Data Management Group
Annual Report
1998

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A co-operative project that is jointly funded by members of the Toronto Area Transportation Planning Data Collection Steering Committee:

- City of Toronto
- GO Transit
- Ministry of Transportation Ontario
- Regional Municipality of Durham
- Regional Municipality of Peel
- Regional Municipality of Halton
- Regional Municipality of Hamilton-Wentworth
- Regional Municipality of York
- Toronto Transit Commission

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1 INTRODUCTION

The Joint Program in Transportation is a research centre located at the University of Toronto, administered by the Faculty of Applied Science and Engineering, with a history spanning more than twenty-five years. The objectives of the Joint Program were originally and continue to be:

a) to encourage research relevant to improved transportation in Canada through the influence of research findings on investment planning, policy development, operations, and the development of human resources and expertise,
b) to serve government and the transportation industry by acting as a source of information, expertise and special purpose training programs,
c) to provide an environment within the university community that is productive to high quality teaching and research in the transportation field.

The Data Management Group is a long-term research activity at the Joint Program that has been instrumental in helping to fulfil the above mandate.

1.1 A Brief History of the Joint Program in Transportation

In 1970, the Canadian Transport Commission (CTC), at that time a regulatory body concerned with Federal Government policy on all aspects of the national transportation system, established a program to encourage research and teaching in the field of transportation at Canadian universities. Part of the program allocated funds to a fellowship program for postgraduate studies. The CTC designed a second part of the program to stimulate research at a small number of regional centres on transportation topics of national interest. The President of the CTC invited the presidents of each Canadian university to submit proposals for the establishment of organized research units or centres that would specialize in transport research across a broad spectrum of the physical and social sciences.

In response to this request, faculty members at the University of Toronto and York University collaborated on a joint proposal to take advantage of the complementary capabilities and interests of faculty at both universities. On the basis of submissions received from a large number of universities, the University of British Columbia, the University of Montreal, and the University of Toronto-York University Joint Program in Transportation were awarded development grants for an initial period of four years. Subsequently, development grants were extended to the University of Manitoba and the Canadian Marine Transportation Centre at Dalhousie University.

In addition to these development grants, the CTC established a special fund, known as negotiated research grants, that were available to the five established centres as well as to smaller groups at the Universities of Calgary, Saskatchewan, Waterloo, McMaster, Carleton, and New Brunswick. Annual competition was the basis of allocation of these funds. Special funds were also available on a case by case basis for the support of Senior Research Fellows, a program designed to encourage greater involvement of industry and government personnel in the university research program.

Initially, the CTC program for university support received the attention of senior officials of both the CTC and Transport Canada. It was treated, in effect, as a grant-in-aid program. Very little direction was given by the sponsors as to the nature of the research to be supported. As a result, a wide spectrum of projects was funded, ranging from the very technical to policy-oriented projects at the urban, regional, and national levels. Of the five major centres that received support from this program, the University of Toronto-York University Joint Program was the most comprehensive in terms of the disciplines covered.

Due to successive reorganizations within Transport Canada, responsibility for the university program (and the fellowship program) shifted from the CTC to the Transportation Development Agency and, with the disbanding of that agency, to the Transport Canada Research and Development Centre, and finally it moved to the Strategic Planning Branch of Transport Canada. With each organizational change, the degree of involvement by senior officials of the Federal Government in defining research priorities became more active. For example, the earlier emphasis on interdisciplinary research was eliminated, and the acceptability of urban transportation research (an area in which there are few, if any, federal responsibilities) diminished. Nevertheless, from 1970 until 1985 the university support program was an extremely important and effective mechanism for encouraging postgraduate transport education and research in Canadian universities, particularly on aspects of the transportation system that operated on a national scale.

In the spring of 1985, the Federal Government cancelled the entire Transport University Program. The impact on the University of Toronto-York University Joint Program in Transportation was catastrophic. During the following two years, relying upon accumulated surpluses to fund day-to-day operations was necessary while new avenues for future funding were explored. This period was characterized by a major reduction in administrative staff and the termination of employment agreements with all permanent research staff. At its peak (1983), aside from the Director, permanent research positions varied from five to six people supplemented by one Senior Research Fellow and the administrative staff of the Joint Program that included two secretaries, one administrative assistant, one librarian, and one editorial assistant. By 1987, the Joint Program supported the Director and one full time secretary.

Efforts to explore new opportunities for research funding materialized in mid-1988 with the establishment of the Data Management Group under the auspices of the Ministry of Transportation Ontario. The scope of the project was to test the feasibility of the Joint Program providing an information system for travel in the surrounding urban area. Initially, the Ministry agreed to be the sole funding agency for a pilot project over a period of two years (effective 1 August 1988). Within a few months, the Ministry changed the funding arrangement to include the Regional Governments in the area, as well as the Toronto Transit Commission. GO Transit became a funding partner in 1990. The project provided, and continues to provide, the necessary base support from which other research areas can be developed.

1.2 A Brief History of the Data Management Group

The Data Management Group (DMG) was established in 1988 on the basis of a proposal from the Joint Program in Transportation for an autonomous research group that stated the following objectives:

a) establish a common, centrally-accessible data base containing information on transportation activities, zone systems, transportation networks and land use activity,
b) provide a transportation data retrieval service to the participating agencies,
c) monitor the adequacy of available data and propose approaches for adding to or updating the data as mutually agreed upon by the agencies,
d) promote greater interaction between university researchers and practitioners concerned with the application of transportation data and methods of demand analysis to transportation planning in the Greater Toronto Area. This should also encourage the development of trained specialists in the field of transportation planning and operations,
e) promote the communication of transportation information and data obtained or administered by the Data Management Group to interested agencies and to the public,
f) further the improvement of transportation demand analysis, research, and forecasting in the Greater Toronto Area.

These objectives continue to guide the activities of the DMG into what is now the eleventh year of continuous operation.

The particular needs of all transportation planning agencies in the Greater Toronto Area plus Hamilton-Wentworth are represented in the composition of the funding agencies. The interests of the provincial government are represented by the Ministry of Transportation Ontario, the interests of local and regional governments by the Regional Municipalities, and the special interests of transit by the Toronto Transit Commission and GO Transit. Since 1990, the

participating agencies have remained;

City of Toronto
GO Transit
Ministry of Transportation Ontario
Regional Municipality of Durham
Regional Municipality of Halton
Regional Municipality of Hamilton-Wentworth
Regional Municipality of Peel
Regional Municipality of York
Toronto Transit Commission

The funding agencies express their individual and collective needs through the administrative structure of the Data Management Group. All policy matters are the responsibility of the long standing Toronto Area Transportation Planning Data Collection Steering Committee (TATPDCSC) and technical guidance is provided by a technical advisory committee of TATPDCSC, the Transportation Research and Data Management Group (TRADMAG). A major review of the Data Management Group's activities at the University of Toronto was undertaken by the steering committee (TATPDCSC) in 1992 after three full years of collaborative funding. The objectives, activities and accomplishments of the Group in its first trimester received scrutiny by each of the funding agencies and concluded with a recommendation to continue support for another three years. Another major review took place at the conclusion of the second trimester and concluded the activities should be continued.

At the conclusion of the third trimester in 1997, the program was reviewed by the Steering Committee (TATPDCSC) and it concluded that activities should continue and should be subject to review on an annual basis. The uncertainty of an appropriate role for the newly formed Greater Toronto Services Board (GTSB) is an important component of this decision. A review of the Annual Reports of the Data Management Group[1] convey the important impact this group has had in the transportation planning community, the research community and on undergraduate and graduate education.

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1 *Data Management Group Annual Report, Report 28, Joint Program in Transportation (September 1992)*
Data Management Group Annual Report 1993, Report 43, Joint Program in Transportation (January 1994)
Data Management Group Annual Report 1994, Report 49, Joint Program in Transportation (May 1995)
Data Management Group Annual Report 1995, Report 54, Joint Program in Transportation (May 1996)
Data Management Group Annual Report 1996, Report 59, Joint Program in Transportation (March 1997)
Data Management Group Annual Report 1997, Report 73, Joint Program in Transportation (October 1998)

In addition to the research activities of the Data Management Group, beginning in 1994, the Group assumed management responsibility for the 1996 Transportation Tomorrow Survey. The Survey is a separate research activity within the Joint Program in Transportation, but intimately linked with the activities of the Data Management Group. It is administered by the 1996 Transportation Tomorrow Survey - Survey Technical Committee, which is made up of representatives of TATPDCSC plus representation from the other funding agencies:

City of Barrie
City of Guelph
City of Peterborough
Peterborough County
Regional Municipality of Niagara
Regional Municipality of Waterloo
Simcoe County
Town to Orangeville
Victoria County
Wellington County

A complete description of the methods used to carry out the survey, the validity of the results, and some preliminary results are contained in a series of reports published under the direction of the Data Management Group.[2]

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[2] *1996 Transportation Tomorrow Survey Working Paper Series, Paper No. 3, Design Specifications, (March 1997)*

1996 Transportation Tomorrow Survey: Design and Conduct of the Survey, Report 61, Joint Program in Transportation (December 1997), available as a PDF file at 'www.jpint.utoronto.ca'

1996 Transportation Tomorrow Survey Working Paper Series, Paper No. 1, Interview Manual, (March 1997)

1996 Transportation Tomorrow Survey Working Paper Series, Paper No. 4, Software Documentation, (March 1997)

1996 Transportation Tomorrow Survey Working Paper Series, Paper No. 2, Coding Manual, (March 1997)

1996 Transportation Tomorrow Survey Working Paper Series, Paper No. 5, Data Expansion, (August 1997)

1996 Transportation Tomorrow Survey: Data Validation, Report 62, Joint Program in Transportation (December 1997), available as a PDF file at 'www.jpint.utoronto.ca'

1996 Transportation Tomorrow Survey: 1996 Travel Survey Summary, Report 64, Joint Program in Transportation, (November 1997), available in abbreviated form at 'www.jpint.utoronto.ca'

1.3 Tenth Anniversary Open House

The Data Management Group celebrated its tenth year of operation with an open house on December 4, 1998. All past and present members of the Steering Committee (TATPDCSC), the Technical Advisory Committee (TRADMAG) and DMG staff were invited to attend a day long open house.

On display at the open house was the release of our new web site operating on a Sun Microsystem Ultra 1 called 'Sam'. In addition, prototype versions of the new browser access systems were displayed. The new data retrieval system (iDRS) for travel information was operational using EMPRESS, the relational data base management system (RDMS) that has been in use since the start of the DMG. In 1999, the final system will be developed using ORACLE. The new CCDRS (cordon count data retrieval system) was displayed but, at that time, was unable to access data.

Improvements in EMME/2 access were demonstrated. It is now possible, using Windows 95/98 or NT to access the software via a modem or the internet within a Windows environment with excellent speed in graphics mode. Members of the funding agencies will be given the necessary software to run the required X11 protocol.

2 INFORMATION PROCESSING

The Steering Committee (TATPDCSC) agreed at the outset of their co-operation on the 1986 Transportation Tomorrow Survey that one of the principles of collective data collection was that the information would be available for a wide variety of applications. In 1988, as coding, checking and validating the data set came closer to completion, it became clear that the task of creating a workable arrangement for the distribution and sharing of these data was complex. If all the data were to be located at one of the nine agencies, it was not clear how the costs could be identified, neither was it clear how these cost could be reimbursed. If the data files were simply to be distributed to every participant, it was possible that some of the effectiveness of the data would be lost because of the difficulty in maintaining nine data access procedures, many of which would be used infrequently.

The University of Toronto's proposal to establish a Data Management Group at the Joint Program in Transportation attempted to address all these issues. The Steering Committee would represent the funding agencies and would have the authority to approve the work program of the group. This arrangement ensures that the activities of the group reflect their collective needs and the level of funding reflects the level of demand for the data. The costs are clearly identified and distributed equitably among the users.

An important question was whether the costs should be allocated on a project by project basis or allocated according to some measure of size, such as population. The latter method was chosen to encourage all users to explore the data, to promote wide spread use of the data, to encourage a dialogue between the data providers and the data users, and to reduce the overhead on providing data. The data are provided without charge to any public sector planning activity whether undertaken by an agency using their own staff or using a private consultant. Because the funding agencies represent all regional governments, which in turn represent all local governments, data are provided to any level of government. The Steering Committee receives regular reports that allow it to monitor use to be certain a reasonable level of fairness is maintained in cost sharing.

The data are maintained at the Data Management Group in the form of a relational data base. Originally, a staff member at the Data Management Group processed a request for information and assembled the results as a computer file in any format specified by the user. This procedure helped to develop user's confidence in the data and established a pattern in the type of travel information requested most frequently. On the basis of common interest, it was also possible to assemble some related information that could be shared by all agencies. It was then possible to develop a data retrieval system that allows the user to prepare their own tabulations and cross-tabulations according to their

own particular needs.

The data are used widely as information later in this report will demonstrate. Because agencies from all levels of government are sharing the same information, improvement in communication and co-operation between agencies has been a tangible benefit. Duplication of effort has been reduced. The funding agencies believe that relevant travel information is being provided to projects at a fraction of the cost of uncoordinated data collection.

Experience with processing of the travel information contained in the three large data sets, 1986, 1991 and 1996 Transportation Tomorrow Surveys, indicates how important ease of access is to wide acceptance and use of the information. As access is improved in terms of ease of use to a wider community of transportation planners, the number of applications and the innovation of these applications improves accordingly.

The Data Management Group currently administers the data files on urban travel contained in the 1986, 1991 and 1996 Transportation Tomorrow Surveys as undertaken collectively by all the funding agencies. The data files on the 1986 travel contain detailed information on 370,000 trips taken by 171,086 individuals residing in 61,453 households, the data files for the 1991 survey contain 157,349 trips taken by 72,538 individuals residing in 24,507 households, while the equivalent data files for the 1996 survey contain 657,971 trips taken by 312,781 individuals residing in 115,193 households. The data are stored on a computer in the form of a relational data base[3], which allows for extraction of the data in any format quickly and efficiently. These data form the factual basis for transportation planning studies carried out by and for local, regional and provincial agencies in the area encompassed by the six regional governments in the Greater Toronto Area.

