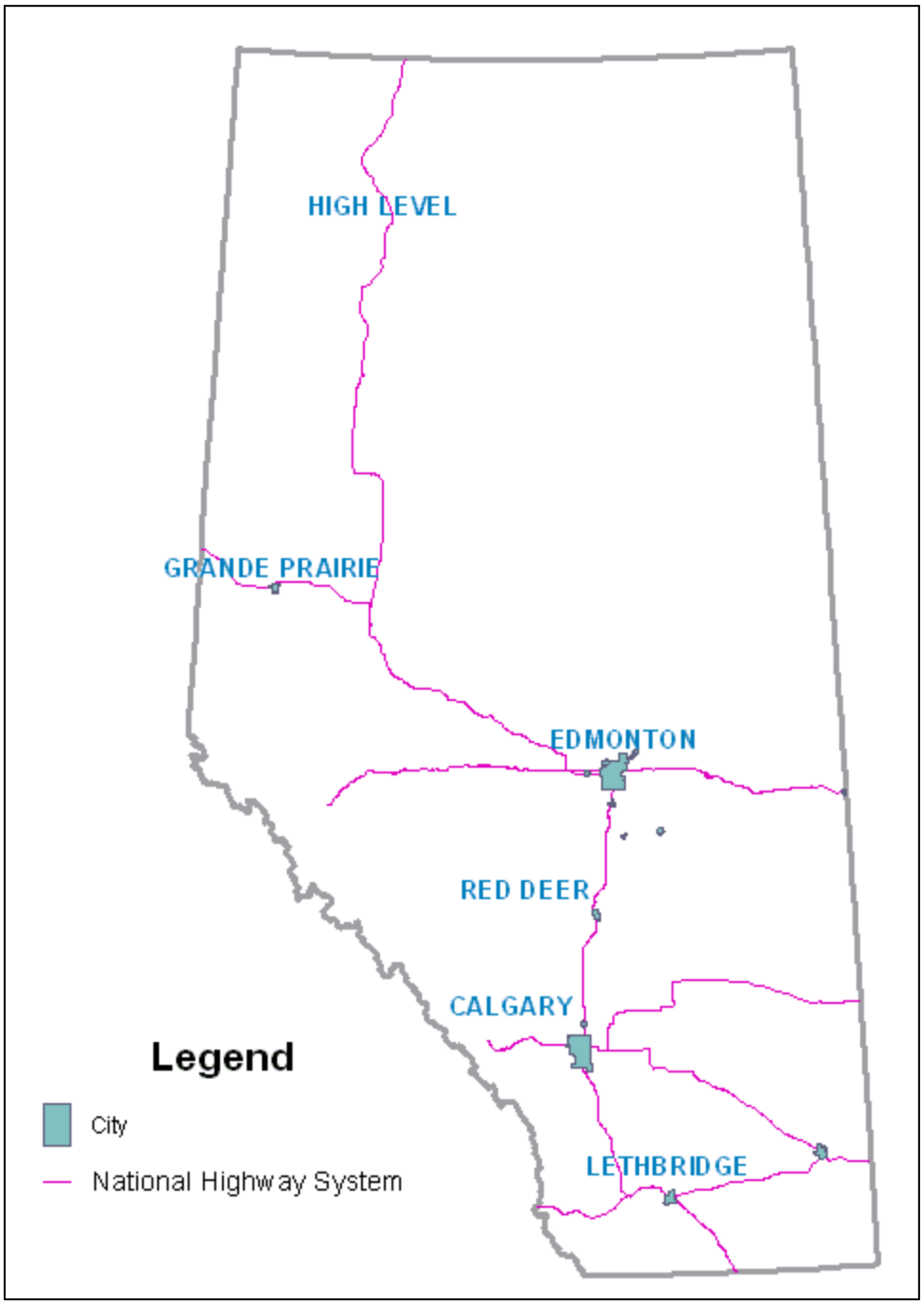

Exhibit 2 – Study Area for Road Weather Information System

Stakeholder Consultation

The stakeholder consultation program developed for the project was based on a three-phase approach as follows:

- Identification of stakeholders agencies and initial contact;
- two workshops as the study progresses to present study findings and recommendations and allow stakeholders to provide input; and
- project website to provide broad access to information about the project and allow stakeholders to provide input.

The initial phase of the stakeholder consultation program was completed in this Needs Assessment phase of the project. Initial contact with stakeholders was through a series of one-to-one interviews with a designated contact person from each identified stakeholder agency. These one-to-one interviews provided a forum for the stakeholders to present the mandate and objectives of their respective agencies, discuss their current problems and needs as they may relate to ITS, and identify some of their aspirations with respect to future applications of ITS technologies onto their fields. The type of information that was collected in these interviews included:

- ***Contact Information***: Contact information of the individual for record purposes and follow-up for additional information, if required.
- ***Mandate***: The mandate of the stakeholder definition of their "circle" of influence as well as what area of ITS may be relevant to their operations.
- ***Operational Procedures***: Procedures on how the stakeholder conducts their daily operations.
- ***Inventory***: An inventory of existing and planned ITS deployments.
- ***Records / Data***: The type and availability of records that may be kept relevant to the stakeholder's operations.
- ***Existing Problem Areas***: Identification of the type and location of problems in the study area to assist in problem identification and analysis.
- ***Needs***: The needs of the stakeholder as they interpret how the project may be able to assist them in fulfilling their mandate.
- ***Existing Data***: A summary of any data or reports the stakeholder may have relevant to the project.

The stakeholders were subdivided into five organizational groups with different areas of interest, roles and responsibilities. The identified stakeholder groups include:

- Alberta Transportation/Government Departments;
- Municipal;
- Maintenance / Meteorological;
- Emergency Services; and
- Users.

Table 1 provides a summary of the agencies contacted and the designated contact person.

