WINTER ACCESS ROADS ON THE BATHURST BARREN-GROUND CARIBOU RANGE: A REVIEW

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ABSTRACT

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INTRODUCTION

Linear developments such as roads, seismic lines, and pipelines have been identified as potential threats to migratory barren-ground caribou (Rangifer tarandus groenlandicus) (Shank 1979, Jakimchuk 1980). Potential effects may include disruption of caribou migrations, interference with local movements, and changes in activity patterns (Klein 1980). In suggesting mitigative measures to reduce or eliminate conflicts between caribou and industrial exploration and development, biologists are often forced to rely more on professional judgement than on empirical data. Problems have evolved because of a lack of wildlife information and techniques that enable biologists to evaluate the effects of disturbance, and the lack of environmental review during the early planning stages of road development (Donihee and Gray 1982).

This report was written in an effort to integrate information on winter roads, and the winter ranges and spring migration corridors of the Bathurst barren-ground caribou herd in the N.W.T.

ROAD DEVELOPMENT AND CARIBOU DISTRIBUTION

Roads: Past, Present and Future

The area accessible by permanent roads in the N.W.T. is limited and, with the exception of the Dempster Highway, is restricted to the southern portion of the Mackenzie District (Fig. 1). The Dempster Highway was completed in 1980 and extends from Dawson City, Yukon to Inuvik, N.W.T. The Yellowknife Highway stretches from the junction located south of Fort Providence to Yellowknife where it merges with the Ingraham Trail, which extends approximately 50 km east of Yellowknife (Fig. 1).

Winter access roads are constructed to supply and service mining operations and small communities. In many cases these roads are constructed along lakes. Construction of winter roads follows a standard procedure whereby grading equipment is used to remove snow from the lake ice; snow is levelled and compacted on the portages using bulldozers with steel drags. Most roads are constructed during January and February, and maintained until spring thaw, which normally occurs in April. The roads are used for three to six weeks each winter.

There are two major winter road corridors in the southern portion of the Mackenzie District. The Gordon Lake corridor consists of a series of winter roads running north from the Ingraham Trail to the Discovery, Camlaren, Tundra, and Salmita Mine sites (Fig. 1). Production at Discovery Mine and Tundra Mine ceased prior to 1970 (Appendix A). During the winter of 1978-79, the access road was extended north to the Lupin Mine site at

Figure 1

Contwoyto Lake (Fig. 1, Appendix A). Echo Bay Mines Ltd. upgraded the winter road in 1983 with plans to open it on an annual basis. In 1982, this winter road was constructed to service exploration on the Salmita Mine property. If this mine is brought into production it is anticipated that work will continue for 2-3 years. The Camlaren Mine was closed down in 1981. A winter road to the Bullmoose and Strike Lake properties, extending approximately 30 km east of the Ingraham Trail, was used in the mid-1970's and may be constructed again if production becomes economically feasible in the future (Fig. 1, Appendix A).

The Rae Lakes corridor is the second major corridor, and consists of a series of winter access roads extending north from the Yellowknife Highway near Rae. From 1963 to 1979 a major winter road was constructed annually to the Echo Bay Mine on the east shore of Great Bear Lake (Fig. 1, Appendix A). The road also serviced the Rae Lakes community and Terra Mine. From the Echo Bay route, an ice road has been constructed to haul fuel and resupply the communities of Fort Franklin and Fort Norman (Fig. 1). Between 1979-81, the Echo Bay Mine was serviced by Hercules aircraft. In 1982 the winter road was again extended to Echo Bay; however, the mine was closed in 1982. The mill at Terra Mine was temporarily closed down in 1981 but was reopened in 1982 (Appendix A). The winter road will be constructed to the Rae Lakes community and Terra Mine in 1983.

The Rae Lakes corridor includes the winter road constructed to Indin Mine in 1981 (Fig. 1, Appendix A). A separate access road (primarily an overland route) has been constructed to service the community of Lac La Martre. The road has been declared a permanent right-of-way and will be constructed each winter. In 1978 the Department of Indian Affairs and Northern Development (DIAND) initiated a study to examine alternative routes and methods to transport ore concentrate from the extensive base metal deposits in the areas of Bathurst Inlet and Contwoyto Lake to outside smelters. The most cost-efficient and feasible routes identified were:

1) a road/marine route requiring the construction of a permanent road 425 km north to Bathurst Inlet and the Gray's Bay area (Fig. 1) for shipment of the concentrate to an outside smelter, and
2) a road/rail route with the construction of a permanent road approximately 550 km south to the Yellowknife Highway and transfer of the concentrate to rail at Enterprise located 40 km south of Hay River (Dubose 1978).

