

Enhancements to Road Emergency Services

Communications Unit (RESCU)

(City Council on July 4, 5 and 6, 2000, adopted this Clause, without amendment.)

The Works Committee recommends the adoption of the following report (May 26, 2000) from the Commissioner of Works and Emergency Services:

Purpose:

To seek approval to enhance the capability of the Road Emergency Services Communications Unit (RESCU) by:

- (a) extending the system geographically north on the Don Valley Parkway and west on the Gardiner Expressway;
- (b) introducing additional functions such as "Video Monitoring at Key Intersections" and "Advanced Road Weather Information Systems"; and
- (c) improving the ability of the system, including the "Situation Room", to manage traffic during major construction activities.

Financial Implications and Impact Statement:

The approved 2000 budget for the Transportation Division's Capital Works Program includes \$500,000.00 for RESCU. The remaining cost for the RESCU enhancements is estimated to be \$10,700,000.00. These funds will be requested as part of the Transportation Services Capital Works Program budget submission in future years.

The Chief Financial Officer and Treasurer has reviewed this report and concurs with the financial impact statement.

Recommendations:

It is recommended that:

- (1) approval be granted to implement the enhancements to the Road Emergency Services Communications Unit (RESCU) as outlined in this report; and
- (2) this report be forwarded to the Telecommunications Steering Committee for their information.

Background:

The full deployment of the detection, monitoring and response capabilities of RESCU currently exists in the Gardiner Expressway-Lake Shore Boulevard corridor between the Don Valley

Parkway and the Humber River, and partial deployment exists on the Don Valley Parkway between the Gardiner Expressway and a point just south of Don Mills Road. This leaves sections of the City's freeway system, which are not subject to the benefits of a fully deployed corridor traffic management system.

Specifically, these sections are the Gardiner Expressway between Highway 427 and the Humber River as well as the Don Valley Parkway between Highway 401 and the Gardiner Expressway. In August 1999, the RESCU Geographic and Functional Expansion Study was initiated to review the feasibility of extending the detection, monitoring, and response capabilities of RESCU to these sections of the freeway system. It was the intention of the study to build on the existing subsystems of RESCU as well as to assess if newer technologies for detectors, cameras, changeable message signs and other subsystems would improve system operations.

In addition, the study examined several functional enhancements to RESCU as a means of introducing new traffic management technologies and strategies, not only to the freeway system but to arterial corridors as well. These functional enhancements included interoperability with the Ministry of Transportation's (MTO's) COMPASS system, video monitoring at key intersections, derivation of travel time data using in-vehicle probes, and the use of advanced road weather information systems.

A functional enhancement for RESCU, which was outside the scope of the Expansion Study, is for RESCU to play a lead role in area traffic management for construction projects. A portion of the 2000 Capital Budget will be dedicated for the procurement and installation of additional portable changeable message signs and temporary cameras. This will enable the Transportation Division to monitor traffic conditions, evaluate the effectiveness of response plans and provide motorists impacted by ongoing major construction projects with real-time traffic information.

Comments:

Traffic Management System Benefits:

The proposed geographic extension of RESCU would maintain objectives consistent with the existing system. These include:

- (a) improved safety;
- (b) quicker response to collisions and breakdowns in the corridors;
- (c) reductions in secondary collisions;
- (d) minimized effects of non-recurring congestion;
- (e) more effective utilization of corridor capacity;
- (f) reduced recurring congestion;
- (g) improved motorist information; and
- (h) reduced energy consumption and emissions.

Since the inception of RESCU in January 1994, the above-noted objectives have been met to varying degrees. For example, a review of collision statistics for the first 21 months since RESCU began operating showed a two percent reduction in the number of collisions, a 16 percent reduction in the number of people injured, and a 36 percent reduction in the number

of people suffering “significant” injuries when compared to the annual average for the four preceding years.