Table 1 - Stakeholders Contacted

Stakeholder Agency
Alberta Transportation/Gov't Departments
Maintenance Operations
Technical Standards Branch
Driver Safety, Research & Traffic Safety
Transportation Policy & Planning
Transportation & Civil Engineering
Highway Policy & Planning
Coordination and Information Centre
Public Affairs
Inspection Services
Municipal Programs
North/South Trade Corridor
Highway Asset Management
Materials & Technical Services
Consultant to Alberta Transportation
Alberta Municipal Affairs
Alberta Economic Development (Tourism)
Albert Solicitor General
Alberta Safety Council
Municipal
City of Edmonton
City of Leduc
City of Red Deer
City of Calgary
City of Airdrie
Alberta Assoc. of Municipal Districts & Counties
Alberta Urban Municipalities Association
Maintenance/Meteorological
City of Calgary
Alberta Agriculture
Alberta Environment
Meteorological Services of Canada
AT Maintenance Inspectors
Maintenance Contractors (ARHCA)
Ledcor Alberta Limited
TSM
LaPrairie Group
Alberta Highway Services
Volker Stevin Contracting Ltd.
Carmacks Enterprises Limited
Emergency Services
RCMP
City of Calgary Fire Dept.
City of Calgary Police
City of Edmonton Emergency Response
City of Edmonton Fire Dept.
City of Edmonton Police
City of Red Deer Fire Dept.
City of Airdrie EMS
Users
Calgary Airport Authority
Alberta Motor Transport Association
Alberta Motor Association
Greyhound Canada
Red Arrow

The two workshops identified in the stakeholder consultation program will be conducted in future phases of the project, one near the end of Phase 2 and one near the completion of the project. These workshops will likely be approximately 4 hours in duration and cover the entire scope of the project (including RWIS applications on Alberta's National Highway System). They will be held in a convenient location within the Highway 2 corridor.

The project Internet web page has been developed to provide broad access to information about the project and allow stakeholders to provide input. It is currently hosted by Alberta Transportation under the following address: http://www.trans.gov.ab.ca/Content/doctype255/production/itsint01.htm

Needs Assessment

Data Analysis

Traffic and safety related data relative to Highway 2 between Edmonton and Calgary were reviewed at an overview level to provide background data into the types of problems and their extent and provide input into the types of ITS applications that would be most relevant for implementation in this section of the study area. From a review of these data and related analysis, the needs of the Highway 2 corridor between Edmonton and Calgary can be summarized as follows:

- High traffic volumes and related congestion are currently prevalent during peak periods in the Deerfoot Trail section of the corridor. Over the longer term, with continued growth forecast and no new alternate routes planned for implementation within this time frame, the level of service provided on this facility will continue to degrade.
- The suburban sections of the corridor (e.g. Airdrie to Calgary, Leduc to Edmonton, Anthony Henday Drive) currently experience limited congestion in peak hours. This congestion is likely to increase over the longer term as volumes continue to increase. Incidents or any unplanned lane closure would have a significant impact on the level of service in these sections of the corridor, particularly during peak hours.
- Commercial vehicles make up a significant portion of the vehicle stream and their needs should be taken into account in any initiative proposed for the corridor.
- Highway 2 cannot be considered as a safety deficient corridor due to its relatively low collision rate. The frequency of collisions in the corridor is however considered to be significant with over 800 collisions occurring in the rural section between Edmonton and Calgary in year 2000. Weather-related collisions and animal hits are two primary factors that contribute to over 50% of the collisions that occur within this rural section of the corridor.
- Agencies responsible for road maintenance and incident response identified bridge decks (especially over river courses) and grades (e.g. coulees, Antler Hill, etc.) as primary locations of collisions during the winter months. Collisions often result at these locations from degradation of driving conditions relative to adjacent sections of the network.
- Closures of Highway 2 are a frequent occurrence (4 to 6 times a year). This indicates a need for a mechanism that allows the highway to be closed safely,

efficiently and in a location that provides travellers the option of turning around or seeking food and/or accommodation nearby.

These data and as well as additional data and analyses will be utilized in future phases of the study to better define the operational needs of the corridor, identify priorities, develop a staged implementation program and conduct a benefit/cost analysis of the proposed ITS program.

Stakeholder Input

The decoding of stakeholders' interviews revealed that there are some common themes in the various issues and needs, which can be used to identify relevant functional areas of ITS applications. These common themes have been used to cluster needs into the following general functional areas:

- Road Condition & Traffic Information
- Incident Management
- Road and Weather Information Systems
- Traffic Control and Management
- Work Zone Safety
- Commercial Vehicle Operations
- Inter-Agency Coordination
- Data Collection / Management

Most stakeholders identified both their needs from a user perspective as well as provided suggestions with respect to equipment or system related requirements that they perceive would help to satisfy their need. For each of the eight categories listed above, the stakeholder needs are presented in terms of users needs and system/equipment related requirements. ***Table 2*** summarizes the user needs and system requirements that were identified by the stakeholders related to each.

Table 2 – Summary of Stakeholders Needs

Functional Area	User Needs	System Requirements
Road Condition & Traffic Information	More accurate & real-time information on road conditions, weather & incidents	• Use existing CMS more regularly • Install more permanent CMS in the Highway 2 corridor • Use of Highway Advisory Radio (HAR), roadside kiosks, pagers, telephone service, Internet, etc.;
	Wider dissemination and easier access to traveller information	
	Improve sharing of traveller information data between agencies	• Use of Highway Advisory Radio (HAR), roadside kiosks, pagers, telephone service, Internet, etc.;
Incident Management	Timely detection & accurate information on incident location	• Dissemination of incident site video images to emergency services dispatch • Numbering of exit ramps • Use of mileage markers • Fog detection systems • Wildlife detection systems • Truck rollover monitoring systems on ramps
	Coordination, control & monitoring of lane closures	• Design of alternate routes and development of implementation procedures • Coordination with maintenance contractors to provide assistance • Use of permanent and portable CMS • Lane control and queue management during lane closures
	Ability to close the highway at a location that is safe and convenient	• Install more permanent CMS
	Protection of incident site & safety of personnel	• Training of emergency services staff • Coordination with maintenance contractors to provide assistance in lane closures • Use of permanent and portable CMS • Lane control and queue management during lane closures
	Knowledge of hazardous materials & atmospheric conditions at dangerous goods spill locations	• Real-time data on existing atmospheric conditions • Tracking of dangerous goods movements

Functional Area	User Needs	System Requirements
Road & Weather Information Systems	Knowledge of existing atmospheric & road conditions Ability to forecast atmospheric, visibility & pavement conditions	• Real-time data on existing conditions at strategic locations and the ability to access this data from a remote location; • Strategic locations for RWIS sites include both problem locations and trigger sites (i.e. sites that are representative of the surrounding road network
Traffic Control & Mgmt.	Improve safety Maximize capacity of existing infrastructure Minimize impacts of recurrent congestion Minimize number of stops & reduce travel time in major corridors	• Use of variable speed limits during congested periods in the Deerfoot Trail; • Use of ramp metering on the Deerfoot Trail to avoid congestion at high volume entrance ramps; • Use of traffic responsive control of traffic signals at ramp terminals to avoid queue back ups onto the Deerfoot Trail; • Coordination of traffic signals in the Anthony Henday corridor (Phase 1); • Integration of AT traffic signals into municipal signal systems (e.g. Calgary, Red Deer and Edmonton); • Central control and monitoring of AT traffic signals on potential alternate routes (e.g. Highway 2A); • Use of HOV and/or reversible lanes in the Deerfoot Trail
Work Zone Safety	Protection & safety of site personnel Improved traveller information	• Improved speed management and enforcement; • Use of portable CMS
Commercial Vehicle Operations	Minimize infrastructure damage due to over height and overweight loads	• Wider deployment of high load warning system and ability to identify offending vehicle; • More efficient method of monitoring and enforcing commercial vehicle weight, dimension and driver regulations (e.g. weigh in motion, electronic license plates, etc.);
	Minimize delays at commercial vehicle inspection stations	• More efficient method of monitoring and enforcing commercial vehicle weight, dimension and driver regulations (e.g. weigh in motion, electronic license plates, etc.);
	Compatibility & interoperability with other provinces and states	• Sharing of CVO safety and maintenance records with other provinces, states and agencies (e.g. Coordination and Information Centre);

