Ontario Commercial Vehicle Survey – Use of GIS for Data Collection, Processing, Analyses and Dissemination

Presented at

FREIGHT DEMAND MODELLING: TOOLS FOR PUBLIC SECTOR DECISSION MAKING

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Presenter: Selva Sureshan
Discussant: Rob Tardif
Ontario Ministry of Transportation

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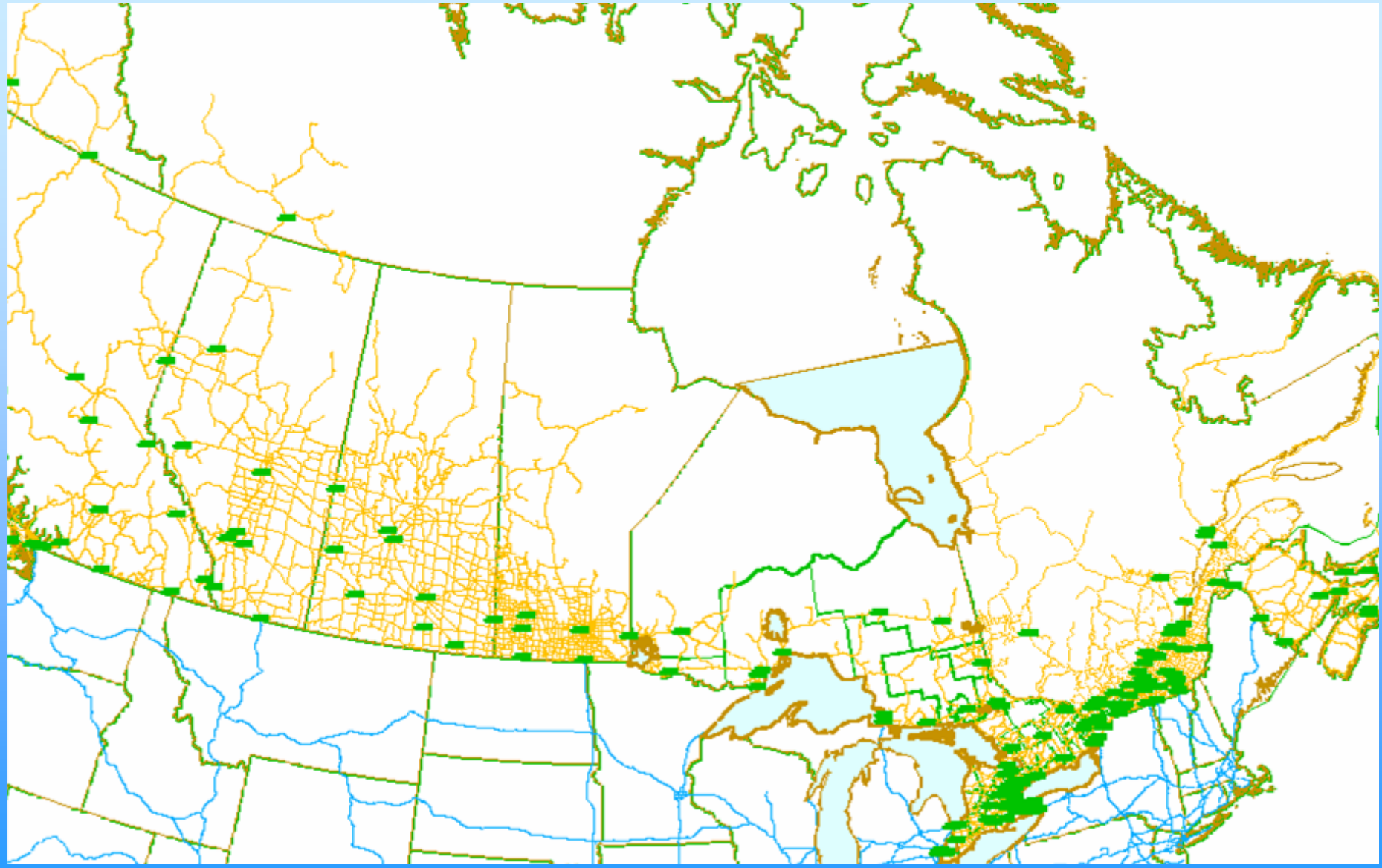
National Roadside Study/Commercial Vehicle Survey

- Collaborative effort between the provinces and the Federal Government
- Conducted every 5-6 years
- Major National Survey in 1999, followed by smaller surveys in 2000 and 2001 in Ontario only
- Roadside Truck Driver Interview to collect trip route, commodity, and vehicle information
- Interviews conducted at 250 locations on highways and major international border crossings across Canada.
- 2005/2007 Survey Currently Underway

CVS – Survey Locations



Ontario Commercial Vehicle Survey

- CVS database contains:
  - 38,700 records Collected from 130 Directional sites on Ontario Highways and Border Crossings
  - 2850 records collected in other provinces that had travelled on Ontario Highways
  - Total weekly trips represented – 646,000

- A supplementary database of 1689 records from 12 sites from Intermodal Terminals, including Toronto Pearson International Airport

DATA COLLECTION

Data Collected

Up to 100 pieces of information collected, including:

- **Trip**
  - **trip stops , inter-provincial and international borders crossed**
- **Commodity**
  - **name, weight, dangerous goods, origin and destination**
- **Vehicle**
  - **type, body style, number of axles, weight and spacing, capacity utilization**
- **Company**
  - **Name, license plate jurisdiction, base city,for-hire/private**
- **Driver**
  - **base city, driver training, experience**

Details of Trip Information

- Trip Origin and Destination
- Stop immediately prior to the survey
- Stop immediately after the survey
- Provincial entry and Exit Points
- International border entry and exit points
  - up to two entry and two exit points
- Survey Location
- Highways used for the trip

Up to 11 geographic points directly related to the trip

Other Data Related to Trip Making

- Commodity Origin and Destination
- Commodity Name
- Carrier Data
  - Name
  - Company Base
  - Type of Business (for hire, private)
- Driver Base

TRIP DATA REVIEW AND CLEANSING

Review of Individual Survey Records

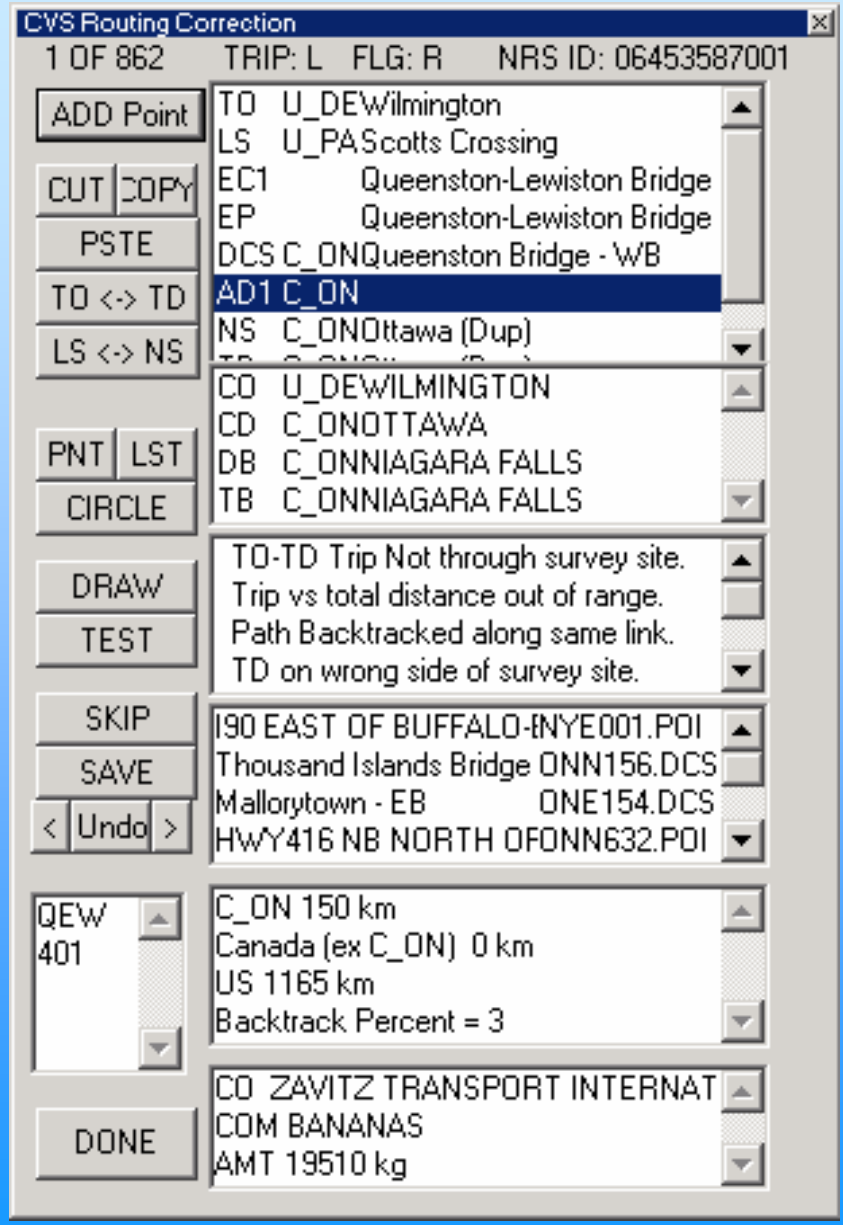
- Each Survey Record was reviewed individually
- GISDK based TransCAD application was used to review routes and make corrections
- Additional fields are calculated once the routing is accepted
  - Distance travelled in each province and state
  - Points of Interest passed

Why is it Important to Get the Route Correct?

