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Analyzing Transportation Issues in Northern Regions: Data Problems and Solutions

*by Jack W. Craven**

ABSTRACT

Analyzing Transportation Issues in Northern Regions: Data Problems and Solutions

Under the Canada-Manitoba Sub-Agreement on Transportation Development, the Canadian Federal Government and the Government of Manitoba agreed to conduct a number of research studies in transportation. One of the studies was an examination of transportation problems in Northern Manitoba. The paper will describe the research team's work in developing a data base upon which to conduct empirical research into the issues raised, the difficulties encountered and solutions used to overcome these difficulties. The solutions included a survey of air charter operators and analysis of airport log books. The paper will present some conclusions about doing research on transportation issues in sparsely inhabited regions and provide recommendations to those doing this type of transportation research.

BACKGROUND

The Study Region[1]

The region studied covers almost two thirds of the Province of Manitoba, but has only about 7.9% of the population (See Figure 1). The terrain is an obstacle to the construction of an all-weather highway network to connect communities in the region. It is characterized by extensive areas of swamp and muskeg and a multitude of lakes and rivers that require bypassing and bridging. Consequently, the cost of all-weather road construction is substantial. The estimated cost per mile for northern all-weather road construction is between $250,000 and $450,000 depending on terrain and other factors.

All-weather roads are the preferred type of infrastructure for transportation to and from northern communities in most instances because they can significantly reduce the isolation of a community and provide the community with much cheaper freight and passenger transportation. In the past, the cost burden on the provincial government for northern road construction has often been reduced through support from private interests. The highway network was extended into Northern Manitoba as need and economics dictated. The major links were constructed with the opening of new mines and the construction of hydro-electric dams. The major mining centres of Thompson, Flin Flon, Lynn Lake, and The Pas and the center for hydro-electric development, Gillam, are all connected to the all-weather road network. The Town of Churchill is the only major northern centre without all-weather road access.

Two major areas of Northern Manitoba still lack connections to the provincial highway network. They are the east side of Lake Winnipeg and the far north.

The region is also generally characterized by a dual economy split between native communities which have commercial fishing and trapping as basic industries and mining communities with primarily non-natives as residents. Many of the native communities lack year-round surface access. This has made them dependent on costly air service for year-round transportation and a variety of temporary alternatives such as barge and winter road. Canadian National Railways has a sparse rail network, serving a portion of the region, and providing some communities with their only surface mode.

Origin of the Study

Under the Canada-Manitoba Sub-Agreement on Transportation Development, the Canadian Federal Government and the Government of Manitoba agreed to conduct a number of research studies in transportation. Federal officials initially proposed several regional transportation studies including one covering Northern Manitoba. The final decision of the Agreement Management Committee was a regional transportation study of Northern Manitoba among other studies to be conducted by provincial staff under direction from a federal-provincial steering committee. Terms of reference identifying a dozen transportation problems confronting policy makers and northern residents were drafted.

The steering committee advised the study team to conduct parallel consultations with the residents of the north. This made sense in terms of confirming the seriousness of the previously identified problems and hearing about other ones. Community councils and regional organizations were informed about the study by letter. Due to limited funds for travel the study term leader only met with regional organizations and several community councils that requested meetings. Information about problems were obtained, but these consultations raised unrealistic expectations that action would be taken within a few years.

To analyze these problems, the study team prepared a work plan that began with the development of an information base describing the existing transportation system in the study area and measuring its utilization. The information base was community-oriented to identify the needs of the