Functional Area	User Needs	System Requirements
Inter-agency Coordination	Coordination, control & monitoring of lane closures	• Establish a protocol and warrant system for the use of the CMS and related messages and notify all agencies; • Use of common radio channels for emergency communications between agencies; • Coordination of response activities, route diversions, etc. in the event of incidents (e.g. incident control centre); • Improved sharing/exchange of information (e.g. lane closure, weather, incident, road condition, traffic data, CCTV images, etc.) between agencies (e.g. police, fire, ambulance, vehicle inspection stations, airports, municipalities, tourism, fleet managers, users, etc.);
	Improve sharing of traveller information data between agencies	• Improved sharing/exchange of information (e.g. lane closure, weather, incident, road condition, traffic data, CCTV images, etc.) between agencies (e.g. police, fire, ambulance, vehicle inspection stations, airports, municipalities, tourism, fleet managers, users, etc.);
Data Collection/Management	Improve sharing of traveller information data between agencies Maximize access to information and data Minimize costs through development of partnerships	• Utilize permanent count stations to collect real-time traffic data (e.g. volume, occupancy, etc.), monitor speeds and disseminate information through a web-based interface; • Improve incident reporting procedures with more accurate location data (using GPS receivers in emergency vehicles) and electronic transfer of MVA reports to a provincial incident database; • Link data to existing road asset database (TIMS) / GIS system; • Maintain a web-based provincial database for commercial vehicle monitoring and regulation enforcement (e.g. driver records, vehicle records, etc.); • Maintain a database of pavement conditions, atmospheric data, residual de-icing chemical, etc for management of maintenance contracts, liability/risk issues, correlation of collision data, etc.; • Automated process for monitoring maintenance contracts (e.g. use of GPS to track maintenance vehicles, maintain records of application of sand and salt, application rates, time of application, etc.);

In summary, a review of the ITS needs and the project stakeholders that identified them provides the following observations:

- The primary needs of the majority of ITS users for this project are focused in the areas of road conditions and traffic information, incident management and road weather information systems.
- Data collection / management and inter-agency coordination are key aspects that support the above primary needs. The sharing of information electronically and coordination between agencies is a particularly strong theme in the needs identified.
- Commercial vehicle operations, congestion management and work zone safety have special needs requirements, but appear to be less of a priority among the stakeholders.
- There is a clear need to provide timely and accurate information to the motorists about road and traffic conditions on Highway 2, including information about scheduled events (e.g., road closures due to maintenance) as well as about incidents and inclement weather. This need for information and the ability to have it easily accessible is a major focus of the majority of project stakeholders.
- There is a common opinion among the majority of stakeholders that the existing equipment and data can be better utilized to provide information to the traveller.
- Traffic management to address congestion and provide incident management is necessary in the urbanized sections of Highway 2 such as the Deerfoot Trail and to a lesser extent, Anthony Henday Drive. Coordination and/or integration with other local urban traffic signal control applications is also important.
- Road weather information systems and commercial vehicle operations applications should be seen from the broader perspective with a need for an inter-provincial and international network.
- There is an overall desire for integrated, efficient and effective ITS applications based on proven and compatible technologies.

Mapping Needs To ITS Architecture For Canada

"User services" is a term that was introduced in the Intelligent Transportation Systems (ITS) program in the United States to identify, define and understand the multitude of user needs of the transportation system and their complexities and inter-relationships. The approach is multi-modal with the user needs representing both the public and private sectors including the individual traveller, the commercial vehicle driver, the infrastructure owner, the public transportation manager and the commercial fleet manager. Within the ITS Architecture for Canada, there are a total of 35 User Services which have been identified. Each of these user services is further broken down into user sub-services of which there are a total of 90 in the ITS Architecture for Canada.

The needs identified from the stakeholder interviews have each been analyzed and the user services and sub-services that best describe these needs are identified. This approach provides a direct connection to the ITS Architecture for Canada and allows the planning for the ITS needs of the Highway 2 corridor to follow the framework provided with the ITS Architecture for Canada. From this analysis a total of 12 user services and 26 sub-services have been identified as being applicable to the Highway 2 corridor.

Table 3 provides a summary of the services and sub-services selected for each of the eight categories of needs.

Table 3 – Mapping of Needs to User Services and Sub-services

ITS Needs	User Service	User Sub-service
Road Condition & Traffic Information	Traffic Control	• Traffic Information Dissemination • Traffic Network Flow Monitoring
	Traveller Information	• Broadcast Traveller Information • Interactive Traveller Information
	Automated Dynamic Warning and Enforcement	• Dynamic Roadway Warning • Variable Speed Limit and Enforcement
	Operations and Maintenance	• Smart Work Zones • Infrastructure Maintenance Management
	Traveller Services and Reservations	• Traveller Yellow Pages • Services Purchases and Reservations
	Weather and Environmental Data Management	• Environmental Information Dissemination
Incident Management	Incident Management Traffic Control	• Incident Management Co-ordination • Traffic Network Flow Monitoring
Road & Weather Information Systems	Environmental Conditions Management Weather and Environmental Data Management	• Road Weather Information System • Roadway Environmental Sensing • Roadway and Weather Data Fusion • Environmental Information Dissemination • Roadway Meso and Micro Prediction
Traffic Control & Management	Traffic Control	• Traffic Network Flow Monitoring • Regional Traffic Control • Highway Control • Surface Street Control
Work Zone Safety	Operations and Maintenance Automated Dynamic Warning and Enforcement	• Smart Work Zones • Dynamic Roadway Warning • Variable Speed Limit and Enforcement
Commercial Vehicle Operations	Commercial Vehicle Electronic Clearance	• Electronic Clearance • Weigh-In-Motion (WIM) • International Border Crossing Clearance
	Automated Roadside Safety Inspection	• Inspection Support Systems