A survey is a sample for all the survey stations along the trip route

The expansion factor of a record is affected by the number of survey stations passed along the trip

Data Review Panel



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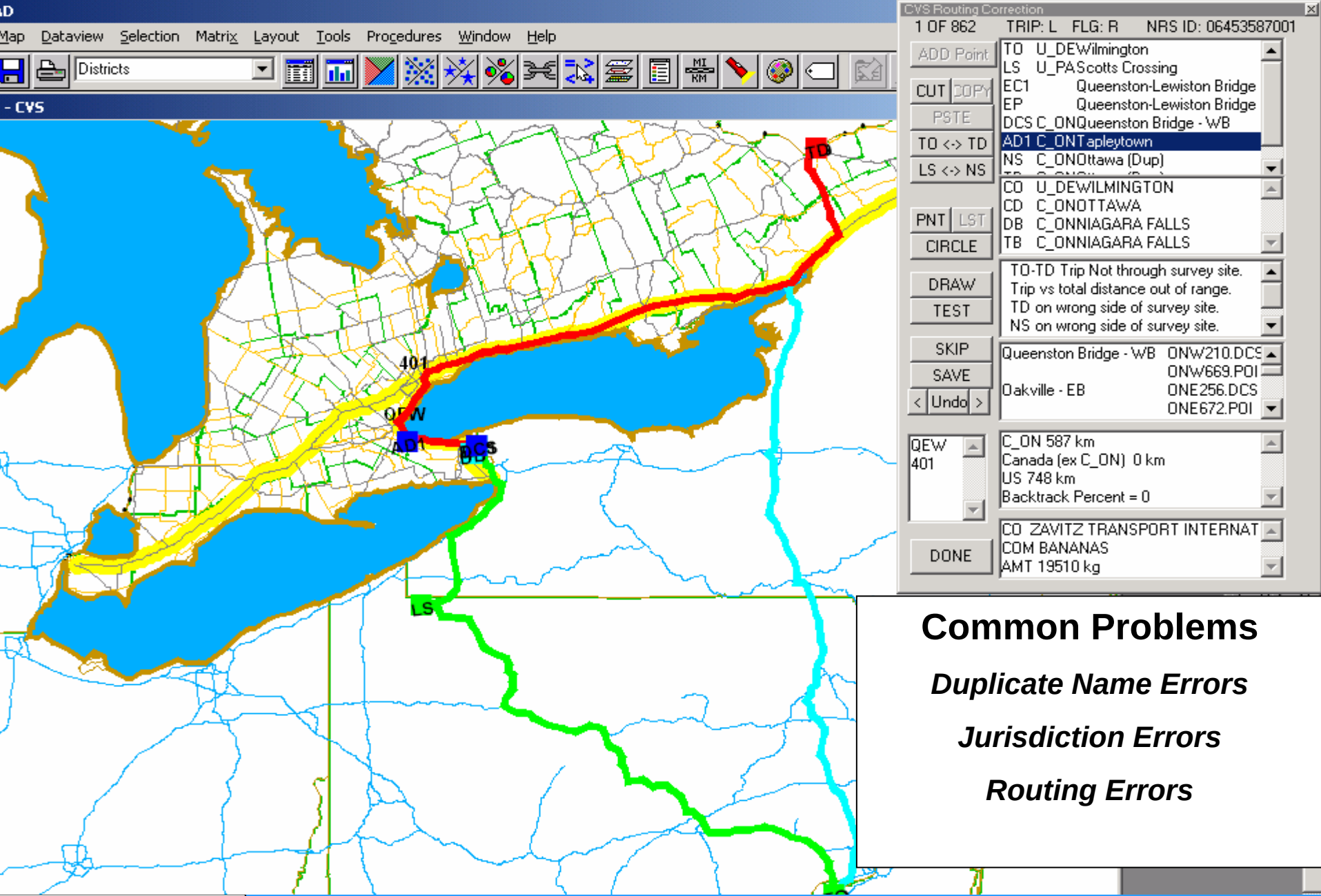


Common Problems

Duplicate Name Errors

Jurisdiction Errors

Routing Errors

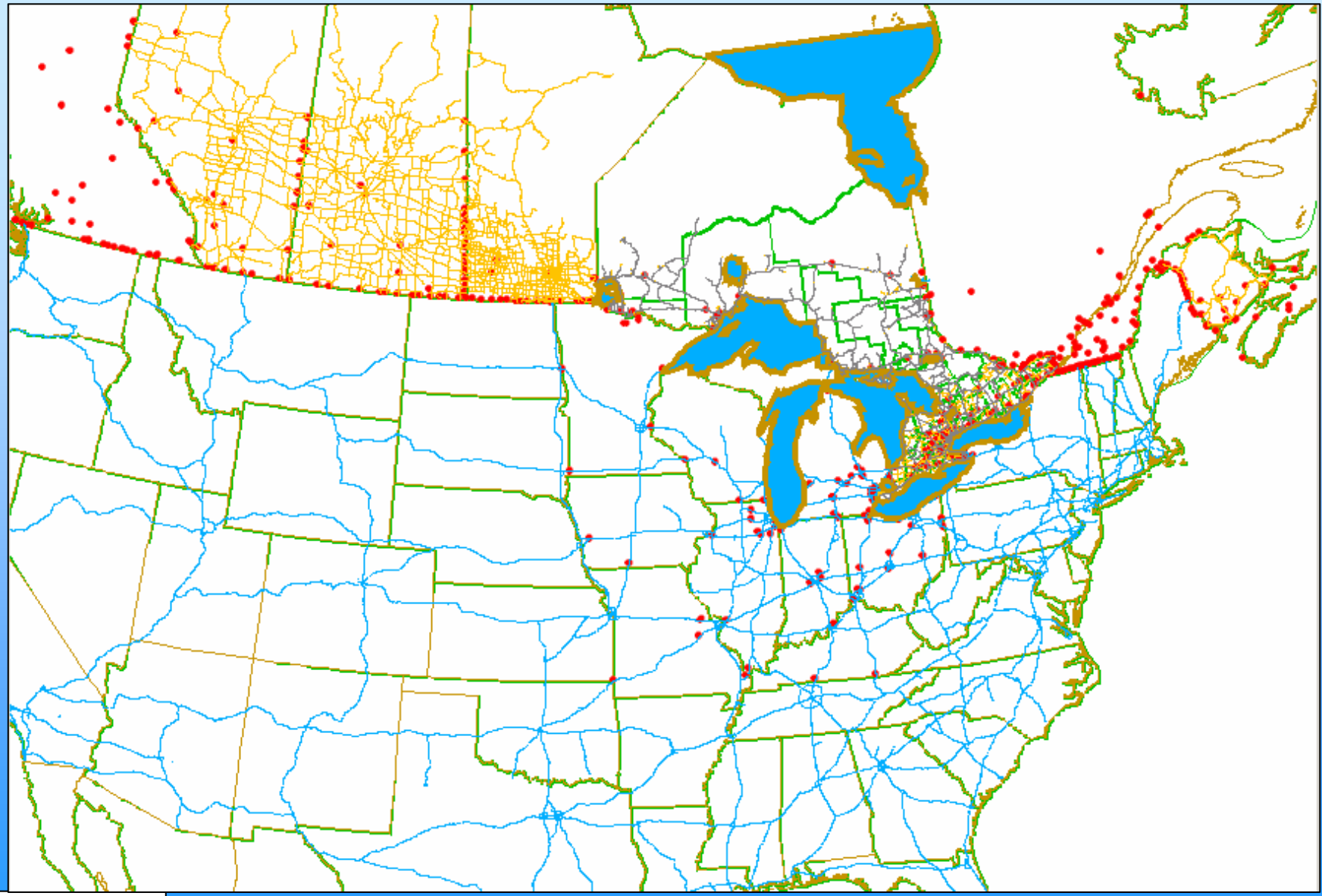
DATA ANALYSIS AND ASSIGNMENTS

Highlights of the CVS Model

Points on Interest (POI)

- **Any point on the highway network**
  - *All NRS survey sites across Canada*
  - *All international and Interprovincial Crossings*
  - *Other points*
- **Can be added as required**
- **Currently more than 1000 directional POIs Across Canada and the U.S.**

Current Points of Interest



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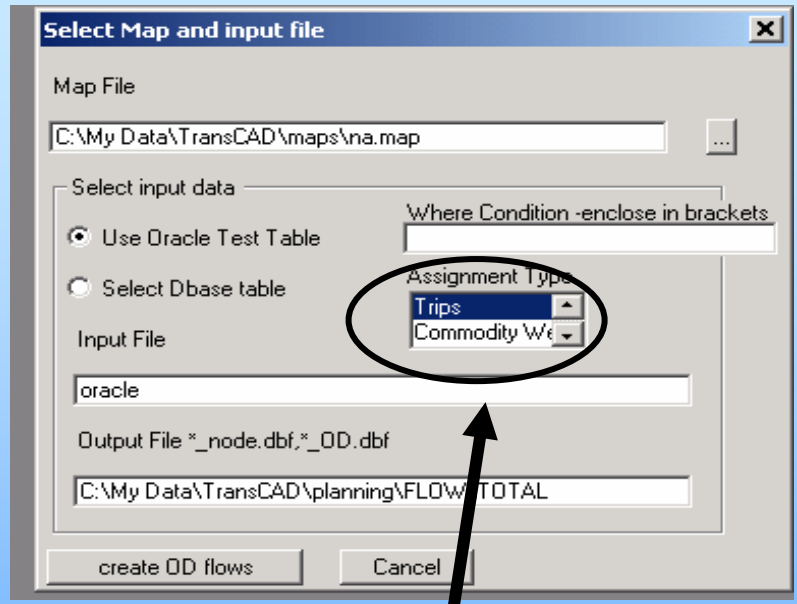
Highlights of the CVS Model