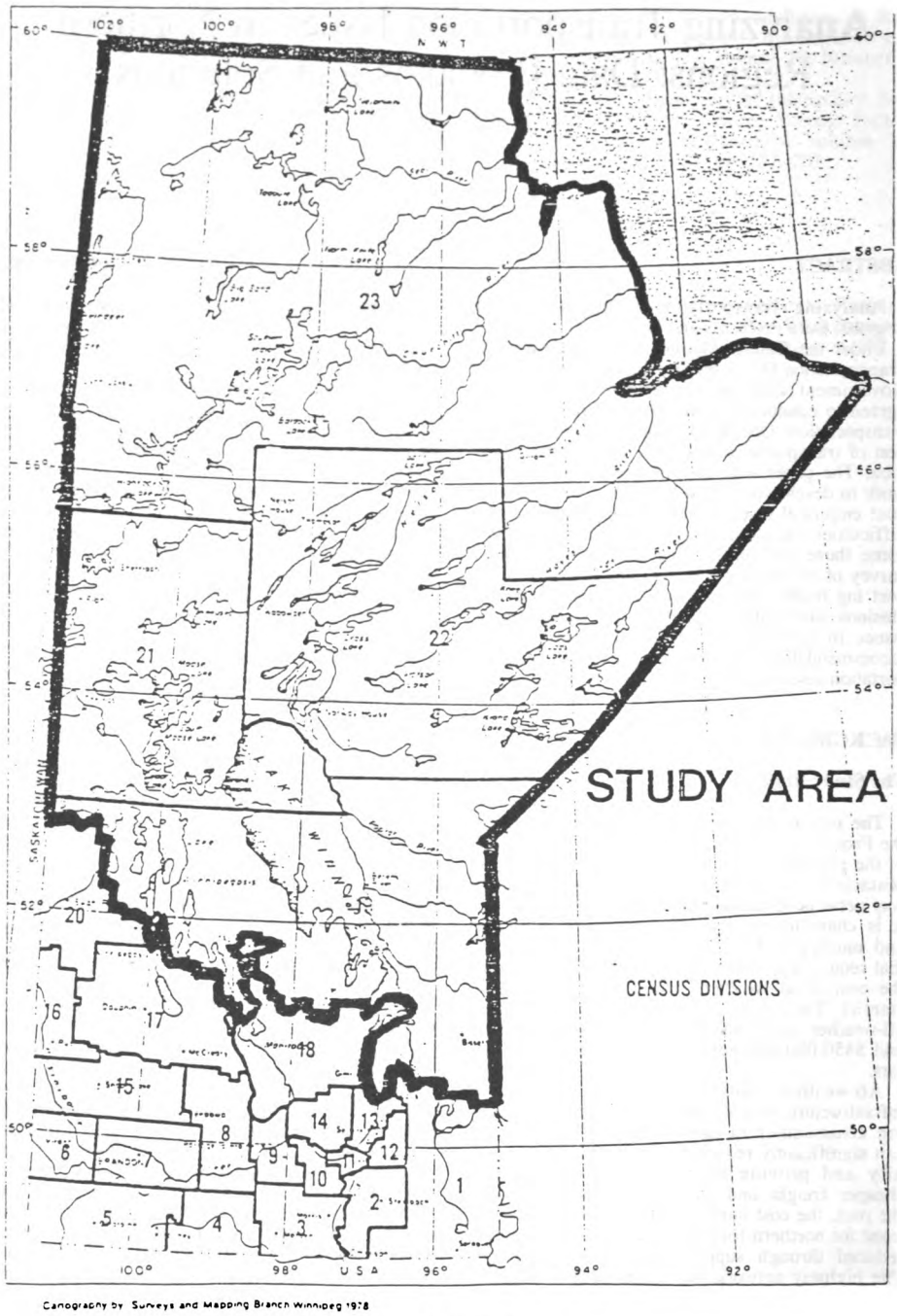

FIGURE 1

CENSUS DIVISION

population. In gathering data on the existing system, the study team first searched for information on the availability of facilities and the supply of transportation services. It then sought information on the level of utilization of these facilities. Considerable time was required to collect and organize the data in a meaningful way given a variety of service levels available from a combination of diverse modes.

A Warning

The consultation meetings provided opportunities to experience the difficulties and novelties in travelling in Northern Manitoba firsthand, for example, rental companies do not lease automobiles for use on the Provincial Roads because automobile windshields get broken by flying gravel on average once a year. Although now relatively safe for public travel, these roads are in transition from rough resource roads designed only for logging or mining trucks. Driving on these roads require more effort and concentration than on gravel roads in the south. Airline schedules and routings lengthen business and pleasure trips. Efficient use of time for business can require the chartering of aircraft. Visiting the communities and encountering the difficulties in personal travel and hearing about freight and transport concerns from local residents is necessary to fully comprehend the nature of the transportation problems.

DATA COLLECTION PROBLEMS AND SOLUTIONS

Native Population Counts

The research team began by identifying the existing communities and their populations. Accustomed to relying on Statistics Canada, the official collector of the population census in Canada, the study team initially believed this would be an uncomplicated task. This was true for the five predominantly non-native cities and towns. However, a problem of obtaining reliable population counts for native[2] communities exists.

The study area contained 48 identified Indian Reserves. However, the number of native communities had to be increased by an additional 60 to account for the populations of separate Metis and other native communities adjacent to the reserve communities, many having the same name as the neighbouring Indian Reserve communities. Some of these adjacent communities and Indian Reserve communities are so scattered that Statistics Canada could not establish specific census boundaries. The population in such communities were counted, but reported as an aggregation called Unorganized Territory which is of no value for a transportation study. Two thousand people out of a reported 1981 population of 72,000 were indicated as living in Unorganized Territory. Statistics Canda's population counts were consistently lower than that of any other source. Possible explanations might include lack of response due to language barriers, disinterest by respondents, and the conducting of the census in June when many families move to wilderness camps for the summer.

Manitoba Northern Affairs conducts its own census of 49 non-reserve native communities believing the Statistics Canada figures to be in error. These counts were used as the population figures for the 49 settlements.

Indian and Northern Affairs Canada has population data on each Indian band in Manitoba. The location of the total population was indicated as being on their own reserve, another band's reserve, on crown lands, or off-reserve. A number of Indian bands in Canada were not given separate reserves, but have resided on other bands' reserves pending land settlements. Bands have historically split for social, religious, and other reasons with one group leaving the reserve and settling on crown land elsewhere. Other sources of information were checked to determine if part of a band living on crown land was a separate community or not. If not, those living on crown lands were assumed to be residents of the reserve community. Off-reserve meant anywhere but the reserve. The on-own reserve category excluded non-band residents including non-status Indians and non-natives.

In addition to the difficulty in obtaining a reasonable current population estimate for northern communities, the data for different years from the same source showed variable growth trends over time making it impossible to make reasonable estimates of future populations. Population instability characterizes communities with an economy based on the extraction of a single resource.

Measuring Air Service

Air services and facilities are integral parts of the Northern Manitoba transportation infrastructure. Industrial centres such as Thompson and The Pass depend on air service for passenger movements into and out of the north. Isolated communities with no readily available ground transportation are almost totally dependent on air service for personal transportation and movement of supplies. Large distances to medical facilities make the speed available in air transport vital in responding to life threatening situations. Air services also play an integral role in fire fighting and search and rescue operations.

Information on airports and water aerodromes were readily available including current descriptions of runway type and length, equipment available, and critical aircraft. However, information on the supply and demand for air service was lacking.

