York Region

On the Move...

...towards sustainable transportation

TRANSPORTATION MASTER PLAN

Policy Paper No. 2

TRANSPORTATION SYSTEM MANAGEMENT & INTELLIGENT TRANSPORTATION SYSTEMS

For Discussion Purposes Only

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1.0 INTRODUCTION

This paper examines and assesses the current issues, trends, programs and options for Transportation System Management (TSM), including the use of intelligent transportation systems (ITS), as they may be applicable to York Region.

2.0 CURRENT ISSUES AND TRENDS

The following provides a brief overview of current TSM and ITS issues and trends.

Transportation System Management is receiving increased attention across North America. This is due, in part, to the increased competition for limited road capacity, the inability of transportation agencies to construct new transportation infrastructure in urban areas due to right-of-way and funding constraints, and the desire to recognize a return on the significant investment in transportation infrastructure.

The Transportation Association of Canada championed a new vision for urban transportation in 1993. This vision embodied the concept of sustainable transportation, and recognized the need to use TSM and ITS as a means to optimize the use of existing transportation systems. More recently, the Greater Toronto Services Board emphasized the need for an expanded traffic management system on GTA and Hamilton-Wentworth expressways, including Highway 407, and at key points on all trade corridors to U.S. border crossings.

The City of Toronto is advocating the expanded use of transit priority systems and HOV lanes through its proposed transportation vision for its new Official Plan. Similarly, the Region of Durham's recently released draft transportation master plan vision and policies include directions for the implementation of traffic responsive signal systems, traffic management and advanced traffic control measures to maximize available road capacity.

TSM encapsulates a variety of practices and methods used by transportation agencies to make the most of their existing transportation infrastructure. These methods can involve a combination of:

- operational improvements such as the use of signal pre-emption for transit and emergency vehicles, and high-occupancy vehicle (HOV) lanes;
- maintenance improvements such as the repair and enhancement of key communications and computer infrastructure;
- minor physical improvements such as the construction of turning lanes and bus bays; and
- technological improvements such as the use of high order traffic control and monitoring systems.

ITS is one component of TSM that involves the use of information and communication technologies to better manage and improve how transportation providers offer services to the public. ITS use varies between urban areas, rural areas and political jurisdictions. According to the U.S. Department of Transportation, urban area ITS can be characterized as a combination of several key elements:

- *Traffic Signal Control Systems* that are automatically adjusted to optimize traffic flow.
- *Freeway Management Systems* that provide information to motorists, detect problems for increased capacity and flow, and minimize congestion from collisions.
- *Transit Management Systems* that allow new ways of monitoring and maintaining transit fleets through advanced locating devices and equipment monitoring systems.
- *Incident Management Systems* that enable communities to identify and respond to collisions or breakdowns with the best and quickest type of emergency services, minimizing clean-up and medical response time.
- *Electronic Toll Collection* that provides both drivers and transportation agencies with convenient and reliable automated transactions, dramatically improving traffic flow and increasing operational efficiency in toll collection.
- *Electronic Fare Payment Systems* that enable a person to use a single smart card to pay for parking, bus and train fares, as well as tolls.
- *Railroad Crossings* that are coordinated with traffic signals and train movements.
- *Emergency Response Coordination* that ensures the closest available and most appropriate emergency unit can be dispatched to a collision.
- *Regional Multimodal Traveller Information* systems that provide road and transit information to travellers, businesses and motor carriers, so they can adjust travel plans when necessary.

In rural areas, ITS is characterized as a combination of several different key elements:

- *Traveller Safety and Security* technologies that use in-vehicle sensors and information systems to alert drivers to hazardous conditions and dangers. This also includes wide-area information dissemination of site-specific safety advisories.
- *Emergency Services* technologies use satellites and advanced communication systems to automatically notify the nearest police, fire or ambulance unit in case of collisions or other emergencies.
- *Tourism and Travel Information* services use in-vehicle navigation and roadside communications systems to provide information to travellers who are unfamiliar with the local area. These services can be provided at specific locations en route or before travellers begin their trip.
- *Public Traveller and Mobility Services* improve the efficiency of transit services and their accessibility to rural residents. Better scheduling, improved dispatching, smart card payment, computerized ride-sharing and ride-matching systems can be achieved through advanced vehicle locating devices and communications systems.
- *Roadway Operations and Maintenance* technologies improve the ability of highway workers to maintain and operate rural roads. These include severe weather information systems and immediate detection and alert of dangers to work crews.
- *Fleet Operation and Maintenance* systems improve the efficiency of rural transit and other rural fleets, such as snowplows and law enforcement vehicles, through advanced vehicle tracking and on-board equipment monitoring systems.
- *Commercial Vehicles* use satellites, computers and communications systems to manage the movement and logistics of commercial vehicles, and locate vehicles during emergencies and breakdowns.