ITS Needs	User Service	User Sub-service
	Commercial Vehicle Administrative Processes Automated Dynamic Warning and Enforcement	• Commercial Vehicle Administrative Processes • Dynamic Roadway Warning
Inter-Agency Coordination	All User Services Listed	• All User Sub-services Listed
Data Collection / Management	Archived Data Management	• Archived Data Warehouse • Archived Data Virtual Warehouse

From a review of the information presented in Table 3, it is clear that a number of the user services are applicable to more than one of the needs categories. There is also a requirement to stage the implementation of various user services and related ITS systems. ***Table 4*** illustrates the correlation of each of the user services and sub-services selected to the various needs and indicates the relative priority of these user services and sub-services. The priority of the various services was based on three criteria:

- ***Potential Benefit***: The potential benefit that can be realized by addressing the need and the number of stakeholders that will benefit based on the experience in other jurisdictions;
- ***Risk***: The risk associated with implementation. Risk was considered with respect to the maturity of the technology, institutional or jurisdictional barriers and the likelihood of acceptance of an initiative in this area by the public; and
- ***Cost***: The capital and operational costs associated with an initiative in this area. A major consideration in this criterion was the ability to use existing infrastructure and the ability and willingness to partner with other agencies.

Table 4 - Correlation of Needs to User Services and Their Priority

ITS Needs	User Services and Sub-Services																										
	Traveller Info.		**Traveller Services & Reserv.**		**Traffic Control**					**Incident Mgmt.**	**Environ. Condition Mgmt.**		**Operation & Maint.**		**Automated Dynamic Warning & Enforcement**		**Commercial Vehicle Electronic Clearance**			**Auto. Roadside Safety Inspect'n**	**Comm. Vehicle Admin. Process**	**Weather & Environ. Data Mgmt.**			**Archived Data Mgmt.**	
	Broadcast Traveller Information	Interactive Traveller Information	Traveller Yellow Pages	Services Purchases and Reservations	Traffic Info. Dissemination	Traffic Network Flow Monitoring	Regional Traffic Control	Highway Control	Surface Street Control	Incident Management Coord.	Roadway Envir. Sensing	Road Weather Info. System	Smart Work Zones	Infrastructure Maint. Mgmt.	Dynamic Roadway Warning	Variable Speed Limit and Enf.	Electronic Clearance	Intn'l Border Crossing Clr.	Weigh-In-Motion (WIM)	Inspection Support Systems	Comm. Veh. Admin. Processes	Rdway & Weather Data Fusion	Environmental Info. Dissem.	Rdwy Meso & Micro Prediction	Archived Data Warehouse	Archived Data Virtual Wrh'se
Road Condition & Traffic Information	●	◎	○	○	●	●							●	○	○	◎							●			
Incident Management						●				●																
Road & Weather Information Systems											●	●										●	●	●		
Traffic Control & Management						●	●	○	○																	
Work Zone Safety													●			○										
Commercial Vehicle Operations															○		◎	○	○	○	◎					
Inter-Agency Co-ordination	●	◎			●	●	●	○	○	●	●	●	●	○		◎	◎	○	○	○	◎	●	●	●	●	○
Data Collection / Management																									●	○

● High Priority ◎ Medium Priority ○ Low Priority

Synthesis of Needs

The needs and related user services identified by the stakeholders are translated into a series of ITS projects. The various ITS projects are organized into initiatives that match directly to the eight categories of needs used in the previous section. This provides a direct traceability of the various ITS projects proposed back to the specific needs that were identified by the stakeholders.

Each of the ITS initiatives is described at an overview level providing a description of the types of projects recommended for implementation, their relative priority, how they would operate from a functional and institutional perspective and the types of ITS components involved. The intent is to provide an outline for ITS deployment in the Highway 2 corridor that will serve as a vision for the project and provide clear direction for the remaining phases of the study.

Road Condition and Traffic Information

The needs analysis identified that more information with respect to road conditions, weather, incidents and congestion within the Highway 2 corridor should be available. This information should be timely, accurate and easily accessible to the traveller as well as a wide variety of interested parties. This relates to the better use of existing equipment in the corridor (e.g. changeable message signs) as well as the deployment of additional technologies and better sharing of information among agencies.

A review of existing conditions and systems indicates that while there are a number of agencies that are well informed of the road and traffic conditions, each agency only has information that is directly relevant to their role or responsibility with little to no sharing of this information. All of the information is of value to the traveller yet in order to disseminate it to the public, there must be a way of collecting and assembling this information into one database. Once there is timely and accurate information available, a method of disseminating this information to the public is required. To address these issues and concerns, the concept is to structure this initiative to first address the collection and assembly of information and to maximize the use of the existing infrastructure. The second priority is then to develop additional methods of disseminating the information to make the information more readily and easily accessible to a wide variety of users.

The method of collection is considered to be one of the more challenging aspects of this initiative. The recommended approach is for each agency or source of information (e.g. police, maintenance contractor, AT operations manager, AT maintenance contract inspector) to report the information through use of a standard report that is submitted via the Internet to a central database or repository. The information is automatically logged into the database and this database then serves as the information source for the dissemination of road and traffic conditions in the Highway 2 corridor. In the short term electronic reporting through the Internet could be difficult to achieve and a staged approach may be more realistic with information in the initial stage being provided verbally over the telephone to an operator who then enters the data into a database.

The location of the database, and the responsibility for updating the information is a major consideration in this initiative and one that lends itself to a partnership with another agency. Currently the Alberta Motor Association (AMA) provides road condition information to their members and the general public through their website. Information is collected from the maintenance contractors and the RCMP and updated once a day. It is recommended that a partnership arrangement with AMA, or other agency as appropriate, be pursued to manage this database as well as develop a website for dissemination of the information in a graphical format. This would require quality control of the data to ensure conflicting information is resolved and may require some interpretation to provide information that can be easily understood by the general public. These tasks will require the use of an operator to manage and administer the database and ensure timely updates to the website. Initially the demands on the operator may be quite high depending on how data is received from each of the different agencies and the extent of automation used to enter the data in the short term.

The dissemination of traveller information is the other major aspect of this initiative and the methods used can take many different forms. For the purpose of this study, we have focussed on media that can be deployed in the short to medium term. This includes methods that utilize existing infrastructure, employ mature technologies, can be deployed within a reasonable capital investment and are readily available to the stakeholders or users of the information. The methods that are considered to be most relevant for consideration within these selection criteria are as follows:

- Changeable Message Signs (CMS);
- Media:
- Internet:
- Kiosks:
- Highway Advisory Radio:
- Telephone Call-in:
- Pager Services:

The type of user of the traveller information and subsequently their needs and dissemination preferences will vary considerably. To better establish the potential of each of the different dissemination media, each of the different users of the information has been categorized into three areas.