A cornerstone task for the DMG since its inception is the processing of data requests relating to the TTS data. The following section describes a direct access system developed by the staff at the DMG. In addition to this system, the Group continues to process requests for information that are unique in some aspect and cannot be processed by direct access. A summary of these special data requests processed in 1997 is provided in Section 7 - Data Requests.

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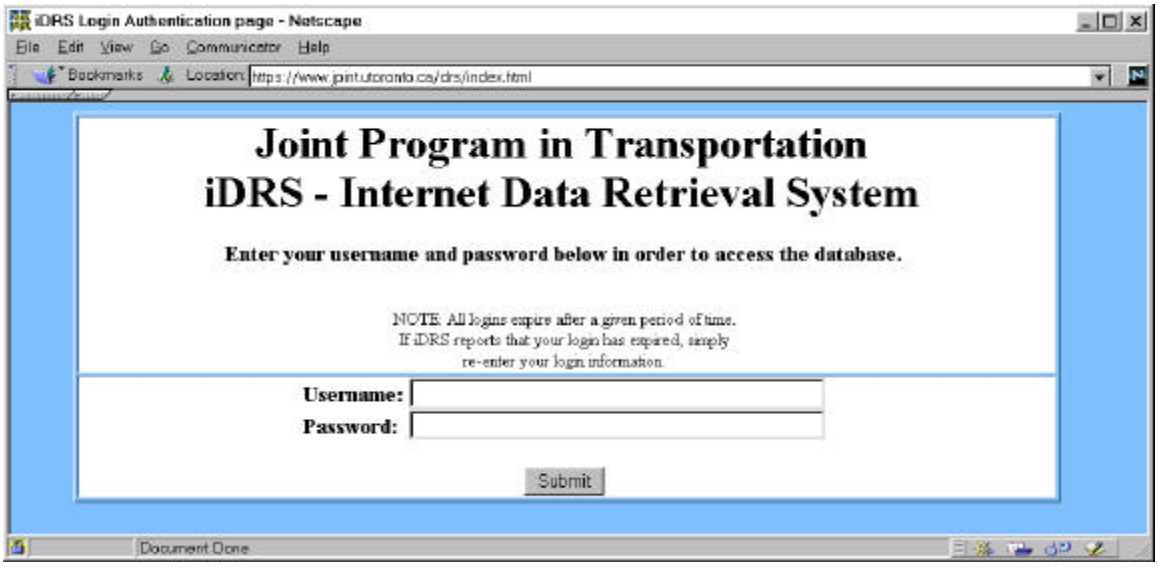
[3] *1996 Transportation Tomorrow Survey: Data Guide Version 2.1, Report 60, Joint Program in Transportation (August 1997), available as a PDF file at 'www.jpint.utoronto.ca'*

2.1 Data Retrieval System (DRS)

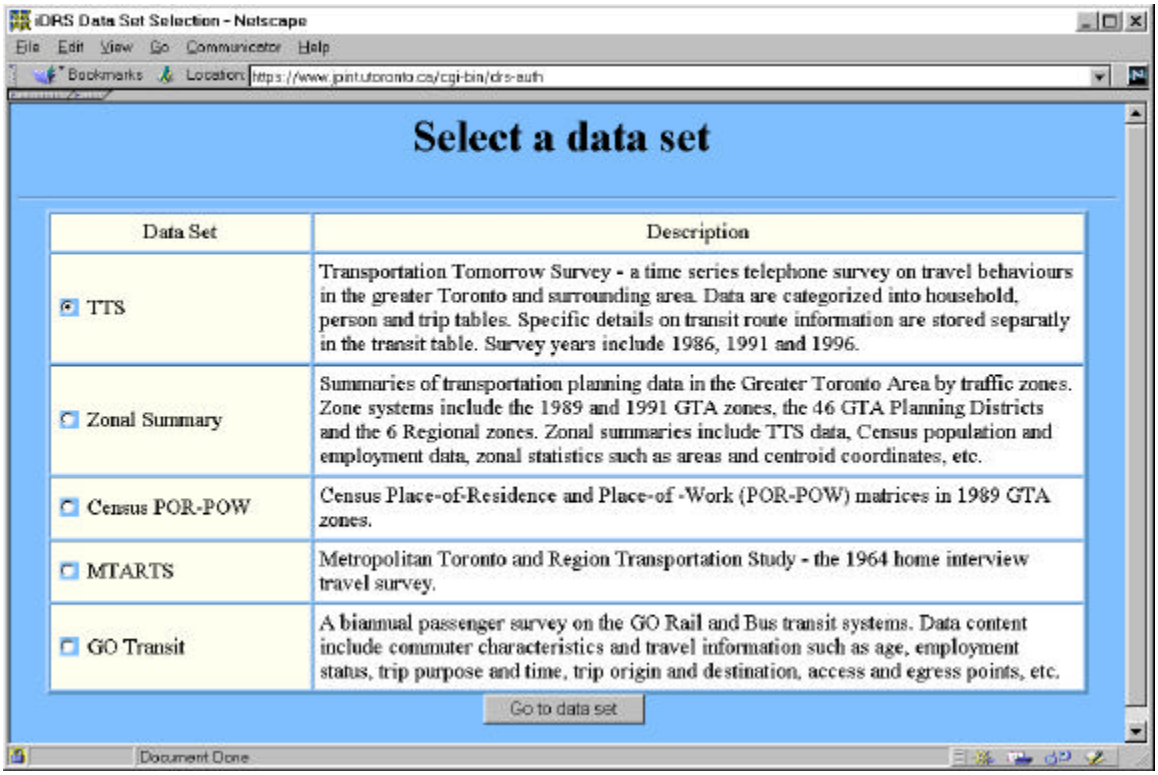
Given that a majority of the participating agencies have an electronic connection to the Data Management Group's computer system, a data retrieval system (DRS) was developed to extract commonly used information from TTS and a variety of related data sets. The original version allowed the user to develop a data request interactively on a text screen. The procedure allows data summaries to be prepared for use on the Group's computer system or transferred for use on their own computer. Recent developments have improved the procedures through the use of a web browser, which most users have available at their desk. The general structure of the request remains the same as the previous text screen access. This section describes the general features of the new browser access.

2.1.1 User Identification



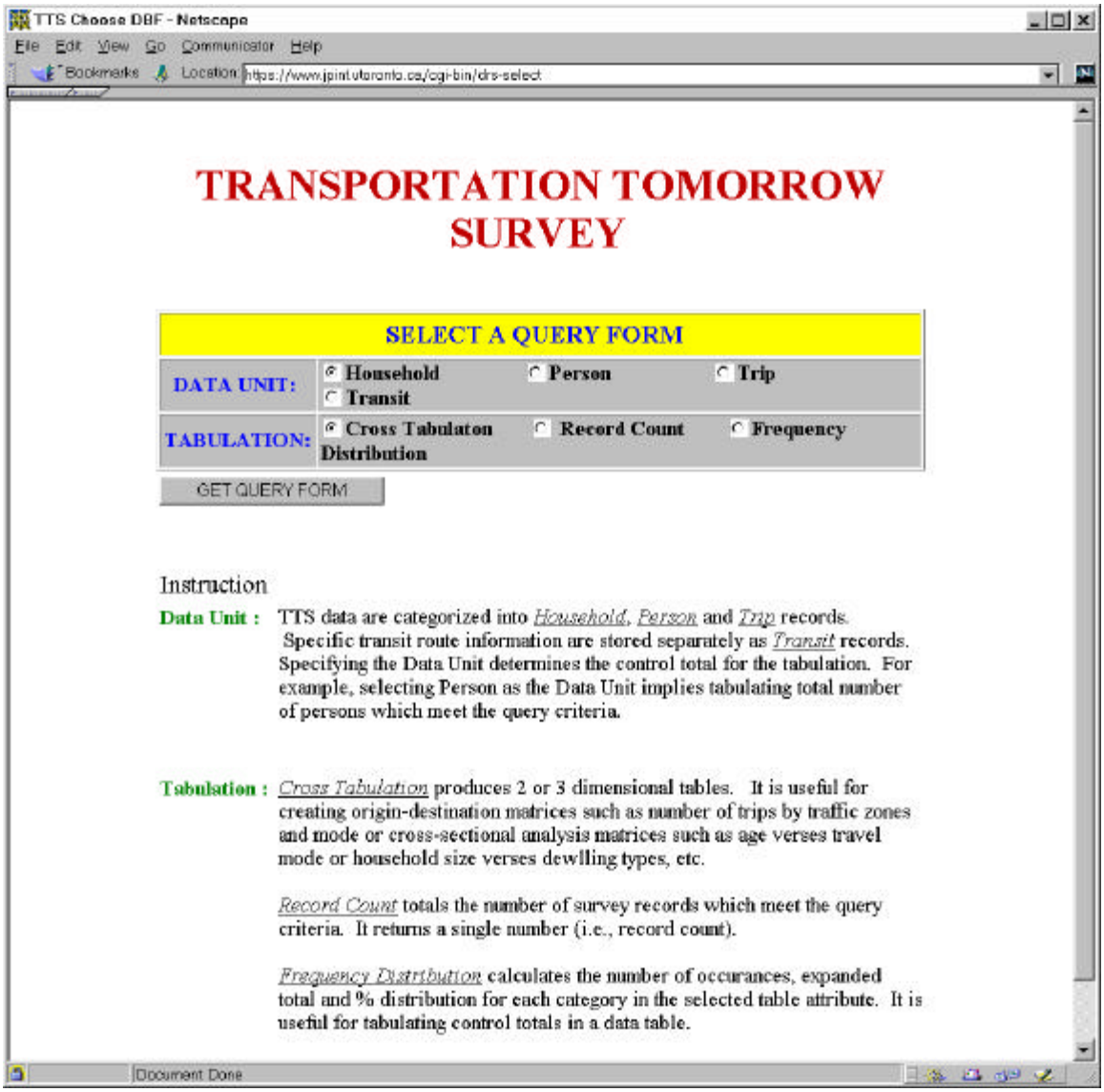
Every authentic user of the Data Retrieval System must be a registered user with a unique 'Username' and 'Password'. The Steering Committee (TATPDCSC) establishes the policy for granting access. In general, members of the provincial, regional and local government transportation planning community, including consultants working on their projects, are given unrestricted access to the system. Data for private or commercial use are required to submit their request for information in writing to the Data Management Group.

2.1.2 Selection of the Appropriate Data Set



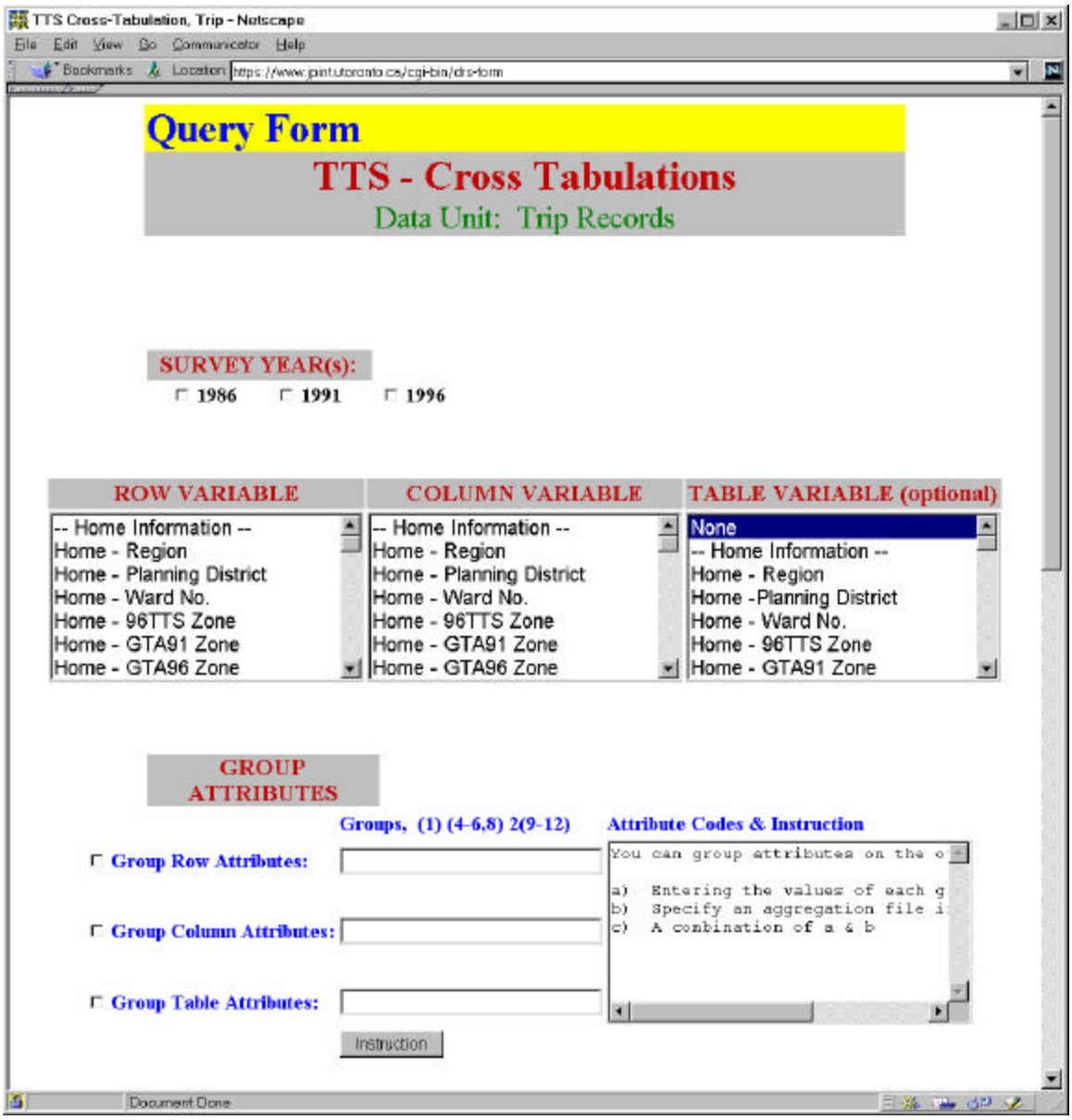
DRS allows access to a variety of data sets of interest to transportation planners. A brief description of each is shown above and selection of the TTS data set is activated. The remainder of this section will describe access to the TTS data.