Regardless of the type and combination of TSM or ITS elements used, there is general consensus that the most successful programs have four essential elements. First, there is extensive cooperation between various political jurisdictions, non-profit agencies and the private sector. Second, they employ integrated technological infrastructure at the appropriate geographic level. Third, TSM and ITS have the capability to build upon and

evolve user services, technology applications and institutional relationships. Finally, TSM and ITS devices must be properly maintained.

3.0 EXISTING YORK REGION POLICIES, PROGRAMS & PRACTICES

The York Region Official Plan includes provisions for the development of HOV lanes as part of the regional transportation system and in support of a rapid transit network. To further this direction, the Region completed an HOV/Rapid Transit study in 1995. The HOV/Rapid Transit study confirms that major investment in HOV and rapid transit facilities is required if York Region is to achieve its Official Plan development goals and a 33% transit modal split during peak periods. Rapid transit facilities are proposed in major corridors with high transit volumes, with HOV lanes that accommodate buses and vehicles with 2+ and 3+ occupants in less heavily used corridors. An early start to the HOV/rapid transit program is recommended to encourage transit-oriented development and provide the initial foundation for developing the HOV/rapid transit network.

The recommended network is designed to be implemented in stages to build demand, limit risk, and keep annual capital expenditures consistent with the estimates in the Region's Growth Management Study. The study provides a four-stage implementation program that is summarized in Table 1. To date, only one of the recommended elements from the HOV/Rapid Transit study has been implemented, that being the HOV lanes on Yonge Street between Steeles Avenue and Clark Avenue in Thornhill.

The Region of York has a centralized traffic control system (CTCS) to provide computerized monitoring and command functions to all traffic signals that are under Regional control. There are currently over 500 traffic signals on roads within the Region, over 400 of which are under CTCS control, with more signals being added to the system on a daily basis. The local municipalities have fewer than 100 signals within their jurisdictions. King, East Gwillimbury and Georgina have no traffic signals on their local streets, while Newmarket has transferred authority for the operation and maintenance of their signals to the Region. The remaining five local municipalities retain control over all traffic signals within their community except for the Town of Markham, which has delegated authority to the Region for three signals which are within close proximity to Regional roads. Finally, the Region also controls all Ministry of Transportation signals within the Region, although MTO retains jurisdiction over the intersection, and has the ultimate authority over phasing and timing.

The Region's CTCS has been in operation for just over four years and is staffed with eight individuals who are responsible for data collection, operations, analysis, supervision and management. The system is "distributed" insofar as the control algorithms are native to the local controller. The CTCS does not monitor every step in the cycle, but polls the intersection every five minutes to retrieve information that the watchdog feature adds to an internal log within the controller. Various alarm states are recorded such as stuck pushbuttons, emergency vehicle pre-emptions and conflict situations which place the signal in "flash" mode. Communication is achieved via leased communication lines from Bell Canada for approximately 100 signals, plus 300 spread

spectrum radio links. The vast majority of signals operate in a semi-actuated mode, and the balance are fully actuated, which are typically found at major intersections.