The most commonly collected statistics for airports are passenger arrival and departure data. These were published for many of the airports, but measure airport activity primarily. Quantifying the supply of air services was complicated by a number of factors.

One was the different types of carriers operating in Canada and servicing the north. Both class 1 and 2 carriers[3] provide scheduled service at unit tolls, but those in Class 2 have revenues below a given threshold. Class 3 carriers normally provide regular services, which are subject to demand, to a number of communities at unit tolls. Regular services are flights on specified days of the week

which can be cancelled if the traffic on a particular day is inadequate. Charter carriers provide service on demand to anywhere with rental of the entire aircraft and crew. The ability to pay restricts the demand for charter service.

Two Class 2 carriers operated to a number of communities in Northern Manitoba. Four out of the six operating Class 3 carriers issued schedules on their routes unofficially and behaved as if they provided Class 2 service (See Figures 2 and 3 for route maps). Instability in the Class 3 sector in the years prior to the study resulted in several carriers ceasing operations in the year under study. Forty-four charter carriers serve Northern Manitoba points.

Another factor was flexible seat availability. Seats in planes operating in Northern Manitoba are removed and returned to adjust space availability for freight. Seat availability in a route could vary with each flight. Another complexity in determining the quantity of air service available was a priacy problem where unlicensed carriers, probably charter operators on empty runs to a particular destination, offered passengers waiting for a scheduled or regular flight to the same destination a ride at a price lower than the existing unit toll.

The research team was constrained to compiling a list of regular, scheduled, and charter carriers containing their corporate names, base of operations, type of aircraft in service and communities served for those providing regular and scheduled service.

Measuring utilization of air services was as complex. Origin and destination information on passengers for the Class 2 carriers is published annually by Statistics Canada. Data for Class 3 carriers are collected, but are not published. To obtain these data from Statistic Canada, the study team had to write to the Air Transport Committee of the now defunct Canadian Transport Commission asking for release of the data. After considering the request, the ATC wrote to the carriers for their refusal to release the data. When no refusal was received, at least two committees at the COmmission and Statistics Canada reviewed the request and lack of refusal and then authorization to release the data was given. Including the time required to assemble the data, the entire process took 11 months.

Such delays in obtaining data can exacerbate other problems for government researchers. Policymakers often demand and expect results from research within a short time frame in order to accommodate planning next year's budget or meeting a legislative timetable. Researchers can be assigned an intervening project of sufficient duration that when they return to the original project, they must spend additional time familiarizing themselves with what has been done previously. Staff turnover before a project is finished is another problem. Delays that protract completion of reports create frustration and impatience. Delays in obtaining data create opportunities for intervening projects and staff turnovers to disrupt research progress. All three difficulties were experienced during this study.

In the meantime, the research team learned that staff at the 28 provincial airports recorded information on passenger and freight arrivals and destinations in log books. With the cooperation of the Northern Airports/Marine Operations Branch, the log books for one year were obtained from all the airports. Summer students, hired through a government program, were trained to extract the pertinent information from the log books. Complete information on every flight entry was unavailable and the degree of completeness varied among airports, but the data collected provided a reasonable representation of air service utilization. The resulting data were organized into a pseudo-origin-destination matrices since the actual origins of passengers and final destinations could not be determined. The data were useful in indicating travel patterns and did provide assistance for at least one related policy question.

The study team also carried out a survey of the charter carrier operators. A survey form and covering letter were mailed to 44 carriers identified in the Directory of Canadian Commercial Air Services as providing air charter service in Manitoba. Questions on the survey form were related to:

1. the locations of flights made in Northern Manitoba and problems specific to those locations;
2. passenger movements and trip purposes;
3. freight movements and types of freight carried; and
4. general problems in providing air service in the north.

Rail Service

Canadian National Railways operates the rail lines in Northern Manitoba. The main line runs northeast from the Manitoba-Saskatchewan border to a point called Sundance and then runs almost directly north to Churchill (See Figure 4). This line joins the southern rail network at Hudson Bay, Saskatchewan. The primary purpose of this line is to ship grain from elevators in the Central Prairies to Churchill for export.

Several branch lines connect mining communities to the main line. The longest runs to Lynn Lake from a point just north of The Pas. Shorter branch lines from this one serve the major communities of Flin Flon and Snow Lake. Two other branch lines from the main line serve the City of Thompson and Kelsey, a hydroelectric generation station.

The crown corporation, VIA Rail, operates passenger trains on these lines. A number of local trains serve northern communities and train runs between Churchill and Winnipeg in the south provide regional service.

Origin-destination information for freight traffic could have been obtained from the Canadian Institute of Guided Ground Transport with the permission of CN. However, providing the data required CIGGT staff to write a special computer program and charge for the work. The initial charge for the first year's data was expensive and it was decided that the information was not likely worth the cost. Although consultation with northern residents produced complaints about high rail freight rates, the available data were only a small part of what would have been required to investigate this problem.