2.1.3 Selecting the Query Form



The next screen establishes whether the information is to be about households, people or trips. In addition, the form of the query is specified. The 'Record Count' option is used where a single number, or scalar, is required. The 'Frequency Distribution' option is used where breakdown is needed on only a single dimension, or vector, is required. The most common is a cross-tabulation where a matrix or a set of matrices are required for a set of specified attributes, whether they are household, person, trip or location attributes. The following sample screens are for a cross tabulation.

2.1.4 Form for Cross Tabulations



Selection of the survey year, or several survey years, is the first selection. If multiple survey years are selected, some constraints are imposed on the subsequent variable selection to include only those common to all selected years.

Depending on the data unit selected on the previous screen (household, person, trip or transit), a different set of available variables will be displayed for selection of row, column and table variables. The user must define a row variable and a

column variable with the table variable optional. The survey year, if more than one is selected, can be considered an additional dimension to the matrices. When trips are selected as the data unit, summaries are possible by person, household or trip attributes.

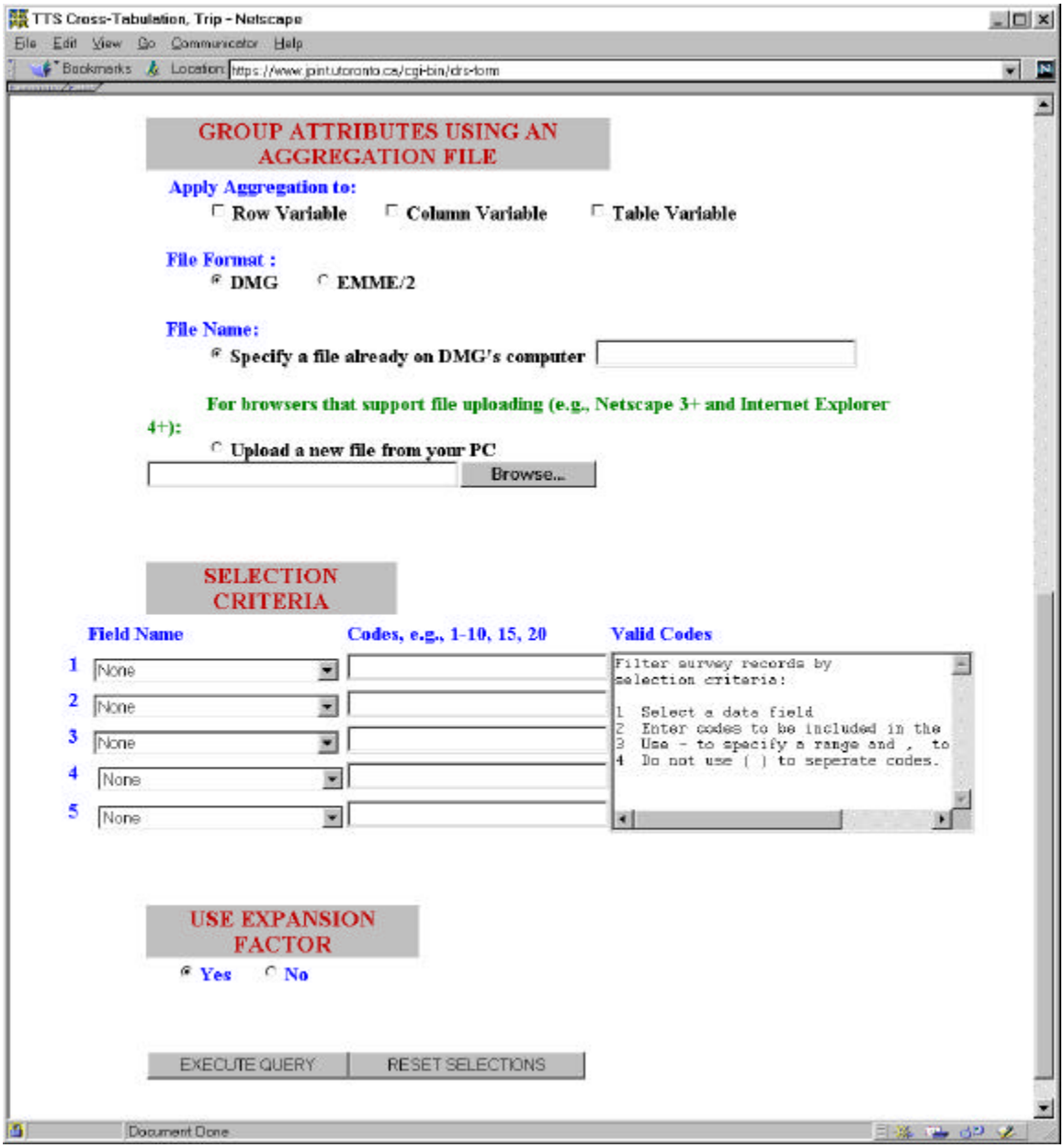
Each variable in the data base contains a rich set of attributes, often much more extensive than required for a particular application. Trip start time is recorded, for example, at every minute in the day where an application may require information for every clock hour. Another example is the thirteen attributes describing mode of travel where an application may want travel by auto and transit. Each variable selected in each of the three possible dimensions may be grouped and the attribute list is displayed when a dimension is chosen for grouping.

The attributes can also be grouped in accordance with a file already prepared and resident on either the DMG computer system, or on the users local computer. The file format and location must be specified.

A final, and very important, stage of data retrieval is to specify the selection criteria. The possible selection criteria are determined by the data unit selected and are automatically displayed for the user. Selection criteria allow the user to extract information for particular types of users, such as employed males with a transit pass, or particular spatial relevance, such as those residing in York Region. The criteria are limited to five in the iDRS system. More than five selection criteria require intervention by one of the analysts at the Data Management Group.

A final selection allows data to be based on a record count or a sum of expansion factors. The default selection is for an estimate of the universe of daily travel with the use of expansion factors.

The user can make any changes on this page in any order until the request is properly formulated. At that time, the user selects the button that submits the query. The browser should indicate activity until the request is completed and a file name is presented. The file is in text format with comma delimiters so that the file can be easily viewed on any text editor and efficiently imported into all common spreadsheet programs.



2.1.5 Updating the DRS

The operating Data Retrieval System (DRS) using a text interface has proven to be a valuable analytical tool since its development in 1992. This system will continue to be available while the new access procedure is being developed and tested. The browser-based interface shown above was developed during 1998 and was demonstrated in December 1998. Access to the new iDRS should be available to representatives of the funding agencies in early 1999.

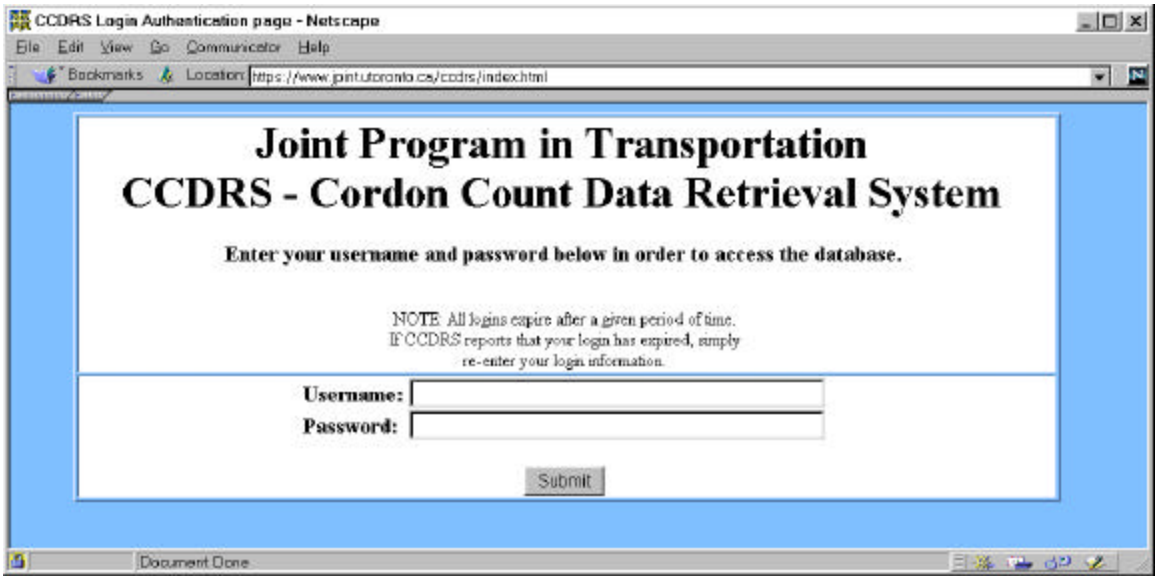
2.2 Cordon Count Data Retrieval System (CCDRS)

The collective results from a regular program of detailed traffic counts undertaken over several years by various Regional Governments in the Greater Toronto Area on the road and transit system are a rich source of valuable data for a wide range of transportation planning projects. Each agency collecting the counts processes its data in accordance with its own requirements. The net result is a series of data sets, which can often be difficult to either access or integrate. The initial Cordon Count Data Retrieval System was a pilot project undertaken in 1994 to demonstrate the efficiency of storing ground count data in a centrally housed data base. To a great extent, the need for the project was based on the need to search and present cordon data in a consistent manner. This central assembly of data saves time for agencies studying projects which cross regional boundaries and greatly reduces regional staff time associated with ground count data requests.

The first operational prototype was on a Windows 3.x based client-server architecture. The data retrieval system (FoxPro and MapInfo) ran on a local 486DX microcomputer operating under OS/2. Each user remotely accesses the computer via a high speed modem line and remotely controls the operation of the machine via RLINK; a software package which allows the remote users screen to effectively become the screen of the central computer. A custom interface was written at the DMG to access the data. The interface was written in FoxPro for Windows and offers several high-level features. The interface is very user-friendly and permits the user to interactively set up search criteria. To assist in the set-up of the search criteria, graphical assistance is provided through a link to MapInfo. This allows the user to map station information, which can assist them in making an error free specification. The results of the search are offered in either ASCII or Dbase formats, which simplifies the presentation and manipulation of the data.

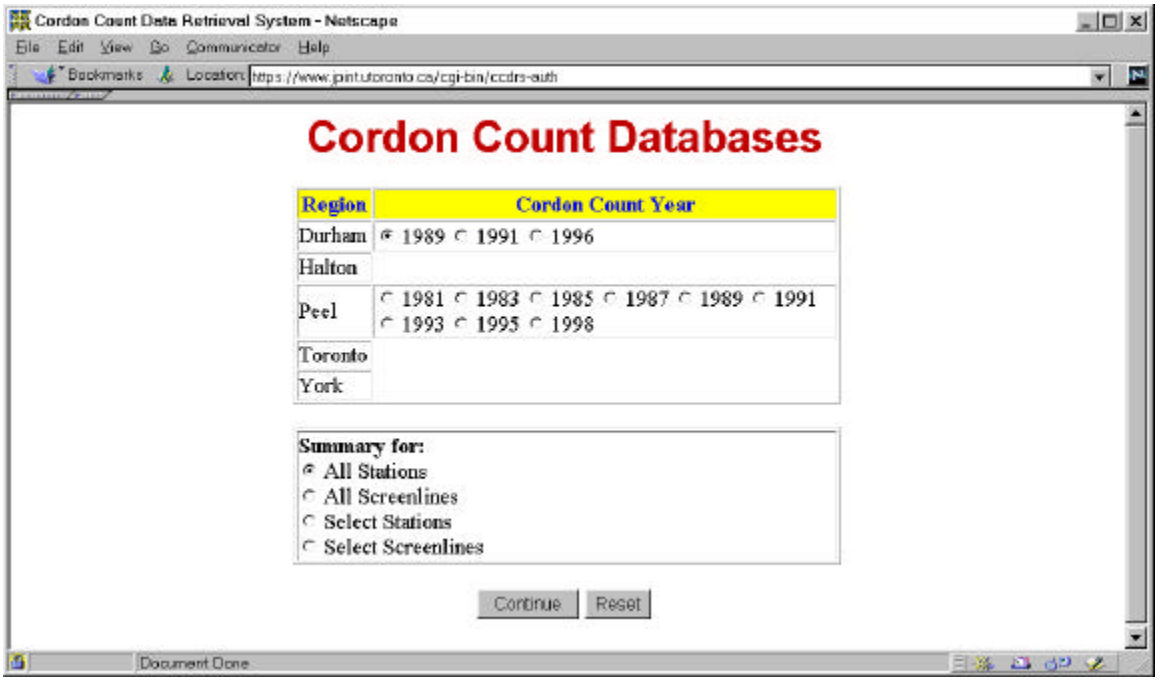
This system, although somewhat unstable and slow, was a valuable prototype for the development of a browser-based access to the cordon count data. The new procedures were developed in 1998 and demonstrated in December 1998. Field testing of the procedures should be possible early in 1999.

2.2.1 User Identification



As with the Data Retrieval System described in the previous section, every authentic user must be registered with a unique 'Username' and 'Password', which can be the same for both systems. The Steering Committee (TATPDCSC) establishes the policy for granting access. In general, members of the provincial, regional and local government transportation planning community, including consultants working on their projects, are given unrestricted access to the system. Data for private or commercial use are not available at this time.