Estimated initial costs for the road/marine option were $206 million. The gross cost estimate (covering transportation of concentrate) was $155/ton of concentrate (Canalog 1980). Estimates for the road/rail option were in excess of $400 million (capital outlay) and $315/ton of concentrate. Winter roads were ruled out as a viable transportation alternative because capital requirements for equipment and storage facilities combined with annual inventory holding costs would result in exorbitant costs per ton of concentrate (Dubose 1980).

Mineral Exploration Activities, 1981

Mineral exploration in the N.W.T. peaked in 1981, and

Tourism 1981). Uranium and silver exploration programs accounted for several projects in the region between Great Bear Lake and Coronation Gulf. Exploratory drilling occurred around Dismal Lakes and along the Coppermine River (Fig. 2, Nos. 2-5, Table 1.). Even though the mill at Terra Mine was closed in 1981, a major exploration program for silver is currently underway near the mine site. Diamond drilling also was conducted on the Leith Peninsula (Fig. 2, No. 1) approximately 50 km west of the Terra Mine site.

Areas around Bathurst Inlet and Contwoyto Lake (Fig. 2, Nos. 6-10 and 12-14) received considerable attention through gold and base metals exploration. The Bathurst Norsemines (No. 7) and Izok Lake (No. 14) properties contain extensive base metal deposits with a combined estimated production potential of 400,000 tons of lead, zinc and copper concentrates per year over the next 20 year period (Dubose 1980).

Other exploratory drilling projects in 1981 primarily were located near existing mine sites. There were two projects near the Salmita property (Fig. 2, Nos. 15 and 20) and three in the vicinity of Camlaren Mine at Gordon Lake (Nos. 16, 18 and 19).

Distribution of the Bathurst Caribou Herd

There has never been a complete documentation of the winter distribution of the Bathurst herd over an entire winter season (November to April) (Urquhart 1981). Existing winter range survey data for the Bathurst herd provide some information on known areas of occupation by caribou during parts of specific winters (Kelsall 1968, Thomas 1969, Jacobson 1979). However, Urquhart (1981)

Figure 2

Table 1. Mineral exploration projects in the Mackenzie District, N.W.T., 1981. Only projects that were at least in the exploratory drilling and trenching stage are included[a].

No.[b]	Company	Location (Lat., Long.)	Mineralization[c]
1	AGIP	Leith Peninsula (65°23'N, 119°06'W)	Ag, U
2	Esso Resources	Dismal Lakes (67°30'N, 117°40'W)	Ag, U
3	BP Minerals	Dismal Lakes (67°27'N, 117°40'W)	Ag, U
4	BP Minerals	Coppermine River (66°45'N, 115°30'W)	Ag, U
5	Uranerz	Asiak River (67°22'N, 114°28'W)	Ag, U
6[d]	Canuc Resources	Coronation Gulf (67°45'N, 111°25'W)	Au
7[d]	Cominco	Bathurst Inlet (65°53'N, 108°20'W)	Ag, Au, Base metals
8	Noranda	James River (67°15'N, 111°20'W)	Cu, Zn
9	Lynx Canada	Ida Bay (68°14'N, 106°28'W)	Au
10	Noranda	Hope Bay (68°04'N, 106°40'W)	Ag, Base metals
11	Noranda	Mazenod Lake (63°30'N, 116°30'W)	Cu, Au
12	Giant Yellowknife	Point Lake (65°18'N, 113°00'W)	Au
13	Canadian Superior	Contwoyto Lake (65°43'N, 111°25'W)	Au
14	Texas Gulf	Izok Lake (65°45'N, 112°40'W)	Base metals
15	Noranda	MacKay Lake (64°10'N, 111°15'W)	Cu, Zn
16	Giant Yellowknife	Myrt Lake (62°50'N, 113°20'W)	Au
17	Ashnola Mines	Johnston Lake (63°03'N, 114°15'W)	Au
18	Burnt Island Gold	Gordon Lake (63°04'N, 113°09'W)	Au
19	Cadillac	Gordon Lake (63°02'N, 113°08'W)	Au
20	Roxwell Gold	Matthews Lake (64°10'N, 111°15'W)	Au

a Data from Department of Economic Development and Tourism (1981).
b For location, refer to numbers on Figure 2.
c Ag - silver, Au - gold, Cu - copper, Zn - zinc, U - uranium.
d The project has advanced to the stage of systematic predevelopment work including closely spaced diamond drilling and preliminary mining and metallurgical studies.