- ***Roadway User***: The motorist on or destined to Highway 2 and includes members of the public, commercial vehicle operators, bus drivers, fleet managers as well as related agencies such as airports, tourism, media, etc.
- ***Public Agency***: Public agencies that are directly impacted by the information and may require immediate action due to their roles and responsibilities. This includes municipalities adjacent to the corridor as well as agencies responsible for maintenance, enforcement and emergency services (e.g. police, fire and ambulance).
- ***General Public***: This category includes the general public who are interested in the information on a “nice to know” basis. The information is not essential but is of interest for trip planning or for general information purposes.

From a review of the information summarized above, it is clear that the Internet is one medium that can address all three categories of users. It is also a medium that can be implemented relatively easily utilizing existing infrastructure. The recommendation is therefore to focus efforts in the short term on the development of an Internet website through a partnership arrangement. The intent is to utilize the Internet website and its associated database as the hub of the traveller information providing information to all of the potential users. The weakness of the Internet medium is its poor ability to disseminate information to the roadway user. Over the longer term however, additional infrastructure can be added that will build upon this initiative including deployment of roadside kiosks, development of a telephone call-in system and use of personal device services such as pager, E-mail, etc. Many of these initiatives can be pursued through partnership arrangements.

CMS's exist within the corridor and can be a very effective means of providing information to the roadway user. They do however have their limitations, particularly in a long linear rural corridor and their application must recognize these limitations. With this in mind, the recommendation for more general traveller information applications is to focus efforts on better use of the existing signs and utilize more portable CMS's for managing traffic and providing advance warning/traffic diversion during incidents and planned lane closures. This would include:

- Better use of the existing permanent CMS's through development of a traffic and road condition database. The operator at Alberta Transportation's Coordination and Information Centre (CIC) would use this information to select the most appropriate message. The intent is to use the existing signs more regularly to warn motorists of lane closures, maintenance crews on the road, incidents, weather advisories, etc.
- Deployment of portable CMS's at lane closures implemented by the maintenance contractor. Locations and messages would be pre-approved in a set of traffic management plans according to the incident location.
- Deployment of portable CMS's at lane closures implemented by construction contractors. Locations and messages would be detailed in the construction traffic management plans and submitted for pre-approval.
- Deployment of portable CMS's may also be of value to the RCMP in the setting of short term lane closures in the event of an incident. This could be implemented through the simple addition of an arrow board (fold down) to the roof of selected highway patrol vehicles.

The role and purpose of permanent changeable message signs will require scrutiny to establish how they can be best utilized within the Highway 2 corridor. While they can be a very effective means of disseminating information to the motorist (e.g. roadway closure), they also have their limitations, particularly in a rural application due to the travel times and distances involved. In the urban sections of the study corridor, they are considered to be much more effective, particularly to provide advance warning to drivers of conditions ahead and to encourage diversion to alternate routes.

Incident Management

In the area of incident management, the needs analysis identified more timely detection and accurate information on collision location and better coordination, control and monitoring of lane closures and designation of alternate routes as being significant

concerns within the Highway 2 corridor. This relates to the need for better systems to detect and respond to incidents. It also identifies the need for better coordination between agencies in which several of the elements of the road and traffic information initiative described previously will be of direct benefit.

In the Highway 2 corridor, incident management is considered to be of most value in the highest volume sections, where an incident can have a significant impact on traffic operations. The first priority for incident management would therefore be the Deerfoot Trail in Calgary, where daily traffic volumes range from 50,000 to 140,000 (year 2001). The recommendation would be to first implement a basic form of incident management in the most heavily travelled sections of the corridor utilizing CCTV and a limited number of vehicle detection stations. CCTV would be the primary component of the system providing 100% coverage of the corridor to enable monitoring of the traffic conditions and verify incidents. The vehicle detectors would provide for computer monitoring of traffic conditions at strategic locations to alert the operator to unusual conditions. The primary objective of the system is to detect and verify incidents as quickly as possible and assist in the dispatch of emergency services in order to reduce the duration of the incident. A control centre would be required, with operators to monitor traffic conditions and report incidents to the 911 operator. The video images would serve multiple purposes; being of use to emergency services to help identify the location of the incident and to assess the type of response required at the scene, to the media and traveller information website for dissemination to the public and to the City of Calgary to monitor traffic conditions on adjacent City arterials. The operation of the control centre (in conjunction with the City of Calgary urban traffic signal system) and the cost of deploying the cameras and related communications network are therefore good candidates for partnership opportunities.

The control centre could also be used as a call centre for incident related calls from passing motorists. This would provide improved detection time, particularly for minor incidents (e.g. vehicle breakdown, debris, etc.), through placement of roadside signage informing motorists of the number to call and providing a free cellular call to the centre. This more passive type of incident detection is recommended in the Deerfoot Trail in the more lightly travelled sections. If successful, this type of operation would be expanded to the Red Deer and Edmonton areas where a similar type of operation can be implemented through their traffic control centres.

Over the longer term the recommendation is to gradually expand the incident management system to the entire Deerfoot Trail throughout Calgary and to work towards a more active type of incident detection system with extensive use of vehicle detectors to monitor traffic operations (e.g. volume, speed and occupancy). Currently much research is underway in automated incident detection (e.g. incident detection algorithms, methods of vehicle detection, use of vehicle probes etc.) and Deerfoot Trail is recommended as a potential site for research projects in this area.

It should be noted that the Calgary, Red Deer and Edmonton control centres would become ideal sources of incident and lane closure information for the road and traffic information initiative. Over the longer term, these control centres could replace the maintenance contractor and RCMP as the source of this information. These control centres could also monitor operation of any portable CMS's within their area of control or

response, essentially becoming a virtual control centre for multi-faceted traveller information and incident management systems in the Highway 2 corridor.

In the Anthony Henday Drive corridor in Edmonton, the projected volumes in the short term do not warrant any immediate deployment of incident management field components on a large-scale basis. It is recommended however that CCTV monitoring at strategic/high collision locations (i.e. bridge crossing of the North Saskatchewan River) be considered. This will require a traffic control centre where an operator can monitor the video images. Over the longer term, it is likely that a more comprehensive approach to incident management will be deployed throughout the corridor.