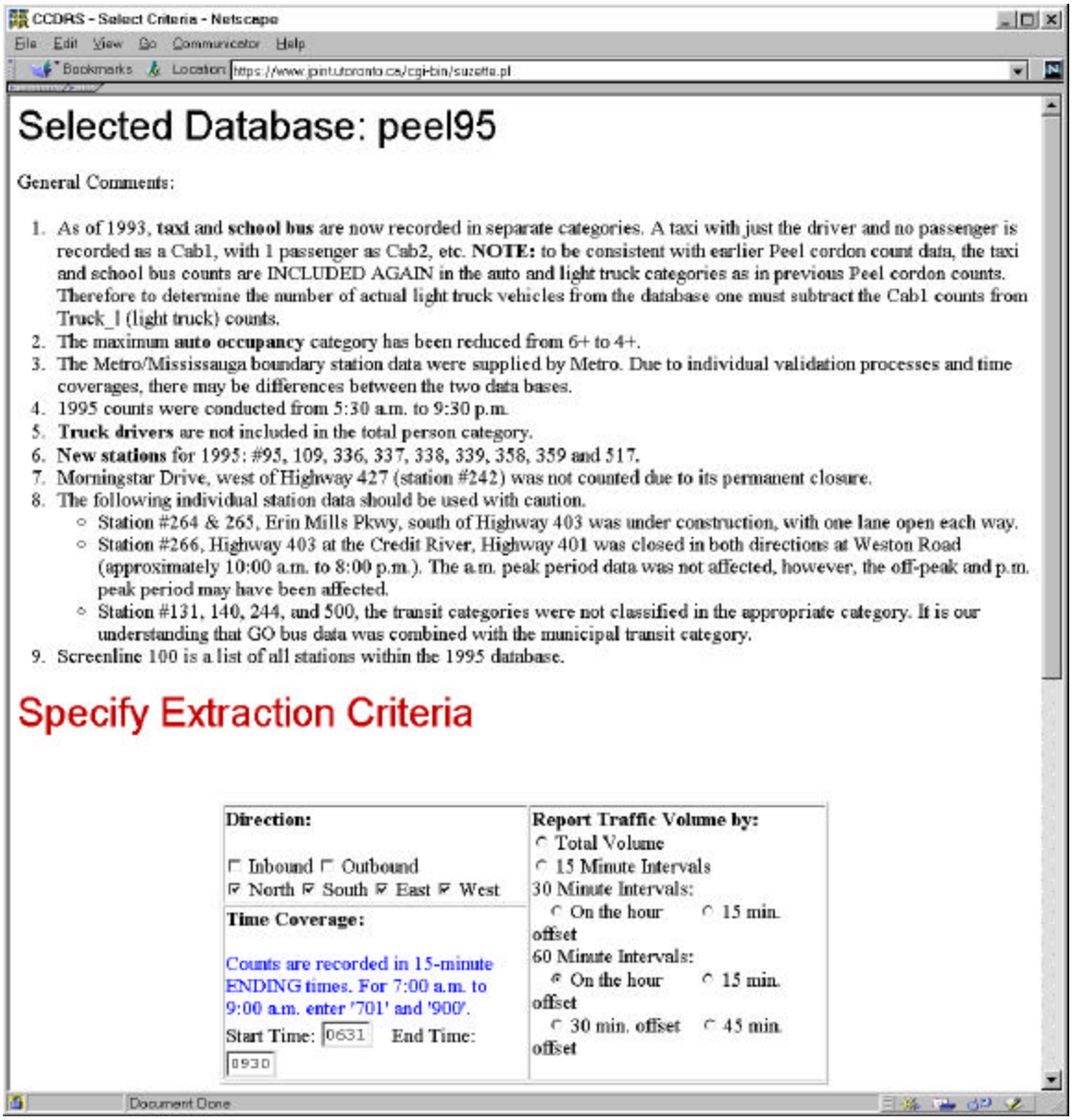
2.2.2 Selection of the Appropriate Data Set



Cordon Count data has been collected by the agencies represented on the Steering Committee (TATPDCSC) at various times since Metropolitan Toronto began taking counts systematically in 1975. The Steering Committee has been a catalyst for other agencies to begin a counting program and for encouraging a common collection procedure. However, the hours over which the counts were taken, the definition of vehicle types and the years in which counts were taken, all vary somewhat from one Region to another. The Data Management Group attempted to make the data definitions as common as possible, but in the interest of data integrity, each counting year for each Region has been maintained as a separate data base. The above screen requires the user to define the Region and year of count for data extraction. The sample screen shows that only the Regions of Peel and Durham were operational at the time of this report.

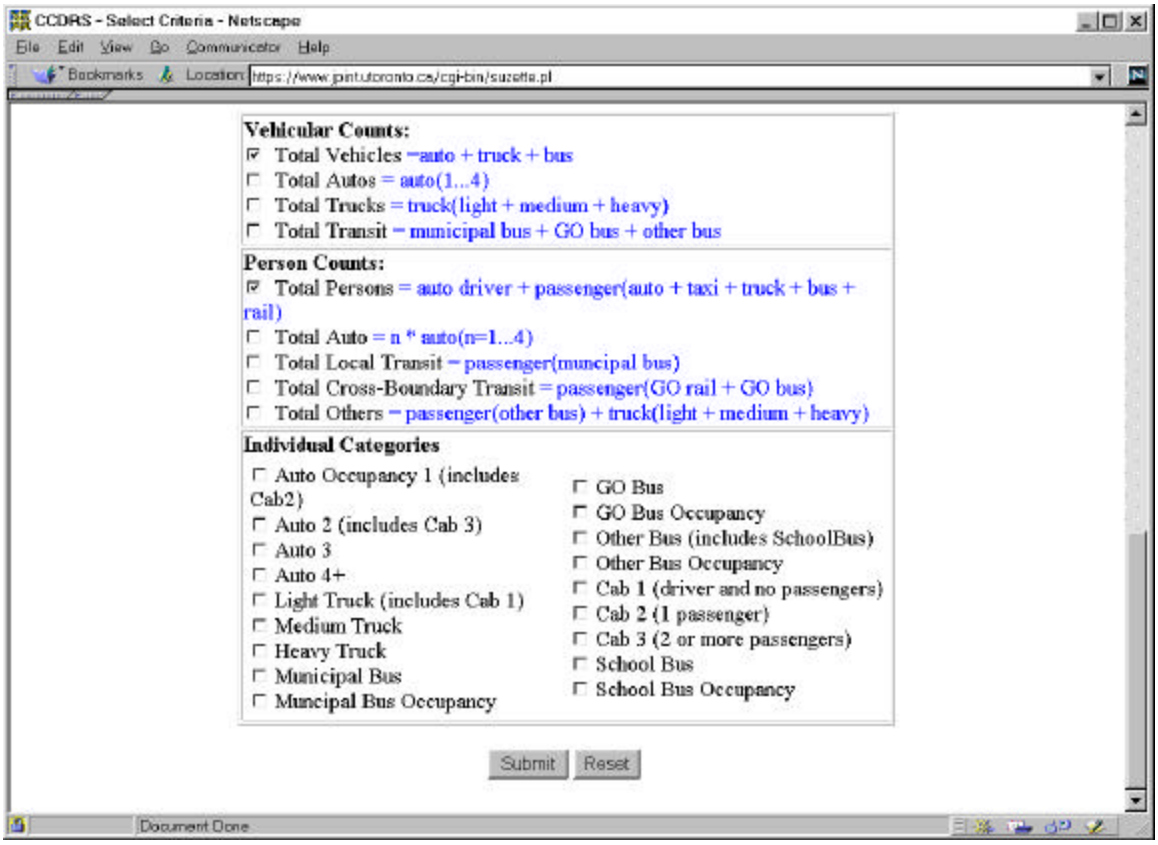
The user can then determine whether the information is to be compiled on the basis of pre-defined screenlines or on the basis of individual counting stations. Selecting all stations gives a complete table of each counting station, and selecting all screenlines gives a table with each row a defined screen line. It should be noted that stations are often included in more than one screenline.

2.2.3 Specifying the Extraction Criteria



Every table selected (Region and year) displays a set of caveats when selected. The comments are intended to aid the user in determining the exact information that will be contained in any data extraction.

The remainder of the form specifies the exact type of information required and is self-explanatory.



2.2.4 Final Development

The final version should be released in early 1999 with the inclusion of all cordon counts. The final version should also include an optional calculation of the peak period, either peak one, two or three hours, during the count duration.

2.3 TTS Data on a World Wide Web Site

The World Wide Web site at

http://www.jpint.utoronto.ca

was created in 1995 and is maintained by the Joint Program in Transportation. The site is used by the Data Management Group to present most of the information from the Transportation Tomorrow Survey Summary Reports and other pertinent information about the Group. The travel information was updated to include the 1996 TTS information in the fall of 1997. The format was changed to reflect the change in distribution policy for the 1996 data. Travel is summarized by Region, rather than by Planning District. Where possible, information is presented in a common format for all three years of TTS. In 1998, the old web server was updated.

One of the functions of the Data Management group is to improve accessibility to transportation data, not only to agencies within the GTA, but to other agencies and persons interested in the urban structure and travel characteristics of residents of the Greater Toronto Area. Most of these interests can be satisfied with a reference to our web site. Any particular request for information is processed in accordance with our access policy and is summarized in Section 7 of this report.

During 1998, the Data Management Group changed its policy with regard to the distribution of reports. In previous years, all reports were published in hard copy with a number distributed to the funding agencies and a number available at the offices of the Joint Program in Transportation. The procedure proved to be too costly in time, staff resources, and a heavy load on available storage space. The current policy is to distribute a single hard copy to each funding agency and make the report available on the web site in a common format (.pdf). The file can then be viewed, and printed if desirable, by any user.

One measure of success of a web site is the number of times the site has been accessed. In the calendar year 1998, the old web site mentioned above transmitted the introductory page 4151 different times in 1998 and the new site 357 times (as compared with a total of 1600 in calendar year 1997). Access to the introductory page is an indication of the number of new user attempts to access the site. The site has been linked to a number of sites in North America that relate to transportation, particularly urban transportation. Each computer used to access our web site has a unique identifier or ID address. There were 2401 unique IP addresses accessing the old web site and 107 unique IP addresses accessing the new web site in 1998.

3 TECHNICAL SUPPORT

The concept of a university research centre providing shared computer resources and technical support in the development and operation of a large scale computer simulation of urban travel began as a small co-operative research initiative between the Ministry of Transportation, Municipality of Metropolitan Toronto and the Data Management Group in 1989.[4] A primary objective of the research project was to investigate the feasibility of sharing the computer resources necessary for large-scale simulation, as this was recognized as a necessary condition for sharing technical procedures. The requisite software to run such a simulation had already been selected by Metro Toronto as appropriate for their particular needs, EMME/2 from INRO Consultants Inc. in Montreal, and it appeared to satisfy the immediate needs of the Ministry.

The Group purchased a small computer that could serve many users at the same time and purchased a version of the software that had the same feature. The results were very encouraging and appeared to provide the justification for planners to use the same analysis framework which would promote sharing information and analytical techniques while still providing the flexibility for tailoring the application to suit particular needs. The concept of sharing the analysis framework has grown from the original two planning agencies in 1988 to include in 1998:

- City of Toronto
  - Planning Department (2 lines)
  - Transportation Department
  - Old City of Toronto
- Regional Municipality of Durham
- Regional Municipality of Peel (2 lines)
- Regional Municipality of York (2 lines shared with):
  - City of Vaughan
  - City of Markham
  - City of Richmond Hill
- Regional Municipality of Halton
- Regional Municipality of Hamilton-Wentworth (data access only)
- Office of the Greater Toronto Area
- GO Transit
- City of Mississauga
- Toronto Transit Commission

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4 *Metro Toronto EMME/2 Development Project, Report 9, Joint Program in Transportation, January 1990.*

Ministry of Transportation Ontario
Demand Management and Forecasting Office
Consultant's access
Central Region
Freight and Economics Research Office

The users are now served by a completely integrated system of five computers plus all the requisite equipment for high-speed access to these computers from remote sites. The computer system is administered by the Group including all maintenance and regular back up procedures to protect the integrity of the extensive information base.

3.1 Policy for EMME/2 and DRS Access

A major advantage to all planning agencies of sharing computer resources is the sharing of labour intensive features in the simulation process. The most widely shared resource is the computer representations of the road and transit networks. The process began by converting a road network that had been developed over a period of years by the Metro Toronto Planning Department for use on another computer system. The co-ordinate system was standardized so that trip information and the network data were recorded to the same base. This also allowed information to be added and edited throughout the entire region using a common co-ordinate system. Each Regional Government assumed responsibility for creating their own representation of a road network using collectively agreed to principles and co-ordinated by the Data Management Group. Users agree collectively on the timing and magnitude of changes to the network, such as the development in 1996 and 1997 of an integrated road and transit network. A representation of the entire road network can then be shared by all planning agencies. The network representation is kept up to date by the Group and new versions are announced to all users.

Access to the system can be allocated by any of the participating agencies to another agency, in particular, a private consultant that is engaged in a planning study for that government agency. This aspect has proven to be successful, as many of the local consulting firms have been provided with access and technical support. The Group provides assistance to any of these agencies, public or private, in setting up their computer system for access to EMME/2. Continuous improvements to the computer system and the remote access procedures are being tested and implemented when appropriate.

3.2 EMME/2 Software Release 9

INRO Consultants Inc. issued a new release of EMME/2 in the fall of 1998. The new release was made operational on November 18, 1998. The new release is compatible with all existing releases except for the use of macros. The macro text files are a representation of operator commands only within a computer text file. Given that some of the commands have been enhanced and expanded, the macro text files require conversion to operate under the new release. This conversion is important to avoid keeping too many different releases of the same software active at the same time. Several new enhancements are available in the new release and information is available on the INRO web site (www.inro.ca). The transition by the participating agencies to a new release will take some time. To ease this transition, the DMG will maintain Release 7, 8 and 9 for a period of time.

The Group will provide the necessary assistance to agencies with complex macro conversion problems. The technical staff can provide this assistance in an effective manner partly because the new version has been tested extensively at the Data Management Group and partly because technical staff can access the files of all users. Later in 1999, the DMG proposes to remove Release 7 from the system. EMME/2 databanks are still automatically updated to Release 9 when they are opened, but tracing the details of complex macros may be more difficult after the removal.

3.3 Technical Support and Training in EMME/2

Staff at the Data Management Group continued to provide technical support to all authorized users of EMME/2 on the Data Management Group's computer system. This support varies from simple questions about connection problems to more complex questions about macro development in Release 8 and 9. In particular, significant support was provided to: Halton Region in the development of an afternoon peak model, Durham Region in implementing the simplified GTA model, TTC in applications of disaggregate assignment, and the Ministry of Transportation in the operation of a GTA model and the development of a model for commercial vehicles.