emphasized the lack of evidence showing that caribou did not occupy certain areas during part or all of a specific winter season. In most years some segments of the herd winter in the taiga (or subarctic boreal forest) while the rest remain on the tundra. Years in which few caribou wintered on the tundra cannot be determined from existing data (Urquhart 1981), and consequently, taiga wintering areas are documented more thoroughly than tundra wintering areas.

The most recent surveys of caribou distribution on the Bathurst winter range were completed between 1974-77 (Jacobson 1979). Wintering groups of caribou were observed from the east end of Great Slave Lake to Great Bear Lake and Coppermine (Fig. 3). Surveys were not conducted on the tundra, and therefore it cannot be determined if caribou were wintering above treeline during that period. During the 1980-81 winter it appeared that most caribou were wintering on the tundra (K. Jingfors pers. obs.). Few penetrated boreal forest regions to the same extent rec orded during previous years.

While some Bathurst caribou wintering areas have been used traditionally for many years, none have been occupied every year (Urquhart 1981). According to Urquhart the most frequently recorded wintering areas are found around Hottah Lake (65°044'N, 118°30'W), Snare Lake (64°11'N, 114°22'W) (20 km east of Indin Mine), Gordon Lake (63°05'N, 118°30'W), McLeod Bay (62°53'N, 110°00'W), Artillery Lake (63°09'N, 107°52'W), Dismal Lakes (67°23'N, 117°07'W), Coppermine River, Coronation Gulf coast, and northern Bathurst Inlet (including Kent Peninsula). With the

Figure 3

exception of the Coronation Gulf coast and northern Bathurst Inlet which were not surveyed by Jacobson (1979), all of the aforementioned areas supported caribou during a portion of the winters between 1974-77 (Fig. 3). One area seldom used by Bathurst caribou lies between Rae and Yellowknife and extends approximately 50 km north of Great Slave Lake and the Yellowknife Highway (Urquhart 1981). Another region that has not been occupied recently (last documented use in 1956, Kelsall 1968) is the area south of Great Bear Lake between the Mackenzie River and the Rae Lakes road corridor.

The timing of spring migration varies between years, and major population shifts towards the calving grounds may occur as early as mid-February (Urquhart 1981). Pregnant cows and some yearlings usually arrive on the calving grounds in late May; bulls, juveniles and other non-breeders often lag far behind.

The traditional calving grounds of the Bathurst herd are located primarily east of Bathurst Inlet (Fig. 3); calving also has been reported to occur in the hills west of Bathurst Inlet and on the Kent Peninsula (Fleck and Gunn 1982). The routes followed by groups wintering in the taiga are dependent upon snow conditions, topography, and the location of late winter concentrations (Urquhart 1981). Migrating caribou usually follow the path of least resistance and during spring migration the animals seek routes with little or no snow, or where the wind has formed a snow crust hard enough to support them. Hence, the wind-packed surfaces of frozen lakes or rivers are often used by caribou of the Bathurst herd during spring migration. While the migration may extend over 400-600 km for animals wintering between Great Bear Lake and Great Slave Lake, distances are considerably shorter for caribou wintering on the tundra near Bathurst Inlet and on the traditional calving grounds.

ENVIRONMENTAL IMPACTS AND PLANNING

Caribou and Winter Roads

Several of the known preferred wintering areas of the Bathurst herd overlap with the locations of current and potential winter roads and mine sites. With the exception of the 1980-81 winter, one segment of the Bathurst herd has regularly wintered in the Gordon Lake area during the past 12 years (Jingfors and Gunn 1982). Hottah Lake, along the Rae Lakes road corridor, and Snare Lake, located approximately 20 km east of Indin Mine (Fig. 3) are other prime wintering areas where caribou are likely to occur from November-December to March-April.