In the rural sections of Highway 2, incident management techniques are not considered to be a high priority due to the cost of installation and the limited benefit that would result, since traffic volumes are relatively low and congestion due to incidents is not expected to be a significant problem in the near future. Therefore in the near term, the recommendation is to rely on the current method of incident management (e.g. calls to 911 via cellular telephone users). Deployment of CCTV cameras at select high collision locations (e.g. interchanges) is also recommended as a pilot test to evaluate the effectiveness of this approach in a rural environment. Video images from these select locations would be transmitted back to the closest control centre for monitoring.

In addition, kilometre markers and numbering of exits are also recommended to assist motorists in knowing their location when reporting an incident. These suggestions are recommended for deployment in both the urban and rural sections of Highway 2 as a low cost approach to help address this need. Over the longer term it is anticipated that vehicle features such as GPS location devices and MAYDAY services will become much more common place. These private sector initiatives will address the timely detection and location needs related to incident management.

With respect to coordination between agencies, two additional components to this initiative are recommended. The first is the development of detailed traffic management plans throughout the Highway 2 corridor. These plans will identify designated alternate routes, the requirements for temporary sign placement and/or detour trail blazers, need for barricades, portable CMS messages, agency roles and responsibilities, communication protocols, etc. for each potential incident site within the corridor. This is an immediate need and should be implemented quickly based on the functional plans that will be developed as part of this study. The other initiative is the designation of emergency radio communications channels and the procurement of radio equipment that will allow emergency services personnel from different agencies to communicate directly with each other in the event of an emergency.

Road and Weather Information Systems

The needs analysis identified the need for knowledge of existing conditions as well as forecast conditions (e.g. atmospheric data, pavement temperature, sub-surface temperature, residual de-icing material present, blowing snow or reduced visibility, etc.) at key locations throughout the road network. This would allow road maintenance staff to make informed decisions on when to apply anti-icing and de-icing material, the type of material and ultimately provide a higher level of service to the road user during the winter season. The study area for this initiative includes all highways within Alberta's National Highway System (Highways 1, 2, 3, 4, 9, 16, 35, 43 and 49 – see Exhibit 2).

The concept within this initiative is relatively well defined with the province of Alberta wanting to deploy 70 road and weather information sites (RWIS) throughout the province to provide information with respect to approximately 3,400 kilometres of highway. This based on a spacing of approximately 50 kilometres between field stations. The intention of this system is to form part of Canada's national RWIS network with the federal and provincial governments sharing in the cost of deployment.

The needs identified by Alberta Transportation and the road maintenance contractors focus on their requirement to be able to remotely monitor both problem locations and "trigger" sites. "Trigger" sites are locations that are considered to be representative of conditions over a larger area of the road network. Having access to real time and forecast conditions at both types of sites will aid significantly in decision-making on when to apply anti-icing or de-icing materials, where and the type of material to apply. It is therefore proposed to deploy a network that is balanced between the need to monitor problem areas as well as locations that are considered to be typical of a larger area.

The deployment of the 70 RWIS sites throughout the province is a high priority, with the sites likely to be prioritized and staged over the short to medium term. There are also a number of environmental sites currently located throughout the province that collect atmospheric data and are owned and operated by Alberta Environment and Alberta Agriculture. The City of Calgary also has existing RWIS stations and the City of Edmonton is in the planning stages of implementing RWIS on their river crossings. This presents an excellent opportunity to partner with these agencies to share data, offset the cost of field components and share in the use of communications infrastructure.

The data received from the sites on existing conditions can be received almost immediately using either vendor provided software or a consolidated view from all vendors that can be provided by Environment Canada. The real value in the system however is in the ability to predict pavement temperatures, humidity, frost, etc. To do this requires the use of extensive atmospheric data and a computer model. Currently Environment Canada offers this service on a user fee basis. Environment Canada has indicated that they do not want to continue in this area of business and as a result, it would be prudent for Alberta Transportation to look for new partners or service providers for this service.

RWIS stations can be equipped with a CCTV camera for the transmission of video images back to the central server. The images are slow scan type of transmission and serve to assist in the interpretation of the data. It is recommended that select RWIS sites be equipped with CCTV cameras. These images will help road maintenance staff in interpreting the data, especially during the first year or two of operations. They will also be of considerable interest to the traveller with the ability to see weather conditions on a real-time basis through the proposed traveller information website.

Fixed Automated Spray Technology (FAST) is considered to be the next generation of RWIS. It involves the deployment of de-icing material at specific problem locations on an automated basis based on real-time environmental conditions. Typically, they are deployed on bridges where the potential for icing and other winter storm events is significant. The deployment of FAST is recommended for consideration at key river

crossings where there is a high frequency of weather-related collisions and traffic volumes are high.

Traffic Control and Management

Traffic control and management refers to active control and management of traffic in order to improve safety and reduce the impacts of recurrent congestion through the implementation of such traffic control devices as traffic signals, lane control signals, ramp meters and variable speed signs. Many of these devices were identified in the needs analysis, particularly with respect to the Deerfoot Trail.

The Deerfoot Trail in Calgary is the most heavily travelled and congested segment of the Highway 2 corridor. The congestion related problems that have been identified within the corridor include:

- Recurring congestion during peak periods with the associated slow downs, "stop and go" conditions, etc. This is most prevalent in the Deerfoot Trail between Southlands Drive and 32 Avenue NE;
- High volume traffic on exit ramps creating queues that impact traffic operations in freeway lanes; and
- High volume traffic on entrance ramps impacting traffic operations in freeway lanes.

In most locations the slow downs and "stop and go" conditions on the freeway are directly related to entrance and exit ramps with the associated weaving, merging and diverging traffic movements. Implementation of measures to smooth ramp related traffic movements would help to address some of these congestion related issues on the Deerfoot Trail.

Exit ramp traffic backing up from the traffic signal at the ramp terminal and impacting freeway operations is considered to be the highest priority due to the potential safety concerns and collision potential. Currently the City of Calgary is currently testing a queue detection system (southbound off ramp to Peigan/Barlow Trail) where vehicle detectors are placed on the exit ramp. Detection of a standing queue sends a signal to the traffic signal controller which then modifies the signal timing to release the queue. It is recommended that this strategy and the related operational tests continue to be a priority. Specific locations on the Deerfoot Trail that have been identified as problem locations include:

- Southbound ramps to Glenmore Trail, 17 Avenue, Memorial Drive and 16 Avenue; and
- Northbound ramp to 32 Avenue.