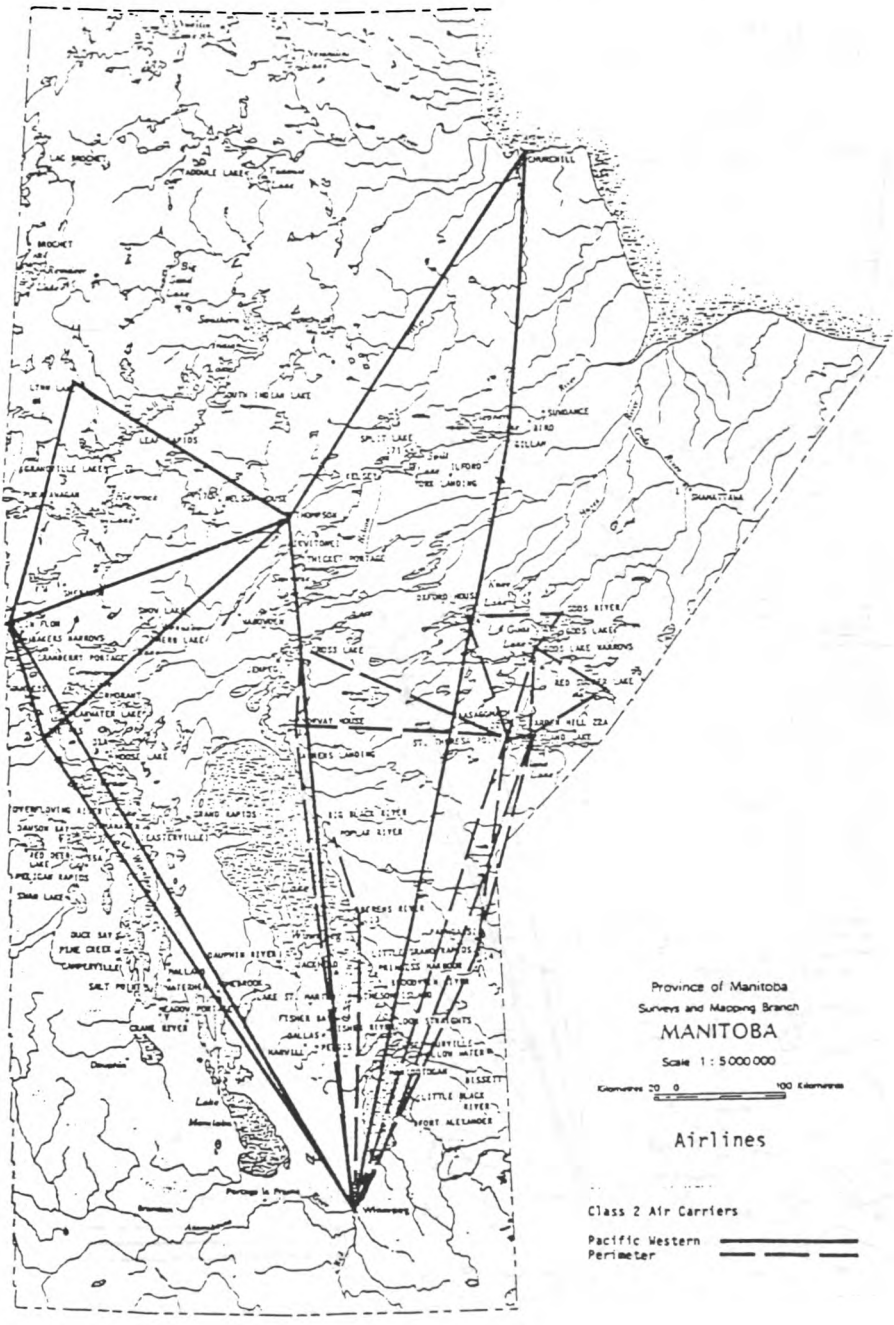

FIGURE 2
AIR CARRIER ROUTES

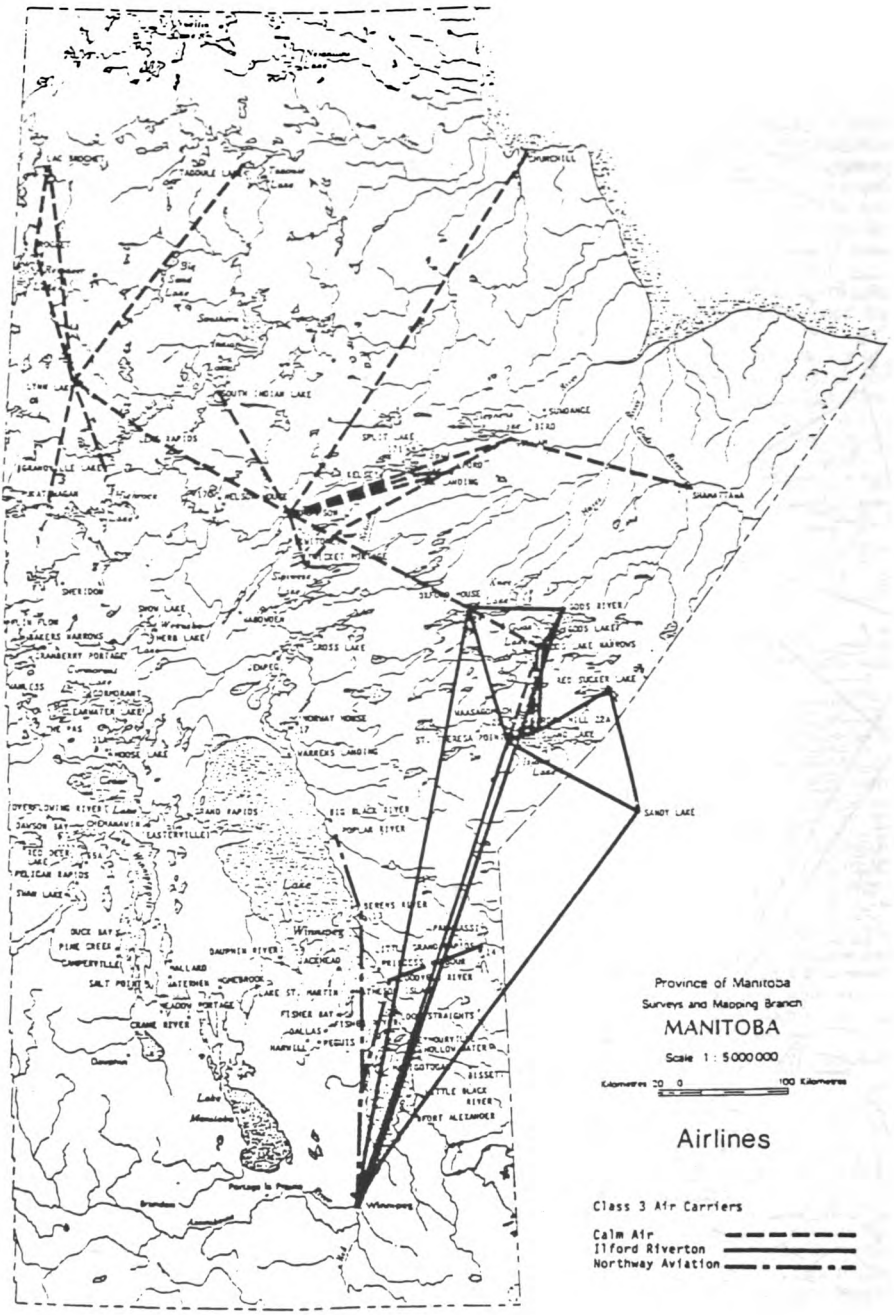

FIGURE 3

AIR CARRIER ROUTES

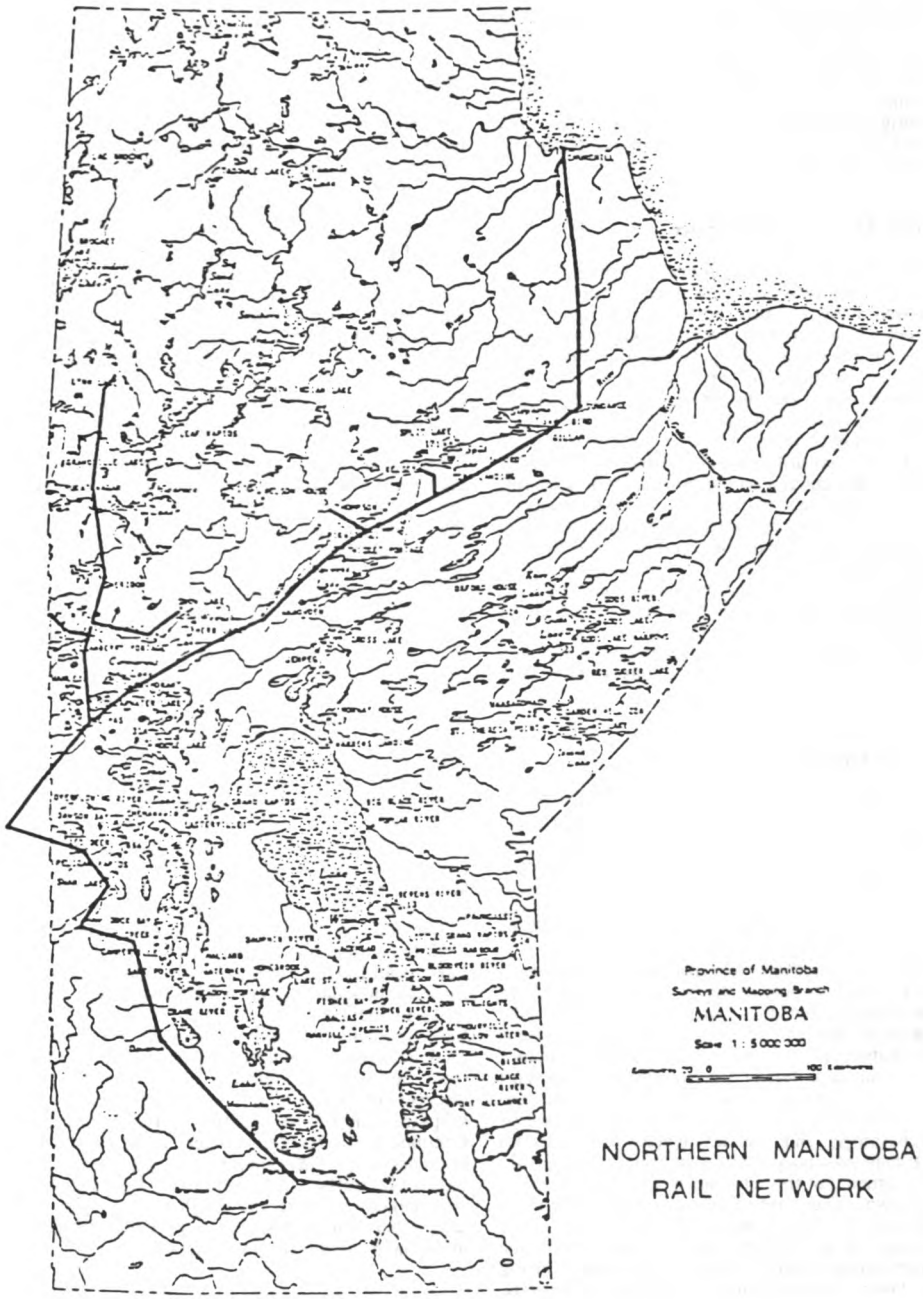

FIGURE 4

VIA Rail provided passenger data. Boarding (on and off) data were provided for points from Winnipeg to Churchill and true origins and destinations were also provided for the traffic coming from and going to Churchill. The research team used a gravity model to convert the raw on/off passenger data to origin/destination data. The conversion formula was calibrated using the known origin/destination data for Churchill.