Table 1: York Region HOV/Rapid Transit Strategy Implementation Program

Timing	Component	Element
Near Term	HOV Lanes	• Highway 7 – Highway 400 to 404 • Jane Street – Steeles Avenue to Highway 7 • Dufferin Street – Steeles Avenue to Highway 7 • Yonge Street – Steeles Avenue to Highway 7 • Don Mills Road/Leslie Street – Steeles Avenue to Highway 7
	Busway	• Highway 7/407 Corridor Busway – construct selected initial stations and sections
	Rapid Transit Precursor	• interim exclusive right-of-way to the Yonge Subway • interim exclusive right-of-way to the Spadina Subway
Medium Term	HOV Lanes	• Highway 7 – Highway 50 to Highway 400, Highway 404 to McCowan • Rutherford Road – Weston Road to Highway 404 • Dufferin Street – Highway 7 to Rutherford Road • Bathurst Street – Steeles Avenue to Major Mackenzie Drive • Yonge Street – Highway 7 to Elgin Mills Road • Warden Avenue – Steeles Avenue to Highway 7 • McCowan Road – Steeles Avenue to Highway 7 • Steeles Avenue – encourage Toronto to implement east of McCowan Road to Durham Region
	GO Transit	• Bradford line – encourage GO Transit to implement full service • Richmond Hill line - encourage GO Transit to implement full service • Stouffville line - encourage GO Transit to implement full service
	Busway	• Highway 7/407 Busway – construct additional busway stations and related sections • Yonge Busway – construct selected initial busway stations and related stations
Long Term	HOV Lanes	• Highway 27 – Steeles Avenue to Highway 7 • Weston Road – Steeles Avenue to Rutherford Road • Jane Street – Highway 7 to 16th Avenue • Keele Street – Steeles Avenue to Major Mackenzie Drive • Yonge Street – Elgin Mills Road to Davis Drive • Leslie Street – Highway 7 to 16th Avenue • Warden Avenue – Highway 7 to 16th Avenue • McCowan Road – Steeles Avenue to 16th Avenue • Highway 48 – Steeles Avenue to 16th Avenue • New Markham Bypass – Steeles Avenue to 16th Avenue • Steeles Avenue – encourage Toronto to complete from Highway 50 to McCowan Road • Highway 400 – support province's implementation
	Busway	• Yonge Busway – construct Langstaff to Elgin Mills section • Highway 7/407 Corridor Busway – complete linked busway
	Subway	• Yonge Subway – enter into agreement with Toronto to extend to Highway 7 • Spadina Subway – enter into agreement with Toronto to extend to Highway 7
Ultimate	Busway	• Highway 7/407 corridor Busway – extension of busway • Yonge Street Busway – completion of busway
	Subway	• Spadina Subway – extension from Jane Street/Highway 7 to Weston Road/Highway 7

Time-based co-ordination is provided among the 400 signals that are currently under CTCS control. Traffic signal coordination is provided from the central computer through the transfer of necessary parameters to the controlling field equipment as required, and a daily synchronization of all traffic signal time clocks to the computer. Data is collected through the detector network, in particular through system loops, which are imbedded in numerous major arterials. In addition, two closed circuit television (CCTV) cameras are located at Highway 7 and Weston Road to provide monitoring capability of this intersection by staff at the Control Centre. Signal pre-emption is provided through the use of an OPTICOM system that gives fire vehicles priority over conflicting traffic at most signalized intersections throughout the Region.

4.0 EXPERIENCES OF OTHER JURISDICTIONS

TSM and ITS policies, programs and practices vary across political jurisdictions. The following provides a brief overview of TSM and ITS methods being employed in the Greater Toronto Area and other selected jurisdictions.

There are two freeway traffic management systems operating within the GTA. The City of Toronto operates one on the Don Valley Parkway and the Gardiner Expressway, and the Ministry of Transportation operates COMPASS on parts of the 400 series highways. These systems include extensive detectorization, CCTV and computerized changeable message signs to inform drivers of downstream traffic conditions. On the QEW, the system provides ramp metering to control access to the eastbound expressway through Mississauga. Collectively, this provides enhanced traffic flow, reduced delay and improved response to collisions and other incidents.

Numerous major municipalities across the GTA and throughout Ontario have computerized traffic signal systems. These include the cities of Toronto, Brampton and Mississauga, plus the regions of Ottawa-Carleton, Durham, Sudbury and Waterloo to name a few.

The Regional Municipality of Ottawa-Carleton also operates an internet site (www/rmoc.on.ca/travelwise) as a community information ITS tool. The website provides a one stop, on-line source for complete information on transportation methods such as walking, cycling, carpooling and public transit. The site is being expanded with an on-line cycling map, information on workplace commuting and walk to school information.

5.0 TSM AND ITS OPTIONS AND IMPLICATIONS

There are several TSM and ITS options that York Region could pursue. Table 2 summarizes the advantages and disadvantages of these options.