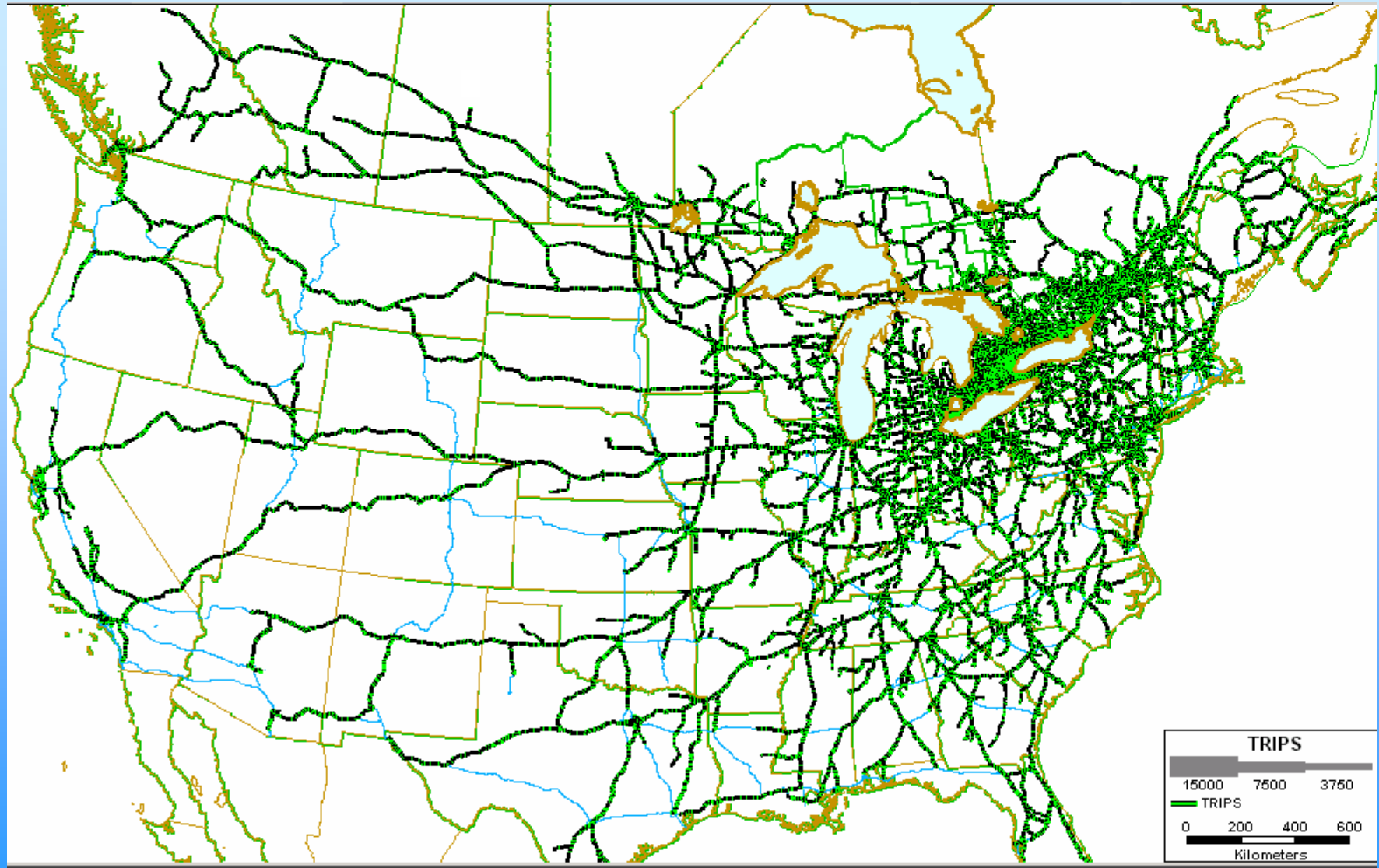
MTO Model

- No zone system
- Tour Based Assignment
- Each trip is broken down into sub-trips
- Network nodes closest to the trip-ends act as temporary centroids
- Trip, Commodity Weight, Value assignments



Type of Assignment

Trip Assignment Results



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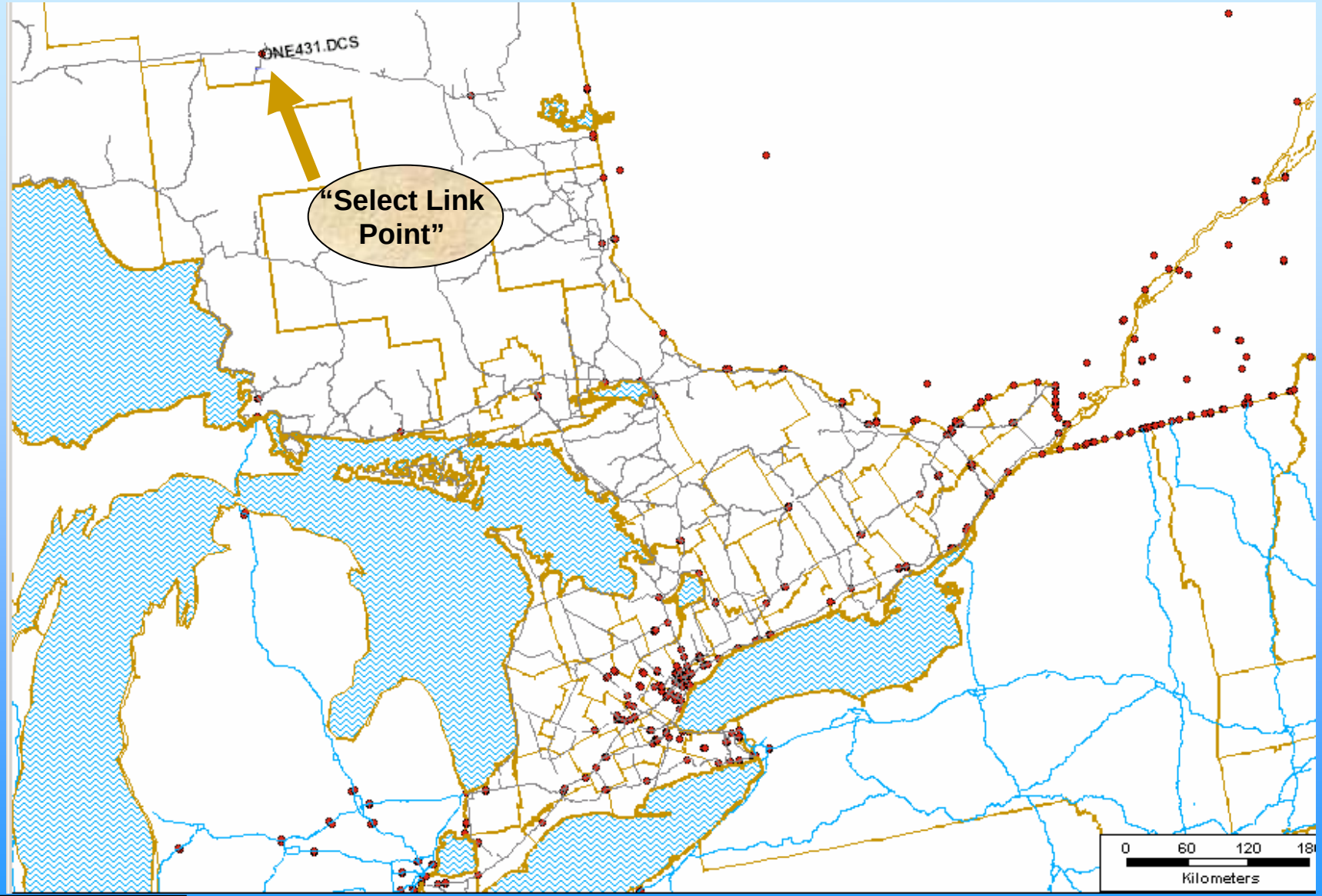
Select Link Assignment



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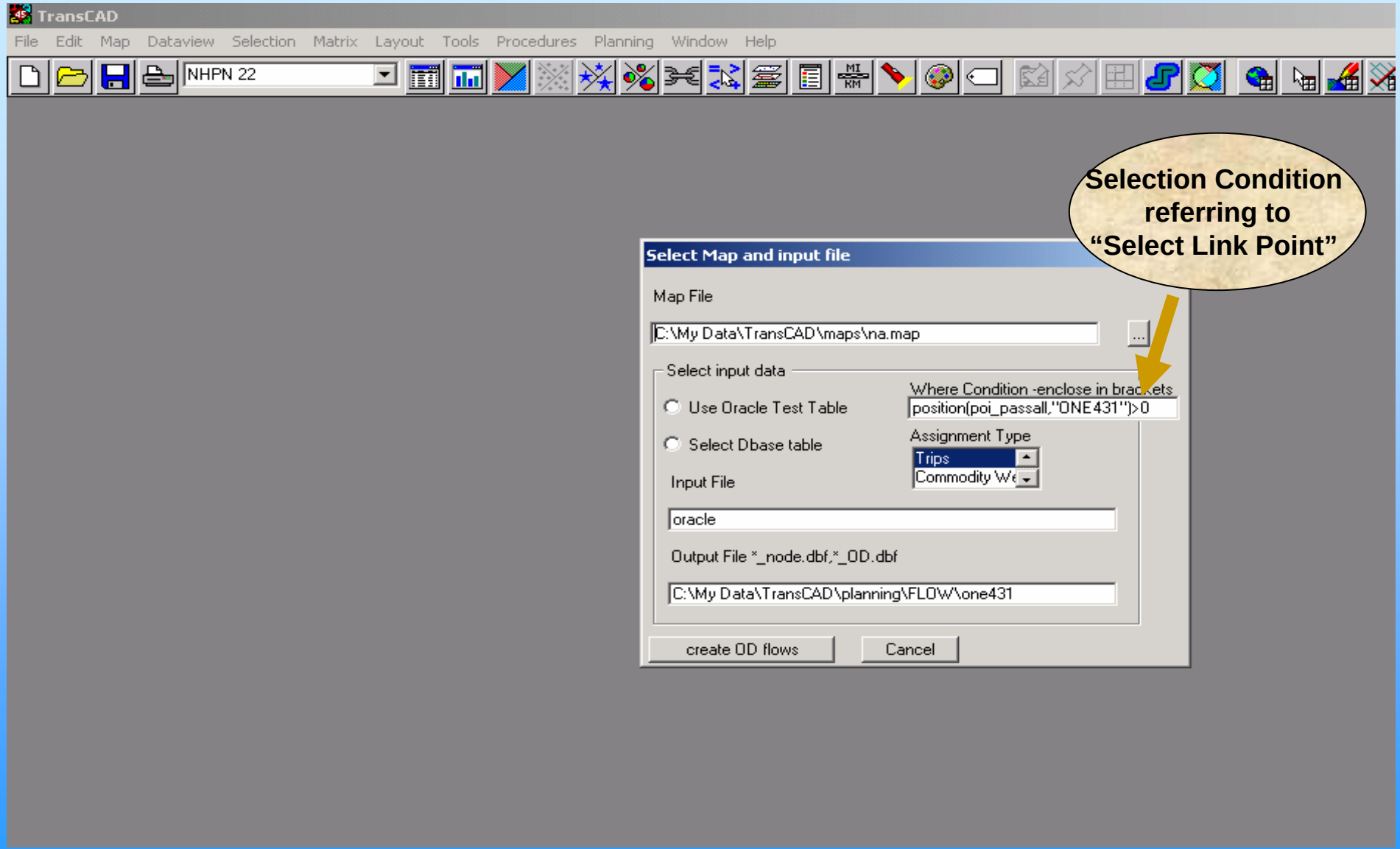
Data Retrieval Screen