INRO no longer supplies a hard copy of the EMME/2 user's manuals, but now distributes a CD. The Data Management Group distributed a copy of the CD to every registered user of the shared licence. In anticipation of quick reference or in case of misplacing the CD, a copy of the entire manuals for both Release 8 and Release 9 are stored on the DMG's computer system. The files are in Acrobat Reader format (.pdf) and can be downloaded to a user's local pc or read on the UNIX system. The procedure for browsing on the UNIX system requires

Xwindow capabilities. Details on how this is possible are available from the DMG staff. Each chapter of the manual is a separate file. The system will automatically detect which release is currently being used and accesses the appropriate directory. The user simply types <cd $EMME2> followed by <cd e2book> to gain access to the files.

The need for extensive training on the EMME/2 system no longer exists as most of the users train their staff in-house. The self-administered tutorial, developed from earlier training sessions, is now used almost exclusively by students. In 1998, twenty-two undergraduate and two graduate students at the University of Toronto undertook the EMME/2 training. The tutorial is to be revised in 1999 and updated to reflect the changes in Release 9.

3.4 Technical Support for 407 Bidders

Access to relevant data files and the EMME/2 software was provided to all the registered bidders on the purchase of Highway 407. This action was taken under the guidance of the Ministry of Transportation Ontario and the process consultant in charge of the bidding process. Each bidder was given an anonymous directory and an anonymous password for all analysts. In this manner it was not possible for the casual (or determined) browser to learn the identity of the bidding parties.

Every active bidder used the system extensively and most used the DMG system to perform their forecasts. DMG support was limited to technical advice on how to gain access to the files and the EMME/2 software. Access will be maintained until the project is complete.

4 COMPUTER SYSTEM SUPPORT

Some advantages of the concept of sharing a central computing facility among all funding agencies have been described in previous sections. The success of such a concept is dependent on three important conditions: a fast and reliable method to access the central system, ease of use, and a level of computing service that is consistent with current technology.

A concern shared by all users is security. The computer system serving the Data Management Group maintains a tight control on the users given access privileges. Each user is asked to use a login name and change their password frequently. When an account has been dormant for a period of time, the system administrator tries to contact the individual associated with the account. If this is not possible, action is taken to limit access for this user. At the end of 1998 there were approximately 137 active accounts; 62 were identified with staff at a provincial, regional or local government office, 11 were identified with DMG staff, 9 were identified with private consultants, 13 were identified with qualified bidders on the 407 project and 29 were identified with various research projects.

Beginning at the end of 1998, any new request for access to the Data Management Group's computer system will require the completion of a request form. This procedure was implemented to protect all the users of the system. The forms are available on the web site.

4.1 Access to Computing Services

Access to computing services at the Data Management Group is currently provided in one of two ways. The first method, and the one used for the longest period of time, is by a conventional telephone connection and a modem. The method uses conventional modems that support communication at 9,600 or 19,200 baud, depending on when the service was installed. Currently, the TTC and the Regions of Durham, Peel, Halton, Hamilton-Wentworth, and York are connected using a high-speed modem (28,800 baud). The method is reliable and provides an access speed that is consistent with the demands placed on a graphical interface. The City of Toronto and the Regions of Durham, Peel, Halton and York have been provided with software to support Xwindow graphical interface, which allows them to operate a terminal emulation while running EMME/2 in a 'Windows 3.x' environment. Testing at the Data Management Group in 1998 indicated that support can be provided to the current users with ppp protocol, which is the same protocol used for internet access. In addition, development began on the use of a secure shell (SSH) that uses a form of data compression that greatly enhances the service when operating in graphics mode. Some problems remain to be resolved for file

downloading from UNIX to a local computer.

A second method, used by the Ministry of Transportation, is through a dedicated data line supplied by the telephone company. The method is more costly to install but can support multiple users. The Ministry is also using eXceed. This connection also provides a connection to a local area network (LAN) operated throughout the Ministry. The development of a reliable connection between the UNIX based system at the Data Management Group and the LAN operating with a system based on IBM standards was problematic at first, but previous changes made the system reliable. In an effort to improve service and reduce cost, the new digital telephone service (ISDN) appears to have potential. Early experiments at the offices of the MTO proved to have some compatibility problems between different computer networks. These issues should be resolved in 1999.

4.2 Improvements in Service

A series of system improvements were carried out in 1998 in an effort to continually improve the level of service provided to the funding agencies. The current UNIX system of Sun computers consists of:

Ultra 1 Model 140	- dedicated exclusively to MTO activities
Ultra 1 Model 200	- for EMME/2 users other than MTO
Ultra 1 Model 200	- for data base activities and web development
Sparc 1	- Empress data base development and staff workstation
Sparc 2	- backup, data base support (DRS) and research
Sparc 2	- test machine for new operating system and security
Sparc 10	- EMME/2 technical support and staff workstation
Sparc 4/330	- (original machine) student and research support

The Ultra 1 Model 200 used for everyone other than MTO users is the most versatile machine and serves many system functions. To improve the performance of the machine, system memory was upgraded in 1998 from 128 MB to 384 MB. The resulting improvement in system performance, particularly with several simultaneous EMME/2 users, was noticeable.

System backup is an essential part of any shared computer system. On a shared system, when a file is deleted for any reason, it is not recoverable except from the files on tape from the last backup. Backups are carried out daily on the computer system at the DMG. If for any reason, the backup does not work, then all users on the system are at risk of not being able to recover their files. This is in addition to the risk of any disk failure. The backup system has been put under increasing strain as the amount of disk space continues to increase. The system of eight Sun UNIX servers now supports approximately 80 gigabytes of disk space. In an effort to ease the strain on the system and improve reliability, new backup procedures were implemented in 1998. Currently all

incremental backups are carried out with compression on a single 30 gigabyte backup tape, and a weekly full backup is placed on another 30 gigabyte tape. This means that accidentally deleted files can be restored with data loss limited to changes made in a single day.

4.3 New Archiving Procedures

A CD burner was installed on the system in the fall of 1998. The funding agencies were then given 6 months to archive their files without any surcharge for the procedure. The six-month trial was intended to give some indication of the level of use of such a system. The intent was for system users, EMME/2 users in particular, to save space by cleaning up their directories. Files that are being kept for historical reasons could be placed on a CD. On-line disk space is costly to set up, operate and maintain, so improvements in space utilization are beneficial to everyone.

The understanding for CD archiving, is that funding agencies will be sent the CD. In this manner, the funding agencies can establish their own filing and storage system, and disposal system if appropriate. Funding agencies can mount the CD on any local computer with a CD drive and upload the files to the UNIX system at any time the files are required.

The current procedure will be reviewed in 1999 and a long-term archiving procedure recommended to TRADMAG for approval.

4.4 Improvements in System Security

A growing concern among system administrators with a connection to the internet is persistent attempts by unauthorized users to access their system. These unauthorized users usually use a system they have broken to disguise their identity when attempting to break into other systems. Unfortunately, they usually broadcast their success over the internet and other users can then gain unauthorized access. The troublesome aspect of all this is the potential for wilful vandalism.

The system at the DMG is no exception. During one rather unusual week in 1998, 75,879 attempts at unauthorized access were carried out from remote sites around the world. On average, 500 attempts per week are carried out from remote sites. In July of 1998, a protective procedure was put in place on the DMG computer system. The protection is a computer that monitors all incoming activity from the internet and restricts access to processes on the DMG system. Some of these processes must have general access, such as mail, but the 'firewall' protects these processes from unauthorized use.

4.5 Evolving Administrative Structure

The administration and servicing of a computer network with a UNIX operating system together with a large number of clients on a wide area network, such as the computer system at the Joint Program in Transportation, requires a particular set of skills. The Faculty of Applied Science and Engineering operates a central computer network for all undergraduate teaching that has many similarities with the network at the Joint Program, albeit larger. This group now allocates one of their staff to maintaining and improving the DMG system. The staff member's first priority is the operation and maintenance of the computer system serving the DMG and its funding agencies. Additional resources would be available from ECF when needed and the staff assigned to the Joint Program would reciprocate when needed. In the first year of operation in 1997, the staff member spent 100% of his time on the system at the DMG. In 1998, because some of the TTS new initiatives (described later in this report) required computer system skills, the staff member continued to spend 100% if his time on DMG related activities. In addition, an undergraduate student from Engineering Science was employed to help with the implementation of some of the system improvements.

It is anticipated that only 60% of the time of the system administrator will be available to the DMG in 1999.

5 TTS NEW INITIATIVES

The 1996 Transportation Tomorrow Survey (TTS) is the third in a series of area-wide travel surveys conducted in Toronto and the surrounding regions. The previous surveys were in the fall of 1986 and the fall of 1991. In the current survey, the Regional Municipality of Waterloo was surveyed in October and November of 1995 and the rest of the TTS was surveyed between September and December of 1996. A total of 115,000 households were successfully interviewed. The survey area, which was significantly larger than the previous surveys, included the Regional Municipalities of Niagara and Waterloo, the Cities of Barrie, Guelph and Peterborough, the Town of Orangeville, the County of Victoria and partial coverage of the Counties of Peterborough, Simcoe and Wellington. Parts of Dufferin and Northumberland Counties were included although those agencies did not participate in funding the survey. These areas were in addition to the six Regional Municipalities (Metropolitan Toronto, Durham, Halton, Hamilton-Wentworth, Peel and York) that make up the Greater Toronto Area (GTA) and which were surveyed in both 1986 and 1991.

The data were released in June of 1997 together with a series of summary reports. The initial project objectives had been met on time with budget remaining to carry out some preliminary analysis. The Steering Committee held two special meetings to select the appropriate projects in this final phase of TTS. The projects were selected in two phases with the results of the first phase influencing the selection of projects in the second phase. First phase projects included:

- 1996 GTA Zone System Development
- GTA Trip Generation Rates, 1986 - 1996
- Simplified GTA Model Update
- Full GTA Model Update
- Transit Disaggregate Assignment Procedures
- Hamilton-Wentworth's EMME/2 Model
- 1986 –1996 Travel Trends in the GTA & Hamilton-Wentworth

Projects in the second phase included:

- Web Site Development
- Base Map Requirements across Regions
- Employment Information and Data Collection Issues
- Panels and Other Survey Extensions to the TTS
- Transit Realities in the Suburban GTA
- 1996 TTS Discretionary Travel
- Auto Passenger Travel and Auto Occupancy in the GTA

5.1 1996 GTA Zone System Development

Principal Investigator: DMG Staff

Most Regional Governments in the GTA expressed a desire to update the traffic zone system that defines the spatial aggregation used in current demand models. These changes, ranging from minor to a complete re-definition, needed to be made before any updates to reflect 1996 were undertaken in the travel demand forecasting techniques. Contract staff were hired to co-ordinate the preparation of electronic files and perform all the necessary checking so that a reliable set of zone boundaries are defined and represent the needs of each Region in the GTA.

"1996 GTA Zone Boundaries", Report 66, Joint Program in Transportation, January 1998

5.2 GTA Trip Generation Rates, 1986 - 1996

Principal Investigators: P. Dalton, E. Miller

This report investigates the changes that have occurred in GTA work trip rates over the period 1986-1996, as well as some of the underlying factors affecting these changes. All data are drawn from the 1986, 1991 and 1996 TTS datasets. The analysis proceeds in two parts. Section 2 documents overall or "macro" trends in trip rates, at both the GTA level and by regional municipality, while Section 3 provides a more detailed investigation of variations in LFPR, WAH, RATE24 and PPF by age, gender and employment status (full-time versus part-time). The primary objective of both analyses is to achieve a better understanding of the factors that may fundamentally affect population-based trip generation rates over time and space. Section 4 then concludes the report with a brief discussion of possible future trends and their implications for trip generation forecasting. Various observations/conclusions can be drawn from the plots presented in this report. These include the following:

- Labour force participation rates (LFPR) have declined since 1986. The decline has been more significant for men, particularly those over age 56, and for those in the 21 to 25 age range of both sexes.
- Work trip rates per worker employed outside the home have remained fairly constant over time.
- The peak-period-factor has changed over time, as the morning peak-period has tended to spread and as temporal work patterns change over time.
- Observed changes over time in work trip rates per person are largely attributable to changes in labour force participation rates, work at home rates (WAH), and the relative age profiles of the resident population.
- Since LFPR is a critical determinant of work trip generation (i.e. it is the factor which converts population into employed workers), and since LFPR varies significantly and systematically with age and sex, ideally one should disaggregate the population inputs to the model by age and sex categories, so that age- and sex-specific LFPR rates such as are shown in Figures 1-4 could be used within the model. At a minimum, it would be very useful to differentiate between "younger" workers (25 or under), "middle-aged" (25-55), and "older" workers (56 and above).
- Disaggregation by full-time and part-time employment status would also be useful, given that employment status clearly affects trip rates and peak-period factors. It probably also affects trip distribution as well. Given the high correlation between part-time employment and age and sex, however, of the two, the age/sex disaggregation is probably the most immediately useful.

"GTA Trip Generation Rates, 1986 –1996", Report 74, Joint Program in Transportation, October 1998

5.3 Simplified GTA Model Update

Principal Investigator: P. Dalton

The procedures used in the GTA Simplified Model were originally developed as part of a Regional Transportation Planning Model for the Regional Municipality of Durham and as a strategic planning tool for the Ministry of Transportation, Ontario. Versions 1 and 2 of the model were developed and calibrated using data from the 1986 and 1991 Transportation Tomorrow Survey (TTS). Version 3 contains extensive revisions and has been recalibrated using data from the 1996 TTS.

The model may be used to project and analyze traffic volumes and public transit ridership in the 3-hour peak period between 6 and 9 a.m. The geographic area represented by the model includes the new City of Toronto plus the Regional Municipalities of Durham, Halton, Hamilton-Wentworth, Peel and York. Trip calculations and travel assignments are based on the 1996 GTA traffic zones system and the transportation network data maintained at the Data Management Group. A number of external zones, and an external skeleton road network, have been added to ensure adequate representation of travel adjacent to and across the external boundary of the primary area covered by the model.