Public Motor Carrier Service

In addition to allowing for private vehicular traffic, the highway network (see Figure 5) has allowed a bus company to provide passenger and parcel service and two trucking companies to provide freight service. Grey Goose Bus Lines provides service along the two major Provincial Trunk Highways and various Provincial Roads to the larger population centres.

The study team contacted Grey Goose to obtain information on utilization of the bus line. Initially, discussions centered on the possibility of accessing ticket records kept in driver envelopes for analysis. Finally, Grey Goose offererd computer print-outs from Statistics Canada surveys completed in 1978 and 1981 which utilized the same raw data. Origin-destination tables were constructed from the information on the print-outs. Although one survey covered a week in winter and the other a week in summer, and were 3 years apart, the travel patterns and utilization levels for bus service were very similar.

Marine Services

Three types of marine services exist in Northern Manitoba. First, provincial ferries are used for passenger and vehicle transport to connect some communities to the all-weather road network. Second, private barge operators provide freight transport service on Lake Winnipeg. Finally, small private boats are used extensively in Northern Manitoba for personal travel.

Manitoba Highways and Transportation operates the program to provide ferry services to northern communities and the Northern Airports/Marine Operations Branch was able to provide the basic information on the services provided. The province owns four cable ferries for crossing rivers or short distances across lakes and three motor vessel ferries for crossing larger lakes. While information on the passenger and vehicle capacity of the ferries was available, no passenger or traffic records are maintained so the utilization of the ferries is unknown. They are used seasonally when the waterway is open. During the winter, they are replaced by ice bridges. Surface transport to the communities served by ferry is interrupted during the Spring break-up and Fall freeze-up periods.

A private company operates a barge carrying bulk fuel, general freight, automobiles, and general freight on Lake Winnipeg to communities on the east shore during the open water season. The owner did provide some statistics on the volume of freight transported. A community cooperative operates a second barge hauling fish south to the end of Provincial Road 234 and returning with some general freight.

Winter Roads

Winter roads are constructed through the frozen muskeg areas by clearing a route and then preparing and maintaining the surface. Snow along the route is compacted to allow the frost to penetrate and freeze the muskeg. Today initial compaction is done using snowmobiles, then lightweight low ground profile equipment when the frozen ground can bear their weight. The route is eventually cleared and compacted by bulldozers and graders. Snowmobiles are used to compact snow over lakes to induce additional freezing of the ice to greater thickness. The snow is cleared to the required width when the ice can hold heavier equipment. Over rivers and streams the snow is first windrowed to the required width. The ice is then flooded to form an ice bridge.

Maintenance of a winter road consists of plowing to remove excessive snow and to maintain surface width. Wood or metal drags are pulled over the roads to eliminate bumps and ruts and to roughen glare ice. The minimum maintenance coverage is one pass in each direction every 96 hours.

Winter roads have been constructed in Northern Manitoba to serve isolated communities for over 50 years (Figure 6). The length of time they are open varies with weather conditions but in recent years they generally are open in January or early February and closed in late March. The roads were usable for an annual average of 50 days in the last five years. Winter roads under the jurisdiction of Manitoba Highways and Transportation are constructed to withstand constant hauling of normal highway vehicles up to a maximum gross weight of 36,500 kilograms. The road surface is constructed to a standard allowing for an average speed of 35 kilometres per hour. Lower speeds may be accepted where severe ground conditions exist and sharp ends or steep hills cannot be avoided.

With the expansion of the all-weather road network to communities such as Norway House, Cross Lake, Split Lake, Moose Lake and others, the winter road mileage has decreased from over 2,000 miles in the 1960's to less than 750 miles today. Large amounts of freight are shipped on the winter roads to those communities which still have winter roads built to them annually or occasionally. The Department monitors the use of the roads and keeps records of the quantity of freight shipped. Community residents travel these roads in automobiles ignoring the Department's preference that automobile traffic not use the road. Frequent vehicle breakdown due to the rough terrain, long distances between settlements, and frigid temperatures make automobile travel hazardous.

RESULTS AND CONCLUSIONS

Assembling an information base to analyze transportation problems in Northern Manitoba proved to be a time-consuming task. Vastness of geography and the small population of many communities obstructs data collection. Many gaps in