The problems related to high volume entrance ramps are also considered to be a high priority. Typically, ramp metering is applied to locations where this is a problem. Ramp metering controls the number of vehicles entering the freeway at one time. This breaking up of the platoons of entering traffic into groups of one or two vehicles significantly reduces the impact on freeway traffic operations. In the Calgary area however, there is likely to be a strong negative public reaction to such a strategy. It is therefore recommended that in the short term entering traffic be controlled through signal timing strategies where traffic entering the freeway is limited by the timing and

phasing of traffic signals at the adjacent intersections. The two locations on the Deerfoot Trail that would benefit the most from such an approach would be the high volume ramps at 17 Avenue and 32 Avenue. This will require the testing of various control strategies and field observations to optimize the approach. In both of these aspects of this initiative, a close partnership with City of Calgary will be required due to the close inter-relationship between traffic operations on the Deerfoot and the City's arterial street network and the requirement to utilize the City's traffic signal management system.

Additional traffic control and management strategies in the Deerfoot Trail including lane control systems and variable speed limits based on traffic congestion levels will require significant capital investment as well as legislative changes. It is recommended that the lower cost ramp management aspects of this initiative be implemented in conjunction with the incident management recommendations described previously. The benefits of these investments can then be evaluated and if necessary, higher levels of control (e.g. variable speed limit, lane control, etc.) can be implemented over the longer term.

As a rule of thumb, traffic control and management strategies should be implemented in a freeway corridor when traffic volumes exceed 100,000 vehicles per day. Based on this approach the Deerfoot Trail is a definite candidate for this initiative. Forecast traffic volumes for Anthony Henday Drive however indicate that traffic control or management strategies are not likely to be required for at least another 10 to 15 years. The potential requirement for ramp management or other traffic management strategies in the future however should be incorporated into the current design of this roadway facility.

Anthony Henday Drive will have a series of four traffic signals operating in the initial stages of its development. Coordinated operation of these traffic signals is considered to be a high priority from both a safety and level of service perspective. It is recommended that a partnership with the City of Edmonton be developed for the incorporation of these traffic signals into the City's traffic signal management system. In the City of Calgary, there are four existing traffic signals on Deerfoot Trail which will be reduced to two (130th Avenue and Douglasdale Boulevard) with the completion of the Deerfoot Trail Extension. The proposed construction schedule and the distance between these intersections does not warrant a similar approach in the City of Calgary.

Currently traffic signals operating on Alberta Transportation's highway network operate in an isolated fashion with no coordination or method of central control or monitoring provided. In most locations throughout the province this type of operation is appropriate due to the rural nature of the corridors involved and the large inter-signal spacing. The Highway 2A corridor however does have several locations where inter-signal spacing is such that coordination would be of some benefit. Highway 2A is also the primary alternate route to Highway 2 in the event of an incident. It is therefore recommended that a method of central monitoring and control of Alberta Transportation's traffic signals within the Highway 2A corridor be implemented in the short to medium term. This would allow signal coordination to be easily implemented and provide a method of altering the signal timing plan in the event of an incident. This would be implemented in a staged approach with emphasis in areas of the corridor where inter-signal spacing would warrant it. It should be mentioned that wherever possible, partnerships with the local municipality and use of their traffic signal management system to monitor and control the traffic signals should be implemented (e.g. Calgary, Edmonton and Red Deer).

Work Zone Safety

Protection and safety of site personnel and improved traveller information were the needs that were identified in the area of work zone safety. For purposes of this report, a work zone is defined as any lane or shoulder closure on the highway that is required due to an incident or road related construction and/or maintenance.

In this initiative the intent is to provide the motorist with as much information as possible with respect to the lane closure and as such it is closely related to the Road and Traffic Condition Information initiative described previously.

Within this initiative the portable CMS is the primary component that is recommended for deployment. It can be applied to work zones for three purposes; to provide advance warning of the work related lane closure for purposes of information and traffic diversion, to provide information to the motorist in the work zone on such aspects as travel distance or travel time through the lane closure, maximum speed limit, etc. and to function as a speed enforcement tool where the speed of vehicles travelling over the speed limit are displayed to encourage offending vehicles to slow down. This information provided to the motorist will allow them the opportunity to divert to an alternate route, or if they continue within the Highway 2 corridor, to be informed of the length (i.e. distance) of the lane closure or expected travel time to reduce driver frustration. Use of the sign as a speed enforcement tool is recommended initially as a pilot test to determine the driver's reaction to the information and assess its ability to reduce travel speed through a work zone.

The signs are to be deployed and controlled by the maintenance or construction contractor. Communication with the sign and the potential to edit messages will be possible from Alberta Transportation's CIC or regional control centres through a cellular modem. For construction or maintenance related lane closures, CMS messages within the work zone will be pre-approved by Alberta Transportation as part of the contractor's traffic management plan. In the case of incidents, CMS messages will be set directly by the maintenance contractor in accordance with the traffic management plans developed under the Road and Traffic Condition Information initiative. For long term contracts where lane closures will be in place for extended periods, it is recommended that vehicle detectors be used in the open lane to detect traffic conditions and have the CMS display messages based on actual traffic conditions (e.g. speed of offending vehicle, estimated travel based on spot speed data, etc.) utilizing a software algorithm to interpret the data and select the most appropriate CMS message.

Commercial Vehicle Operations

The Highway 2 corridor is part of the CANAMEX North South Trade Corridor that links Alberta and the rest of Canada to the United States and Mexico. As such it serves as a vital link to Alberta and carries a large volume of commercial vehicle traffic. In conducting the stakeholder interview process a number of needs relevant to commercial vehicle operations were identified. The needs identified include minimizing infrastructure damage due to over height and overweight loads, minimizing delays at vehicle inspection stations and compatibility and interoperability of regulatory and monitoring systems with other provincial, state and national agencies.

Currently in the Highway 2 corridor there are two overpasses that have high load detection systems in operation; the Highway 2A overpass in Leduc with a vertical clearance of 5.0 m and the Highway 11 overpass in Red Deer with a vertical clearance of 5.2m. There are also high load collisions on other structures within the Highway 2 corridor. These collisions cause damage to the structures and result in unnecessary capital and maintenance costs to repair the structures. In order to better protect the infrastructure in the Highway 2 corridor, inform drivers of over height loads, enforce the provincial regulations and recover the costs of repair in the event of a high load collision, it is recommended that an over height load detection system be deployed at vehicle inspection stations as well as various locations throughout the Highway 2 corridor. The systems located at the vehicle inspections stations would be set-up to measure load heights, with all loads over the provincial regulation required to obtain a permit and/or wait for an escort. The other over height systems would be located at problem locations in the Highway 2 corridor (e.g. structures that are frequently damaged from over height loads) and able to detect an over height load, warn drivers of the problem in advance to enable them to divert to an alternate route and identify the offending vehicle as well as record the necessary information to enable fines to be levied.