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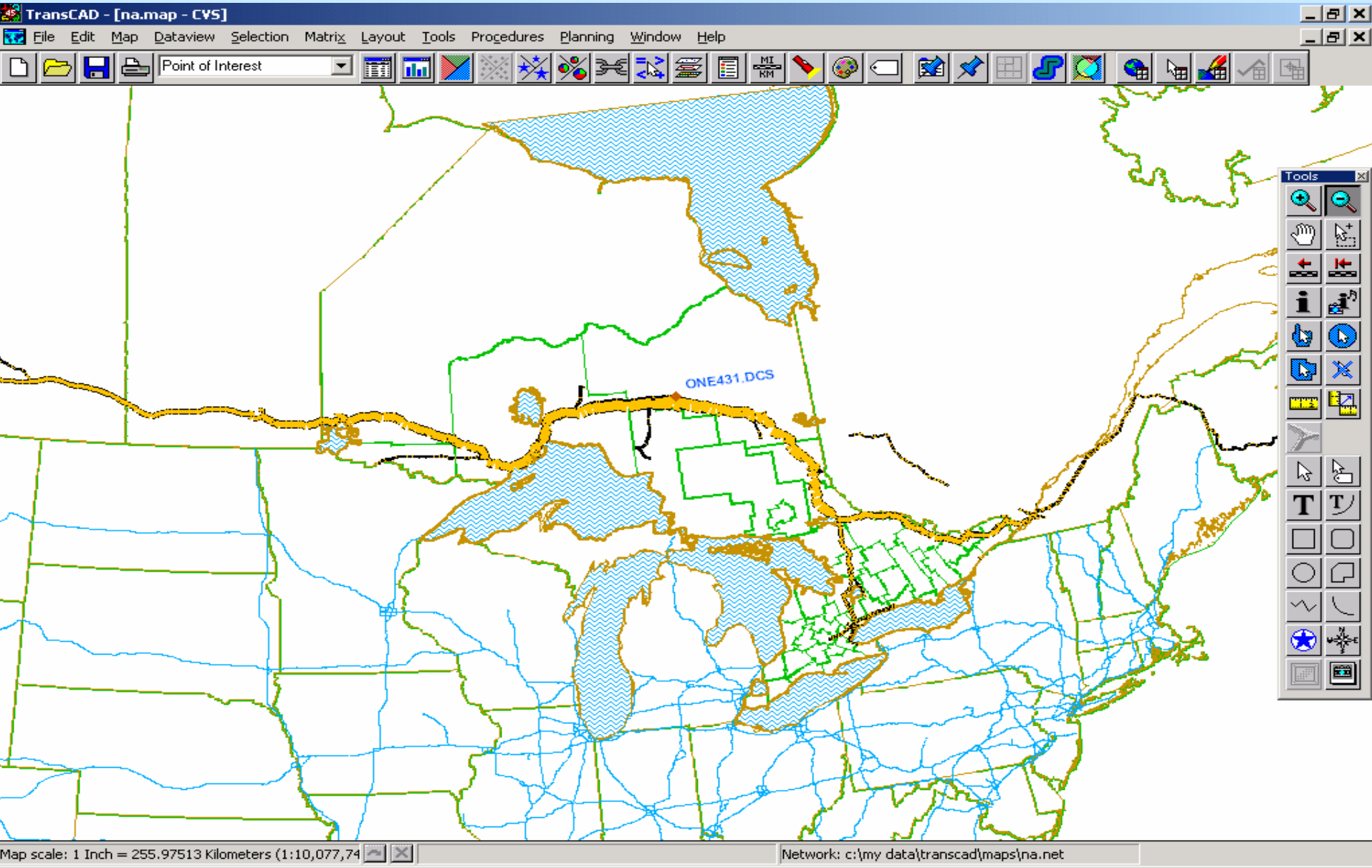

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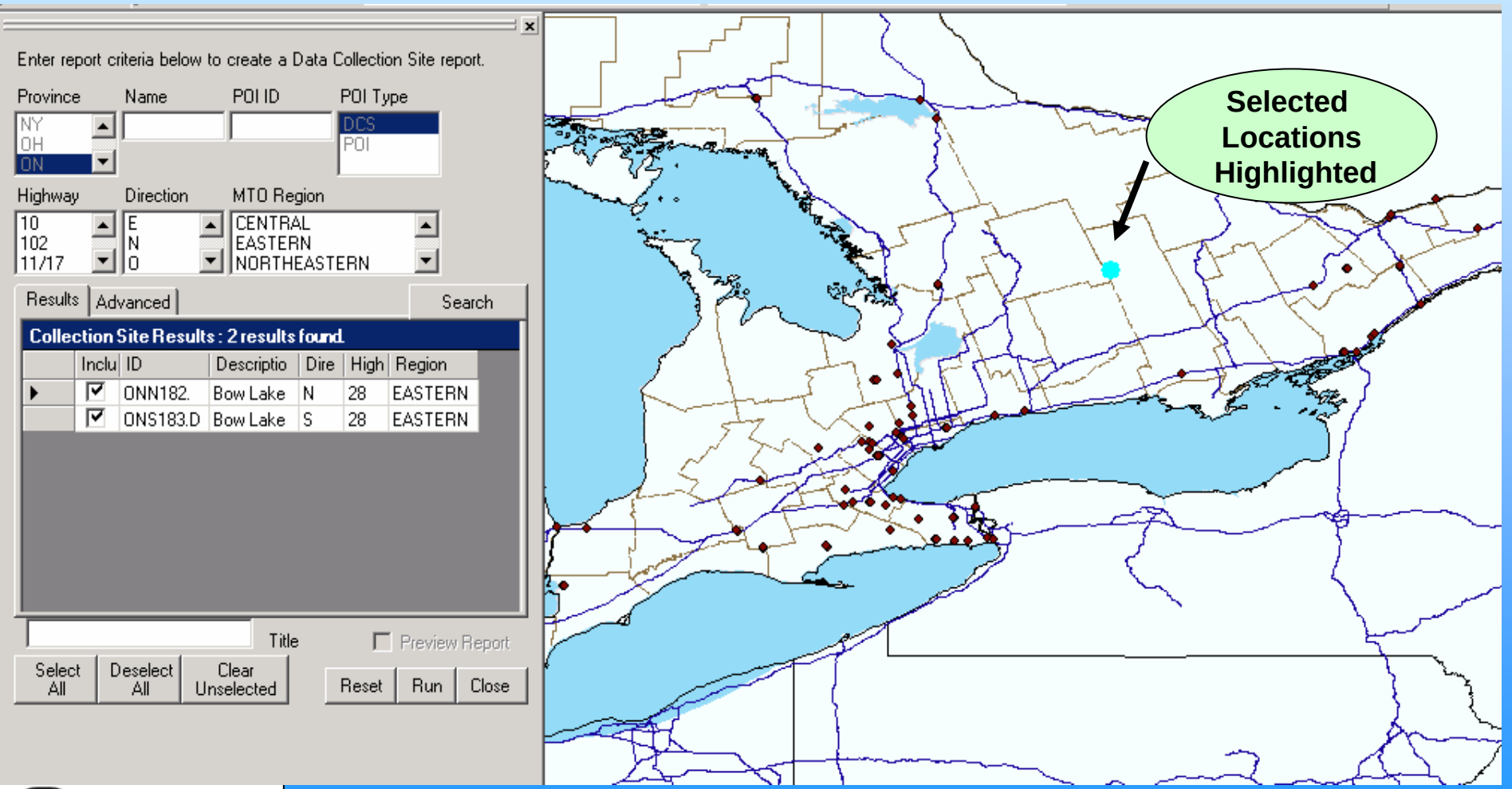
REPORTING

FEATURES OF CVS REPORTING SYSTEM

- Application developed using ArcGIS, Crystal Reports, and Adobe Acrobat
- Creates a 3 or 4 page predefined report containing Charts, graphs and a thematic map of Ontario
- Output is in Acrobat format that can be distributed electronically

CVS Reporting System



Types of Reports

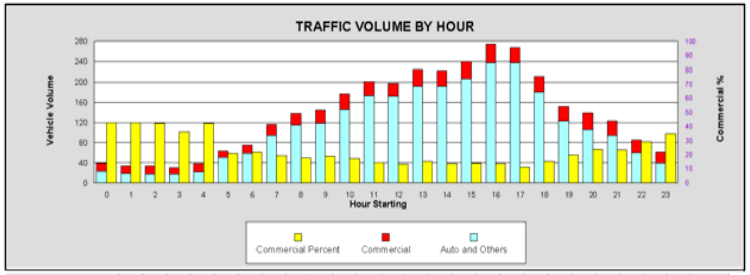
1. Data Collection Site Report
2. General Point of Interest Report
3. Area Report
4. Corridor Report
5. Custom Report