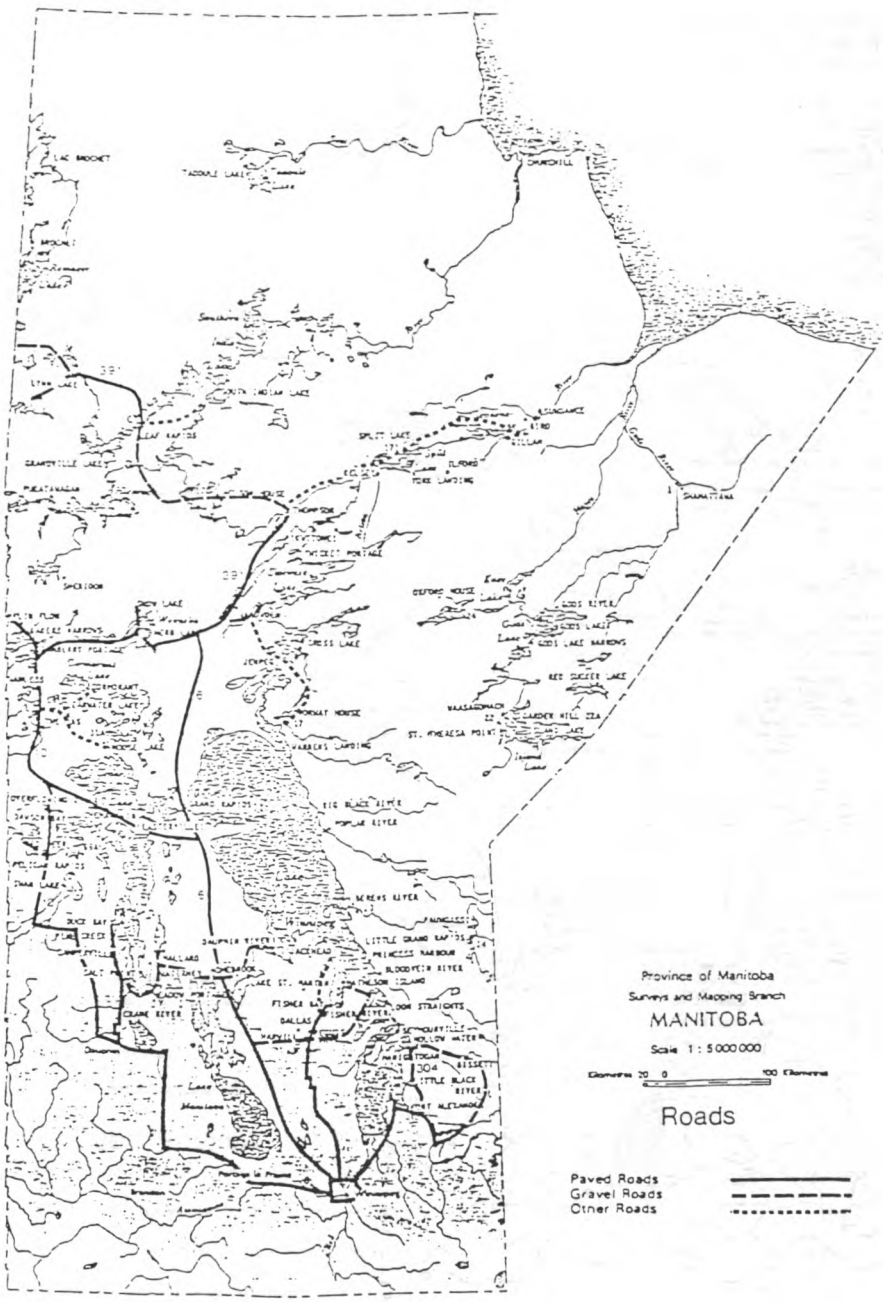

FIGURE 5

FIGURE 6

the data collected by national agencies exist. Without secondary sources to provide a complete data set, researchers face very expensive data requirements. However, useful information can be obtained from administrative records and other sources. Inexpensive mail-out surveys which yield significant information are possible given a limited population, e.g., charter air operators.

The survey of charter air operators generated a number of useful results. About two thirds of the forty-four charter air carriers responded to the survey sent to them.

Charter carriers served many communities but mainly those that were not easily accessible by ground transport. Charter services tended to supplement rather than substitute for scheduled air service. Multiple carriers were identified for any location having a significant number of charter flights. Vigorous competition appears to exist in the air charter industry. Thompson, in Norther Manitoba, and Winnipeg, in Southern Manitoba were both the major origin and destination points for air charter passenger travel. Winnipeg serves as the most important source of freight going to Northern Manitoba, while Thompson serves as the second most important source. With the exception of freight destined for the Northwest Territories, almost all freight is destined for points in he region east of Lake Winnipeg. A much smaller portion of air charter passenger travel was destined for that region. Charter services seemed to be used primarily to transport freight to that region, while scheduled service provided primarily passenger service. Seven percent of the person trips were for emergency or medical purposes, and 29% of the passengers were on recreational trips. Business travellers made up 20% of the total person trips. Passengers on government business accounted for 37% of all chartered person trips.

However, a reviewer of the survey results, familiar with the air industry in Northern Manitoba, suggested that business travellers substantially outnumber government travellers using scheduled air service to Northern Manitoba. No demographic data exists on travellers by scheduled air service to confirm or refute this observation.

The adequacy of transport facilities in Northern Manitoba could be assessed from information on the availability of low cost, year round freight and passenger transport service, the existence of a nearby airstrip for convenient passenger travel (shorter travel time) and for emergency evacuation, and general accessibility to health care.

Table 1 shows the distribution of Northern Manitoba communities and the regional population of approximately 79,000 by availability of inexpensive, year round service. Having a road connected to the provincial highway network would make available relatively inexpensive freight and passenger transport service. Road connections were characterized according to type and the length of time during a year that the road mode could be used.

Ferry-Road access means road traffic can not reach the communities during the freeze-up and break-up periods (six-eight weeks) during the year and during the hours when the ferries do not operate in the summer. Communities separated from the local airstrip by water are completely isolated during those periods although helicopter service is used in emergencies.