Land-use permit records indicate that in 1981, exploratory diamond drilling operations were primarily restricted to the summer season (June-August). However, a diamond drilling program at Ida Bay (Fig. 3, No. 9) north of the Bathurst calving grounds, was initiated in May; caribou usually calve in late May and early June. Drilling in the Dismal Lakes area (Fig. 3, No. 2) was initiated during April 1981. This is an area where caribou frequently winter, although by April most caribou have begun their spring migration to the calving grounds.

If mineral production proves feasible and the construction of winter or permanent roads remains a viable transportation option, numerous potential caribou/land-use conflicts exist. Developments around Dismal Lakes (Fig. 3, Nos. 2 and 3), Gordon Lake (Fig. 3, Nos. 15, 18 and 19), and MacKay Lake (Fig. 3, Nos. 15 and 20) will occur within prime wintering areas while activities in the

Bathurst Inlet area (Fig. 3, Nos. 6-10) will be located on the spring migration routes close to the traditional calving grounds. The existing Lupin Mine at Contwoyto Lake is located along a frequently used migration corridor (Beak Consultants Ltd. 1980). Caribou have often been observed near the mine site and associated airstrip.

The effects of linear developments, such as winter road on migratory barren-ground caribou are not well understood because our knowledge of disturbance-related effects on wildlife remains rudimentary. Jingfors and Gunn (1981) reviewed previous disturbance research and stressed the importance of developing appropriate techniques that would enable biologists to measure "effects" of disturbance. Currently, we are limited to using overt behavioural responses to document short-term effects of human activities on caribou. To predict the effects of winter and permanent roads on caribou it is necessary to develop a thorough understanding of "normal" behaviour and of seasonal changes in caribou distribution and movement patterns within, as well as between, years. The unpredictable nature of caribou distribution and movements makes previous observations of behaviour a poor basis for judging land-use activities (Urquhart 1981). The observations will, however, provide resource managers with some indication of the probability as to what areas are likely to receive use by wintering, migrating, or calving caribou. With respect to timing and location, the arrival of the pregnant cows on their traditional calving ground every spring remains the most predictable characteristic of the annual movements. Hence, we are relatively more knowledgeable about the location of calving grounds than about wintering areas or migration routes.

One of the most obvious effects of winter roads is the improved access it creates for hunters, which can result in an increase in the caribou harvest. For example, during early 1980 large numbers of caribou wintered in the Gordon Lake area and as a result, an estimated 2,000 caribou were harvested by hunters who gained access by the winter road (Donihee and Gray 1982). In March 1982 when caribou were again close to Gordon Lake and the winter road, the N.W.T. Wildlife Service established a special Wildlife Management Zone along the road to regulate access and to prevent another large harvest. The zone extended for 8 km on either side of the winter road and transport of meat in vehicles (excluding snow machines) was prohibited within the zone.

Future of Winter Roads

Mineral exploration and development in the N.W.T. is presently depressed. Average metal prices are dropping while the costs of metal production are increasing, thereby reducing profit margins. Because depressed industrial growth tends to reduce base metal and uranium demand, gold will probably be the primary target over the next five years. Increased gold exploration and development will likely offset decreased base metal and uranium activity (Padgham 1981). Should the current market situation continue, it is unlikely that new base metal mines will be developed within the next 10 years (T. Daniels, B. Lynn, and W. Padgham, pers. comm. 1982).

As a result of the depressed and unpredictable nature of the metal market, additional winter road developments will not likely occur over the next 5-10 years. Winter roads are expensive to build, difficult to maintain, and only can be used during a relatively short period of time. In comparison, ice landing strips are relatively easy to construct and maintain. However, existing winter roads will continue to be constructed each year into the Rae Lakes and Lac La Martre communities and to gold mines close to Yellowknife. It is likely that mine sites such as Salmita will be serviced by a combination of winter roads and aircraft.

In view of the vast mining potential in the N.W.T., the depressed market will cause a slow down in the rate of exploration and development; however, should base metal prices increase, mining of the extensive deposits at Bathurst Inlet and Izok Lake (Fig. 3, Nos. 7 and 14) may prove feasible. The tonnage of ore that will be transported requires permanent roads rather than winter roads. The proposed transportation corridors (Canalog 1980) will transect large portions of the Bathurst caribou migration routes.