There are currently two commercial vehicle inspection stations located within the study area, Balzac and Leduc. Currently there are a variety of initiatives within Canada to standardize truck regulations between provinces. It is likely that this standardization will reduce the weight limit requiring a truck to enter the vehicle inspection station. This reduction in weight limit will increase the number of trucks requiring inspection and therefore the operational costs of the inspection stations unless a more efficient method of inspection can be developed. To achieve this, the recommendation is to implement a mainline sorter and bypass system that would allow pre-approved commercial vehicles to bypass a vehicle inspection station. Only vehicles with a good safety and compliance record would be pre-approved. This would be similar to Alberta's current bypass system with the exception that it would be automated, allow trucks to bypass without entering the vehicle inspection station and be compatible with other provincial and state databases to accommodate out of province trucks. This will require the use of vehicle identification technology, vehicle classification equipment and a database of pre-approved vehicles that is current and available at each vehicle inspection station. Over the longer term, it is recommended that weigh in motion technologies be tested to evaluate their accuracy, maintenance requirements and the developments that have occurred in this technology.

Inter-Agency Coordination

The operation of any roadway facility requires management, maintenance, enforcement and monitoring activities that are conducted by a wide variety of agencies. The ability to share information between these agencies and to conduct their various activities in a coordinated manner presents significant opportunities in efficiency and effectiveness. Inter-agency coordination is a common theme that was raised in the discussions with the majority of stakeholders.

In the descriptions of the various initiatives provided previously, inter-agency coordination is a significant focus with many of the initiatives and related ITS components structured to provide this ability. This initiative does not identify any additional ITS components or systems, rather the intent is to identify the specific areas where this coordination is most relevant and to emphasize the importance of this

partnership aspect of the program for the Highway 2 corridor and RWIS on Alberta's National Highway System.

The primary focus of this initiative is in the sharing of information between agencies. This includes:

- The sharing of road and traffic condition information not only to the road user and information service providers for dissemination, but also to such agencies as police, emergency services (911, fire, ambulance, hazardous materials, etc.), municipalities, vehicle inspections stations, fleet managers/dispatchers, airports, etc. Use of the Internet as a dissemination tool will be very valuable in getting this information to these various agencies in an effective manner.
- The sharing of information with other non-road transportation related government agencies. Examples would include weather information, airline schedules, tourist related information, etc. This can be accommodated through the use of the Internet traveller information site and the provision of "hot links" to other agencies' sites.
- The development of partnerships with other agencies for the sharing of data and joint use of infrastructure.
- The development of policies, procedures and detailed traffic response plans for planned and unplanned lane closures within the Highway 2 corridor.

Data Collection/Management

The deployment of ITS elements in the field and the ability to communicate with them electronically from a central location provides a significant opportunity in the collection and management of data. The data, while being directly relevant to the purpose it was originally intended, can also be of significant value to other applications as well as to other agencies. As such, this initiative is directly related to the inter-agency coordination initiative.

In the discussions with stakeholders a number of potential applications or uses of data were identified. Several of these applications do not require the deployment of any additional field elements while others link to additional initiatives that are being considered within these agencies. In this initiative the potential opportunities related to sharing of information or the ability to utilize field components for multiple purposes are identified. This presents potential partnerships with various agencies and the ability to offset capital and operating costs. Examples of such opportunities are described below.

- GPS vehicle location systems are under test or being contemplated by a number of emergency services agencies for computer-aided dispatch purposes. The use of the GPS location information and electronic equipment in the vehicle would provide a convenient method of accurately locating the incident as well as providing a method of entering incident information for uploading to a central database (e.g. traveller information).
- GPS has been tested by Alberta Transportation and is currently in use on maintenance vehicles in Edmonton and Calgary for computer-aided dispatch and monitoring purposes. Connecting a vehicle monitoring system to the vehicle electronic and communications systems to report vehicle location, speed, plow status, material application rate, etc. would provide a convenient method of

monitoring contractor activity for payment as well as for record purposes. It would also provide a convenient method of updating surface condition information for traveller information purposes.

- Video images used for incident management can also be of significant value to a number of agencies including the media for traveller information, emergency services dispatchers to asses needs at an incident site, traffic management staff in adjacent municipalities to monitor traffic conditions at an incident, etc.
- Storing historical records of atmospheric and surface condition data from RWIS stations can be of considerable value to monitor contractor performance.
- Permanent count stations are located throughout the Highway 2 corridor. Using these stations to collect volume, vehicle classification, occupancy and speed data and retrieving the data to a central database would make the data available to multiple agencies. The data can then be used for the typical planning purposes as well as for speed monitoring for police purposes, background information for traveller information, research applications, etc.
- GPS vehicle location is also in use in some trucking fleets for tracking cargo and fleet management purposes. Use of this information for purposes of tracking hazardous materials would be an asset.
- The set-up of a pre-clearance system that allows commercial vehicles with a good record to bypass a vehicle inspection station is one of the recommendations in the commercial vehicle initiative. Maintaining this database at a central location and providing access to vehicle inspection staff, the CIC for dangerous goods movements as well as other agencies including customs, immigration and other provinces would allow maximum use of the information.

The opportunities presented above present an overview of the importance of the data collected within the many systems that are contemplated within the Highway 2 corridor. Some will be directly under the control of Alberta Transportation while others will require close cooperation between agencies. The most important aspect of this initiative is to recognize the potential, maintain close working relationships with the various agencies and to use open systems standards in the design of the various systems. This includes the use of common interfaces, standards and communications protocols so that data can be shared between systems and agencies.

Data Communications

Communications is the one element that is common to all of the initiatives. The ability to control and monitor field equipment from a central location, store data in a central repository and share information (data and video) all requires data communications. In addition to being common to all of the initiatives it also represents one of the most cost intensive aspects of ITS, requiring significant capital and operational funds to provide.

There are many different types of media that can be used to provide data communications ranging from cable (e.g. telephone, coaxial, fibre optic, etc.) to wireless (e.g. radio, microwave, satellite, cellular telephone, etc.). From a business perspective, they can also be provided on an agency owned basis requiring a large capital investment or over leased facilities (e.g. telephone) requiring operational costs over the life of the system. The optimal alternative is largely dependent on the data transmission

requirements (e.g. amount of data, speed, etc.), geographic coverage and the distances involved.

In the next phase of the project the communications requirements of the various initiatives will be investigated and recommendations developed with respect to the alternatives and the type of communications that would be most appropriate for the various ITS components. This communications strategy will be developed with both the short and long term initiatives in mind and partnership options will be considered.