Through the early detection and removal of lane-blocking incidents, RESCU reduces the delays to both commercial vehicles and private automobiles. Using very conservative values of \$32.50 per hour of delay for commercial vehicles and \$5.40 per hour to private automobiles, the resultant benefit is equal to \$6,400,000.00 annually.

Because the RESCU system contributes to the reduction of vehicle delays, it also contributes to reducing the emission of pollutants. It is estimated that RESCU reduces pollutant emissions by 456,000 kilograms of hydrocarbons, 697,000 kilograms of carbon monoxide and 146,000 kilograms of nitric oxides, annually. In this manner, RESCU forms part of a sustainable transportation system, as advocated by the Environmental Task Force in its report “Clean, Green and Healthy” dated January 2000.

The RESCU system has provided improved traffic management capability in the Gardiner-Lake Shore corridor without increasing roadway capacity. Daily traffic volumes have not actually increased. Similar to volumes recorded since 1993, the Gardiner – Lake Shore corridor currently handles between 215,000 and 250,000 vehicles per day.

Overall, these benefits contribute to productivity, competitiveness and the economic vitality of the City of Toronto.

Geographic Extension – Don Valley Parkway and Gardiner Expressway:

The study reviewed the application of both expressway and corridor system deployments to the geographic “missing links” in the RESCU system.

Similar to the current RESCU system, the deployment strategies would be designed to provide incident detection capabilities, in addition to congestion detection, incident confirmation and response capabilities. Detectors would be installed at 500 metre intervals, cameras at one-kilometre intervals, and overhead changeable message signs (CMS’s) would be installed at strategic locations. The communications subsystem would be a dedicated fibre-optic network.

A “corridor” is defined as the combination of a freeway and parallel arterials in close proximity to the freeway. Traffic conditions on one facility are affected by the traffic conditions on the other facility, and they serve as diversion routes. For the purposes of this study, a corridor deployment would consist of a full system deployment on the freeway, and a light system deployment on the arterials.

SCOOT, our traffic adaptive signal control system, currently exists on Don Mills Road and The Queensway, but not on Victoria Park Avenue.

Therefore, the “corridor” preliminary quantities for the Don Valley Parkway include the installation of SCOOT on Victoria Park Avenue between York Mills Road and Eglinton Avenue East. This will provide the capability for the traffic signals on Victoria Park Avenue also to automatically respond to traffic volume fluctuations.

The preliminary quantities for each type of deployment on both the Gardiner Expressway and Don Valley Parkway corridors are tabled below.

Don Valley Parkway Extension Preliminary Quantities

Capability		Don Valley Parkway	Corridor*
Detector Stations		78	SCOOT on Victoria Park
Cameras		10	8
Changeable Message Signs		2	4
Communications	Fibre Optics	6.6 km	-
	Wireless link	2 systems	2 systems

* Installations on Don Mills Road and Victoria Park Avenue.

Gardiner Expressway Extension Preliminary Quantities

Capability		Gardiner Expressway	Corridor*
Detector Stations		53	-
Cameras		2	4
Changeable Message Signs		0	4
Communications	Fibre Optics	3.3 km	-

* Installations on The Queensway.

The potential benefits for both the Don Valley Parkway and Gardiner Expressway corridors were derived from the ability of the traffic systems to efficiently manage traffic during incident events and cope with the resultant disruption. The benefits considered were limited to those that result from improved management of traffic “events” during peak periods. Therefore, the quantified benefits are under-estimated to some degree. The quantified benefits include: reduced vehicle delays; reduced fuel consumption; and reduced secondary collisions. The qualitative benefits associated with improved construction/special event management, improved motorist information, reduced emissions and reduced driver frustration were not included in the benefit-cost analysis.

The costs to deploy the traffic systems were based on the corresponding infrastructure and communication requirements. The costs were broken down to both initial and annual costs, as well as the present value of those costs.