The model is divided into two main components. The first of these components consists of a set of spreadsheets that are used for inter-active input of land use, trip generation and mode split assumptions. Population based trip generation rates are used to project work trip origins, non-work trip origins for trips made by automobile and school trip origins for trips made by local transit. Employment based trip attraction rates are used to project work trip destinations. Base case trip generation and attraction rates have been developed using the 1996 TTS data. The rates are composite factors that, in the case of work trips, reflect trips that occur within the peak period. Each of these factors may be modified independently to reflect different scenarios for future conditions. A four-way mode split (Auto, GO Rail, Local transit and Other) is applied to the work trip component. The mode split calculations use separate mode split factors for origins and destinations. The work trip generation rates and mode split factors are adjusted to ensure that the total number of trip origins matches the total number of trip destinations for each mode. The user can select the relative weight given to the origin and destination totals.

The second major component of the model consists of an EMME/2 databank and a set of macros. The macros duplicate the trip generation and mode split calculations performed in the spreadsheets and then perform trip distribution and assignment by mode. The model may be used to project future travel "demand" based on existing (1996) levels of service or a capacity restraint procedure can be used to modify the auto trip distribution to reflect projected changes in level of service on the road network. The EMME/2 databank may be

used to create and test alternative future network scenarios. Outputs from the EMME/2 components of the model include values for an extensive list of performance indicators that can be used in the strategic assessment of land use and network alternatives.

A third component of the model consists of spreadsheets for the analysis and comparison of a number of standard outputs from the model. Those outputs include the performance indicators, screen line crossings and a number of aggregated trip and travel time matrices.

"GTA Simplified Model Version 3.0 - User's Manual", Report 77, Joint Program in Transportation, February 1999

5.4 Full GTA Model Update

Principal Investigator: E. Miller

The Full GTA Model has been developed in an incremental, evolutionary way over the past five years, initially with the support of the Metro Toronto Planning Department, and more recently with the MTO. The model development strategy has been one of getting a model up and running, identifying priorities for model improvement, developing "off-line" a new version of the model which addresses the identified needs, and then bringing the improved model "on-line" into a planning application once it has been tested and verified. The process then begins again with another round of identifying model improvement needs, development and testing, and implementation.

The work plan for this project deals with the next set of logical steps in the on-going evolution of the Full GTA Model. These steps fall into four broad categories:

- to update model parameters to reflect 1996 conditions and the new zone system,
- to improve the model's structure and policy analysis capabilities, including an improved treatment of HOV/shared-ride usage, express bus services, and road pricing strategies (toll roads, area pricing, etc.),
- to implement miscellaneous improvements in the model, such as upgrading the EMME/2 macros from Version 7 to Version 8, improving the criteria used to determine model convergence, incorporation of integrated networks into the model, and various programming changes designed to reduce the disk storage and/or run-time requirements of the modelling system,
- to improve the user interface, including improvements to both the model "front end", which is used to "set up" a model run, and the model "back end", which provides standardized outputs from a model run, will be undertaken to increase the ease with which the model can be run, as well as to increase the utility and accessibility of the model results.

Project was not completed at the end of 1998 and a report is not available at this time.

5.5 Transit Disaggregate Assignment Procedures

Principal Investigator: B. Farrol and DMG Staff

The advent of disaggregate transit trip information from the 1986 Transportation Tomorrow Survey (TTS) created an opportunity to model transit trips at the route level. The availability of disaggregate transit trip information from the 1996 TTS created an opportunity to update the calibrated parameters to reflect any trip-making behaviour changes that may have occurred over the past 10 years. An updated set of calibrated parameters will ensure that transit planners will be generating assignment results that best reflect the decision-making patterns of transit users.

This is the first major project undertaken by TTC Planning staff with the use of EMME/2. The TTC's on-line connection to the EMME/2 model at the Data Management Group provides an opportunity to assess its applicability as another tool to analyse the effects on TTC riders due to service changes.

This report documents the procedure and results of calibrating the EMME/2 disaggregate transit assignment model using 1996 a.m. peak transit (TTC only) trips and the 1996 a.m. peak transit network.

The final calibration parameters are only applicable for analysing the effects of TTC service changes. A TTC-only model was developed because of the additional complexity of calibrating agency-to-agency transfers at a disaggregate trip level. A new exercise is required to produce a calibrated transit assignment model that can simulate these inter-agency transfers correctly. The resulting parameters provide a very good fit with correlation coefficients in the 0.99 range.

There are several refinements that can be made to the assignment algorithm and even to the method used to calibrate the model. There is potential for the EMME/2 disaggregate transit trip assignment model to be used for TTC Service Planning purposes. This calibrated model provides a firm base from which to make informed and responsible decisions on planning transit services for the TTC.

"Analysis of Individual Transit Trips in EMME/2", Report 80, Joint Program in Transportation, October 1998

5.6 Hamilton-Wentworth's EMME/2 Model

Principal Investigator: DMG Staff

The only funding agency of the Data Management Group that is not a current user of the shared computer system and EMME/2 software is the Region of Hamilton-Wentworth. INRO recently announced they are discontinuing support for the computer system that runs the Hamilton-Wentworth travel demand model. One option for the Region is to operate on the shared computer system. A necessary first step in determining if this would be advantages is to port their current model onto the shared system and make comparisons. The comparisons would take two forms:

- compare the operation of their existing model on the shared computer system,

- investigate the feasibility of changing over to the shared network and suite of GTA models.

The project is not complete at this time. The project will be completed by DMG staff when the timing is convenient for participation by staff at the Region of Hamilton-Wentworth.

5.7 1986 –1996 Travel Trends in the GTA & Hamilton-Wentworth

Principal Investigator: D. Crowley, P. Dalton, J. Ng

This report documents changes in the Greater Toronto Area (GTA) and Hamilton-Wentworth locational and socio-demographic patterns and related changes in travel behaviour since 1986, with reference to the 1986, 1991 and 1996 TTS results. The analysis of changing travel characteristics focuses on work trip generation and distribution and mode choice issues. The report considers how and why such changes have emerged, and the implications of the identified changes for the planning of road and transit facilities and services across the GTA.

Changes in population, labour force, employment and student population over the 1986 to 1996 period are discussed in Section 2. The documented trends largely determined changes in the work-related trip making that dominates the peak travel periods and determines transportation requirements. The available data suggest that whereas Toronto saw continuous declines in employment and labour force over the 1986-1996 period, the four suburban Regions in the GTA experienced continuous growth during the same period.

The trends in labour force activity resulted in proportionately fewer work trips due to decline in labour force participation rate and shift from full-time to part-time work. However, during the 1986-1996 period, changes in the number of work trips per worker were also noted, including increased numbers of first work trips per day for both full-time and part-time workers. Job losses in Toronto and Hamilton combined with continued population and employment growth in the suburban Regions led to changes in live-work relationships and commuting patterns between 1986 and 1996, as documented in Section 4.3, with reference to exhibits showing changes in first work trips ending in seven destinations across the GTA and Hamilton-Wentworth.

A number of trends over the 1986-1996 period imply reduced transit ridership potential in the future and the need to update current approaches to estimating transit mode choice. The relevant trends include aging of the population, suburbanization of employment, decentralization of the work force, availability of cars, and declining mode split and transit trip rates.

The changes in labour force activity, employment and trip distribution patterns observed in the 1986 to 1996 period were unexpected and are not reflected in current forecasts. These changes highlight the benefits of the Transportation Tomorrow Survey and the need to continue to monitor travel behaviour on a regular basis.

"1986 - 1996 Travel Trends in the GTA & Hamilton-Wentworth", Report 67, Joint Program in Transportation, March 1998

5.8 Web Site Development

Principal Investigator: DMG Staff

Preliminary investigations have shown that access to data, both travel and cordon count, at the Data Management Group can be simplified with the use of commonly used web browsers such as Netscape and Microsoft Explorer. The procedures would allow a more intuitive interaction between the user and the computer system in the formulation of a data request. At the same time, the relational data base management system (RDMS) is to be changed from EMPRESS to ORACLE as a cost saving measure.

The initial development of a replacement for the text based data retrieval system (DRS), called the internet data retrieval system (iDRS), is complete on the EMPRESS data base system and is ready for initial testing. The conversion to ORACLE should occur some time in 1999. A browser replacement for the cordon count data retrieval system (CCDRS) is now operational for some of the participating agencies using an ORACLE data base. The remainder of the data will be added progressively in 1999. The two systems (EMPRESS and ORACLE) will be operated in parallel for some time until it is certain that the new system is functioning properly. The conversion should be transparent to the users.

Early is 1999, an alpha test on the CCDRS is to be conducted in co-operation with willing agencies. The results of this test will be incorporated into a final version. Testing of the iDRS will be somewhat later because of the complexity of the relational data base and its inherent conversion problems in ORACLE.

The browser version of the data retrieval systems are the basis for the computer screens shown in Chapter 2 of this report.

5.9 Base Map Requirements across Regions

Principal Investigator: J. Ng

The lack of a consistent base map through all six regions of the GTA was a major problem in the process of geo-coding the 1996 TTS data. In addition, the same lack of a consistent base map is a major contributor to the delay in Statistics Canada providing 1996 POW/POR data at the traffic zone level. The issue is not specifically related to transportation but a general concern in all aspects of planning data, consistent across regions. As an incentive for planning groups to look at the problem, this project is conducting an inventory of mapping issues in each of the six regions. The task is to attempt a summary of the current situation and raise possible improvements that would benefit everyone sharing planning information.

Preliminary results indicate that the offices responsible for land-use planning at each of the Regions is actively interested in the same topic. The topic is broader than the interests of transportation planners and the related coding of travel information and more suited to the interests of these land-use planning offices. The project is currently on hold until it is clear that transportation planning interests can make a positive contribution to the process.

5.10 Employment Information and Data Collection Issues

Principal Investigator: L. Cheah

Two different issues prompted the initiation of this study. First, the traditional approach to employment data collection in the Greater Toronto Area and the Region of Hamilton-Wentworth ("the GTA") makes use of the municipal property assessment file as a starting source of employer information. The key information in the assessment file is the tenant information. As of 1998, the assessment file no longer contains tenant information.

Secondly, while the GTA has developed into an integrated economic area and most strategic planning activities cover more than a single region, the collection and reporting of employment data are neither uniform nor consistent across the GTA.

The objective of this study is to review current employment data collection activities in the regional planning agencies of the GTA by:

- assembling an inventory of data and collection methods,
- identifying current issues in regard to data collection, and
- beginning a discussion on the options available to collect appropriate data.

Based on the investigations conducted as part of this study, a number of options have been identified to assemble appropriate employment data throughout the GTA. These can be described as follows:

- continue the disjointed collection of employment data by the respective planning and economic development agencies in the GTA,
- establish a process to conduct co-ordinated employment survey on a regular basis,
- development of a dynamically maintained repository of employment data, based on partnerships with other organizations,
- enhance Census-based data collection activities,
- application of advanced analytical methods to synthesize multiple existing data bases.

"Employment Information and Data Collection Issues", Report 78, Joint Program in Transportation, February 1999

5.11 Panels and Other Survey Extensions to the TTS

Principal Investigator: E. Miller

The purpose of this report is to discuss the strengths and weaknesses of alternative survey methods and to investigate the extent that one or more of these methods might be used to supplement the current TTS format in the 2001 data collection exercise. That is, the issue is not one of replacing the current format, rather, it is whether some of the survey methods should be used to undertake a parallel, supplementary data collection effort.

In particular, the question has been raised as to whether a panel survey, in which the same sample of households is repeatedly interviewed at several points over an extended period of time, might prove to be an effective means of gathering information of practical use to GTA planners and modellers which cannot be obtained through the conventional repeated cross-sectional TTS format (in which different, randomly selected households are interviewed at each point of time). The primary purpose of this report is to investigate the question of developing and implementing a panel survey within the TTS data collection program.

From the discussions and analysis in this report, two major recommendations are put forward for consideration. The first finding is that the repeated cross-sectional TTS program has served the GTA extremely well, and should be continued through the next decade. That is, a cross-sectional survey, similar to the preceding three TTS, should be undertaken in the Fall of 2001, 2006 and 2011 with a nominal sample rate of 5%. While needs for additional survey information may exist and be justifiable on a cost-effectiveness basis, such additional survey activities should not detract from the "core" TTS data collection activity.

The second finding deals with the possibility of undertaking a panel survey within the GTA, as a complement to the current TTS. Based on the preliminary analysis presented in this report, a GTA panel survey undertaken in parallel with the cross-sectional TTS survey during the 2001-2011 time period possesses the potential to provide considerable benefits in terms of significantly increased information concerning temporal trends in GTA travel behaviour and the underlying factors affecting these trends. Such a survey also appears to be feasible to execute in a cost-effective fashion, with a preliminary cost estimate in the order of $300,000 over the lifetime of the project. Such a panel survey can be "financed" either by adding additional funds to the GTA survey budget over this time period, or by reducing the cross-sectional TTS sample rates marginally (to approximately 4.75%, relative to the nominally desired target of 5%).

"Panels and Other Survey Extensions to the Transportation Tomorrow Survey", Report 79, Joint Program in Transportation, February 1999

5.12 Transit Realities in the Suburban GTA

Principal Investigator: D. Crowley, P. Dalton

This report looks at current transit realities and trends in the four Regional Municipalities that make up the suburban GTA, based primarily on the analysis of Transportation Tomorrow Survey (TTS) data for 1986, 1991 and 1996. It documents transit use in the Suburban GTA by Region as of 1996 considering how transit is used, who rides, and why they ride, describes recent trends in travel for individual Regions, and assesses possible reasons for observed changes in transit ridership. The report also assesses the implications of recent trends for the future of transit and transportation in the GTA.

As documented in Section 2, most transit use in the suburban GTA can be classified in terms of two distinct travel markets: Toronto oriented cross-boundary travel and intra-municipal travel using local transit.

Toronto-oriented commuters accounted for 58% of all transit trips originating in the Suburban GTA in 1996. This market is dominated by peak period work travel. Most cross-boundary trips to Toronto were made by so-called "choice riders" -- persons who were licensed to drive and had a car available.