CVS Reporting System – Report Layout 1

DRYDEN - WEST BOUND TRAFFIC

ON HWY 17 ABOUT 1.6 KM EAST OF DRYDEN

LHRS: 22050 0.0 LOCATION ID: ONW513.DCS



Start Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
All Vehicles	39	34	34	28	38	83	75	116	139	144	177	201	198	225	222	241	274	267	212	152	140	123	85	61	3288
Auto and Others	23	19	18	18	22	50	59	94	115	119	146	173	172	191	192	207	238	238	180	123	106	94	60	39	2696
Commercial	17	15	16	12	16	13	16	22	23	26	30	28	26	34	30	34	37	29	31	30	34	29	25	22	595
Straight Trucks	1	1	1	1	2	2	3	4	4	3	3	2	3	2	3	4	2	3	3	2	3	2	2	1	67
Tractor and Trailer(s)	16	14	15	10	14	11	13	18	20	22	27	26	23	32	27	29	35	27	28	27	31	27	24	21	528
% Commercial	43	43	42	36	42	21	22	19	18	19	17	14	13	15	13	14	14	11	15	20	24	23	29	35	18

INTERVIEW DATES AND SAMPLE

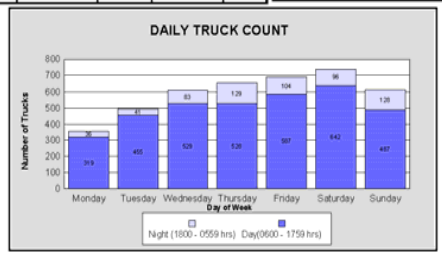
Day of Week	Month - Year	Number of Hours	Total Surveys	Night Surveys (1800-0559)	Sample Size (%)
Sunday		0	0	0	0
Monday		0	0	0	0
Tuesday		0	0	0	0
Wednesday		0	0	0	0
Thursday	AUG-99	18	38	18	7
Friday	AUG-99	22	69	23	11
Saturday	AUG-99	8	20	0	8

SAMPLE CHARACTERISTICS

Vehicle Configuration	Collected At Station		All Trips Through the Station	
	Number of Surveys	Daily Trips	Number of Surveys	Daily Trips
Tractor + 1 Trailer	100	132	1382	513
Tractor + 2 Trailer	12	9	165	76
Straight Trucks	12	25	27	42
Other Trucks	3	3	29	17

STATION PROPERTIES

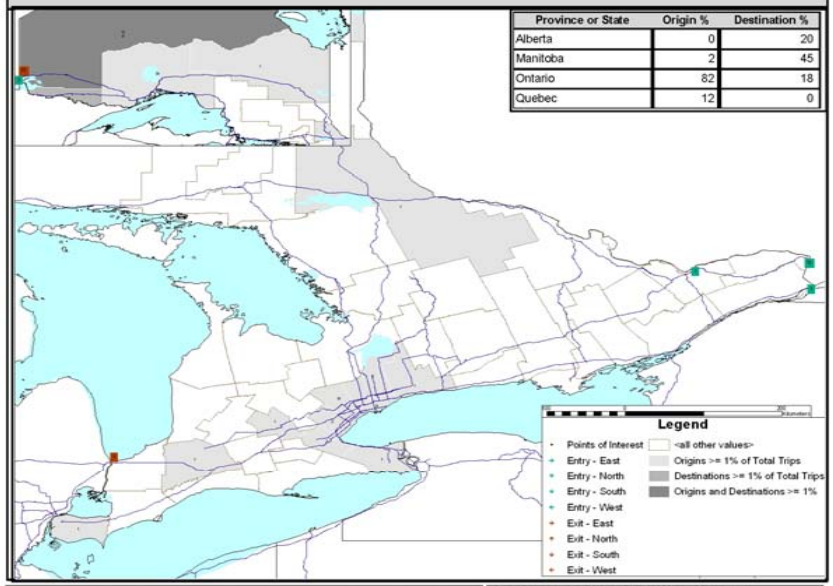
Station Type	Truck Inspection Stat
Weigh Scale	Fixed
Refusal Rate	6.00%
AADT - One Way	3,300
Annual Average Truck Traffic Growth Rate 1995 - 2002	-0.79%
Annual Average Auto Traffic Growth Rate 1995 - 2002	1.60%

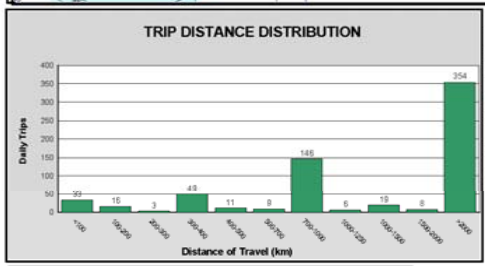


DRYDEN - WEST BOUND TRAFFIC

ORGIN-DESTINATION TRIP DISTRIBUTION BY COUNTY, PROVINCE AND STATE

Province or State	Origin %	Destination %
Alberta	0	20
Manitoba	2	45
Ontario	82	18
Quebec	12	0





MEAN TRIP DISTANCE BY COMMODITY

Commodity	Mean Distance(km)
Agricultural Products	3296
Food	2451
Petroleum&Products	3034
Chemicals & Products	2074
Minerals	2230
Wood & Products	1305
Metals & Products	3088
Machinery & Electrical	2643
Manufactured Products	2213
Transportation	3355
Waste & Scrap	2998
Empty Shipping Containers	1315
All Trucks with Commodity	2308
Empty	793

ROUTE TYPE DISTRIBUTION

Route Type	Number of Trips	Trips %	Commodity Value (Mil$)	Value %	Mean Distance (km)
Intra-Ontario	113	17	4.31	9	296
Interprovincial	515	80	40.44	89	2411
International	20	3	0.94	2	3411
All Trips	648	100	45.69	100	2074

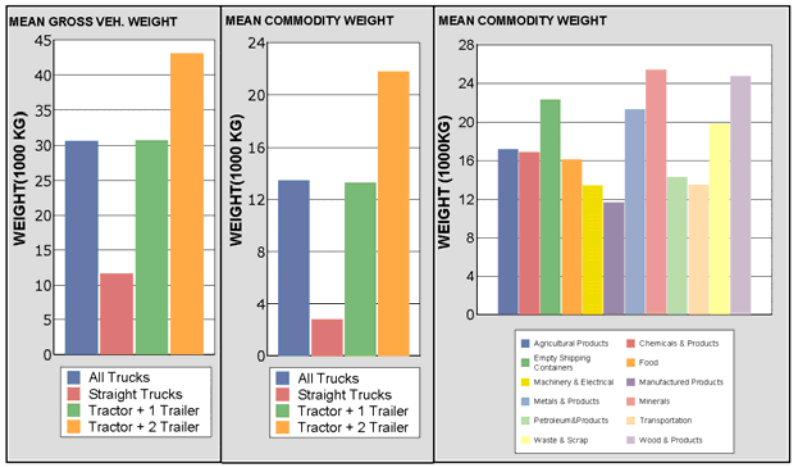
INTRANSIT TRIPS (TRIP-ENDS OUTSIDE ONTARIO)

Route	Daily Trips	Mean Trips Distance	Mean Distance In Ontario (km)	Route Type
US-US				International
US-ROC or ROC-US	11	3809	1975	International
ROC-ROC thru US	0	3109	2113	International
ROC-ROC not thru US	97	3486	1981	Interprovincial
All Intransit Trips	109	3519	1981	

Note: ROC - Rest of Canada

CVS Reporting System – Report Layout 2

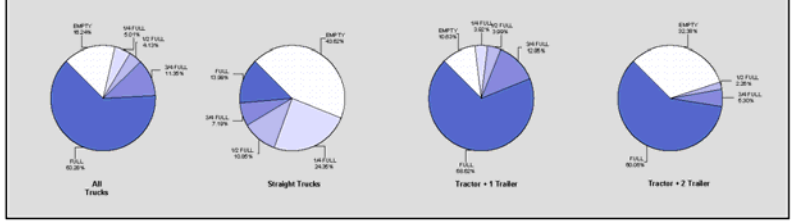
DRYDEN - WEST BOUND TRAFFIC



COMMODITY COMPOSITION

Commodity	Intra - Ontario Trips	Inter - Provincial Trips	International Trips	Daily Trips	Total Commodity Weight (1000 kg)	Total Commodity Value(Mill $)	Intransit Trips
Agricultural Products	0%	3%	2%	17	290	0.45	7%
Food	3%	16%	7%	86	1,385	3.06	21%
Petroleum&Products	0%	1%	0%	3	42	0.02	0%
Chemicals & Products	3%	6%	7%	36	615	1.91	2%
Minerals	6%	2%	3%	17	425	0.65	5%
Wood & Products	26%	5%	18%	59	1,461	0.87	7%
Metals & Products	3%	7%	20%	45	961	1.79	12%
Machinery & Electrical	8%	4%	2%	30	401	7.60	7%
Manufactured Products	27%	36%	23%	222	2,594	27.36	27%
Transportation	0%	4%	6%	21	286	1.95	7%
Waste & Scrap	0%	0%	0%	2	36	0.02	1%
Empty Shipping Containers	0%	2%	3%	10	213	0.00	1%
Empty	25%	14%	9%	100	0	0.00	3%
Total	100%	100%	100%		8,709	45.68	100%
Total Trips	113	515	20	648			109

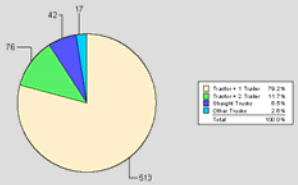
LEVEL OF UTILIZATION BY VEHICLE CONFIGURATION