Summary of Benefits and Costs

	Gardiner Expressway Corridor	Don Valley Parkway Corridor
Capital Costs	\$2,300,000.00	\$6,600,000.00
Annual Operating Cost	\$ 152,000.00	\$ 425,000.00
Present Value Capital	\$2,230,000.00	\$6,400,000.00
Present Value Operating	\$1,179,000.00	\$2,652,000.00
Present Value Total Cost	\$3,409,000.00	\$9,052,000.00
Benefits	\$10,300,000.00	\$25,500,000.00
B/C	3.0	2.8

Based on the positive results of the benefit/cost evaluation, it is recommended that corridor level deployment be pursued for both the Gardiner Expressway and Don Valley Parkway.

The installation of fibre optics and the spare ducts on the Don Valley Parkway between Don Mills Road and Highway 401 would have additional benefits. Firstly, the spare ducts would facilitate the installation of part of a City-owned fibre optic network in the future. This concept is under consideration by the Telecommunications Steering Committee and City staff under the direction of James Ridge. Secondly, staff of Fire and Ambulance Services have expressed an interest in receiving RESCU video at their new headquarters at 4330 Dufferin Street. Toronto Police Services would also benefit from the presence of the RESCU video, since 4330 Dufferin Street will act as a back-up location for the “911 Emergency Response System”. The fibre connection between 703 Don Mills Road and 4330 Dufferin Street would be accomplished by using fibre installed on the Don Valley Parkway as part of RESCU expansion, existing COMPASS fibre along Highway 401, and fibre in sewers along Allen Road/Dufferin Street between Highway 401 and No. 4330 Dufferin Street. Trial installations of fibre optic cable in sewers are currently being undertaken. Should the technology prove viable, the subject section of Allen Road/Dufferin Street would be considered as a candidate location for permanent installation. The budget for RESCU enhancements provides funding only for the fibre installation along the Don Valley Parkway. Future justification would be provided for any additional funding request to either lease or install fibre optic cable along Highway 401/Allen Road/Dufferin Street.

Functional Enhancements:

The following is a description of the main functional enhancements recommended by the RESCU Expansion Study:

Interoperability:

With the geographic expansion of RESCU, the closing of the “missing links” between RESCU and COMPASS and improved interoperability between the two systems becomes more achievable. Currently, the RESCU and COMPASS systems perform limited joint event management through telephone calls and faxes.

It is recommended that RESCU should pursue the installation of a centre-to-centre communications link, in order to receive COMPASS video and event data. Senior staff of the MTO have agreed in principle to pursuing this arrangement. Ultimately, RESCU operators would be able to select and control particular COMPASS cameras and changeable message signs.

The following are some examples of potential incidents on COMPASS facilities, which might affect the City of Toronto road network:

- (a) There is a hazardous material spill at the Keele Street and Highway 401 interchange. Traffic is diverting to other interchanges, and using alternatives such as Sheppard Avenue and Wilson Avenue. Right now, RESCU staff could only observe the extent of the problem by accessing the COMPASS web page, and viewing still images. With improved interoperability, they could select live video feeds to view first hand the impacts of the incidents, and monitor the effectiveness of the City's response plan.

If camera control was added to the functionality, RESCU operators could actually assume control of key cameras for a short time period, and operate them to view the impacts on the adjacent City of Toronto roads. Traffic Signal Control staff could use this information to make decisions on temporary signal timing changes to manage the diverted traffic.

- (b) An incident occurs on northbound Highway 427. By receiving the incident/detector data from COMPASS, RESCU operators are automatically notified of the incident. If the incident is serious, RESCU operators could display a message on the westbound Gardiner Expressway changeable message sign, and introduce an appropriate response plan.

The total hardware and software capital cost is estimated at \$185,000.00. Until such time as a fibre optic link was in place between RESCU and COMPASS, the operating budget would cover the cost of leased communication lines.

Arterial Traffic Monitoring:

The installation of cameras at key intersections outside of the RESCU corridors would provide important monitoring capabilities on strategic routes within the City of Toronto.