Intra-municipal transit travel accounts for approximately 34% of all transit use by residents of the Suburban GTA. School was the most significant trip purpose for intra-municipal transit use accounting for 43% of local transit trips in 1996. Work was the second most important trip purpose for intra-municipal travel, accounting for 31% of local transit trips. Whereas most cross-boundary transit users are "choice riders," necessity was the primary reason for using transit to travel locally in the suburban GTA.

Total transit ridership grew rapidly between 1986 and 1991 but declined thereafter, as documented in Section 3. However, the growth in total transit ridership in the 1986-91 period was less than would be expected based on the growth of the suburban population. Whereas the four Regions saw their populations increase by 43%, transit ridership by the residents of the suburban GTA increased by only 27%. Between 1991 and 1996, reported transit ridership fell by 2%, whereas the Regions' combined population grew by 12%. Section 3 reviews these trends by mode focussing on underlying trends in trip rates and mode splits and discusses possible explanations including changing travel patterns, service levels, driver licensing and auto availability.

Section 4 presents conclusions and implications including discussions of transit's role in serving suburban growth and transit's future prospects.

"Transit Realities in the Suburban GTA", Report 75, Joint Program in Transportation, November 1998

5.14 1996 TTS Discretionary Travel

Principal Investigator: P. Dalton

Discretionary travel is defined as all trips other than home-based work and home-based school. For the purpose of this report discretionary trips are divided into three sub-categories - home-based shopping, home-based other and non home-based. The definition of a home-based trip is one that either starts or finishes at home. This report addresses three topics:

- the under reporting of discretionary travel in the 1996 TTS and the appropriate methods of correction,
- the analysis of discretionary trips and trip making characteristics,
- issues that need to be addressed with respect to the formulation of p.m. peak period and 24-hour travel demand models.

It is concluded that the primary source of under reporting in the TTS stems from the use of third-party respondents to report the trips made by other household members. Previous studies have established that home-based work and school trips are reported with a high degree of accuracy for both respondents and other household members. Under reporting of discretionary travel is significant with respect to both auto driver and public transit trips.

The use of the following factors is recommended to correct for under reporting caused by the use of third-party respondents:

	Auto Driver	Public Transit (Excl. GO Train use)
Home-based	1.34	1.39
Home-based	1.27	1.31
Non Home-based	1.41	1.36
Combined totals	1.33	1.34

There is no evidence of any under reporting of auto passenger trips in the TTS data base. Discretionary travel is of minor importance with respect to GO Train operations accounting for 12%, or less, of daily trips.

The adjustment factors may be applied to most subsets of the TTS data after extraction from the TTS data base. The adjustment made to auto driver trips give daily traffic volumes which, in total, are 5% to 10% less than observed cordon counts. It is not possible to say if this difference is due to other sources of under reporting, traffic that is not represented in the TTS or problems in the method of comparison. There is no valid basis for making further adjustment.

Discretionary travel in the GTA and Hamilton-Wentworth is estimated at 64% of

total daily auto driver trips and 34% of the trips made by public transit excluding GO Train use. The characteristics of discretionary travel are such that these proportions will likely increase in the future. Discretionary travel volumes are significant between the hours of 7:30 a.m. and 10.30 p.m. Trip generation rates based on TTS data, adjusted to correct for under reporting, should produce peak hour traffic volumes that are 10% to 15% higher in the afternoon than in the morning. The afternoon peak also extends over a longer period of time. Simulations of the p.m. peak period are likely to be more complex than the a.m. peak, because of the greater diversity of trip characteristics, but other factors are identified which favour simulation of the p.m. peak period. As a result it should be possible to develop a p.m. peak period model that is at least as reliable and robust as the current a.m. peak models. Chapter 5 contains suggestions as to how both the Full and Simplified GTA modelling procedures might be modified to produce p.m. peak and 24-hour simulations.

"1996 Transportation Tomorrow Survey Discretionary Travel", Report 63, Joint Program in Transportation, January 1999

5.14 Auto Passenger Travel and Auto Occupancy in the GTA

Principal Investigator: M. McLeod

Auto use continued its rapid growth in the GTA from 1986 to 1996 as recorded by the Transportation Tomorrow Survey (TTS) program. The over volume of auto passenger trips has been increasing at a faster rate than the auto trips themselves. At the same time, the number of transit trips has continued to decline.

Transportation decision-makers and planners need information that will provide a better understanding of recent trends in auto and auto passenger trips. We need to understand the nature of the changes that are behind the increased use of the auto mode and the growth in auto passenger trips.

The number of daily auto passenger trips in the GTA now exceeds the number of local transit trips (1.59 million vs. 1.25 million daily transit trips in 1996). The auto passenger mode has assumed increased significance in GTA transportation. The implications of this growth should be further reviewed by planners and policy-makers with a view to assessing the impacts of these trends, and also to identify any opportunities that may be associated with this growing market.

The following have been identified as important factors in the growth of the auto passenger trips:

- suburban growth,
- increase in discretionary travel and school-related activity,
- growth in children taking auto passenger trips,
- aging of the population and the preference of seniors for auto travel,
- gender effects,
- a.m. peak period growth.

The Greater Toronto Area, like most of the metropolitan areas in North America, has experienced a steady decline in auto occupancy, particularly during peak periods. For example, the occupancy in the a.m. peak period, inbound across the City of Toronto boundary declined from 1.21 to 1.16, a reduction of about 4% over 10 years. The proportion of single occupant vehicles has increased from 82% of the vehicles in 1986 to 86% in 1996, thereby reducing the average occupancy.

The significance of a 4% reduction in auto occupancy in the GTA is that it is equivalent to an increase of about 250,000 vehicle trips per day and 25,000 vehicle trips in the peak hour. This represents close to one year's growth across the entire road system.

This report also briefly reviews auto occupancy trends in the GTA based on the

Cordon Count program and estimates derived from the TTS surveys. Comparisons are made with auto occupancy trends in Ottawa, Vancouver and urban areas of the United States using results and analysis from the National Personal Transportation Survey in the United States.

"Auto Passenger Travel and Auto Occupancy in the GTA", Report 76, Joint Program in Transportation, January 1999

6 RESEARCH

A portion of the funding provided to the Data Management Group is allocated to unspecified research on topics related to urban transportation. In addition to these funds, the very research nature of the DMG's activities is conducive to encouraging other research projects, some of which receive funding from other sources. The research support that is made possible by the existence of the Data Management Group include; access to the TTS data, access to the EMME/2 network and modelling system, access to software (SAS, ArcInfo, Empress, etc.), and technical support in the use of these data and software.

The following itemized list includes only those activities that were carried out in 1998 and that are directly related to the activities of the Data Management Group.

6.1 Related Research Projects

Dr. Amer Shalaby, a recent graduate from the Department of Civil Engineering, was awarded an NSERC Industrial Fellowship for the years 1997 and 1998. The fellowship is specifically for young researchers to gain some experience in industry while carrying out their research. Dr. Shalaby held the fellowship with the Toronto consulting firm of IBI until he accepted a research and teaching position at Ryerson University in the fall of 1998. His area of research was "Exploring Person Travel Trends in the Greater Toronto Area" and made extensive use of the TTS data. Two reports on his findings are available on the web site[5].

Two large projects have recently been awarded to the Joint Program in Transportation, both of which have Professor Eric J. Miller as the Principal Investigator, and both of which include external participation.

A three year National Science and Research Council (NSERC) Collaborative Research Grant concluded in 1998. The research team included academics from the University of Toronto, McMaster University, University of Laval and the University of Calgary. The topic, "Integrated Transport and Land Use Modelling

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[5] Exploring Person Travel Trends in the Greater Toronto Area, Part 1: Changes in Travel-Related Factors and Implications for Travel Demand, Report 69, Joint Program in Transportation, August 1998

Exploring Person Travel Trends in the Greater Toronto Area, Part 2: Changes in Travel and Relationship with Factors, Report 70, Joint Program in Transportation, August 1998

for Environmental Analysis" received funding at $160,000.00 per year for the three years. Many of the research tasks in this project used data from the DMG.

6.2 Graduate Student Theses

Alvarado, G., "Conical Travel Time Functions for the GTA Road Network" (M.Eng.)

Doherty, S., "The Household Activity-Travel Scheduling Process: Computerized Survey Data Collection and the Development of a Unified Modelling Framework" (Ph.D.)

Elmi, A., "Analysis of the Temporal Transferability of Work Trip Distribution 'Gravity Models'" (M.A.Sc. Carleton)

Putra, E., "A Simulation Model of Vehicular Modal Emissions" (M.Eng.)

6.3 Graduate Student Thesis Work Currently in Progress

Peiravian, F., "Road Network Modelling for Environmental Impact Analysis" (Ph.D.)

Lee, C., "Network Microsimulation Methods", (M.A.Sc.)

6.4 Research Papers

Badoe, D.A. and E.J. Miller, "*Transportation - Land-Use Modeling: Empirical Findings and Implications for Modeling*", Technical Memorandum No. 2, Transit Cooperative Research Project H-12, Toronto: University of Toronto Joint Program in Transportation, December, 1997, 57 pages.

Miller, E.J. and A. Ibrahim, "Urban Form and Vehicle Usage", *Transportation Research Record*, 1998.

Badoe, D.A. and E.J. Miller, "An Automatic Segmentation Procedure for Studying Variations in Mode Choice Behavior", *Journal of Advanced Transportation*, Vol. 32, No. 2, 1998, pp. 190-215.

Badoe, D.A. and E.J. Miller, "Modeling Mode Choice with Data from Two Independent Cross-Sectional Surveys: An Investigation, *Transportation Planning and Technology*, Vol. 21, 1998, pp. 235-261.

7 DATA REQUESTS

The data housed at the DMG is accessed primarily by the funding agencies. In addition to the data requirements of the Regions, the Municipalities which comprise each Region, are permitted access via their Region's connection. Consultants working on behalf of the Regions and Municipalities are encouraged to make use of the data sets. As part of the DMG's funding and mandate, researchers at the Joint Program in Transportation and the Department of Civil Engineering at the University of Toronto are provided with access. Lastly, private groups wishing to access the data are provided with restricted access whereby a DMG staff member, for a nominal fee, performs data searches.

Access to the data sets varies according to the data required and the complexity of the request. Over the past 7 years, an on-line Data Retrieval System has been developed which provides direct access to the 1986, 1991 and the 1996 Transportation Tomorrow Survey data by the users (DRS - see Section 7.1). The DMG staff (see Section 7.2) undertakes more complex requests. This one-off approach to data retrieval allows users to expand their requests which consequently maximizes the overall use of the data. The following summarizes the demand for the data in 1998 and offers details on some of the custom data searches completed.

7.1 DRS Data Extraction Summary

The following table summarizes the demand for the on-line Data Retrieval System. The number of queries is significant and could not be cost effectively served in a manual fashion. It is interesting to note that typically users are making several data queries each time they log on the system.

Summary of DRS Data Requests

Month	Number of Data Queries	Number of Sessions
January	201	45
February	270	43
March	141	35
April	113	42
May	63	20
June	77	21
July	141	31
August	211	39
September	57	18
October	76	24
November	97	26
December	44	16
Total	1491	360

DRS Users in 1998

City of Scarborough
City of Mississauga
GO Transit
IBI Consulting Group
McCormick Rankin
Ministry of Transportation, Ontario
City of Toronto
Peter Dalton Consulting
Professor Eric Miller
Regional Municipality of Durham
Regional Municipality of Halton
Regional Municipality of Hamilton-Wentworth
Regional Municipality of Peel
Regional Municipality of Waterloo
Regional Municipality of York
Toronto Transit Commission
Totten Simms Hubicki Associates
University of Toronto undergraduate and graduate students
ELM Project User

7.2 Data Requests Summarized by Agency

In addition to the data requests that are served directly through the on-line interactive TTS Data Retrieval System (DRS), the DMG staff processed the following requests. The diversity of the requests illustrates the robust nature of the Transportation Tomorrow Survey Data sets as currently housed at the DMG.

7.2.1 Participating Agencies

January

1996 TTS population, employed labour force, employment, number of dwelling units, and afternoon peak hour auto trip matrix for the Region of Halton were requested by Tranplan Associates for an update of the 1995 Oakville Transportation Study.

1996 TTS household, person and trip information for the Town of Oakville were requested by the Oakville Transit for internal studies.

1996 TTS 24-hour and afternoon peak period auto trips made by residents for the 27 aggregated zones and the GTA zones of the Niagara Region were requested by the Ministry of Transportation for the Niagara Frontier international gateway study.

1996 TTS transit trips broken down by trip purpose, origin and destination at the ward level were requested by the TTC.

1996 TTS O-D 24-hour all-purpose all-mode trip matrix was requested by the Region of York.

February

1996 TTS home to work trips made by Oakville residents by destination planning district were requested by Oakville Transit.

Population and employment by GTA zones from the 1986 Census, 1991 and 1996 TTS data were requested by the Region of Durham.

March

The Region of York requested population and employment at planning district level from the 1991 and 1996 TTS data.

Total number of morning peak TTC trips was requested by the TTC.

1986 and 1996 TTS geographic, household, person and trip data were requested by City of Toronto Planning Department for the Travel Behaviour Bulletin.

Population and employment at 1991 GTA zone level from the 1996 TTS data base were requested by Eric Miller for the development of the GTA model.

April

The City of Toronto Planning Department requested Manhattan distance for all trips from the 1986 and 1996 TTS data.

The Toronto Planning Department requested straight-line and Manhattan distances between household location and nearest subway station for Toronto residents and between household location and nearest GO Train station for GTA residents.

May

1996 TTS access-egress transit matrices for trips using two specified TTC bus routes were requested by the TTC.

June

1996 TTS O-D mode-split matrices for morning peak period, afternoon peak period and 24-hour were requested by iTrans Consulting Inc. for the GO Station Location Study for the Town of Markham.

1996 TTS modal split of total daily trips by Toronto residents was requested by the Toronto Transit Commission.

1996 TTS trips that originated in zones 311, 317, 319 and 309 were requested by TTC to estimate the mode split for the catchment area consisting of the 4 zones.