August 10, 2006

DRYDEN - WEST BOUND TRAFFIC

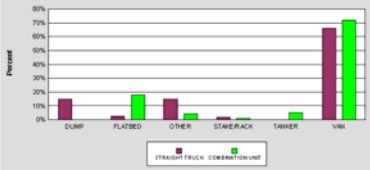
VEHICLE CONFIGURATION



OTHER COMMERCIAL TRAFFIC PROPERTIES

Trucks Carrying Dangerous Goods	8%
Linehaul Trips	77%
Peddlerun Trips	23%
Trucks owned by the Driver	24%

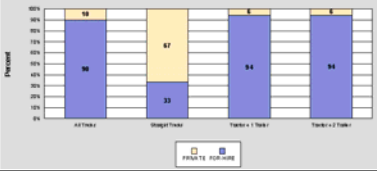
TRIPS BY VEHICLE BODY STYLE



LIFT AXLES

Vehicle Configuration	Number of Lift Axles				
	0	1	2	3	4
Tractor + 1 Trailer	94%	1%	4%		
Tractor + 2 Trailer	93%	7%	0%		
Straight Trucks	92%	8%			
All Trucks	94%	3%	3%		

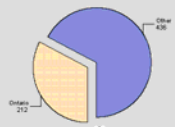
CARRIER TYPE



NUMBER OF AXLES

Vehicle Configuration	Number of Trucks	Number of Axles						
		2	3	4	5	6	7	8+
Tractor + 1 Trailer	513		0%	0%	64%	30%	2%	3%
Tractor + 2 Trailer	76				0%	3%	12%	85%
Straight Trucks	42	62%	30%	8%				
All Trucks	648	4%	3%	1%	52%	24%	3%	13%

VEHICLE BASE



OTHER

Eastern Provinces	3%
Quebec	5%
Western Provinces	92%
USA	1%

USA - Top 5

Washington	0%
Alabama	0%
Illinois	0%
Utah	0%
Oregon	0%

AVERAGE EQUIVALENT SINGLE AXLE LOADINGS (ESAL)

Vehicle Configuration	Number of Axles							
	2	3	4	5	6	7	8+	Overall
Tractor + 1 Trailer		0.53	4.23	1.72	2.31	5.77	7.09	2.16
Tractor + 2 Trailers				2.34	1.27	0.32	4.06	3.53
Straight Truck	0.23	1.14	2.83					0.71

TOTAL EQUIVALENT SINGLE AXLE LOADINGS

Vehicle Configuration	Number of Axles							
	2	3	4	5	6	7	8+	Overall
Tractor + 1 Trailer		1	6	567	352	54	126	1106
Tractor + 2 Trailers				0	3	3	264	270
Straight Truck	6	14	9					30

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LESSONS LEARNED and PROCESS IMPROVEMENTS

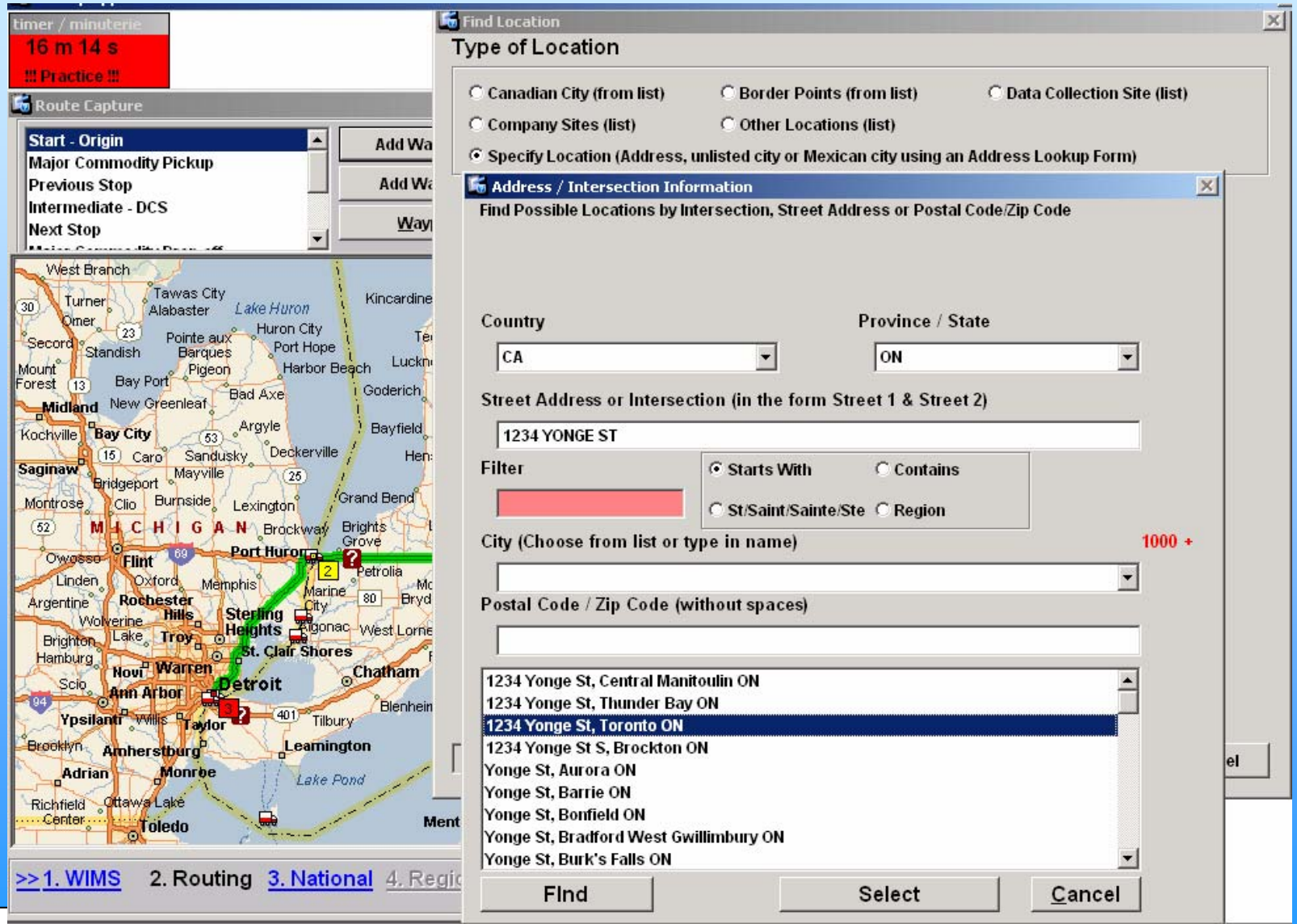
"Insufficient Routing information Collected adds significant Delays to Data Processing"

Measures Taken to Mitigate this Shortcoming

- ***2006 National Roadside Study Survey Software Integrates Routing Component using Microsoft MapPoint***
- ***Address Level information is Collected to accurately project the trip route***
- ***Built-in Validity checks to Ensure Core Route Data is Collected – e.g. Border Crossings for International Trips***

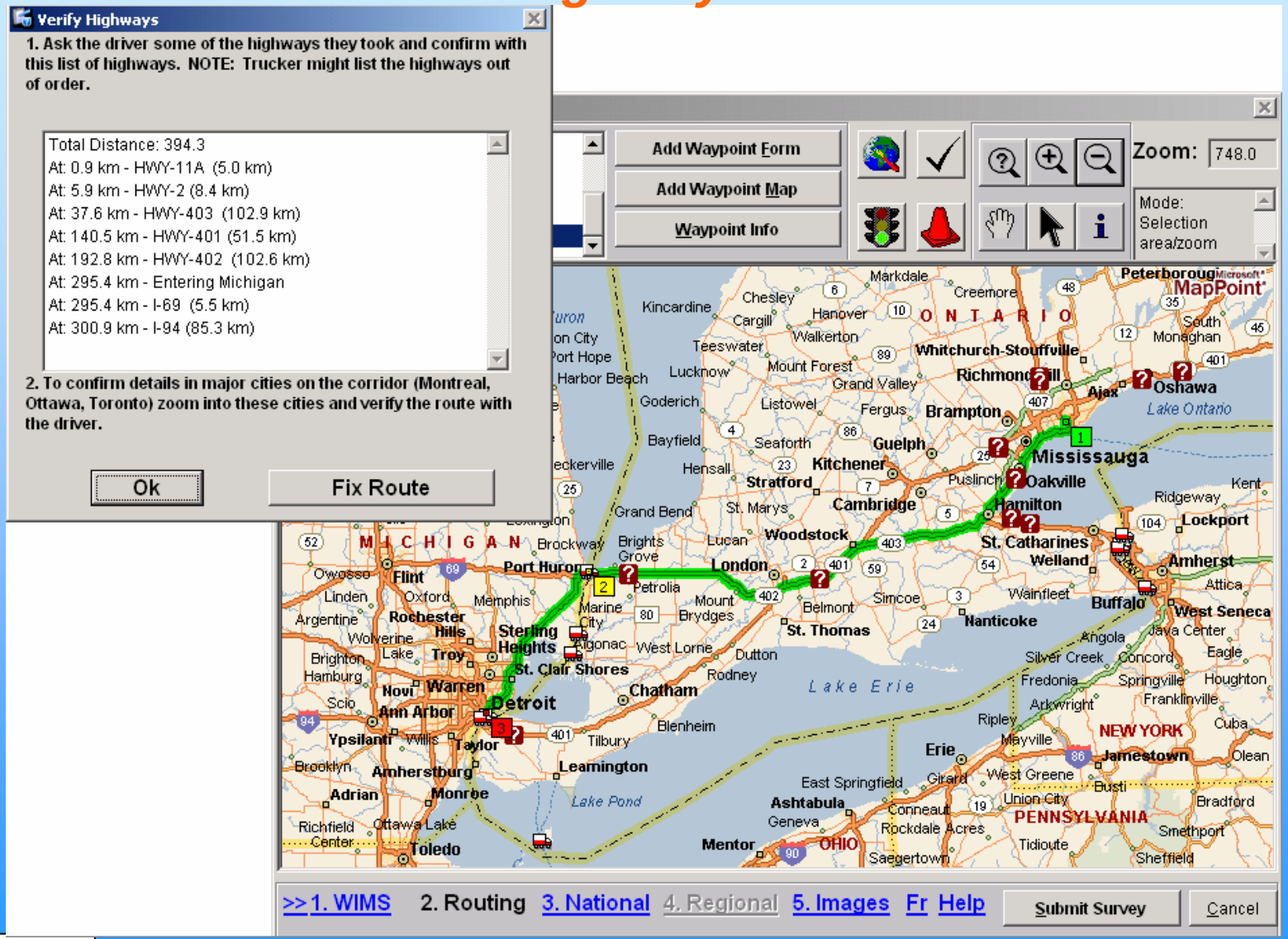
2005/2007 NRS Survey Software

Address Locator Screen



2005/2007 NRS Survey Software

Review of Highways Used



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Other Innovative Truck Monitoring Methods Under Development