TABLE 1

Distribution of Northern Manitoba Communities and Population by Availability of Inexpensive, Year Round Service

Availability of Inexpensive, Year Round Service	Number of Communities in Category	Percent of Regional Population
1. Paved All-weather Road/Airstrip within 20 miles	9	45.1%
2. Paved All-weather Road/No Airstrip within 20 miles	10	5.1%
3. Gravel Road Access/Airstrip within 20 miles	9	10.4%
4. Gravel Road Access/No Airstrip within 20 miles	31	13.0%
5. Ferry-Road (Winter Ice-Road) Access/Airstrip	1	0.0%
6. Ferry-Road (Winter Ice-Road) Access/No Airstrip	1	0.0%
7. Rail Service Only/Local Airstrip	7	3.9%
8. Winter Road Only/Local Airstrip	9	4.9%
9. Winter Road Only/Local Airstrip Separated by Water	5	6.0%
10. Local Airstrip Only	5	2.5%
11. No Surface Access/No Airstrip	4	0.2%

Table 2 shows the distribution of Northern Manitoba communities and regional population by accessibility to health care. The availability of a hospital or means of accessing a hospital were the key factors considered. Three categories were established; communities with hospitals; communities with a nursing station, and communities with no health facilities. Access to a community with a hospital could be by road or air. In Table 2, no distinction between gravel or paved roads were made, nor was the road distance to the nearest airport. These distinctions can be determined from Table 3 which shows a matrix combining the information from Tables 1 and 2.

Table 3 indicates the distribution of the regional population according to the ranking of their communities by the criteria of availability of inexpensive, year round service and accessibility to health care. In the ranking scales, 1 is best with the higher number indicating less desirable categories. The scattering of non-zero entries reflects a relationship between the availability of transport service and accessibility to health care. The boundary between adequacy and inadequacy is arbitrary, but one can infer that while a majority of the population has adequate transport facilities, a significant minority has reason for dissatisfaction. This population is primarily located in the eastern half of the region. In absolute terms, this population is small and divided amoung two dozen communities although five have a population exceeding 1,000. The small populations result in traditional benefit/cost ratios for all weather-road construction to approach zero, not justifying extension of the permanent road network.

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TABLE 2

Distribution of Northern Manitoba Communities and Population by Accessibility to Health Care

Category of Accessibility	Number of Communities in Category	Percent of Regional Population
1. Communities with Hospitals	9	52.9%
2. Communities with Nursing Station Only/ Nearest Hospital Within 50 Miles by Road	14	11.8
3. Communities with Nursing Station Only/ Nearest Hospital Over 50 Miles by Road	12	9.3
4. Communities with No Health Facilities/ Nearest Hospital Within 50 Miles by Road	14	6.0
5. Communities with No Health Facilities/ Nearest Hospital Over 50 Miles by Road	10	1.4
6. Communities with Nursing Station Only/ Nearest Hospital Within 50 Miles by Air	15	8.2
7. Communities with Nursing Station Only/ Nearest Hospital Within 100 Miles by Air	12	10.1
8. Communities with No Health Facilities/ Nearest Hospital Within 50 Miles by Air	5	0.1
9. Communities with No Health Facilities/ Nearest Hospital Over 100 Miles by Air	1	0.1

TABLE 3
Analysis of Adequacy of Transport Facilities in Northern Manitoba
Percentage of Population and Number of Communities[a]

Ranking By Accessibility to Health Care \ Ranking by Availability of Inexpensive Year Round Service		Category 1	2	3	4	5	6	7	8	9	10	11	Total Percent
Category	1	40.2 4		7.4 3		3.6 1		1.7 1					52.9 9
	2		5.7 4	0.6 1	5.5 9								11.8 14
	3	1.1 1	0.8 1	1.3 3	2.5 5	3.5 2							9.2 12
	4	0.2 2	3.9 4		1.9 7			a 1					6.2 14
	5		0.1 4		1.1 5	0.2 1							1.4 10
	6			1.1 1	0.2 1	1.5 2		2.2 4	0.7 2	1.1 2	1.4 2	0.1 1	8.3 15
	7							4.1 6	4.9 3	1.1 3			10.1 12
	8				−a 1		−a 1					−a 3	− 5
	9								−				
Total Percent		41.5 7	10.5 13	10.4 8	11.2 28	8.8 6	−a 1	8.0 12	5.6 5	2.2 5	1.4 2	0.1 4	100 91

Footnotes: (a) Communities shown as whole numbers (b) Less than 0.1 percent

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ENDNOTES

* Manager, Transportation Research; Transportation Policy, Programs, and Research Division; Manitoba Highways and Transportation, Winnipeg, Manitoba, Canada.

1. The region is that part of Manitoba under the jurisdiction of the Department of Northern Affairs.
2. Indian and Northern Affairs Canada recognizes as Indians those who are registered with the government as members of a band. Most bands have been given land reserves. Many Indians are not registered for a variety of reasons. The Metis are people of both Indian and European ancestry.
3. (a) Class 1: Scheduled domestic service, being a service that is required to provide transportation and that serves points in accordance with a service schedule at a toll per unit of traffic;
   (b) Class 2: Regular specific point domestic service, being a service that is required to provide transportation to the extent to which facilities are available and that serves points in accordance with a ser vice schedule at a toll per unit of traffic;
   (c) Class 3: Specific Point domestic service, being a service that, consistent with traffic requirements and operating conditions, offers transportation and serves points at a toll per unit of traffic;
   (d) Class 4: Charter domestic service, being a service that offers transportation on reasonable demand at a toll for the charter of an entire aircraft with air crew; and
   (e) Class 4G: General domestic service, being a service that does not belong to any of the Classes described in paragraphs (a) to (d).