The deployment of arterial cameras to complement the existing RESCU system would provide the following important capabilities:

- (a) monitoring of key intersections and the introduction of signal timing changes;
- (b) monitoring of freeway diversion routes and the introduction of improved response plans;
- (c) monitoring of recurrent congestion on arterial roads and the development of remedial measures;
- (d) support of SCOOT traffic monitoring capabilities; and
- (e) monitoring of recurrent illegal curbside activity for information and traffic management purposes.

An associated benefit of deployment of these cameras would be the ability of RESCU operators to confirm on-site conditions reported by the public or other sources.

Ten high priority potential arterial monitoring sites have been identified (see Appendix A). It is recommended that initially one installation be completed to demonstrate the benefits for congestion and incident management, and that other high priority sites be installed after the demonstration. The average installation cost is estimated at \$67,000.00 per location.

Deriving Travel Time Data:

Real-time travel data can play an important role in traffic management. Travel time measures are understood by non-technical audiences, yet are rigorous enough for technical analysis. Therefore, travel time data can be used for a number of applications, such as corridor management and measuring network performance.

Congestion management is particularly useful for corridor applications where travel time data can be used to balance the traffic demand between alternative routes. Motorists can use real-time travel time data to determine their most appropriate route, and emergency response crews can use this data to react to incidents in the most efficient manner possible.

A decision to apply strategies that rely on travel time information would result in a need to measure travel times accurately and cost effectively. One method of travel time collection is Automatic Vehicle Detection (AVI) – Dedicated Short-Range Communication (DSRC). This technology involves a roadside antenna and a transponder in a vehicle which can be used to determine the time at which the vehicle passes the antenna.

The following equipment is necessary for AVI travel time data collection:

- (a) vehicle transponders;
- (b) roadside reader for each travel time checkpoint;
- (c) communication network for reader sites; and
- (d) computer and control centre for processing tag information and matching consecutive tag reads.

There may be an opportunity to utilize the transponders currently in vehicles for Highway 407 toll operations. However, although on Highway 407 there is a high percentage of vehicles equipped with transponders, the level of market penetration of transponder equipped vehicles on the streets of Toronto is not known at present. In fact, there may be an insufficient number of equipped vehicles in the Toronto traffic streams to derive accurate traffic time data. Therefore, it is recommended that a pilot project be undertaken to study these and other issues. The pilot project should examine the application to both freeway and arterial roadways. An agreement to read transponders has not yet been reached with the owners of Highway 407. Once an agreement has been reached with Highway 407, a pilot project is estimated to cost \$550,000.00.

Advanced Road Weather Information Systems (ARWIS):

ARWIS systems provide current pavement data as well as forecast pavement and air conditions. Municipalities use ARWIS systems mainly as a tool for improved winter maintenance decision-making. The improved pavement condition data results in the optimization of salt applications (quantity and timing) as well as plow/spreader routes. The direct benefits are cost savings due to reduced salt use, improved safety, and the mitigation of environmental damage.

As a pilot project, ARWIS installations could be added to the Gardiner Expressway and Don Valley Parkway. Each site is estimated to cost approximately \$60,000.00 for installation and \$6,000.00 annually for maintenance. Complete coverage of the City of Toronto may require the installation of up to six sites. International experience with ARWIS has resulted in direct benefit/cost ratios to the operating jurisdiction of greater than 2:1, with higher indirect benefit/cost ratios once the greater costs to society are factored in, e.g., reduction in collisions, reduction in environmental damage. For example, direct benefit/cost ratios have been documented in Minnesota of 2.1:1 and in Sweden of 2.5:1.

Area Construction Traffic Management:

Historically in the City of Toronto, traffic management of major construction projects has been focused on the installation of static signs and pavement markings in the immediate vicinity of the construction site. In more recent years, the importance of area traffic management plans for construction activities has been recognized, resulting in area-wide static sign plans for alternate routes as well as the use of temporary traffic signal timings during construction. The role of RESCU has been one of information dissemination through the use of four overhead changeable message signs in the Don Valley Parkway – Gardiner – Lake Shore corridor, two portable changeable message signs, the “Road Info” voice information system, a subscriber based “Remote Traffic Information System”, a web site showing snapshot images of live traffic conditions, and faxed notices to the media.