Use of Truck Mounted GPS to:

- **Monitor Urban Truck Movement Patterns**
- **Monitor Highway Congestion and Incident Detection**
- **Estimate Cost of Incidents**
- **Learn Truck Origin Destination Patterns**
- **Derive Commodity Flow Patterns**
- **Report Near Real-Time Transit Times at International Border Crossings (Initiative by Transport Canada – Ontario Region)**

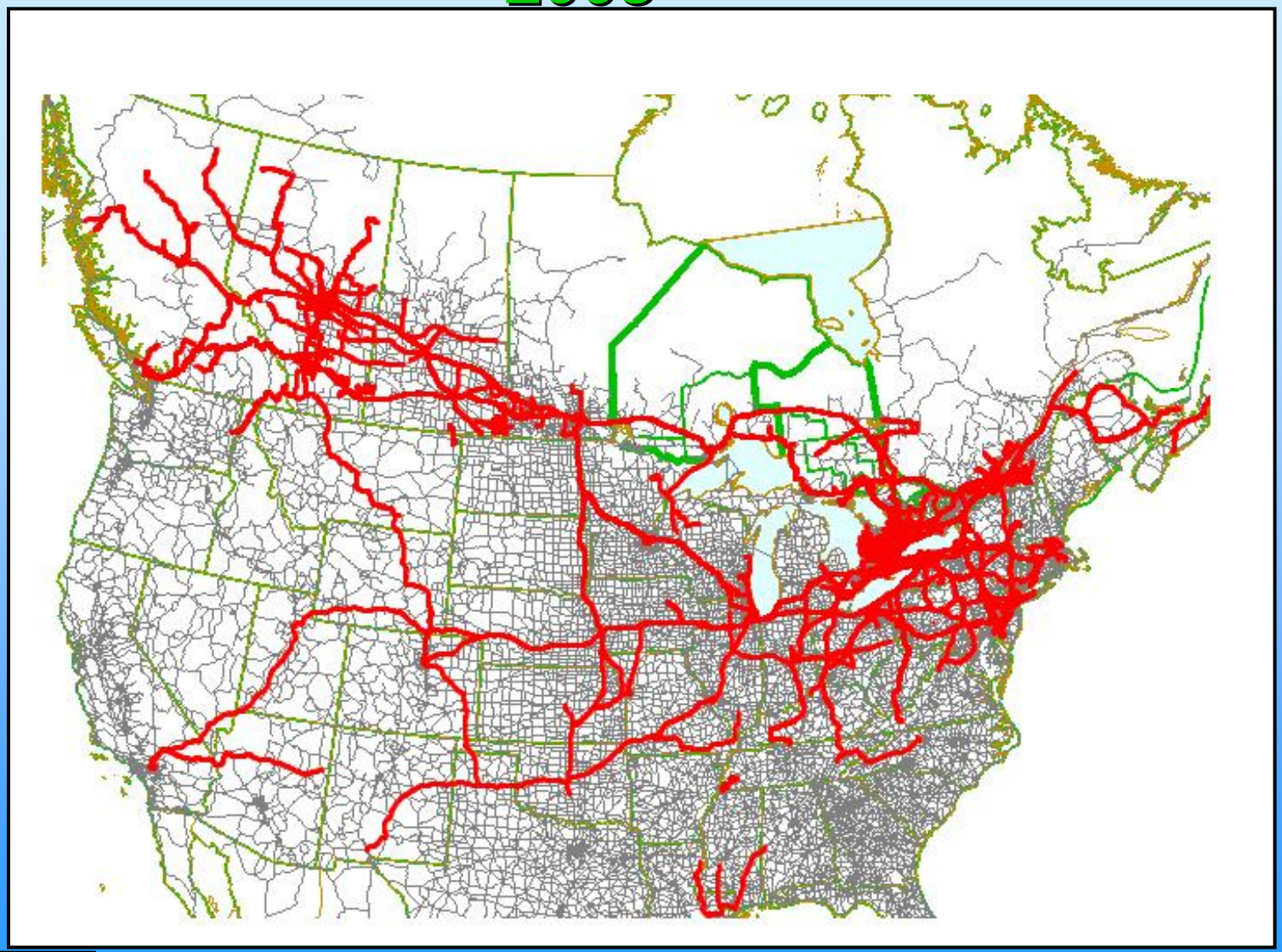
Advantages of GPS Technology

Continuously Monitor Truck's Location – record the position every few seconds

O-D Data for Many Trips for the Same Truck Can be Collected Compared to a Single Trip From a Survey

Data Not Limited to Trucks – Useful to Analyse General Traffic Conditions

Single Day Coverage of GPS Equipped Trucks - 2005



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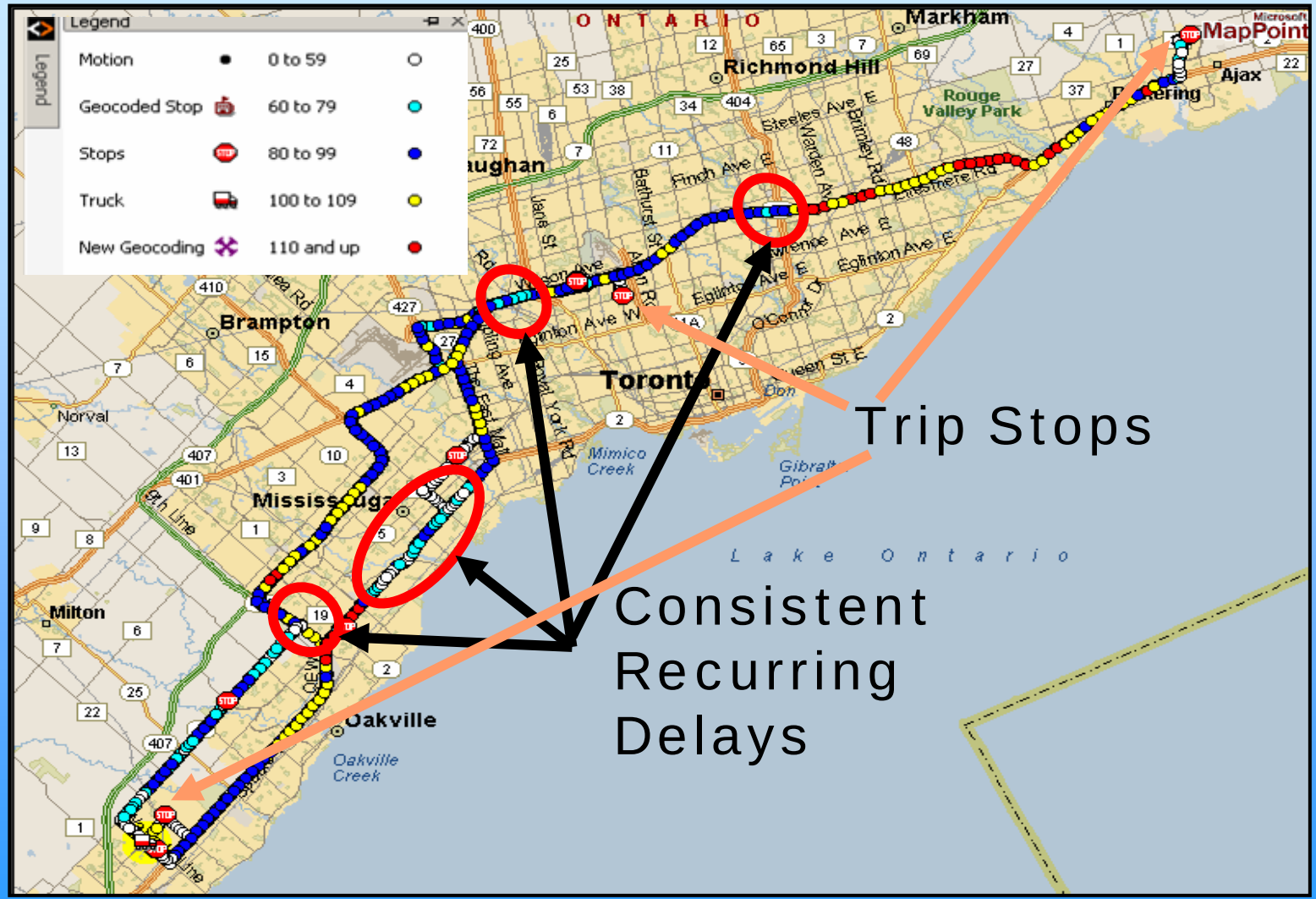
Path of a Vehicle in a Single Day



Trip Report

kedirect.com/Turnpike/canvas.aspx

TURNPIKE

- Signout
- Help
- Print
- OPS Status
  - Driver Activity
  - Vehicle Exception Reports
  - Vehicle Activity
    - Vehicle Detail
    - Vehicle Activity Unit
    - Vehicle Activity Group
  - Driver Exception Reports
  - Route Data Download
  - Vehicle Status
- Reports
- Data Entry
- Profiles