Table 2: TSM and ITS Options for York Region		
Option	**Advantages**	**Disadvantages**
Arterial High-Occupancy Vehicle (HOV) lanes	Preferential treatment for HOV 2+ and 3+ on designated arterials	Adds to roadway congestion for trucks, and is very difficult to enforce
Signal pre-emption for emergency and transit vehicles	Reduces delay for fire vehicles and buses at traffic signals	Signal priority for buses is capital intensive, and cannot be effectively implemented until a Regional transit system is in place
Freeway Management System	Reduces delay and congestion on freeway network	Requires a complementary system on the parallel arterial network to maximize effectiveness
Regional Multi-modal Traveller Information System	Reduces both passenger and motorist delay on transit and arterial road network. Especially effective for visitors to the Region, or those unfamiliar with the road network	Very capital intensive, and requires broad cooperation among a variety of agencies and vehicle manufacturers
Roadway Operation and Maintenance Technologies	Enhances response to severe weather emergencies	Moderately capital intensive, and other sources of information can be utilized such as the Weather Network
Traffic Responsive Area Control (TR1)	Provides significant improvements to traffic operations on arterial roads that are parallel to a freeway	Requires software and moderate capital and maintenance expenditures for detectorization
Traffic Responsive Intersection Control (TR2)	Provides substantial enhancements to key signalized intersections	Requires software and moderate capital and maintenance expenditures for detectorization
Assumption of all Traffic Signal Control Functions under York Region	Provides effective co-ordination of all signal operations under one responsible jurisdiction	Requires co-operation among all local authorities and the Region of York. Initially, there may be a perceived loss of local autonomy. Additional capital and maintenance costs to be assumed by the Region, but overall there would be a net saving.
Traffic Adaptive Control (SCOOT)	Provides area wide responsive control to all selected intersections under central control	Requires significant software and computer hardware plus high capital and maintenance expenditures for detectorization and other field equipment.

6.0 DIRECTIONS FOR CHANGE

As noted in the previous Table 2, there are a number of options that the Region of York can pursue. A plan is in place for the HOV network, and this should be implemented as per the proposed schedule. The Region already has an OPTICOM system in place to provide emergency vehicle pre-emption for fire trucks. Technology similar to that currently being used in the City of Toronto could be implemented for buses in the Region, but this should not be undertaken at least until a Region wide transit system is in place. Similarly, the MTO COMPASS project can and should be extended into the Region on Highways 400, 404 and 407, and ultimately the 427 extension. Since the Region has no freeways directly under its jurisdiction, there is no advantage to developing or implementing any form of FTMS. By simply taking advantage of Provincial expertise in this area, the Region can reap the benefits of FTMS without incurring the significant capital and maintenance costs associated with a system of this complexity.

The options that should be pursued, however, are the implementation of Traffic Responsive Area (TR1) and Critical Intersection (TR2) control along freeway corridors and key intersections throughout the Region. This would enable the CTCS to respond to freeway incidents and unforeseen changes in traffic patterns in a dynamic and effective manner. A move towards the consolidation of all traffic signals under Regional control is also a desirable goal, if effective co-ordination of signal operations is to become a reality. The implementation of Traffic Adaptive control should be a longer-term initiative, once TR1 and TR2 control are well established. As much as possible, the Region should learn from the efforts of other jurisdictions in the GTA, especially the City of Toronto. This will preclude the need to develop and test any new technology that has already been well researched elsewhere. This will minimize costs and speed the installation of enhanced control algorithms to the benefit of Regional taxpayers and the travelling public.

7.0 BIBLIOGRAPHY

Cross, Gregory. 2000. "Rural ITS: Northern Shenandoah Valley Model Deployment Initiative", *ITS World Magazine*. Volume 5, Number 1.

City of Toronto, 2000. *A Transportation Vision for the City of Toronto Official Plan*.

Greater Toronto Service Board, 2000. *Removing Roadblocks to Continued Economic Prosperity for the Greater Toronto Area, Ontario and Canada*.

Gregorski, Tim. 2000. "Forecast Calls for Steady Traffic", *ITS World Magazine*. Volume 5, Number 1.

Kallender, Paul. 1998. "Priority Proven", *ITS International*. Issue 19.

McManus, Sean. 1998. "Battle of the Bulletins", *ITS International*. Issue 19.

Mitchell, Dennis J. 2000. "Their Brother's Keeper", *ITS World Magazine*. Volume 5, Number 3.

Ontario Ministry of Transportation, 1996. *Transportation Infrastructure: Expenditure Trends and Preservation Requirements*.

Ontario Ministry of Transportation, 1997. *TDM Business Case Review*.

Ontario Ministry of Transportation, 1999. *Transportation Planning for the Greater Toronto Area and Hamilton Wentworth*.

Region of Durham, 2000. *Working Paper #2: Vision, Policy and Issues.*

Region of Peel, 1995. *Summary of the Peel HOV and Transit Priority Studies*.

Region of York (McCormick Rankin), 1995. *York Region HVO/Rapid Transit Study*.

Region of York, 1999. *Official Plan (Office Consolidation)*.

Transportation Association of Canada, 1993. *A New Vision for Urban Transportation*.

U.S. Department of Transportation, 1998. *ITS Standards*.

U.S. Department of Transportation, 1998. *ITS Standards*.

U.S. Department of Transportation, 1998. *Metropolitan ITS*.

U.S. Department of Transportation, 1998. *Rural ITS*.

U.S. Department of Transportation, 1998. *The National ITS Architecture*.