In 2000, RESCU will expand its role in construction traffic management through the use of additional portable changeable message signs as well as temporary cameras. This will essentially result in a “portable” system which can be deployed to help manage traffic in the area of major construction projects. The strategically located cameras will be monitored by existing RESCU operators, and messages reflecting real-time conditions will be posted on the portable changeable message signs. This year, RESCU has budgeted \$500,000.00 for the acquisition of four portable changeable message signs and three temporary cameras.

This includes an allowance for the development or purchase of new software which will improve the ability of “Situation Room” operators to handle incoming data from various construction/special events sites. The applications of this portable traffic management system in 2000 will include the Gardiner Expressway East Dismantling project between the Don Valley Parkway and Leslie Street, the Gardiner Expressway Deck Rehabilitation project between York Street and Jarvis Street as well as the Don Valley Parkway Bridge Rehabilitation project in the vicinity of Lawrence Avenue East.

Implementation Plan:

The total capital cost for the proposed geographic and functional expansion of RESCU is \$11,200,000.00. A proposed work plan for the complete geographic and functional expansion of RESCU is tabled below.

Activity	Cost
DVP Extension	\$ 6,600,000.00
Gardiner Extension	2,300,000.00
Arterial Monitoring Cameras (10)	700,000.00
Deriving Travel Time Data	540,000.00
ARWIS Installations (6)	360,000.00
Area Construction Traffic Management	500,000.00
RESCU/COMPASS Interoperability	200,000.00
Total Cost	\$11,200,000.00

This year, \$500,000.00 of the Transportation Services Capital Works Program budget has been allocated to RESCU. Given the funds available, as an early objective, it is recommended that RESCU pursue design of corridor system deployment on the Don Valley Parkway where no facilities are currently in place. In addition, implementation of the other higher priority functional enhancements would begin. The work plan for 2000 is tabled below.

Activity	Cost
Area Construction Traffic Management	\$250,000.00
Don Valley Parkway extension design	\$ 53,000.00
Initiate RESCU/COMPASS Interoperability	\$ 10,000.00
Design and installation of arterial surveillance camera	\$ 67,000.00
ARWIS installation (2 sites)	\$120,000.00
Total	\$500,000.00

A number of influences external to RESCU may have an impact on the funding and work plan for RESCU in 2000 and subsequent years. There may be cost-sharing possibilities with MTO as we connect to the COMPASS system, particularly at the west end of the RESCU system with the proposed modifications at the Queen Elizabeth Way/Highway 427/Sherway Gardens interchange.

Conclusions:

The geographic expansion of RESCU would result in complete coverage by a freeway management system on both the Gardiner Expressway and Don Valley Parkway. Several functional enhancements would introduce new traffic management strategies to both the freeway system and the arterial road network. An area construction traffic management system could be introduced with application to several major projects. Implementation would begin in 2000, with a completion date dependent on funding availability.

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List of Attachments:

Appendix A: Potential Arterial Traffic Monitoring Locations

Appendix A

Potential Arterial Traffic Monitoring Locations:

- (1) Steeles Avenue East at Woodbine Avenue;
- (2) Steeles Avenue East at Markham Road;
- (3) Warden Avenue at Ellesmere Avenue;
- (4) W.R. Allen Road at Eglinton Avenue West;
- (5) Don Mills Road at Sheppard Avenue East;
- (6) Yonge Street at Sheppard Avenue;
- (7) Danforth Avenue at Pape Avenue;
- (8) Yonge Street at York Mills Road/Wilson Avenue;
- (9) Bayview Avenue at Moore Drive/Southvale Drive; and
- (10) Black Creek Drive at Lawrence Avenue West.