Vehicle Detail

Unit: 3772
Date: 2005-12-01

State	Location	Arrival - Departure	Distance (km)	Stop Time (hh:mm)	Avg Speed (km/h)
ON	Palmer (BURLINGTON)	19:14 - 09:22		14:08	
ON	QEW		1.9		64.4
ON	QEW		32.9		84.5
ON	427		7.8		102.4
ON	401		11.4		61.8
ON	Downsview (NORTH YORK)	10:01 - 10:02		0:01	
ON	North Park (NORTH YORK)	10:02 - 18:34		8:31	
ON	401		17.2		79.7
ON	403		19.9		97.9
ON	DUNDAS ST E		4.4		60.8
ON	DUNDAS ST W		8.5		69.7
ON	DUNDAS ST		4.0		59.8
ON	WALKERS LINE		3.5		41.9
ON	Palmer (BURLINGTON)	19:18 -			
	Trip Summary Detail	TOTAL	111.4	22:40	80.5

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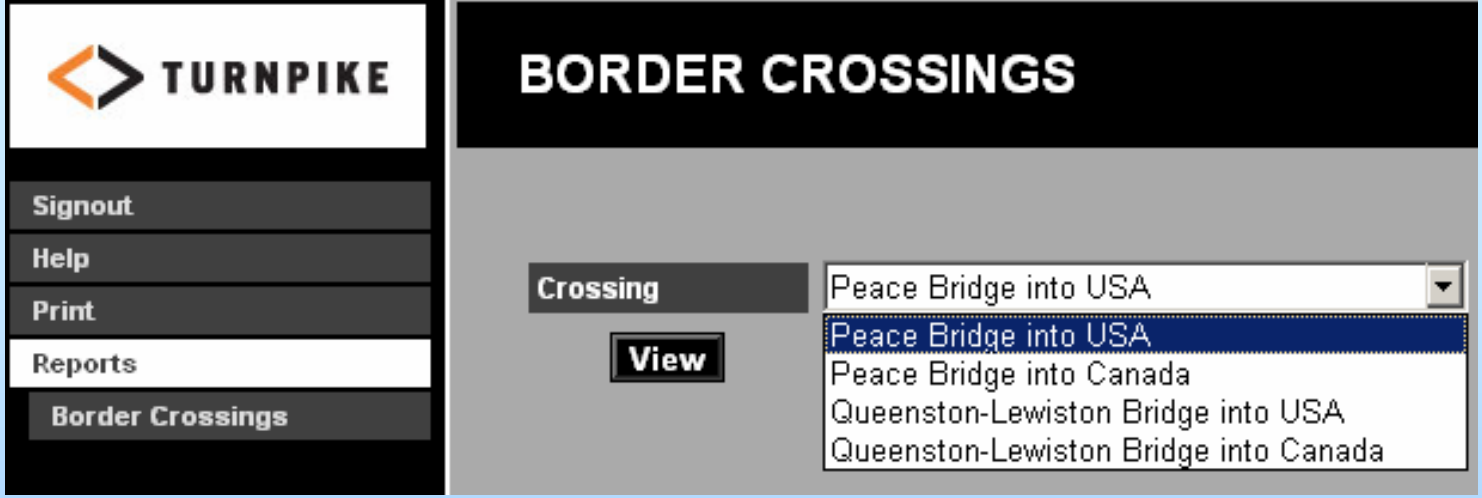
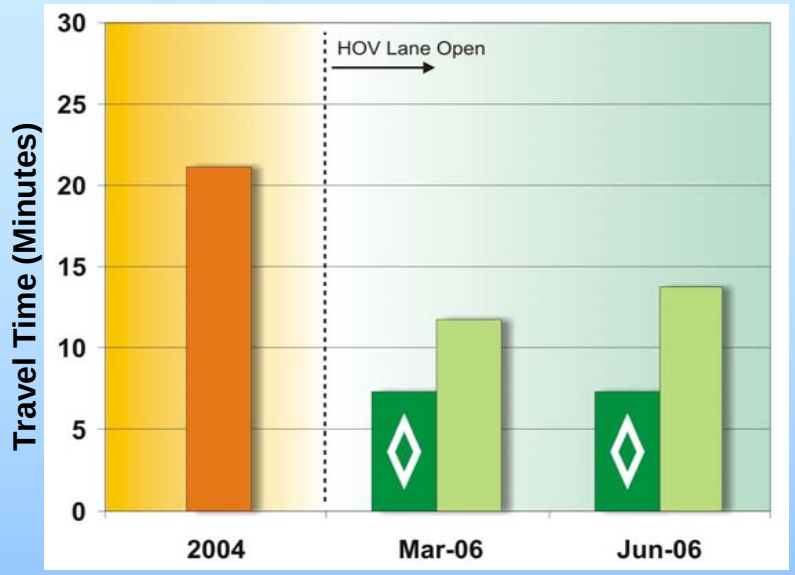


Peace Into USA

Start Date	End Date	Stop Time	Crossing Time
2005-10-06 03:27 PM	2005-10-06 03:31 PM	0	4.2
2005-10-06 03:09 PM	2005-10-06 03:26 PM	0	17.03
2005-10-06 03:06 PM	2005-10-06 03:11 PM	0	4.95
2005-10-06 03:00 PM	2005-10-06 03:02 PM	0	2.03
2005-10-06 02:04 PM	2005-10-06 03:02 PM	0	57.25
2005-10-06 02:47 PM	2005-10-06 02:50 PM	0	3.32
2005-10-06 02:38 PM	2005-10-06 02:43 PM	0	4.32
2005-10-06 02:17 PM	2005-10-06 02:28 PM	0	11.38
2005-10-06 02:20 PM	2005-10-06 02:26 PM	0	6.37
2005-10-06 01:36 PM	2005-10-06 02:10 PM	0	34.55
2005-10-06 02:00 PM	2005-10-06 02:05 PM	0	5.43
2005-10-06 01:33 PM	2005-10-06 01:55 PM	14.3	7.85
2005-10-06 01:40 PM	2005-10-06 01:54 PM	7.5	6.68
2005-10-06 01:34 PM	2005-10-06 01:38 PM	0	4.3
2005-10-06 01:03 PM	2005-10-06 01:12 PM	0	9.03
2005-10-06 12:36 PM	2005-10-06 12:56 PM	0	20.55
2005-10-04 10:59 PM	2005-10-06 12:19 PM	0	2239.87
2005-10-06 11:23 AM	2005-10-06 11:50 AM	0	27.3
2005-10-06 10:55 AM	2005-10-06 11:12 AM	0	17.35
2005-10-06 10:57 AM	2005-10-06 11:10 AM	0	12.82
2005-10-06 10:28 AM	2005-10-06 10:32 AM	0	4.5
2005-10-06 09:53 AM	2005-10-06 10:08 AM	0	15.32
2005-10-06 10:03 AM	2005-10-06 10:08 AM	0	4.32
2005-10-06 09:56 AM	2005-10-06 09:58 AM	0	2.1
2005-10-06 08:57 AM	2005-10-06 09:19 AM	0	22.67
2005-10-06 08:41 AM	2005-10-06 09:09 AM	0	28.6
2005-10-06 08:44 AM	2005-10-06 09:09 AM	0	24.48

HOV Monitoring



Highway 403 AM Peak Hour Eastbound

Highway 404 AM Peak Hour Southbound

Pre-HOV Conditions

HOV Lane

GPLs

Hwy 403 Truck Travel Times

Period	Sample	Travel Time Minutes	Time Savings in Min. Over Pre HOV
Pre - Implementation	116	23.9	
Immediately After	67	21.8	2.1
One month Later	186	13.8	10.1

Ontario
MINISTRY OF TRANSPORTATION

Discussant: Rob Tardif

Ontario has been involved in roadside data collection for 40 years.

Primary Objective:

Increase awareness then prioritize Freight infrastructure investments.

Support $2 B annual investment in highway maintenance and expansion.

Time interval 5 years, 2 years of data collection

- **Costs: Intercept surveys $5 million, Traffic Counts/WIM +$1 million**
- **Coverage 50% urban truck trips, 70% inter-city VKT's & trips**
- **Enables project and link level analysis.**
- **Promotes multi-modal Freight Model development**

Discussant: Rob Tardif

Data Gaps:

- Lacks robust urban activity, limited service vehicles
- Limited knowledge of hour of day usage on each link
- Unable to address congestion monitoring

Future of Freight Data Collection in Ontario

- Roadside surveys are intrusive, depends on Enforcement, costly, timeliness of data.
- Envision a reduced focus on roadside surveys.
- GPS is the wave of the future for non-regulatory purposes
- In 2003, monitored 2000 trucks daily, now +20,000 in Ontario
- Ability to monitor 40,000 in the U.S. and Canada
- Every 400 yards, knowledge of location, time stamp, routes, speed, fuel consumption, hard brake activity.
- Exceptional data on: congestion, route mitigation, link performance/bottlenecks, weaving, safety issues, HOV/GPL evaluation, impact of HOV on truck travel, dwell time vs. travel time.

Discussant: Rob Tardif

Future of Freight Data Collection in Ontario – Continued

- **Access to 3rd party GPS data is a privilege**
- **Planners must respect carrier privacy**
- **Demonstrate benefits to carriers & their associations**
- **Challenges exist in linking Roadside/GPS/WIM/ATR data**

Limitations:

- **Huge volume of data forms data management issues**
- **No software to support GPS data processing & dissemination**
- **GPS data lacks information related to:**
  - **Commodity, utilization, empty moves, truck type, carrier name, carrier type, licence plate, axle weights & spacing.**
- **GPS sample may form a biased sample.**
- **Calibration remains critical and even more complex.**
- **Access in the long-term remains unknown**
- **Regulatory efforts to deploy system wide remain uncertain.**