Environmental Planning

The pace and magnitude of northern development often leaves the environmental assessment process behind. Of necessity, studies are usually short-term, cursory, and of an inventory type, (i.e., descriptions of physical and biological characteristics). There is little integration of the biophysical parameters that can be used to isolate known and potential impacts associated with a development. Techniques are seldom standardized and hence, not repeatable, which limits useful comparisons of results with other studies. Time constraints and lack of integrated planning often prevent biologists from collecting sufficient information that is relevant and applicable. For example, despite the fact that predevelopment information is vital for long-term monitoring programs and initial identification of potential impacts, it is very rarely available in a manner that facilitates environmental regulation. Under these conditions, it is not surprising that biologists are forced to deal with the symptoms rather than the causes of impacts resulting from development.

A long-term approach that would allow biologists to recognize and evaluate effects on wildlife is necessay to provide sound biological advice for minimizing conflicts with industrial development. Wildlife resource concerns must be incorporated early, during the initial planning stages of development, and used to guide design and planning efforts (Donihee and Gray 1982). When different transportation corridor options were developed for the extensive base metal deposits around Izok Lake and Bathurst Inlet (Dubose 1978), DIAND and the N.W.T. Wildlife Service collaborated to fund a predevelopment survey of wildlife resources in those areas (Searing and Alliston 1979). The study described deficiencies in the wildlife information base and stressed the need for interdisciplinary cooperation between government managers, highway engineers and biologists.

The time frame of integrated planning must include pre-development, development, and post-development stages. Hence, wildlife resource concerns should be incorporated during all stages of linear development, from the route selection process to the final design. Continued monitoring is then necessary to determine the effectiveness of mitigation measures and to make modifications, if needed.

The reduced rate of mining activity over the next years may allow the lead time required to include wildlife resource concerns in an integrated planning process. It also may give biologists time to develop appropriate and standardized techniques to evaluate the potential effects of linear developments on caribou. In 1981, a method was developed for documenting distributional changes of caribou in the vicinity of the Gordon Lake winter road (Jingfors and Gunn 1981). The technique was based on a block survey design that included "exposed" blocks located near the road and control blocks away from the road. Differences in distribution and density of caribou between exposed and control blocks before, during, and following road construction would have been recorded. Unfortunately, there were not sufficient numbers of caribou close to the road to evaluate the design at that time. In 1982, a similar design was used to study the effects of a different type of linear development, a seismic operation, on the winter range of the Bluenose herd (D. Carruthers pers. comm. 1982). Again, caribou densities were too low at the time of the study and intensive aerial surveys along the seismic operation were never attempted. However, snow and habitat characteristics were recorded to better understand caribou winter distribution and trails near the seismic line were mapped. Work will likely continue. These attempts to recognize behavioural responses to disturbance are only the first steps in a long-term approach to planning and developing mitigation measures designed to minimize conflicts between northern exploration and development and wildlife.

RECOMMENDATIONS

1) The overlap between present and potential road developments, and the winter distribution and migration routes of the Bathurst caribou herd may result in future land-use conflicts. Wildlife resource concerns must be incorporated early in the planning process and must be based on sound biological information that goes beyond the inventory stage, (i.e., information that describes how linear developments affect caribou). A long-term research approach and a thorough understanding of factors influencing seasonal distribution and movements of caribou is necessary to allow recognition of overt behavioural responses to road related activities.

2) An essential component of a road management program is a comprehensive and systematic approach to mitigating road related impacts on wildlife and wildlife habitats. In essence, mitigation measures should be selected as part of a review process which identifies environmental impacts at an early planning stage. Impacts that cannot be eliminated can be reduced through mitigation. The key to the successful implementation of mitigation is the development of an operating guideline handbook or mitigation manual that focuses on wildlife resource problems. It is therefore recommended that work to develop such a manual be initiated.

3) Wildlife populations and the land from which they draw their existence are dynamic and intimately related. Within the overall land allocation process, wildlife habitat will be managed in a variety of ways, which range from complete to minimal protection and/or management. The land allocation process is contingent upon land-use requirements which include industrial experimental development and traditional use activities. Wildlife habitat and use of that habitat must therefore be identified and evaluated to ensure that suitable management regimes are developed.