York Region requested median work trip distance from the 1996 TTS data for all residents of York Region.

Durham Region requested 1996 TTS occupation and trip destination data for Durham residents making a work purpose trip in the a.m. peak period. A boundary file for Durham Region and Peterborough and Victoria Counties was also requested.

July

1986 and 1996 TTS morning peak period and 24-hour mode split for two aggregated zones were requested by the Region of York for the Mode Split Report.

1986 and 1996 TTS morning peak total and transit trips either made to or by the residents of the specified GTA zones were requested by the Region of York for the Official Plan.

August

1996 TTS household, person and trip information for four specific (1996) GTA zones was requested by the City of Toronto Planning Department.

1996 TTS mode split for (1996) GTA zone 102 was requested by the City of Toronto Works and Emergency Department.

1996 GTA zone boundary and street network files were requested by the Region of Halton for their O-D survey.

Zone boundary files for the six regions in the GTA in MapInfo format were requested by Statistics Canada.

Total population and population that work within the area including and excluding work at home, for the Region of Durham and the City of Oshawa, from the 1986 Census POR-POW, 1986, 1991 and 1996 TTS data were requested by the Legislative Research Service of the Ontario Legislative Library.

York Region requested total trips and transit trips originating in or destined for York Region in the morning peak period from the 1986 TTS and 1996 TTS.

September

1996 TTS trip information was requested by the Region of Peel.

The Region of Halton requested 1996 TTS trips broken down by trip start time, trip purpose and trip origin and destination.

GO Transit requested the geocode reference files for the 1997 GO Rail Survey report.

1996 TTS morning and afternoon peak period home-based work trip matrices broken down by travel mode were requested by Entra Consultants Inc. for the Region of Durham Hwy 2/Hwy 401 Corridor Transit Services Review.

HBW, HBO and NHB trips between Oakville and Burlington for the p.m. peak period and p.m. peak hour were requested by Halton Region.

October

The Region of Durham requested morning peak period auto driver trip matrices broken down by trip purpose from the 1986, 1991 and 1996 TTS data.

1996 TTS auto driver trip matrices broken down by trip purpose and start time were requested by the Region of Durham.

November

1996 TTS household, person and trip information was requested by Eric Miller for the development of the GTA Model.

Population and employment at 1991 GTA zone level from the 1996 TTS data base were requested by Eric Miller for the development of the GTA model.

December

1996 TTS O-D trip matrices broken down by trip start time and travel mode were requested by iTrans Consulting Corp. for the Town of Ajax Master Transportation Study.

Town of Halton Hills requested the average number of vehicles available for the Town of Halton Hills.

Zone boundary files for external regions of the GTA in MapInfo format were requested by Statistics Canada.

1996 TTS O-D trip matrices broken down by trip start time, travel mode and trip purpose were requested by Sage Information Consultants Inc. for the update of the Niagara Regional model.

IBI Group requested 1996 TTS a.m. peak trip matrices by mode aggregated by planning districts for the Transportation Funding Opportunities Study. The study was for a task force comprising of representatives from Halton, Toronto, Peel, Hamilton-Wentworth, York, Durham and GO Transit.

7.2.2 University Research

1996 TTS trip and person information of GTA residents were requested by Yael Levitte from the University of Toronto for her master thesis.

1986 TTS morning peak period O-D trip matrix at 1991 GTA zone level was requested by Hanna Maoh from McMaster University for his master thesis.

1986, 1991 and 1996 TTS 24-hour home-to-work and home-to-non-work trips broken down by planning district were requested by Andrew Peters from McMaster University for his master thesis.

Population, employment, area, morning peak period all purpose and GO transit trips made to planning district 1 and the City of the Toronto by origin planning district were requested by Professor Richard Soberman from the 1996 TTS.

1996 TTS 24-hour all purpose and home-based trips and trip distances broken down by origin area and destination planning district were requested by Professor Pierre Filion from the University of Waterloo for the GTA Suburban Downtown Study.

1996 TTS 24-hour trips broken down by origin area, destination planning district, destination trip purpose and travel mode were requested by Professor Pierre Filion from the University of Waterloo for the GTA Suburban Downtown Study.

1996 TTS average daily trips per person in GTA requested by Professor David Foot at the University of Toronto.

1996, 1991, and 1986 TTS demographic and trip data were requested by Murtaza Haider, graduate student in Civil Engineering at the University of Toronto, for the research paper “Airport Ground Access Study” with Professor Soberman.

1986 TTS and Travel Diary Survey demographic data, home to work trip matrices, and a.m. peak travel time matrices for residents of Hamilton-Wentworth Region were requested by Darren M. Scott from the School of Geography and Geology at McMaster University for his Ph.D. research.

Trip origins and destinations for all trips in the 1986 TTS data base were requested by Darren M. Scott, graduate student at McMaster University.

1996 TTS demographic and trip data for auto passengers and transit were requested by Susanna Tai, an MBA student at the University of Toronto for a statistics project.

1995 and 1996 Cordon Count information for major screenlines throughout the GTA was requested by Peter Dalton for the report “1996 Transportation Tomorrow Survey Discretionary Travel.”

7.2.3 Private

Entra Consultants Inc. requested O-D trip matrices broken down by trip purpose, travel mode and trip start time from the 1996 TTS data.

Cole, Sherman & Associates Ltd. requested the number of trips made to GTA zone 1159 from the 1996 TTS data for traffic impact study.

Tranplan Associates requested the number of vehicle trips made by the residents of and originated from three specific GTA zones broken down by trip start time from the 1996 TTS data.

BA Consulting Group Ltd. requested morning and afternoon O-D trip matrices for work and all purposes broken down by travel mode from the 1996 TTS data.

BA Consulting Group Ltd. requested morning peak period O-D matrix for work trips at planning district level disaggregated in Mississauga from the 1996 TTS data.

RGP Transtech Inc. requested morning peak period O-D trip matrices for work and all purposes, auto driver or all modes from the 1996 TTS data.

BA Consulting Group Ltd. requested afternoon peak period trip matrices for trips made by residents of the GTA, broken down by travel mode at planning district from the 1996 TTS data.

IBI Group requested matrices of auto vehicle-km of travel and transit passenger-km of travel for four trip purposes and matrices of trips by mode aggregated by zone of residence for a study for the Canada Mortgage and Housing Corporation.

iTrans Consulting requested origins and destinations of auto driver trips during 5 time periods for the 46 PDs plus 5 aggregated super zones for Vaughan, Brampton, and Mississauga.

1986, 1991 and 1996 TTS demographic and trip data were requested by Murray McLeod of Cole Sherman Consulting Engineers for the report “Auto Passenger Mode and Auto Occupancy in the GTA.”

Marshall, Macklin, Monaghan Limited requested morning peak period auto vehicle trip matrix at the planning district level from 1996 TTS data.

1986, 1991 and 1996 TTS 24-hour home to work trips originating from Oshawa and Hamilton to the City of Toronto and all destinations was requested by the Toronto Star.

8 LIST OF PUBLICATIONS

No	Title
1	The Transportation Tomorrow Survey: Design and Conduct of the Survey (December 1987)
2	The Transportation Tomorrow Survey: Data Validation (August 1988)
3	The Transportation Tomorrow Survey: Version 2.2 Data Guide (August 1988)
4	The Transportation Tomorrow Survey: An Overview of Travel Characteristics in the Greater Toronto Area (December 1988)
5	The Transportation Tomorrow Survey: Travel Survey Summary for the Greater Toronto Area (June 1989)
6	The Transportation Tomorrow Survey: Trip Diary Survey Analysis (January 1990)
7	The Transportation Tomorrow Survey: Trip Diary Survey Data Guide Version 1.1. (January 1990)
8	Developing Transportation Networks using Area Master Files and AutoCAD (July 1989)
9	Metro Toronto EMME/2 Development Project (January 1990)
10	EMME/2 Matrices, Macros, Graphics (June 1990)
11	EMME/2 Access Policies and Guidelines (June 1990)
12	Transportation Tomorrow Survey Version 3 Data Guide - Empress format (March1990) Transportation Tomorrow Survey Version 3 Data Guide - Supplement: Text format (March 1990)
13	1989 Greater Toronto Area Zone Boundaries (March 1990)
14	1979 Tarms Zone Boundaries (March 1990)
15	Updating Transportation Tomorrow Survey Data to Version 3 (April 1990)
16	Analysis of Transportation Tomorrow Survey Data Bias: Due to Use of Informants (April 1991)
17	Greater Toronto Area Road Network Coding Manual (April 1991)
18	EMME/2 Library (April 1991)
19	Transportation Tomorrow Survey Data Retrieval System User's Manual (May 1991)

No.	Title
20	Development of an Integrated, Multimodal Mode Choice and Route Assignment Model (June 1991)
21	Development of an Individual Trip Assignment Model for Application to Commuter Rail and Regional Bus Transit (June 1991)
22	Zone Boundary Aggregation Procedure User's Manual (October 1991)
23	1990 EMME/2 Transit Network Version 2.0 Coding Standards (November 1991)
24	Mode Choice Behaviour in the Greater Toronto Area: Analysis of 1986 Transportation Tomorrow Survey Data (June 1992)
25	1991 Transportation Tomorrow Survey: Data Guide - Version 2.1 (June 1992)
26	1991 Transportation Tomorrow Survey: Design and Conduct of the Survey (October 1992)
27	1991 Transportation Tomorrow Survey: 1991 Synthesized Trip Matrices Version 1.0 - Data Guide (February 1993)
28	Data Management Group Annual Report (September 1992)
29	1991 Transportation Tomorrow Survey Seminar: Preliminary Comparisons with 1986 (July 1992)
30	The Use of Direct Data Entry for Travel Surveys (August 1992 - draft)
31	A Summary of Changes in the Travel Characteristics of the Greater Toronto Area, 1986 to 1991 (December 1992)
32	Under-reporting of Trips in Telephone Interview Travel Surveys (January 1993)
33	Demand for Aircraft Gates (January 1993)
34	Travel Trends in the City of Mississauga 1986 to 1991 (June 1993)
35	Travel Trends in the City of Mississauga 1986 to 1991 - Appendix Trip Tables (June 1993)
36	1991 Transportation Tomorrow Survey: Preliminary Comparison of Changes between 1986 and 1991 by Regional Municipality (November 1992)
37	EMME/2 GO transit Network Version 1, Coding and Procedures Manual (November 1990)
38	Advanced EMME/2 Training Manual (September 1993)
39	Departing Passenger Arrival Patterns at Air Terminals (October 1993)

No.	Title
40	Quantitative Analysis of Urban Transportation, Energy Use & Emissions: Phase I Final Report (May 1993)
41	Quantitative Analysis of Urban Transportation, Energy Use & Emissions: Phase I Executive Summary (December 1993)
42	1991 Transportation Tomorrow Survey: Version 3.0 Data Guide (October 1993)
43	Data Management Group Annual Report 1993 (January 1994)
44	Modelling Central Area Work Trip Modal Choice and Parking Demand (June 1992)
45	1991 Transportation Tomorrow Survey Version 4 Data Guide (July 1994)
46	1991 & 1986 Travel Survey Summaries for the Greater Toronto Area (June 1994)
47	GTA Network Coding Standard (February 1995)
48	GTA Transportation Plan - Base Year (1986) Network Coding (April 1995)
49	Data Management Group Annual Report 1994 (May 1995)
50	Urban and Travel Changes in the Greater Toronto Area, and the Transferability of Trip Generation Models (July 1995)
51	Performance of Trip Generation Models of Morning Peak-Period Travel in Long Range Forecasting (August 1995)
52	The Subarea Planning Macro: Development of a Method for Subarea Planning in the EMME/2 Software Environment (April 1996)
53	The Greater Toronto Area Travel Demand Modelling System, Version 1.0 Volume II: Model Documentation (March1997)
54	Data Management Group Annual Report 1995 (May 1996)
55	The Greater Toronto Area Travel Demand Modelling System Version 1.0 Volume I: Model Overview (June 1996)
56	The Greater Toronto Area Travel Demand Modelling System, Version 1.0 Volume III: User's Manual (June 1996)
57	Investigating Mode Split for the Work Trip: Role of Relative Level of Service and Interaction with Mobility Dimensions (November 1996)
58	A Parametric Analysis of Arterial Travel (August 1996)
59	Data Management Group Annual Report 1996 (March 1997)

No.	Title
60	1996 Transportation Tomorrow Survey: Data Guide Version 2.1 - document (August 1997)
61	1996 Transportation Tomorrow Survey: Design and Conduct of the Survey - PDF document (December 1997)
62	1996 Transportation Tomorrow Survey: Data Validation - PDF document (December 1997)
63	1996 Transportation Tomorrow Survey Discretionary Travel
64	1996 Transportation Tomorrow Survey: 1996 Travel Survey Summary (November 1997)
65	Not available for distribution
66	1996 GTA Zone Boundaries - PDF document (January 1998)
67	1986 - 1996 Travel Trends in the GTA & Hamilton-Wentworth (March 1998)
68	GTA A.M. Peak Hour Network Coding Standard: Part I – Notation (May 1998)
69	Exploring Person Travel Trends in the Greater Toronto Area: Part 1: Changes in Travel-Related Factors and Implications for Travel Demand (August 1998)
70	Exploring Person Travel Trends in the Greater Toronto Area: Part 2: Changes in Travel and Relationship with Factors (August 1998)
71	Integrated Urban Models for Simulation of Transit and Land-Use Policies: Guidelines for Implementation and Use (September 1998)
72	Integrated Urban Models for Simulation of Transit and Land-Use Policies - Final Report ((September 1998)
73	Data Management Group Annual Report 1997 ((October 1998)
74	GTA Trip Generation Rates, 1986 – 1996 ((October 1998)
75	Transit Realities in the Suburban GTA (November 1998)
76	Auto Passenger Travel and Auto Occupancy in the GTA (January 1999)
77	GTA Simplified Model Version 3.0 - User's Manual (February 1999)
78	Employment Information and Data Collection Issues (February 1999)
79	Panels and Other Survey Extensions to the Transportation Tomorrow Survey (February 1999)

No.	Title
80	Analysis of Individual Transit Trips in EMME/2 (October 1998)