PERSONAL COMMUNICATIONS

Carruthers, Dan, Senior Biologist, Renewable Resources Consulting Services Ltd., Sidney, B.C.

Daniels, Terry, President, N.W.T. Chamber of Mines, Yellowknife, N.W.T.

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APPENDIX A. Winter road use in the Mackenzie District, N.W.T.: a review.

Mine/community	Period of use	Description
A. Gordon Lake corridor		
Discovery Mine 63°11'N, 113°55'W (gold)	a) 1948-58	serviced by aircraft
	b) 1958-69	serviced by truck; mine closed mid-60's
	c) 1976-77	winter road built to mine site
	d) 1980-81	winter road built to Johnston Lake (25 km south of mine)
	e) future	ore depleted, mine closed down in 1982
Camlaren Mine 62°59'N, 113°12'W (gold)	a) 1968-69	small amount of ore hauled to Discovery for milling
	b) 1975-77	serviced by truck via Gordon Lake winter road
	c) 1978-81	serviced by truck
	d) future	mine closed down in 1981
Salmita Mine 64°04'N, 111°15'W (gold)	a) 1974-75	serviced by truck; trailers brought in
	b) 1980-81	serviced by truck; equipment brought in
	c) 1981-82	winter road planned to bring in heavy equipment and bulk fuel
	d) future	Production to start in 1983. Ore to be milled on site; mine to be supplied via winter road and aircraft, anticipated duration of project is 2.5 years
Tundra Mine 64°02'N, 111°10'W (gold)	a) 1961-68	serviced by truck via Discovery route
	b) future	mine closed down in 1969
Lupin Mine 65°45'N, 111°15'W (gold)	a) 1961	mine discovered; serviced by aircraft
	b) 1978-79	serviced by truck
	c) 1980-82	all supplies and milled concentrate transported by aircraft; production to begin in 1982

Appendix A. continued

Mine/community	Period of use	Description
	d) 1983	winter road upgraded for long-term use;
	e) future	mine will continue to be supplied by air. Good potential over next 10 years
Bullmoose Mine 62°20'N, 112°45'W	a) 1974-75	serviced by truck;
	b) 1982 and future	small exploration program but (gold) potential good over next 5 yr; winter road developed in winter of 1982-83.
Strike Lake Mine 62°20'N, 112°46'W (gold)	a) 1974-75	serviced by truck
	b) 1976-77	serviced by truck
	c) future	small operation with good potential over next 5 years; would be supplied via winter road.
B. Rae Lakes corridor		
Lac La Martre 63°08'N, 117°16'W (community)	a) 1970-82	serviced via winter road as a permanent right-of-way (no land-use permits required)
	b) future	winter road will continue to be built over a 3-4 wk period (February-March) each year to service the community
Rae Lakes 64°10'N, 117°20'W (community)	a) 1963-82	community serviced by truck
	b) future	same as Lac La Martre
Echo Bay Mine 66°00'N, 117°50'W (silver, copper)	a) 1963-79	serviced by truck via Rae Lakes route; supplies also by barge from Fort Norman
	b) 1979-81	serviced by aircraft; nearby Eldorado Mine refurbished
	c) 1982	winter road built in February along old route
	d) future	ore depleted; mine shut down in 1982.

Appendix A. continued

Mine/community	Period of use	Description
Terra Mine 65°36'N, 118°07'W (silver, copper)	a) 1969-79	serviced by truck via Rae Lakes route
	b) 1981-82	mill shut down in 1981, but operations resumed in 1982; serviced by truck
	c) future	exploration and drilling will continue;
Indin Mine 64°15'N, 115°13'W (gold)	a) 1981	bulk sampling and drilling concluded. Heavy equipment and trailers hauled in via winter road
	b) 1982	winter road planned for February-March 1982 but never constructed
	c) future	small operation with moderate to good potential. If put into production, mine will be serviced by truck and aircraft.
Fort Franklin 65°11'N, 123°26'W (community)	a) 1940's-80	supplies barged to Fort Franklin and Port Radium along Great Bear River from Fort Norman
	b) 1980-82	winter road constructed to haul fuel and resupply communities; represents an extension of winter road to Wrigley and Fort Norman; also connects with the Echo Bay winter road
	c) 1982-83	winter road upgraded from Fort Norman to Fort Franklin.